Drivers of Firm Performance: A Holistic and Multivariate Panel Data Approach

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By

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Abstract

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Firm performance is important for a number of reasons related to job creation, firm survival, innovation, competitiveness and overall economic performance; motivating a large body of research on its determining factors. It is essential to consider the macroeconomic environment in any firm performance analysis, as this determines the strategies employed by firms, as well as subsequent performance. Despite the imperative of such research, a lacuna exists in the literature. To address this gap, a holistic multivariate model is developed which relates firm performance to firm-level characteristics, firm strategy and key elements of the macroeconomic environment. This thesis, therefore, investigates the determinants of firm-level performance using descriptive analysis and System Generalised Method of Moments (SYS-GMM) regression models to analyse panel datasets from the Irish Census of Industrial Production and Annual Services Inquiry for 2,200 firms covering the manufacturing and services industries in Ireland over the period 1991-2007. This provides insights on the performance of firms during a export-led growth phase (1991-2000) and a credit-led domestic demand-driven growth phase (2001-2007) in the Irish economy.

Results show that the performance of firms is strongly influenced by changes in the macroeconomic environment, with manufacturing firms showing higher employment growth during the period of export-led growth and higher turnover and productivity performance during the credit-led domestic demand-driven growth phase. The impact of firm strategy on firm performance is also moderated by macroeconomic conditions, with firms adopting strategies such as trade and training to increase turnover and productivity during the second growth phase. A strong negative firm size-growth effect is found which remained robust to time period, industry and ownership type. There are performance differentials between foreign and domestic firms, with domestic firms performing better than foreign firms in terms of employment and turnover, while foreign firms showed higher productivity performance. These results imply that small Irish-owned firms are important sources of job creation and output growth. Overall, in many of the firm performance model specifications in this study, the effect of the determinants on firm performance is dependent on the definition of firm performance and firm size employed.

These results suggest the need to adopt a holistic multivariate approach to the study of firm performance which incorporates both internal (firm-specific characteristics and strategy) and external factors (the macroeconomic environment). The multidimensional nature of firm performance should also be taken into account through the use of multiple firm performance measures for any meaningful analysis. Finally, the findings suggest a potential role for policy aimed at ensuring macroeconomic stability, supporting small indigenous firms and improving their productivity so as to ensure that they are more competitive in global markets.

This study not only makes an important contribution to the firm performance literature, the results also have possible policy implications in the area of small business development.
Declaration of Originality

No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or institute of learning.

I declare that the thesis represents the results of my own work. Following normal academic conventions, I have made due acknowledgments of the work of others. The work has been completed with a total word count of 114,226 excluding references and appendices.

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Signed: __________________________

Olubunmi Alice Ipinnaiye
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<th>Description</th>
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<tbody>
<tr>
<td>ASI</td>
<td>Annual Services Inquiry</td>
</tr>
<tr>
<td>BLUE</td>
<td>Best Linear Unbiased Estimator</td>
</tr>
<tr>
<td>CIP</td>
<td>Census of Industrial Production</td>
</tr>
<tr>
<td>CI</td>
<td>Condition Index</td>
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<tr>
<td>CSO</td>
<td>Central Statistics Office</td>
</tr>
<tr>
<td>DIFF-GMM</td>
<td>Difference Generalised Method of Moments</td>
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<tr>
<td>ESRI</td>
<td>Economic and Social Research Institute</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>FE</td>
<td>Fixed Effects</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GNP</td>
<td>Gross National Product</td>
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<tr>
<td>GL</td>
<td>Gibrat’s Law</td>
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<tr>
<td>LM</td>
<td>Lagrange Multiplier</td>
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<tr>
<td>LPE</td>
<td>Law of Proportionate Effects</td>
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<tr>
<td>MES</td>
<td>Minimum efficient scale</td>
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<tr>
<td>NACE</td>
<td>Nomenclature Générale des Activités Économiques des Communautés Européennes</td>
</tr>
<tr>
<td>NUTS</td>
<td>Nomenclature of Territorial Units for Statistics</td>
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<tr>
<td>OLS</td>
<td>Ordinary Least Squares</td>
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<tr>
<td>RBV</td>
<td>Resource Based View</td>
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<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>SME</td>
<td>Small and Medium Sized Enterprise</td>
</tr>
<tr>
<td>SYS-GMM</td>
<td>System Generalised Method of Moments</td>
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<tr>
<td>VIF</td>
<td>Variance Inflation Factor</td>
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Chapter 1: Introduction

1.1 Introduction

The aim of this chapter is to present the rationale for this study, as well as to outline the research purpose and its contributions. Firms, particularly, small and medium-sized enterprises (SMEs), have been acknowledged in economic discourse as mechanisms for job and wealth creation. Moreover, firms are seen as essential to engendering national competitiveness due to their significant contributions to economic growth, employment, innovation and the promotion of entrepreneurial skills (Birch, 1981, 1987; Hart, 1989; Audretsch, 2000; Lenihan et al, 2010; European Commission, 2012). A study of the factors governing the performance of firms in any economy is, therefore, critical to enhancing performance in poorly performing firms, as well as ensuring continued and indeed increased success in good performers.

Although superior performance at the firm-level is essential to attaining overall economic success, the macroeconomic milieu within which firms operate is also important in determining subsequent performance of firms, as well as in defining strategies employed by firms to boost performance. There exists a large body of research investigating firm behaviour and performance (e.g. Simon and Bonini, 1958; Mansfield, 1962; Evans, 1987) but, only a few studies have considered the specific impact of macroeconomic factors on firm performance (e.g. Higson et al, 2002, 2004; Beck et al, 2005). The central focus of this thesis, therefore, is to address this gap by developing a holistic multivariate model which relates firm performance to key elements of the macroeconomic environment, firm strategy and firm-specific characteristics. This thesis aims to analyse the performance of firms in...
manufacturing and services industries in Ireland between 1991 and 2007 to determine the impact of prevailing macroeconomic conditions on firm performance. This research is, to the best of the author's knowledge, the first attempt to model the impact of the macroeconomic environment on the performance of firms in Ireland. Although Ireland serves as the laboratory, this research on firm performance provides valuable insights, which remain relevant for researchers even within international contexts. The question thus arises, what makes Ireland an interesting case study? A discussion on insights gained from situating this firm performance research within an Irish context is provided in the section that follows.

**The Case of Ireland**

Ireland makes an interesting locale during this period (1991-2007), characterised by two distinct growth trends: a period of rapid export-driven economic growth and a period of domestic demand-led growth driven by low interest rates, with a resultant bubble in the construction/property industry (Honohan, 2009; Dineen et al, 2012). The remarkable growth rates experienced during the so-called Celtic Tiger period led to a transformation of the Irish economy, from high unemployment, to one of close to full employment (Murphy, 2000). Thus, Ireland serves as a suitable laboratory in which the performance of firms in an economy at full employment can be studied and analysed. This analysis is undertaken by the use of a holistic model, which integrates a firm's characteristics, its strategy and the macroeconomic environment in which it operates.

**Sample Period**

As indicated above, analysis in the thesis is carried out over the period 1991-2007 for two reasons. First, the sample period represents a period of rapid economic growth in Ireland; the so-called Celtic Tiger period, consisting of two growth phases (an export-led growth phase,
1991-2000 and a credit-led domestic demand-driven growth phase, 2001-2007), with different drivers which allow the research objectives of the thesis to be fully addressed. A more detailed discussion of the two growth phases and drivers of growth is provided in Chapter 4. Moreover, given that this research is based on the analysis of datasets of manufacturing and services firms obtained from the Irish Central Statistics Office (CSO), 1991 is the earliest period for which data is available. Whilst data is available up to 2011, a change in the classification of industrial activity in 2008 from NACE (Nomenclature Générale des Activités Économiques dans les Communautés Européennes) Rev. 1.1 to NACE Rev. 2 resulted in the reclassification of some industries from Industry to Services, such as publishing and the introduction of new industries (e.g. Veterinary Services) not previously surveyed (CSO, 2010). Consequently, data from 2008 onwards are not directly comparable with earlier data.

**Definition of Key Concepts**

The aim of this thesis is to investigate the determinants of firm performance in Ireland, as previously outlined. It is therefore essential to define the key concepts in the study to provide a background to the subsequent research analyses undertaken. Definitions of the firm, firm performance, macroeconomic environment and industry are presented in this section. For the purpose of this thesis, the firm is defined as an administrative organisation with a collection of productive resources which confer on the firm some form of competitive advantage in terms of its ability to use and develop its resources in response to changes in the external environment. The above definition of the firm draws on the theory of the firm and a more detailed discussion is provided in Chapter 2. Furthermore, given the interdependence between firm growth, productivity and other firm performance measures (as will be detailed in the material which follows), firm performance is defined in terms of
growth (employment, turnover and productivity) and productivity (turnover per employee).

Moreover, the use of the above measures captures the objectives of the key stakeholders (e.g. the firm, policy makers, employees and consumers), as suggested by Richard et al (2009). Following on from this, the term, ‘performance’ is used interchangeably with firm growth and productivity in this thesis. A further discussion on the firm performance measures adopted in this thesis is presented in Chapter 3.

The key macroeconomic objectives of many economies are high economic growth, low inflation and low unemployment (Wilkinson, 2005; Agarwal, 2010). Taking into consideration the remarkable economic transformation which occurred in Ireland during the period of the study, the macroeconomic environment is defined in terms of growth in real Gross Domestic Product (GDP), Inflation rate and Unemployment rate. Furthermore, given the open nature of the economy, along with the loss of international competitiveness and phenomenal credit growth experienced in the Irish economy (particularly in the second growth phase), the macroeconomic environment is further defined in terms of the Real Effective Exchange Rate, Unit Labour Costs and Domestic Credit to the Private Sector as a percentage of GDP. The aforementioned macroeconomic variables measure competitiveness and domestic credit growth respectively. A more detailed discussion of these terms is also provided in Chapter 3.

This thesis aims to distinguish between firm performance in manufacturing and services industries due to the growing importance of the services industry in many economies, accounting for approximately 70 per cent of employed persons in the EU-27 and about 77 per cent of employment in Ireland in 2011 (Eurostat, 2012). Although a large part of the international firm performance literature focuses on manufacturing firms, some studies such
as Audretsch et al. (2004), and particularly of late, those of Daunfeldt et al. (2012) and Shehzad et al. (2013) have analysed service industries. A significant number of firm performance studies in Ireland are based largely on manufacturing, while the few studies investigating the services industry that do exist tend to focus on internationally traded services (e.g. Görg and Strobl, 2003a; Girma et al, 2008). However, despite their increasing importance, services industries are still largely omitted from many firm performance analyses (Nunes and Serrasqueiro, 2009). In the context of the above, industry is defined in terms of manufacturing (NACE 15-37) and services (NACE 50-93) industries. The above definition takes into account both internationally traded and non-traded services firms. Having defined the key concepts in this research, a discussion on some conceptual issues related to the study of firm performance is provided in the next section. This provides insights on key issues that should be considered in the analysis of firm performance to be undertaken in this research.

Firm Performance: Conceptual Issues

Issues related to the multidimensionality of firm performance and its definitions are outlined in this section. This informs the choice of firm performance measures employed in this thesis. Firm performance is multidimensional with several measures in use such as growth, profitability and productivity, each of which captures different aspects of firm performance (Yildiz et al, 2011). According to Richard et al (2009: p4), the multidimensional nature of firm performance “...arises out of the stakeholders that interact with within an organization, the heterogeneity of organizational resources, environments and strategic choices, and the variation of performance over time”. Stakeholders in the firm (e.g. management, shareholders, and policymakers) often have varying interests, thus firm performance is best measured with those performance measures most closely linked to their objectives. Furthermore, firms’ response to changes in their operating
environments is determined by their resources and capabilities, as well as the strategic choices made in exploiting these resources and capabilities. Thus, performance outcomes vary across firms to the extent which firm differences exist in terms of resources, capabilities, strategy and response to the macroeconomic environment. Lastly, firm performance varies over time. Feedback between past and current performance has been found for many firm performance measures, which may cause performance differences across firms. Hence, the time frame for the measurement of firm performance matters (Richard et al, 2009). Taken together, the above discussion implies that the multidimensional nature of firm performance, as it relates to the stakeholders, heterogeneity in resources, strategic choices and the environment, along with performance variations over time, must be addressed in the choice of performance measures to be adopted in any study of firm performance.

Notwithstanding the wide array of performance measures available to researchers, a large number of research studies conceptualise firm performance as only growth or less frequently as profitability, while some others combine both measures or employ some other indicator, providing little or no justification for the choices made (Kiviluoto et al, 2011). The current research differs from other studies in that the multidimensional nature of firm performance is considered within a macroeconomic context, through the use of several performance measures (growth in employment, turnover and productivity, as well as productivity level) in a holistic framework. This provides insights as to whether firm-specific characteristics, firm strategy and macroeconomic conditions have differing impacts on different facets of firm performance.

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1This is discussed in further detail in Chapter 2 under the resource-based and evolutionary theories of the firm.
Following on from the above discussion, a key issue arising from the multidimensional nature of firm performance is that it is subject to the interpretation of various stakeholders (Carton and Hofer, 2006; Richard et al 2009). This suggests the need to take cognisance of major stakeholders’ perceptions of success in analysing performance. Consequently, an assessment of firm performance in terms of growth and productivity (such as is undertaken in this thesis) takes into account some of the specific objectives critical to stakeholders, such as managers, shareholders and governments, who may differ on what constitutes superior performance given their particular interests. For instance, the use of turnover growth as a performance indicator captures the increased market share objective for many businesses. In addition, firms are interested in the efficient use of resources critical to their survival, ability to increase market share and compete with other firms. Thus, the use of productivity measures suitably addresses this goal.

Policy makers, on the other hand, are often motivated by the need to achieve job creation and retention critical to attaining full employment and high living standards in the economy. Therefore, employment growth is a useful indicator in evaluating success in fulfilling this aim. Finally, policy makers are also concerned with increasing national output and competitiveness, thus the use of productivity as a firm performance measure is appropriate given its pivotal role in determining the firm’s capacity to expand output and compete in global markets. Based on the above discussion, the definition of firm performance employed in this thesis takes account of the desires of various stakeholders (e.g. firms and policy makers), while the use of multiple firm performance measures recognises the multidimensional nature of firm performance. Having dealt with issues relating to how firm performance is best defined, it is important to establish the significance of this research by examining the economic importance of firm performance.
Importance of Firm Performance

The discussion presented in this section is aimed at highlighting the motivation for the study of firm performance which is rooted in its implications for firm survival, growth, competitiveness, employment, innovation and overall economic performance. Firm performance is a crucial determinant of overall economic performance and is vital to the continued existence of firms. The probability of firm survival is positively linked to growth and productivity which are essential drivers of survival (Geroski, 1995; Sutton, 1997; Syverson, 2011; Garcia-Manjon and Romero-Merino, 2012), while firm failure rates and employment patterns have both fiscal and social cost implications for the economy. Similarly, the likelihood of firm failure increases with lower levels of growth and profitability, whereas low levels of productivity in the firm reduce growth, competitiveness, and the probability of survival. Additionally, firm growth is assumed in the academic literature to be an indicator of performance based on the idea that it is a key precursor for profitability. Thus, a firm’s failure to grow will impact on its ability to generate profits, while profitability itself is essential for survival and growth (Brännback et al., 2009).

The impact of firm-level performance on economic performance is transmitted through several mechanisms; For instance, firm productivity is a major source of economic growth and competitiveness (OECD, 2012) wherein productivity increases bring about higher profits, higher wages and price savings, which are then passed onto the macro economy through increased consumer spending, higher exports and more investments, thus increasing GDP and overall economic growth. In addition, the relation between firm size and growth determines market concentration, hence, a study of firm growth and the evolution of firms in a given market is useful in providing an understanding of the evolution of patterns of concentration of

The above discussion highlights the linkages between several measures of firm performance (i.e. growth, profitability, productivity, competitiveness and survival), as well as the importance of firm performance analysis for future firm survival, growth, competitiveness, employment, innovation and overall economic performance. A discussion of the theoretical underpinnings of this research is presented in the next section. This provides insights as to the theoretical literature from which this research draws.

Theoretical Foundation of Firm Performance

This section outlines the theoretical basis of the research undertaken in this thesis. This provides a brief overview of the relevant literature to highlight the research gap which the thesis seeks to fill. Wide disparities in performance in firms within a given industry have been acknowledged in the literature (Caves, 1998; Bartelsman and Doms, 2000), with several theories formulated to explain the observed differences. The analysis of firm performance in this research study draws on the evolutionary theory of the firm and the firm growth literature. According to the evolutionary view of the firm, a firm derives competitive advantage based on its ability to use and develop its resources in response to changes in its operating environment (Nelson and Winter, 1982; Teece et al, 1997). It then follows that the firm’s responsiveness to changing external conditions determines how well it performs relative to its competitors.

The firm growth literature, on the other hand, evolved from Gibrat’s (1931) seminal work on firm growth to explain the observed differences in firm size in a given industry (i.e. many
small firms co-existing with a few large firms in the industry). Gibrat’s *Law of Proportionate Effect* (LPE) states that a firm’s growth is independent of its initial size (Lotti et al, 2009) such that firm growth is an entirely random process with every firm, irrespective of size class, having an equal chance of increasing or declining in relation to the size at the beginning of the period (Mansfield, 1962; Santarelli et al, 2006). Consequently, a large number of studies have emerged to test the validity of the LPE, employing a multiplicity of methodologies and samples with somewhat differing empirical results. Following several other firm performance studies, the starting point of the analysis of firm growth undertaken in this thesis is Gibrat’s Law (GL). This provides evidence not only on the validity of GL, but also on the effect of other drivers of firm performance in providing a theoretical explanation of the observed performance heterogeneity within firms in the same industry. Issues arising from the empirical study of GL are outlined in the section which follows.

**Empirical Evidence on Gibrat’s Law and Related Issues**

The validity of GL was confirmed in earlier studies (Hart and Prais, 1956, Simon and Bonini, 1958 for UK manufacturing firms; Hymer and Pashigian, 1962 for US manufacturing firms) and rejected in more recent studies (Jovanovic, 1982; Evans, 1987a for US manufacturing firms; Li et al, 2007 for Irish manufacturing firms; Petrunia, 2008 for Canadian manufacturing and retail firms and Daunfeldt and Elert, 2013 for Swedish limited liability firms). Earlier studies (such as Hart and Prais, 1956, Simon and Bonini, 1958; Hymer and Pashigian, 1962) were univariate studies mainly concerned with testing the validity of GL, specifically, the relationship between firm size and growth. More recent studies, on the other hand (e.g. Evans, 1987a; Li et al, 2007; Petrunia, 2008 and Daunfeldt and Elert, 2013) adopt a multivariate approach in investigating other factors, besides firm size which determine firm growth. Although, the above-mentioned studies employ multivariate models which examine a
wide range of factors (e.g. location, innovation, ownership, and trade), the specific impact of the macroeconomic environment on firm growth is yet to be examined. This thesis seeks to address this gap by developing a holistic multivariate model, which examines both the internal and external factors of the firm. As earlier detailed, developing such a holistic multivariate model, contributes not only to the firm performance literature in Ireland, but also to the international literature on firm performance.

Despite, however, the seemingly large volume of empirical studies, the process of firm growth is yet to be fully understood due to observed differences linked to the multiplicity of measures, heterogeneity of firm characteristics and resources, varied research objectives and definitional issues associated with conceptualisation of the firm (Caves, 1998; Davidsson and Wiklund, 2006; Hynes, 2006, Richard et al, 2009). This divergence can also be linked to the multi-disciplinary approach in the study of firm growth traversing disciplines such as economics, management, and entrepreneurship which greatly influences research focus. Additionally, the observed differences in empirical evidence from earlier and more recent studies is related to the increased availability of large longitudinal firm-level datasets, as well as a growing interest in controlling for possible econometric issues (such as for example heteroskedasticity, sample bias and autocorrelation) arising from the estimation of firm growth (Caves, 1998; Piergiovanni et al, 2003; Coad, 2009). The divergent evidence on GL suggests the need to examine other drivers of firm growth such as the firm’s internal characteristics and the macroeconomic environment within which it operates, given the inherent heterogeneity in firms even within narrowly defined industries (Caves, 1998; Bartelsman and Doms, 2000).
Storey (1994) and Hynes (2006) in their review of small firm growth studies acknowledged a wide array of factors observed to influence firm growth and suggested the use of multivariate models of analysis which offer more robust insights on firm growth. The aforementioned studies, however, focus solely on internal factors of the firm, neglecting the macroeconomic environment which potentially drives performance in firms, as outlined in the evolutionary theory of the firm. Therefore, this thesis adopts a holistic approach to the study of the determinants of firm performance, which takes into account the simultaneous impact of internal and external factors on firm performance. This provides a better understanding of the degree to which these factors impact the growth process, as well as the channels through which this occurs. Furthermore, the heterogeneity of firms highlighted in the industrial organisation literature implies that these variations should be taken into account in any firm performance analysis to provide clearer insights. This chapter aims to provide a justification for this study, as well as to outline the research objectives and contributions. The remainder of the chapter is structured as follows: Section 1.2 outlines the justification for the study, as well as the research objectives and research questions. Section 1.3 highlights the contribution of the thesis. Section 1.4 provides details on the structure of the thesis. Section 1.5 concludes.

1.2 Rationale for Study and Research Objectives

The rationale for the study is presented in this section. Following from this discussion, the research questions and related objectives are also outlined. This study investigates the determinants of firm growth and productivity, stressing the use of several performance measures to capture different facets of the firm. This approach incorporates both internal and external factors found to influence firm performance in the context of the Irish economy, which offers insights into variations in performance outcomes of firms faced with similar
circumstances. It also allows the impact of government economic policies, as indicated by macroeconomic variables, (McNamara and Duncan, 1995) on micro-level performance to be assessed. The use of multiple performance measures is informative, as a firm may not always achieve success in all aspects of its performance concurrently (Hynes, 2010). For instance, it has been argued that productivity increases resulting from ongoing technological change in some industries, may not necessarily be accompanied by growth in employment or assets, rather higher productivity growth may lead to lower employment levels (Anderson et al, 1997; Nordhaus, 2005).

A study of the link between macroeconomic factors and firm performance is vital, as firms do not exist in isolation, but operate within the confines of the macroeconomic environment. To some extent, micro-level performance is governed by macroeconomic conditions which in turn impact aggregate economic performance. This is shown in Figure 1.1 which illustrates the feedback mechanism between macroeconomic conditions and firm performance. Here, firm performance is indicated by growth, productivity, profitability, competitiveness and survival. Figure 1.1 also provides evidence of linkages between firm performance measures, for example, a firm’s level of productivity can potentially determine future profitability and growth. Productivity determines competitiveness, which in turn impacts significantly on the firm’s survival and growth.
An adverse change in the macroeconomic environment, for example, rising inflation rates increases production costs which may be passed on to consumers through higher prices. This may result in lower aggregate demand with a knock-on effect on output and profits. Lower output or productivity levels reduce competitiveness and firm growth, while the probability of firm survival decreases at lower levels of growth and profitability. In the long run, poor performance at the firm level feeds back to the economy. Based on the illustration in Figure 1.1, it is imperative that macroeconomic effects should be considered in any firm performance analysis.
Nevertheless, as emphasised heretofore throughout the current chapter, the specific impact of macroeconomic factors on firm performance has not been dealt with in detail in the industrial organisation literature. Rather, year dummy variables have been employed in many studies to control for the impact of macroeconomic effects on firm growth (Geroski and Machin, 1994 and Hardwick and Adams, 2002, Coad and Rao, 2008). A limited number of studies (Higson et al, 2002; Higson et al, 2004; Holly et al, 2013) have examined the link between the business cycle (measured by GDP growth rate) and firm growth (indicated by sales growth). However, these studies examine cross-sectional (overall) distributions of firm growth rates and do not consider firm-specific characteristics in their analyses. In contrast to these studies, the current research investigates the performance of individual firms in terms of firm growth and productivity, as well as analysing the effect of the macroeconomic environment, with the use of multiple macroeconomic variables. A range of firm characteristics is also examined which allows identification of the specific characteristics of high-performing firms, along with providing an understanding of firm performance that takes into account firm differences.

Other studies (Forbes, 2002; Beck et al, 2005; Mahendra, 2009; Mateeva and Anastasov, 2011) have explored the effect of macroeconomic factors such as inflation, exchange rate volatility and currency depreciation on firm performance, commonly measured by growth. Nevertheless, these are all cross-country as opposed to within-country studies. Cross-country studies are generally hampered by “…definitional and measurement issues…induced by cross-country differences in coverage, unit of observation, classification of activity and data quality” (Bartelsman et al, 2009: pp.16-17). Finally, Oberhofer (2012) analysed the impact of European industry fluctuations and domestic business cycles on the employment growth of 86,000 firms in 14 European countries from 2000 to 2003. Similar to the aforementioned studies, this study also affected by issues related to cross-country studies, as outlined
earlier. Furthermore, the time period of the Oberhofer (2012) study is not adequately long enough to allow for a detailed examination of the effect of the macroeconomic environment on firm growth.

While it is noteworthy that the above studies adopt a multivariate approach (similar to that adopted in this thesis), the within-country nature of the current research overcomes the limitations associated with cross-country studies as detailed above. In addition, the time period of the study (1991-2007) presents a reasonably suitable and long enough timeframe within which the effect of the macroeconomic environment on firm performance can be modelled. Moreover, the inclusion of firm strategy and macroeconomic variables in addition to firm-specific characteristics, which allow investigation of whether (and how) macroeconomic conditions determine firm strategy, differentiates the current research from previous studies. The approach adopted here provides an understanding of the specific strategies adopted by firms in response to changes in the operating environment, thus, contributing to the knowledge of the channels through which macroeconomic conditions influence firm performance.

Given the above context, the thesis addresses several research questions which inform the research objectives as outlined below.

The main research question for this study can be stated as follows: What are the determinants of firm performance in Ireland during the period 1991-2007?

This question gives rise to the following key research objective:

- To develop a holistic multivariate model which integrates firm performance (firm growth and productivity) with key elements of the macroeconomic environment, firm strategy and firm-specific characteristics.
Arising from this main objective, three research questions emerge as follows:

1. What is the impact of macroeconomic conditions on firm performance in Ireland in the period, 1991-2007?

This research question informs a second research objective:

- To determine the impact of the macroeconomic environment (measured by GDP growth, inflation, unemployment rate, competitiveness and availability of credit) on firm performance.

2. What is the impact of the type of firm strategy adopted on firm performance in Ireland in the period, 1991-2007?

This research question leads to a third research objective:

- To determine whether and to what extent (if any) firm strategy (trade, innovation, training, use of subsidies) affects firm performance.

3. What is the impact of firm-specific characteristics on firm performance in Ireland in the period, 1991-2007?

This question allows for a fourth research objective:

- To determine whether and to what extent (if any) firm characteristics (size, industry characteristics and ownership) matter in relation to firm performance.

Following on from a detailed review of the relevant literature and theories, the hypotheses emanating from these research objectives are presented in Chapter 3, while empirical testing of the hypotheses is undertaken in Chapter 6. Having presented the motivation for this study, its objectives and research questions, the next section outlines the major contributions of the thesis.
1.3 Contribution of the Study

Using Ireland as a case study, this research investigates the drivers of firm performance, with emphasis on both the internal and external factors which influence firm performance. To the knowledge of the author, this is the first study which employs data in this novel way within the Irish context to investigate the effect of a transition between a sustainable and unsustainable growth phase on firm performance. More specifically, addressing the research questions outlined in Section 1.2, this study makes several contributions to the firm performance literature. These are outlined as follows:

Theoretical contributions

- This thesis adopts a holistic approach to the study of firm performance, which explores the link between internal (firm-specific characteristics and firm strategy) and external (macroeconomic conditions) factors. This provides insights as to whether (and how) these factors impact firm performance, as well as the channels through which these occur.

- The multidimensional nature of firm performance is considered in this study through the use of multiple performance measures (productivity level, employment growth, turnover growth and productivity growth), which permit the effect of firm performance drivers on different dimensions of firm performance to be captured. This provides insights as to whether the effects of firm performance determinants vary with the definition of firm performance measures employed.
Empirical contributions

- This thesis contributes to the knowledge of firm performance in Ireland\(^2\) through the use of large panel datasets for 2,200 firms, with a significant time-series dimension, which increases the reliability of statistical inference (Abdallah and Goergen, 2011).

- In contrast to several other Irish studies, this study focuses on services (internationally traded and non-internationally traded services sectors inclusive), as well as manufacturing firms. This analysis of firms in manufacturing and services industry increases our understanding of firm performance in Ireland in terms of the analysis of firm growth and productivity, as well as providing knowledge on whether performance patterns differ across manufacturing and services firms.

- The inclusion of data on micro-sized firms (with less than 10 employees), commonly omitted in many studies, (Heshmati, 2001; Reid, 2006) allows the heterogeneity of firms to be taken into account, thus providing a clearer understanding of firm performance in Ireland.

- Ireland serves as a good laboratory in which the effect of the macroeconomic environment on firm performance can be successfully modelled in an open, trading economy, with a strong policy emphasis on Foreign Direct Investment (FDI). Furthermore, the sample period, 1991-2007 is one of high growth, consisting of an export-led growth phase (1991-2000) and a credit-led domestic demand–driven growth phase (2001-2007), in an economy which transitioned from high unemployment to full employment. Thus, the adoption of a holistic approach to the study of firm performance not only frames the performance of firms in Ireland within the context of variations in the macroeconomic environment during the period of

\(^2\)Although Ireland is used as the locale for this study, it is the author’s belief that the research undertaken provides interesting transferrable lessons and insights (from theoretical, knowledge, empirical and methodological perspectives) for researchers who study firm performance in other country contexts.
analysis, it is also a useful approach in isolating those factors critical to engendering success in firms with the potential to offer important insights for policy.

- Given the Irish government’s drive to attract and retain FDI, as well as promote indigenous firm start up and growth (Department of Finance, 2012; Department of Jobs, Enterprise and Innovation, 2014), findings from the study provide suggested policy outcomes valuable in designing more targeted policies to improve performance in firms.

**Methodological contributions**

- Application of a holistic multivariate modelling approach to the analysis of firm performance allows for a more in-depth study of the link between the internal (firm-specific characteristics and firm strategy) and external (macroeconomic environment) drivers of firm performance.

- The use of the System Generalised Method of Moments (SYS-GMM) estimation model, which allows for the control of potential endogeneity\(^3\), is appropriate in providing robust results useful in providing important insights to researchers and policy makers.

- Additional use of the Fixed Effects (FE) model is useful for the purpose of comparison, as well as to determine the robustness of estimated SYS-GMM results.

- Inclusion of a range of macroeconomic variables (e.g. inflation, GDP, unemployment rate, unit labour costs, real effective exchange rate and domestic credit growth) which allows the investigation of the interactions between the macroeconomic environment

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\(^3\) Endogeneity in this research may arise from a simultaneous relationship between, for instance, productivity and firm size (Kukenova and Monteiro, 2009).
(domestic and international) and firm performance, as well as the link between firm strategy and the macroeconomic environment.

1.4 Structure of the Thesis

Based on the above discussion, this thesis investigates the determinants of firm growth and productivity within the framework of the macroeconomic environment, using Ireland as a case study during the period 1991-2007. The remainder of this thesis is organised as follows: Chapter 2 presents the theoretical basis for the firm performance analyses carried out in the empirical chapters. To provide a theoretical explanation on the observed firm differences in a given industry, theories of the firm are outlined, with a focus on the neoclassical, resource-based and evolutionary theories. Such an approach offers insights as to why some firms are more successful than others. The theoretical foundation of the firm growth literature originating from Gibrat’s seminal article on firm growth is also presented. The discussion in Chapter 2 examines the evolution of the firm growth debate and also highlights major contributions to that same debate. As previously outlined, firm performance is multifaceted; therefore, key definitional issues arising from this multidimensionality are identified in Section 2.3. A review of the firm growth debate is undertaken in Section 2.4; this outlines the theoretical foundations of firm growth, highlighting key contributions and approaches to the debate, as well as presenting empirical evidence on Gibrat’s Law of Proportionate Effect. The main approaches outlined include the active (Ericson and Pakes, 1995; Pakes and Ericson, 1998) and passive (Jovanovic, 1982) learning models. A review of the international firm performance literature, with a focus on key determinants of firm performance (using Storey’s (1994) and Hynes’ (2006) framework for the analysis of firm growth), is carried out in Section 2.5, while Section 2.6 outlines the factors identified in the literature as hampering
firm growth. A review of firm performance studies in Ireland is undertaken in Section 2.7 which draws out key considerations relevant to the subsequent analyses undertaken in the thesis.

The research approach adopted in investigating the determinants of firm performance in this study is outlined in Chapter 3. This examines related literature on methodologies and techniques for analysing the drivers of firm performance in order to identify the methods and measures employed in empirical analyses, as well as to inform the choice of methods and measures to be adopted in addressing the research questions in this thesis. The discussion in the chapter highlights the multidimensional nature of firm performance as reflected in the multiplicity of measures and methods employed in its analysis. Based on the empirical and theoretical evidence gleaned from the literature review in Chapter 2, the hypotheses to be tested in the study, as well as the methods to be adopted in testing them (Ordinary Least Squares, Fixed Effects and System Generalised Method of Moments) are presented. The datasets analysed in the research (Census of Industrial Production and Annual Services Inquiry for manufacturing and services respectively) are also introduced in this chapter.

The context of the research laboratory (locale) is examined in Chapter 4 to give an overview of the Irish economy, as well as to identify its key features and trends in economic development during the period of analysis (1991-2007). The discussion presented in the chapter highlights the important contributions of foreign-owned firms, small firms, the services industry and high-tech industries to Irish economic performance during this period. Two distinct phases of the Irish economic boom, each driven by different factors are also identified; an export-led boom (1991-2000) and a domestic demand-led boom driven by an unsustainable housing bubble fuelled by borrowing (Drudy and Collins, 2011), with
implications for the performance of firms during the period. Analysis of employment performance across the two growth periods revealed lower manufacturing performance resulting from plant closures, downsizing and a shift to services.

Chapter 5 presents descriptive and non-parametric analyses of firm performance in Ireland over the period 1991-2007, based on secondary data obtained from the CSO. This not only offered insights on the link between firm performance and macroeconomic conditions (performance in firms was shown to vary across both growth phases), but also provided preliminary evidence on the relationship between firm-specific characteristics (such as firm size) and firm performance (growth and productivity).

Results of the econometric analyses carried out with the use of SYS-GMM and FE estimation methods are presented in Chapter 6. This addresses the research questions and tests the hypotheses set out in the thesis, so as to establish a causal link between firm performance and its drivers. Based on these results, Chapter 7 provides a discussion of key findings, drawing out conclusions, possible policy recommendations and suggestions for future research.

1.5 Conclusion

In conclusion, the dearth of research relating to the impact of the macroeconomic environment on firm performance has been highlighted through a review of the firm performance literature. The main aim of this thesis, therefore, is to address this gap by adopting a holistic multivariate modelling approach, which relates firm performance to firm characteristics, firm strategy and macroeconomic factors.
Through the development of a holistic model of firm performance, which incorporates both internal (firm-specific characteristics and strategy) and external factors (the macroeconomic environment), and based on results from the estimation of the econometric models, issues relating to whether (how) the macroeconomic environment influences firm performance and the channels through which this occurs can be acknowledged. The thesis, therefore, contributes to the firm performance literature, as well as providing possible policy insights into the factors governing firm performance. The relevant literature on firm performance is reviewed in the next chapter which serves to contextualise the research undertaken in this thesis.
Chapter 2: Survey of the Literature on Firm Growth

2.1 Introduction

Firm growth is important for a number of reasons related to employment generation, survival, competitiveness and overall economic performance (Mason et al., 2009). However, in spite of the vast number of studies, there is no single unifying theory to explain the firm growth process. Rather many of the attempts to explain firm growth appear to be empirically driven. Since the emergence of Gibrat’s (1931) seminal article on firm growth, a large amount of research has been carried out, with a view to providing theoretical explanations for empirical findings, however, the process of firm growth is yet to be fully understood due to divergent opinions related to heterogeneity of growth measures, research objectives and definitions of the firm (Davidsson and Wiklund, 2006). This thesis therefore, makes a contribution to the firm growth/performance literature by providing a holistic model, which integrates both external (macroeconomic environment) and internal (firm-specific) drivers of firm performance. Additionally, through the development of a holistic approach, the multidimensionality of firm performance is taken into account.

In the context of the above, the purpose of this chapter is to present a review of the literature on firm growth so as to provide a theoretical basis for the firm growth analyses subsequently carried out in the empirical chapters of this thesis. The current chapter outlines major contributions to the firm growth debate and identifies key determinants of firm growth, with a view to highlighting the lacuna in the literature in terms of the influence of macroeconomic conditions on firm growth, which this research aims to address. The theory of the firm is discussed in Section 2.2 to provide a theoretical explanation of the observed performance.
2.2 Theory of the Firm

Prior to investigating the drivers of firm performance, which is the central focus of this thesis, addressing the questions of why firms exist, how they are defined and why they differ is imperative and crucial to the investigation. This theoretical analysis provides the underlying assumptions of the firm’s goals and objectives, which in turn inform the most appropriate measures of its performance. Thus, to provide a theoretical explanation which addresses the above questions, a discussion regarding the neoclassical, resource-based and evolutionary theories of the firm is presented in this section.

The theory of the firm is valuable in defining and explaining the existence of a firm, its behaviour and internal organisation (Foss et al, 1998). Various strands of the theory of the firm exist and although these have evolved over the years, Chandler (1992: p79) identified four attributes of the firm, elements of which can be seen in these theories albeit with varying levels of emphasis. These are:

(i) the firm as a ‘legal entity’ which enters into contracts with different parties such as employees, suppliers and customers;
(ii) the firm as an ‘administrative entity’ which has a team of managers concerned with co-ordinating and monitoring its activities;

(iii) the firm as a ‘pool of resources’ (physical facilities, liquid capital and learned skills);

(iv) the firm as a ‘for profit’ entity since in modern economies firms are vehicles for the production and distribution of goods and services.

The attribute of the firm as a ‘pool of resources’ is most relevant to this research, given the concern with exploring the interaction between internal factors of the firm and its performance. Thus, given the focus of this thesis is on firm performance, a discussion on the resource-based view and evolutionary theories of the firm is presented in this section, as these are most relevant in explaining the observed differences in firm performance outcomes. Nonetheless, any discourse on the theory of the firm must begin from the neoclassical perspective from which all other theories of the firm derive their roots (Hart, 1989). The section which follows begins, therefore, with a discussion on the neoclassical theory of the firm drawing out the key assumptions and weaknesses.

### 2.2.1 Neoclassical theory of the firm

The earliest stream of the theory of the firm, the neoclassical theory, developed from the work of economists like Walras, Marshall and Jevons (Andréosso-O’Callaghan and Jacobson, 2005). A firm is conceptualised in the neoclassical model “...as a black box that transforms inputs into outputs according to the laws of technology” (Williamson, 2002: p178), with a profit-maximisation objective. Inherent in this perspective of the firm is the existence of an optimal size at which profit is maximised and the assumption that the firm has perfect knowledge of prices. This view of the firm assumes rational maximising behaviour by firms, with a focus on convergence towards an equilibrium position (Hodgson, 1998). Here, firm
growth is seen only as a means to attaining the optimal size and not an end in itself (Coad, 2009). Therefore, a firm would be deemed to have performed well when it achieves its profit-maximisation goal.

However, one criticism of the neoclassical view is the inability to explain the existence of firms as noted by Coase (1937), which informed the transaction-cost theory of the firm. Coase’s work on the nature of the firm was the first formal attempt to provide an explanation for the existence of firms and the basis for the development of alternative theories of the firm such as the managerial theory (Berle and Means, 1932; Baumol, 1959; Marris, 1963, 1964), behavioural theory (Cyert and March, 1963; Simon, 1957), extension of transaction cost theory (Williamson, 1971, 1975), property rights (Alchian and Demsetz, 1972), agency theory (Jensen and Meckling, 1976) and cooperative game theory (Aoki, 1984). These theories address the shortcomings of the neoclassical theory such as its assumption of perfect information and profit-maximisation objective, its neglect of transaction costs and possible conflicts that may occur between stakeholders in the firm (Hart, 1989; Kantarelis, 2007). However, the role of learning, technological innovation and dynamic change in explaining firm performance are not incorporated both in the neoclassical and aforementioned theories of the firm (Hodgson, 1998). Furthermore, these theories fail to explain the evolution of the firm (Kantarelis, 2007) and the emphasis on static equilibrium does not explain performance differences in firms even within the same industry (Hodgson, 1998). The resource-based theory of the firm, which emerged to address limitations associated with the theories of the firm as outlined above, is more relevant in explaining performance heterogeneity in firms. A discussion on the resource-based view of the firm is thus provided in the section that follows.
2.2.2 Resource-Based Theory

An overview of the Resource-Based View (RBV) of the firm, developed from the seminal work undertaken by Penrose (1959) in her book, *Theory of the Growth of the Firm*, is provided in this section. This offers theoretical insights on performance differences in firms. Penrose (1959, 1995: p31) defined a firm as “an administrative organisation and a collection of productive resources” and capabilities (Hodgson, 1998; Peteraf and Bergen, 2003) which are major factors in formulating its strategy. This implies that the firm’s resource base determines what it can do (capabilities) conferring on it a competitive advantage, while its strategy focuses on the most appropriate method to be used in exploiting its resources and capabilities, given external opportunities faced by the firm (Grant, 1991). The competitive advantage gained, in turn, determines the firm’s ability to grow and survive, as well as compete with other firms (Penrose, 1959).

However, it has been argued that a firm’s resources are sources of competitive advantage or sustained competitive advantage only if they possess four attributes: valuable (enable the firm to achieve better performance), rare (not easily found among the firm’s current and potential competitors), inimitable and non-substitutable—that is, alternative resources cannot be used by its competitors to achieve the same level of performance (Barney, 1991; Madhani, 2009). This implies that performance differs across firms to the extent to which

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4 Barney (1991: p101) identifies three categories of firm resources: physical capital resources including technology, firm plant and equipment, its geographic location and access to raw materials; human capital resources including training, experience and insight of individual managers and workers in the firm; organisational capital resources which include formal reporting structure, informal relations among groups within a firm and between a firm and those in its environment.

5 Capabilities are defined as what a firm...“can do as a result of teams of resources working together” (Grant, 1991: p120).

6 A distinction is made between competitive advantage and sustainable competitive advantage. A firm possesses competitive advantage when the value-creating strategy it pursues is not concurrently being implemented by its competitors (current and potential). A firm has sustainable competitive advantage only if the value-creating strategy it pursues is not concurrently being implemented by its competitors, and the benefit from the strategy cannot be replicated by these competitors (Barney, 1991).
they possess resources which are valuable, rare, inimitable and non-substitutable (VRIN), which confer competitive advantage when those resources are heterogeneous and immobile across firms (Barney, 1991; Madhani, 2009). Implicit in the RBV model, is the notion that the firm has to constantly develop new capabilities to sustain the initial advantage gained, thus highlighting the importance of learning, innovation and dynamic change. Therefore, superior firm performance is dependent on the ability to create and use resources, such that firms pursue growth in order to utilise unused resources, which in turn create more resources which the firm seeks ways to exploit (Coad, 2009).

However, a criticism of the RBV is its static approach which focuses mainly on resource types and capabilities and neglects the external environment in which firms operate, necessitating the need for a model of the firm which takes into account how firms adapt resources and capabilities in response to changes in the external environment (Teece et al, 1997; Lockett et al, 2009). In contrast to the RBV model, the evolutionary theory of the firm provides a theoretical explanation of performance differences in firms based on both learning and adaption (Hölzl, 2005). Since this thesis is focused on the interaction between firms and the macroeconomic environment within which they operate, the evolutionary theory offers a better insight into why some firms are more successful than others, given its emphasis on learning and dynamics (in terms of the firm’s ability to respond to changes in its operating environment based on previous experience). A discussion on this theoretical model of the firm is, therefore, presented in the section that follows.

2.2.3 Evolutionary Theory

As earlier indicated in Chapter 1 (Section 1.1), the evolutionary theory of the firm is most relevant to this research given its ability to explain performance heterogeneity in terms of the
firm’s response to its external environment. Thus, a discussion regarding this theory is presented in this section. The evolutionary theory is an offshoot of the RBV model of the firm developed from Nelson and Winter’s (1982) seminal book, *Evolutionary Theory of Economic Change*, in response to the criticism of the RBV’s perceived neglect of the external factors surrounding the firm’s resources. Drawing from Biology, the firm is viewed as ‘a changing organism’ characterised by ‘reactive and purposeful behaviour’ with learning by doing (experience) as the mechanism through which productivity growth is achieved (Lucas, 1988; Hodgson, 1998: p.46; Levitt et al, 2013). The evolutionary model differs from the static and equilibrium-based approach of other theories of the firm, given its emphasis on adaptation and deliberate learning.

**Key Elements of the Evolutionary Theory**

In the evolutionary view of the firm, Nelson (1991) identifies three important features of the firm: its strategy, structure and core organisational capabilities. The strategy is linked to how the firm defines and intends to pursue its objectives; structure relates to the firm’s organisation and governance, while organisational capabilities refer to specialised knowledge and skills embedded in the firm’s resources, procedures, contacts and team relationships (Nelson, 1991; Chandler, 1992; Ricketts, 2002). These capabilities confer a competitive edge on the firm which enable it to, for instance, produce goods more cheaply, respond more quickly to market changes or carry out certain productive activities more efficiently relative to its competitors. Thus, organisational capabilities are essential for ensuring the firm’s sustained growth and explain why some firms are more successful than others. Furthermore, organisational capabilities are learnt through knowledge acquired by the firm in the process of introducing new products, altering existing products in response to changing demand, searching of new suppliers and hiring and training of workers and managers.
Organisational routines, also referred to as organisational memory (Nelson and Winter, 1982: p99), are another critical element of the evolutionary theory. These are repeated patterns of behaviour, learned by the firm which can be updated in response to changes in the firm’s operating environment (Nelson and Winter, 1982; Teece et al, 1997; Salvato and Rerup, 2010). Routines are firm-specific (e.g. R&D and exporting) and confer superior performance on firms, in addition to the ability to respond to changes (both adverse and favourable) in the macroeconomic environment. Routines are, however, distinct from capabilities which are a ‘collection of routines’ representing the firm’s ability “…to reflexively revisit what it routinely does, particularly in dynamic changing environments” (Winter, 2003: p983; Felin and Foss, 2004: p11). In other words, the firm’s routines (what it does) are embedded in its capabilities (what it can do) given its resources.

In contrast, dynamic capabilities are “higher level routines” for modifying routines and capabilities to a changing environment (Teece et al, 1997; Salvato and Rerup, 2010). Teece et al (1997: p516) introduced the term, ‘dynamic capabilities’ defined as “the ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments”. This dynamic view of the firm’s capabilities implies deliberate action by the firm to create, broaden and alter its resource base (Helfat et al, 2007) and considers the changing nature of the operating environment, uncertainty and technology. The firm’s resources are assets which are firm-specific (developed within the firm), difficult to imitate and not easily transferred due to transaction costs, as well as elements of tacit knowledge embedded in them (Chandler, 1992; Zollo and Winter, 2002). Thus, the firm is able to compete successfully based not only on its capacity to select appropriate resources, but to the extent to which it is able to develop and renew its resources, that is, its ability to reconfigure its resource base in a timely manner in response to a dynamic environment.
Implicit in the evolutionary perspective is the concept of path dependence, wherein the firm’s subsequent performance is dependent on its initial conditions or starting point. Firms which possess an initial advantage may have this advantage strengthened over time due to increasing returns resulting from investments in R&D and learning by doing, while firms with initial levels of disadvantage may decline or exit (Fagerberg, 2003). This implies that the firm’s initial characteristics (such as size and age) may potentially influence its behaviour in the long run. Additionally, it highlights the importance of learning, feedback and some elements of trial and error in the firm’s ability to update its routines and capabilities based on past experience to generate superior performance (Chandler, 1992; Becker, 2004; Hözl, 2005).

Firm dynamics in the evolutionary theory is governed by the mechanism of search and selection. It is assumed that firms are “…motivated by profit and engaged in search for ways to improve profits”, while the theory “emphasises the tendency for more profitable firms to crowd out less profitable firms in the market” (Nelson and Winter, 1982: p4). Thus, the market or the environment within which the firm operates not only defines what routines and capabilities are developed by the firm, but also acts as a mechanism to eliminate poor performers in a manner akin to natural selection. Consequently, the selection environment in which a firm operates influences its performance and governs the degree to which the firm expands or contracts, that is, the extent of firm growth. The evolutionary theory is, however, not without criticism. These include its treatment of the conflict within the firm (between factors of production and between stakeholders in the firm); how routines are updated; entrepreneurship (Witt, 1998; Hözl, 2005). Notwithstanding its criticism, the evolutionary theory is a robust theory in explaining why firms differ in performance, consistent with the research with which this thesis is concerned.
To summarise, performance heterogeneity observed in firms even within the same industry (Caves, 1998), necessitates the formulation of a theory of the firm to explain the existence and nature of firms with a view to increasing our understanding of the sources of divergence among firms. However, theories of the firm such as the neoclassical and transaction cost theories are inadequate in explaining the firm performance differences due to their focus on static equilibrium and the neglect of learning, innovation and dynamic change. Although the RBV view of the firm acknowledges learning and innovation (in contrast to earlier theories of the firm), its emphasis on the firm’s ability to use and develop resources as its source of competitive advantage neglects the external environment within which the firm operates. The evolutionary theory, on the other hand, links the firm’s source of competitive advantage to its ability to use and develop its resources in response to changes in the operating environment. That is to say, successful performance is dependent not only on the firm’s ability to reconfigure its resources, but also on the degree of its responsiveness to a dynamic environment. The evolutionary theory, therefore, provides a suitable theoretical basis for this research because it explains: how firms can be defined (in terms of the routines they possess); why firms differ (because of heterogeneity in routines embedded in the firm, which are not easily transferrable) and firm dynamics, through mechanisms of selection and searching (Coriat and Weinstein, 1995; Hölzl, 2005).

Considering the above discussion on the theories of the firm, for the purpose of this thesis the firm is defined as an administrative organisation with a collection of productive resources which confer on the firm some form of competitive advantage in terms of its ability to use and develop its resources in response to changes in the external environment. Having outlined various strands of the theory of the firm to explicate why some firms perform better than others, issues related to the definition of firm performance are addressed in Section 2.3.
2.3 Firm Performance: Definitional Issues

In this section, a discussion on issues associated with defining firm performance is presented, with a view to providing a definition suitable for the purpose of this thesis. This discussion draws on the objectives of the firm implied in the theories of the firm discussed previously in Section 2.2 and guides the choice of performance measures to be adopted in this research. Firm performance is mainly concerned with the extent to which a firm’s stated objectives are attained and is broadly connected to effectiveness in the utilisation of resources given a certain level of resources. It therefore follows that performance in firms should be defined in terms of the degree of success in achieving the firm’s objectives. Given that firm performance is multidimensional and subject to interpretation of various stakeholders based on their specific interests (Industry Canada, 2003; Aral and Weill, 2007; Richard et al, 2009), the decision on how performance should be defined or measured should be based on the achievement of those objectives particularly relevant to stakeholders’ interests.

Notwithstanding the large volume of studies motivated by the need to study firm performance, wide divergence exists with regard to its definition, dimensionality and measurement (Santos and Brito, 2012). This implies that, given the plethora of performance measures, researchers may be tempted to substitute one performance measure for the other. For instance, Kiviluoto et al (2011: p25), in their study of commonly used measures of firm performance across 5 peer-reviewed entrepreneurship and general management journals, observed that many firm performance studies really just employ growth measures, specifically sales growth, which they found to be the most frequently used performance measure. Nonetheless, Santos and Brito (2012) warn that although firm performance is multidimensional, its dimensions cannot be used interchangeably as these capture different...
aspects of the firm’s performance. This provides an argument to support the inclusion of multiple measures in any performance analysis.

In view of the above, prior to defining firm performance and its most suitable measures, there is a need to specify the objectives of the firm implied in the neoclassical, RBV and evolutionary theories of the firm, discussed earlier in Section 2.2. According to the neoclassical view of the firm, the firm’s key objective is to maximise profit (Andréossou-O’Callaghan and Jacobson, 2005). The firm then pursues growth in order to attain the optimal size at which profit is maximised so as to enjoy economies of scale (Coad, 2009). Therefore, based on this view of the firm, firm performance is best defined in terms of profitability.

As previously outlined (Section 2.2.2), Penrose’s (1959) resource-based view of the firm, assumes firms possess productive resources which confer on them the ability to compete, grow and survive. The extent to which the firm attains superior performance is, therefore, determined by its ability to exploit these resources, that is, the ability to use existing resources and develop new ones. Hence, firm performance in the RBV is best measured by the expansion of a firm’s productive resources and the efficiency with which these resources are expanded (i.e. growth and productivity). The evolutionary theory assumes that successful firms (as proxied by profitability or productivity) will survive and grow based on the deliberate creation of resources, while unsuccessful firms will decline and exit the market (Coad, 2009; Johnson et al, 2013), implying that productivity/profitability is positively linked to firm survival and subsequent growth. A firm’s performance may then be assessed in terms of growth\(^7\), profitability\(^8\) and productivity, which are perceived as crucial to its survival and

---

\(^7\) The different growth measures employed in firm performance studies are outlined in Chapter 3 (Section 3.3.1).

\(^8\) Profitability is important for firm survival and growth, because the availability of profits for reinvestment provides the firm with an internal pool of funds (Fitzsimmons et al, 2005; Bottazzi et al, 2008). Moreover, healthy profits act as a positive signal to investors and financial institutions thereby, facilitating ease of access to
subsequent growth. Having examined the definition of firm performance linked to firm objectives implied in the theories of the firm discussed earlier in Section 2.2, a definition of firm performance relevant to this research is presented.

As previously detailed, according to the evolutionary theory of the firm, the extent of a firm’s success or failure is determined both by its ability to use resources and respond to changes in its environment. Given that this research is concerned with investigating whether (how) performance in firms is influenced by the macroeconomic environment, firm performance in the thesis is defined in terms of growth (i.e. growth of employees, turnover and turnover per employee) and productivity levels. Firms have to be productive (efficient in the use of resources) in order to grow and remain profitable, while firm growth is critical to survival. Thus, these two performance measures are appropriate for the purpose of this research, due to their importance to other performance measures (such as survival and profitability). A more detailed discussion on the rationale for the choice of these measures is provided in Chapter 3.

Moreover, the use of these two measures encompasses the specific interests of stakeholders; firms are concerned with increasing output and becoming more efficient in the use of resources, while policymakers are concerned with the number of jobs created and retained. Because the use of a single measure may introduce bias which does not consider value created across stakeholder groups (Kiviluoto et al, 2009), the use of multiple measures (i.e. three growth measures and productivity level) in this research ensures that different dimensions of firm performance can be assessed.

external financing (Bottazzi et al, 2008). Although, profitability in itself is an indicator of a firm’s performance, it is also used as a measure of firm growth, where growth is defined as a change in the firm’s profit levels.
A discussion on definitional issues in firm performance related to its definition, dimensions and measurements was outlined in this section. It was argued that performance should be defined and measured based on the firm’s objectives taking into account the specific interests of stakeholders in the firm. Consequently, performance in this thesis is evaluated in terms of growth and productivity given its relative importance to the success of other firm performance measures. In the discussion that follows, the firm growth debate is reviewed in Section 2.4 so as to provide theoretical underpinnings for the subsequent empirical analyses carried out in Chapters 5 and 6.

2.4 A Review of the Firm Growth Debate

A survey of the firm growth literature is presented in this section to highlight the origin and evolution of the firm growth debate, as well as outlining key approaches to the study of firm growth. As previously indicated in Chapter 1, the starting point of the analysis undertaken in this thesis is Gibrat’s Law (GL), in line with several other empirical studies on firm growth. Based on theoretical and empirical evidence, the discussion on GL presented in this section explicates firm performance differences, in terms of industry effects (for instance, scale intensity, capital intensity and sunk costs) and learning effects. This discussion provides a theoretical foundation for the empirical analyses which follow in Chapters 5 and 6.

The firm growth debate beginning with the Law of Proportionate Effect (LPE) was developed by Robert Gibrat in 1931 in response to the need to analyse the prevalent market structure, as well as explain the observed asymmetry of firm size distributions in a given industry (Sutton, 1997, Lotti and Santarelli, 2004). Using data from French Manufacturing firms, Gibrat (1931) observed that the typical firm size distribution in an industry was positively skewed and well
described by a lognormal distribution, with a few large firms and many small firms (Lotti and Santarelli, 2004; Coad, 2007). He then proposed the LPE as an explanation for the observed skewness in firm size distribution. Gibrat argued that the lognormal distribution gives a good explanation of firm size distribution and observed that the LPE fits a large number of economic distributions. He further went on to apply the LPE to food expenditure distribution, income distribution and a distribution of French manufacturing firm sizes as measured by the number of employees.

The logarithmic specification of Gibrat’s Law is:

\[ Z_{t,i} = \beta Z_{t-1,i} + \epsilon_{t,i} \]  

Where \( Z_{t,i} \) is deviation of the logarithm of size of company \( i \) at time \( t \) from the mean of the logarithms of the sizes of companies at time \( t \), \( \beta \) is a parameter to be estimated and \( \epsilon_{t,i} \) is a disturbance term. Gibrat’s Law is said to hold when \( \beta = 1 \). However, when \( \beta \) is less than 1, there is a reversion to the mean (i.e. smaller firms grow faster than larger firms). A \( \beta \) coefficient greater than 1 indicates that larger firms grow faster than smaller firms (Hart 1962; Chesher, 1979).

Given that a lognormal curve is generated when a number of small independent random forces act multiplicatively on a variate, it then follows that the determinants of firm growth act randomly without any tendency to favour firms of any particular size, that is, firm growth is independent of firm size (Hart, 1962). Bearing this in mind, the implications of the LPE are that: (i) firms have the same mean proportionate growth irrespective of their sizes; (ii) firms have the same deviations from the mean growth rate regardless of their sizes; (iii) the distribution of proportionate firm growth rate is lognormal; and (iv) the relative dispersion of
firm sizes tends to increase over time, with implications for size mobility of firms over time (Hart, 1962).

2.4.1 Empirical Evidence on Gibrat’s Law

In this section, a review of the firm growth literature is undertaken with emphasis on empirical evidence from growth studies. This provides insights on the validity of GL, as well as the context wherein the assumption of validity is supported or rejected. Earlier studies on firm growth such as Hart and Prais (1956); Simon and Bonini (1958) and Hymer and Pashigan (1962) confirmed the validity of GL in UK and US firms respectively. However, starting from Mansfield (1962), more recent studies have failed to confirm the validity of this law. Empirical findings are, however, mixed. Results from some studies favour the growth of large firms (e.g. Singh and Whittington, 1975 for UK manufacturing and service firms; Das, 1995 for a sample of 51 firms in the Indian computer software industry; Geroski et al, 1997 for 271 large quoted UK firms; Oliveira and Fortunato, 2006a for an unbalanced panel of Portuguese manufacturing firms and Bentzen et al, 2012 for 2,500 Danish firms across all industries from 1990 to 2004).

On the other hand, findings from many other studies indicate a negative relationship between firm growth and size (e.g. Mansfield, 1962; Jovanovic, 1982; Evans, 1987; Hall, 1987 for US manufacturing firms; Li et al, 2007 for Irish Manufacturing firms; Morone and Testa, 2008 for Italian SMEs and Oberhofer, 2012 for European firms). A negative relationship between firm size and growth has been found for some developing countries (McPherson, 1996 for small manufacturing firms in 5 Southern African countries and Sleuwaegen and Goedhuys, 2001 for small manufacturing firms in Côte d’Ivoire) and transition economies (Krasniqi, 2007 for SMEs in Kosovo; Mateev and Anastasov, 2011 for SMEs in 7 transition economies).
It is worthy to note that the methodologies employed in the various empirical studies on firm growth range from simple descriptive analyses (as in earlier studies) to the more sophisticated econometric analyses adopted in more recent studies.

In a similar manner, significant divergence exists in the sample data used in these firm growth studies. For instance, tests of GL have also been undertaken for banks (Alhadeff and Alhadeff, 1964 compared the growth of the 200 largest US banks to the total banking industry assets and observed that the large banks grew less than the banking system as a whole; Tschoegl, 1983 rejected GL for the world’s 100 largest international banks; Shehzad et al, 2013 found GL valid in the banking industry using data for 15,000 banks across 148 countries from 1988 to 2010), farms (Weiss, 1998 found a negative relationship for Austrian farms), credit unions (Ward and McKillop, 2005 observed an inverse relationship for credit unions in the UK) and the insurance industry (Hardwick and Adams, 2002 found no significant difference between size and growth for firms in the UK life insurance industry). To further highlight the ambiguity of empirical results, Audretsch at al (2004), in their review of 59 firm growth studies, found GL was rejected in 31 studies, accepted in 9 studies, while results from 19 studies were inconclusive.

Nevertheless, in spite of the divergent empirical evidence, a stylised fact emerging from the survey of the literature is a negative relationship between firm growth and size, an indication that small firms show faster growth rates than larger firms. In earlier studies, the main concern was with investigating the relationship between firm size and growth, while analysis was based on samples of large firms in the UK and US. However, with more recent evidence of firm size-growth dependence, attempts have been made to gain further insights into the
drivers of firm growth as evidenced by the plethora of determinants included in growth analyses.

To this end, Sutton (1997) and Caves (1998) in their surveys of firm growth studies have suggested GL as a regularity rather than a general law, valid only for large firms which have already attained their minimum efficient scale (MES)\(^9\). Hardwick and Adams (2002) observed GL as a long run phenomenon in their study of UK insurance firms, using the weighted least squares estimator over the period 1987-1996. Related to this is the life cycle effect on firm growth. Lotti et al (2001) in their study of Italian new firms demonstrated that GL fails to hold in new start-ups only in the periods immediately after entry. A negative relation between initial size and growth is observed immediately after start up as small firms ‘rush’ in order to quickly reach a size large enough to increase their probability of survival. However, in successive years the growth pattern of the new entrants is not significantly different from that of the industry as a whole.

Furthermore, Lotti et al (2009) in their investigation of growth in Italian electronics firms, with the use of a sample selection model in the period 1987-1994, showed that in the long run, the firm size effect diminishes and the growth process converges to a Gibrat-like state. Their findings indicated that GL was rejected over the entire sample period, with smaller firms showing faster growth than larger ones. However, results from the yearly regressions show that the negative relation between size and growth is only observed in the first three years after which a convergence to the law is observed through time, providing evidence of learning effects. Similarly, Piergiovanni (2010) in his study of Italian firms found that when

\(^9\) According to Delmar and Wennberg (2010: p129), the minimum efficient scale of production is “…the smallest size or output level necessary for a firm in a given industry at which the long run average costs are at a minimum”. In other words, the MES is the size beyond which the firm can no longer achieve significant additional economies of scale (Sloman et al, 2013).
firm size and age is controlled for, GL cannot be confirmed in the early stages of a firm’s lifecycle, while it can not be ejected once a certain age threshold is reached. The above findings seem to suggest GL as a long run phenomenon, with firms converging to a mean size over time. Hence, the probability of confirming the validity of GL tends to increase with firm size and age.

Following on from this, ambiguity in empirical results could also be attributed to the types of firms included in the sample. GL seems to hold when only large firms or firms that have exceeded the minimum efficient scale are included in the sample, as indicated by earlier studies. For example, in Becchetti and Trovato’s (2002) study of a sample of Italian SMEs based on multivariate regression over the period 1995-1997, GL is accepted for large firms. The authors, however, found that GL does not hold for SMEs under financial constraints in a bank-oriented financial system in which access to external finance is difficult. This suggests the effects of financial constraints as highlighted by Cabral (1995). In contrast, an inverse relationship between growth rates and size is observed in a sample of firms consisting of both large and small firms due to the high probability of exit shown by small firms, as the sample of surviving small firms may show some bias towards high-growth firms (Audretsch et al, 2004).

The survey of the empirical evidence on GL carried out in this section has provided insights on the contexts in which the validity of the law can be supported or rejected. In general, the review identified an apparent lack of evidence on the law, as well as highlighting the argument that the law is a regularity and long run phenomenon, rather than a general law. It was also suggested that the extent to which the validity of GL is confirmed is dependent on the size composition of the sample being analysed, with the law more likely to be confirmed
for large firms that have reached the industry minimum efficient scale, as well as a life cycle effect. The implication of evidence from the survey undertaken above for the current research is that firm growth is not quite random and is likely driven by other factors. Additionally, implicit in the discussion presented in this section is the importance of industry characteristics and learning selection effects as determining factors of firm growth.

In the context of the above, there is a need to consider factors other than firm size that may possibly influence growth such as factors related to the firm, industry and the macroeconomic environment. However, a stylised fact emerging from the literature review above is a negative relationship between firm size and growth, which suggests that small firms grow faster than larger firms, thus invalidating GL. To provide a theoretical explanation regarding this observed negative firm size-growth effect, several studies have examined the role of factors such as scale economies, capital intensities, sunk costs and learning selection effects (Audretsch, 1995; Audretsch et al, 2004). Major theoretical contributions on these factors are outlined and discussed in the section that follows.

2.4.2 Firm Growth: The Role of Industry Effects

The role played by industry effects in explaining the observed inverse relation between firm growth and initial size has been examined in the literature. Mansfield (1962), in his seminal article, developed the first model on the effects of industry characteristics (such as profitability, capital requirements and the minimum efficient scale) on firm entry and exit rates using data for all US firms in steel, rubber tire and petroleum refining industries. Mansfield identified three versions of GL, with implications on the interpretation of research findings. Following on from Mansfield’s (1962) study, GL can be said to hold for:

(i) All firms including all firms that exited from the industry (GL rejected),
(ii) All surviving firms (results on GL not conclusive),

(iii) All surviving firms that exceed the minimum efficient scale in the industry (GL valid).

Testing all three versions, Mansfield (1962) found that smaller firms have relatively high exit rates and those that survive tend to have higher and more variable growth rates than larger firms. Following on from this, GL will only be valid for large firms which have reached the minimum efficient scale in the industry.

Cabral (1995) provided a theoretical model which attributed the observed negative relation between firm size and firm growth to the presence of sunk costs\(^{10}\) and financing constraints in an industry. Cabral noted that capacity and technology choices involve some degree of sunkness (i.e. investments for which value is forgone upon exit). Since small firms have a higher probability of exit than larger firms, smaller firms benefit from investing more gradually, and thus experience higher expected growth rates, than do larger firms. In addition, smaller firms will delay investment to the second period—implying their expectations of a higher growth rate between the first and second period.

Financing constraints have also been suggested by Cabral (1995) and Cabral and Mata (2003) to explicate the negative size-growth relation. Low efficiency and cash constraints may limit a firm’s initial start-up size, thus, cash-constrained start-up firms should expect higher-than-average growth rates since cash constraints are expected to be less binding after start-up. As a result, expected growth rates should be higher among small start-up firms. In conclusion, in

\(^{10}\) A cost (e.g. R&D expenditure) is said to be sunk “...if it was incurred in the past, cannot be changed by current decisions, and therefore cannot be recovered” (Arnold, 2013: p 515). Since sunk costs cannot be recovered, they may act as barriers to the exit of incumbent firms and the entry of new firms.
the presence of sunk costs and financing constraints, GL will no longer hold and a negative relationship between firm size and growth will be observed.

Ghosal (2002) also argued that small firms located in industries with greater uncertainty about profits and higher probabilities of exit and experience an aggravation of their financing constraints as lenders are unwilling to supply them with funds for investment. Therefore, firms with high dependence on external financing (borrowing) who are also negatively affected by tighter credit constraints will have lower probabilities of survival and high rates of exit. Surviving firms will therefore show higher growth rates. Conversely, entry is also likely to be restricted for prospective new entrants who are more affected by tighter credit conditions. Due to the loss of smaller firms in the industry, the firm size distribution becomes less skewed. The exit of smaller firms from the industry also has a positive impact on industry concentration, although this effect is quantitatively small. These effects are, however, more pronounced in industries characterised with high sunk costs (Ghosal, 2002). Other studies which have also highlighted industry-specific features such as sunk costs, capital intensity and scale economies11 include Mata and Portugal (1994) and Audretsch and Mahmood (1995). Following on from the discussion above, small firms in capital-intensive industries characterised by high scale economies and large sunk costs have lower probabilities of survival. Consequently, survival bias is introduced; surviving small firms in such industries, thus tend to have higher growth rates than larger firms (Audretsch et al, 2004).

11 Scale economies or economies of scale are achieved when an expansion in the firm’s scale of production results in lower cost per unit of output produced, that is, the cost of producing a unit of a given good/service falls with an increased rate of output (Boyes and Melvin, 2012).
In general, the overriding stylised fact emerging from the review of empirical studies on the validity of GL undertaken in the preceding section is the negative relationship between initial firm size and subsequent growth. Taking the above into consideration, a summary of some key theoretical reasons related to industry effects for the observed negative firm size-growth relation was presented. Consequently, scale intensities, sunk costs, financing constraints and capital intensities were suggested as driving factors behind the small firm growth phenomenon. Thus, firms located in industries with high sunk costs, high scale economies and capital intensities show higher growth due to survival bias, as the probability of failure is higher in such industries. This finding suggests that the need to account for industry characteristics and financing constraints in the empirical investigation of drivers of firm performance. Going forward, theoretical models of learning and selection have also been developed to explain the size-growth dependency. These include passive and active learning models, which suggest that firm performance is determined by the firm’s learning capacity. The learning models are discussed below.

2.4.3 Learning Models

Having examined the role of industry effects (e.g. sunk costs, capital and scale intensities) as drivers of the observed small firm growth phenomenon, a discussion regarding the effect of the firm’s learning abilities on subsequent growth is presented in this section. This approach, developed from the evolutionary theory of the firm (detailed previously in Section 2.2.3), tracks the development of the firm over its lifecycle. As firms evolve over time, they acquire knowledge and experience which promotes future performance (Goddard and Wilson, 2005).

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12 Scale-intensive industries (such as automobiles and chemicals) depend on the returns to scale in production, thus, profits are earned only at a large scale of production (Dudu and Kiliçaslan, 2009).
A discussion on the passive and active learning models is presented in the section which follows.

**Passive Learning Models**

Lucas (1978) provided a theoretical model which predicts firm size distribution of firms given a distribution of managerial talents. GL is valid under the assumption of heterogeneity in managerial skill levels with constant returns to scale and the costs of rearranging assets between managers with diminishing returns to scale. Jovanovic (1982) proposed a theory of noisy selection to explain the empirical evidence in support of smaller firms growing faster than larger firms. In his model, Jovanovic (1982) assumes small industry size, homogenous products, known time path for products and factors supplied at constant prices. Each firm has some level of efficiency, but this is not known prior to entry. Over time, the firm gains information about its relative efficiency (unit costs of production) from the profits earned in the previous period. Therefore, in every time period, a firm is faced with decisions on what strategy to adopt (i.e. whether to exit, continue with the same size, grow or reduce production capacity). Based on this model, over time as firms learn their true efficiency, the efficient grow and survive, while the inefficient decline and fail. The implication of the Jovanovic model is that growth decreases with firm size, while productivity in increases with size. Additionally, the market acts as a selection mechanism in line with the evolutionary theory of the firm. The Jovanovic learning model has however, been criticised for not explaining why firms differ in productivity levels (Ericson and Pakes, 1995; Cabral, 2007). The active learning model discussed in the section which follows deals with this shortcoming.
Active Learning Models

Building on Jovanovic’s (1982) model, Ericson and Pakes (1995) and Pakes and Ericson (1998) suggest a model of active learning where the firm has knowledge both of its own and its competitors’ current value, as well as the future distribution of the industry structure conditional on the current structure. In their model, the decision to enter, exit or invest is made to maximise the expected discounted value of future net cash flows conditional on the current information set. In the active learning model, firms incur a cost of gaining information about their own characteristics and that of their competitors and the industry whereas, in Jovanovic’s passive model, no cost is incurred, as all knowledge is gained from the firm’s past experience. The firm’s profit is adjusted over time in response to its realised profits, as well as that of its competitors in the same market (Ahn, 2001). In the active learning model, the productivity differences found in firms is explained by their decision to invest in research and development (R&D), as well as the magnitude of investments (Cabral, 2007). The decision on whether to remain active and the scale of R&D investment is updated in every period, as a result of which, small firms able to learn through active investment in R&D show higher growth rates.

The passive and active learning selection models have been discussed in this section to explain the observed size-growth dependence. These highlight the importance of learning as a means through which firms achieve high growth rates, while the market serves as a mechanism to weed out less successful firms consistent with the evolutionary theory of the firm. Based on the above discussion, the firm’s learning capacities and its initial conditions should be taken into account in the analysis of firm performance. Another key issue to be considered in the firm growth analysis is the persistence of growth, that is, high growth in one
period encourages (discourages) growth in the next period. The implications for the validity of GL are presented below.

2.4.4 Persistence of Growth

This section presents a discussion on the persistence of growth which is an essential part of the empirical investigation of firm growth. Failure to take account of growth persistence in the growth analysis may potentially distort findings on the validity of GL. Introducing the concept of ‘persistence of growth’, Chesher (1979) argued that the LPE can be said to hold only when $\beta=1$ and there is no correlation in the disturbance term, $\varepsilon_{t,i}$. He argued that even if $\beta=1$, GL will not hold if the disturbance term is serially correlated, as this indicates a dependent relationship between the proportionate firm growth rate and firm size in the previous period, as well as a correlation between proportionate growth rates. That is to say, a firm which experiences fast growth in a previous period is likely to experience more growth in the current period and vice versa. Chesher (1979) proposed a method to test the observed serial correlation of growth rates and suggested the need to incorporate past growth into the Ordinary Least Square equation.

According to Chesher (1979), the growth of firms in two consecutive periods ($t$, $t-1$) can be written as:

$$Z_{t,i} = \beta Z_{t-1,i} + \varepsilon_{t,i}$$

(1)

Where $Z_{t,i}$ is the deviation of the natural logarithm of the size of firm, $i$ at time $t$ from the mean of the natural logarithms of the sizes of firms at time $t$, $Z_{t-1,i}$ is similarly defined for the previous period, $\varepsilon_{t,i}$ is the error term and $\beta$ is the parameter to be estimated. Based on the above equation, GL is valid when $\beta=1$, however, $\beta<1$ implies small firms grow faster than larger firms, while $\beta>1$ means that large firms grow faster than smaller ones (Fotopoulos and
Giotopoulos, 2010: p195). To deal with the possibility that past growth could be correlated with the error term which could lead to inconsistent OLS estimates, a first-order autoregression for the error terms $\varepsilon_{i,t}$ was assumed:

$$
\varepsilon_{i,t} = \rho \varepsilon_{i,t-1} + \mu_{i,t}
$$

(2)

Where $\mu_{i,t}$ is an error term assumed to be serially uncorrelated and $\rho$ is the autocorrelation coefficient. Equations (1) and (2) can be combined to yield:

$$
Z_{i,t} = \beta Z_{i,t-1} + \rho \varepsilon_{i,t-1} + \mu_{i,t}
$$

(3)

$\varepsilon_{i,t}$ may also be expressed in terms of $Z_{i,t-1}$ and $Z_{i,t-2}$, thus equation (3) may be rewritten as:

$$
Z_{i,t} = \gamma_{1} Z_{i,t-1} + \gamma_{2} Z_{i,t-2} + \mu_{i,t}
$$

(4)

Where $Y_{1} = \beta + \rho$ and $Y_{2} = -\beta \rho$

The estimators of $\beta$ and $\rho$ can then be obtained using the following quadratic equation solution:

$$
(\hat{\beta}, \hat{\rho}) = \frac{1}{2} \left( \gamma_{1} \pm (\gamma_{1}^{2} + 4 \gamma_{2})^{1/2} \right)
$$

Based on the estimated coefficients, the validity of GL is confirmed when $\beta=1$, that is, firm growth is independent of size and $\rho=0$, that is, no autocorrelation in the error terms. Thus, the null hypothesis to test the validity of GL is: $H_{0}: (Y_{1}, Y_{2}) = (1, 0)$ while the alternative hypothesis is $H_{1}: (Y_{1}, Y_{2}) \neq (1, 0)$.

Following from the above discussion, GL holds when three propositions are fulfilled:

- Firms of different size classes have the same mean proportionate growth rate (i.e. growth is independent of size).
• Variance of growth rates is the same for firms of different size classes.
• No serial correlation in growth rates.

GL is rejected when any of these propositions fail to hold (Petrunia, 2008).

Although the absence of serial correlation of growth rates is an important assumption for the validity of GL, only a few studies have explicitly considered this in the firm growth analysis (Audretsch et al., 2004; Fotopoulos and Giotopoulos, 2010). Similar to tests of the validity of GL, empirical evidence regarding the persistence of growth is also mixed. Kumar (1985) tested this proposition of the LPE with data for 2000 UK quoted firms and observed persistence of growth in the sample. Wagner (1992) using manufacturing establishment data for 7000 firms in Germany, also found GL does not hold in the sample due to the positive persistence of growth, while Oliveira and Fortunato (2006a) found negative persistence of growth in Portuguese manufacturing firms from 1990 to 2001. Finally, Piergiovanni (2010) was not able to confirm growth persistence in a sample of Italian manufacturing firms from 1995-2005, while Fotopoulos and Giotopoulos (2010) find positive persistence of growth in Greek manufacturing firms from 1995-2001.

In light of the discussion presented in this section, it can be concluded that the focus in earlier firm growth studies was on testing the validity of GL and providing explanations for firm size distributions based on empirical evidence. Recent firm growth studies, however, have focused mainly on rooting the observed empirical evidence in theory, as well as dealing with any econometric issues likely to distort results. As previously outlined, the divergent empirical evidence on GL suggests the role of factors, other than firm size, in engendering firm growth (Oliveira and Fortunato, 2006a). Therefore, a survey of the international firm
growth literature is presented in the section that follows to highlight and explore other drivers of firm growth.

### 2.5 Determinants of Firm Growth and Productivity

In this section, a review of the international literature on firm growth is carried out to identify key determinants of firm growth and productivity analysed in empirical studies. This offers useful insights on the determining factors of firm growth and productivity to inform the econometric modelling for the empirical investigation carried out in Chapter 6 of the thesis.

Following Storey (1994), three categories of firm growth factors are identified and presented in Table 2.1. These are: (i) factors related to the entrepreneur; (ii) factors related to the firm and (iii) factors related to the firm’s strategy. Storey argued that entrepreneurial characteristics are determined prior to business start-up, while the firm’s characteristics are embedded within its strategy and reflect entrepreneurial decisions made at the firm’s inception. Strategy, on the other hand, is a reflection of entrepreneurial and firm characteristics and embodies all decisions made after start up. Storey (1994) concluded that a suitable combination of all three categories of factors is requisite for attainment of rapid growth. For instance, a firm’s decision to enter into new global markets may result in poor performance if the entrepreneur lacks the requisite skills to deal with conditions in the new market.
Table 2.1: Factors Influencing Growth and Productivity

<table>
<thead>
<tr>
<th>The Entrepreneur/ Resources</th>
<th>The Firm</th>
<th>Strategy</th>
<th>Macroeconomic Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Motivation</td>
<td>1. Age</td>
<td>1. Workforce training</td>
<td>1. GDP growth</td>
</tr>
<tr>
<td>7. Family history</td>
<td></td>
<td>7. Planning</td>
<td>(Real effective exchange rate and Unit labour costs)</td>
</tr>
<tr>
<td>8. Social marginality</td>
<td></td>
<td>8. New products</td>
<td></td>
</tr>
<tr>
<td>10. Training</td>
<td></td>
<td>10. State Support</td>
<td></td>
</tr>
<tr>
<td>11. Age</td>
<td></td>
<td>11. Customer concentration</td>
<td></td>
</tr>
<tr>
<td>13. Prior sector experience</td>
<td></td>
<td>13. Information and advice</td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Gender</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Source: Author’s elaboration of Storey (1994)

Nevertheless, the impact of macroeconomic conditions on firm growth is omitted from Storey’s (1994) framework. Since this thesis aims to extend the literature by refining our understanding of whether and how the macroeconomic environment influences firm performance, the model outlined in Table 2.1 is extended to include a group of factors related to the macroeconomic environment. The link between firm performance and the macroeconomic environment is dependent on what macroeconomic factors influence the firm and how these factors inform the strategies adopted. Thus, an appropriate combination of the first three groups of factors outlined in Table 2.1 determines the firm’s ability to respond to changes in the macroeconomy, while it can also be guided that specific impact of macroeconomic conditions on firm growth may be conditional on firm characteristics, strategy adopted and the characteristics of the entrepreneur.
Given theoretical predictions from the learning models that firm productivity is positively related to firm growth (Jovanovic, 1982, Ericson and Pakes, 1995) and the theoretical and empirical evidence that wide heterogeneity in firm performance is related to variations in firm characteristics and strategies as earlier discussed in the evolutionary theory of the firm (Section 2.2.3), it can be argued that similar factors affect both growth and productivity. Yazdanfar and Salman (2012), in a review of the performance literature, noted that the process of firm performance in terms of growth, productivity and profitability which follows an inverted U shape, increasing initially and then decreasing with age, can be predicted by firm characteristics, owner’s preferences and industry characteristics. Thus, the factors of the growth model outlined in Table 2.1 can also be applied in analysing the determinants of productivity levels. Furthermore, the growth model can be applied to the analysis of firm performance in both manufacturing and service industries. Although, the effect of some factors such as technological sophistication, may be more pronounced in one industry than the other.

A discussion of some of the factors of growth and productivity outlined in Table 2.1 is provided below. First, firm characteristics are discussed, followed by firm strategy, factors related to the entrepreneur and lastly, the macroeconomic environment. Inclusion of variables related to the macroeconomic environment in the growth model contributes to the firm growth debate by providing insights on how macroeconomic conditions influence firm performance and strategies adopted by firms.

### 2.5.1 The Firm

Based on observed heterogeneity in performance outcomes, even within firms in narrowly defined industries, the impact of firm characteristics on firm growth and productivity has
been investigated in several studies. In this section, characteristics of the firm in terms of size, age, location and ownership are discussed. First, the effect of size on firm growth and productivity is outlined.

(i) Firm Size

The study of the relationship between firm size and growth is motivated by GL. Empirical evidence on the law is however, mixed as outlined in Section 2.4.1. GL was confirmed to be valid in early studies, such as Hart and Prais (1956) and Simon and Bonini (1958), while a negative size-growth relation has been found in many recent studies (Mansfield, 1962 in US manufacturing firms; Nunes and Serraqueiro, 2009 using Least Squares Dummy Variables in Portuguese services industry; Yazdanfar and Salman, 2012 using ANOVA tests in Swedish micro-sized firms). As outlined previously in Section 2.4.2, theoretical explanations of the negative size-growth relation have highlighted the importance of sunk costs, capital intensities, scale economies and financial constraints in determining the impact of size on firm growth as discussed in Section 2.4.2.

Small firms are commonly financially constrained at start up due to the low pool of internal funds, as well as difficulties in accessing external funds. Consequently, small financially constrained firms are more likely to fail, while those firms able to survive grow more. Financial constraints also mean that firms in industries with high sunk costs, capital intensities and scale intensities may be unable to recover the high costs associated with entry, thus less successful firms decline or exit, while successful firms grow more (Audretsch et al, 2004, Strotmann, 2007). The negative size-growth link has also been related to selection effects as suggested by Jovanovic (1982) and Ericson and Pakes (1995), thus small firms
either decline and/or or fail or succeed and grow based on their learning ability. This effect, however, diminishes with size.

Econometric issues such as measurement error, heteroskedasticity and sample attrition arising from survivor bias have also been suggested as sources of the inverse firm size-growth link. Hall (1987) investigated the effect of initial size on firm growth using data for 1,778 publicly quoted US manufacturing firms. GL was rejected for the smaller firms in the sample and accepted for larger firms. These results remained even after controlling for the effect of sample attrition.

On the other hand, large firms have been found to grow more in some other studies, suggesting increasing returns to scale effects may be at play in such industries (Singh and Whittington, 1975 for UK manufacturing and service firms; Bentzen et al, 2012 for Danish industries). Mixed results have also been found; Morone and Testa (2008) using ordered probit models found small firms grew faster in terms of employment in a sample of 2,600 Italian firms, while large firms grew more in terms of turnover. The finding by the authors suggests that small firm growth in the sample was consistent with decreasing returns, with growth decreasing with increased employment (input), while growth in large firms was consistent with increasing returns to scale with more output (turnover) produced as the firm expands production. Likewise, Fotopoulos and Giotopoulos (2010) found GL was valid for medium-sized and large older firms, while it was rejected for micro-sized, small and young firms based on results from ordinary least squares (OLS) estimations in a sample of Greek manufacturing firms. This provides evidence to support GL as a long run phenomenon or regularity, as previously indicated in the preceding section.
Following on from this discussion, mixed evidence on the validity of GL is related to a number of factors:

- Differences in sample data (Rogers et al, 2010) as indicated in the three versions of the law suggested by Mansfield (1962). Thus, GL will be rejected in a sample of only surviving firms; accepted in a sample of firms which have attained the MES in the industry (large); and evidence on GL may be inconclusive in a sample of all firms.

- Methodological issues such as controlling for autocorrelation and heteroskedasticity in analyses may also affect the validity of the law. Persistence of growth and a relationship between size and the variability of growth violate the GL assumptions of no correlation of growth rates and the independence of growth variability and firm size. Additionally, whether and how sample selection is dealt with affects findings due to survivor bias (Hall, 1987; Sutton, 1997; Rogers et al, 2010).

With reference to the size-productivity relationship, productivity is related to firm size, with larger firms being more productive than smaller firms due to the reallocation of resources from less productive firms to more productive firms, in line with the market selection model (Bigsten and Gebretesus, 2007). Small firms commonly start up at a lower level of productivity and are prone to high failure rates. Consequently, resources from failing firms are allocated to successful firms (Bartelsman and Dom, 2000). However, as large firms increase size, co-ordination costs and bureaucracy could result in productivity losses relative to smaller firms (Schiersch, 2013).

Empirical evidence is mixed; Badunenko (2010) found efficiency is positively linked to firm size in German chemical manufacturing firms using Data Envelopment Analysis during 1992-2004. Using Stochastic Frontier Analysis, Diaz and Sanchez (2008) found small firms
are more productive than large firms in Spanish manufacturing firms from 1995-2001, while Gumbau-Albert and Maudos (2002) found a positive relationship between productivity and size in 15 industries and a negative relationship in 2 industries in a sample of Spanish manufacturing from 1991-1994\textsuperscript{13}. In his analysis of the size-productivity link in the German mechanical industry from 1995-2004, Schiersch (2013) found the size-productivity relationship is U-shaped, with small and large firms being more efficient. The author concludes this result is due to coordination problems associated with increased size, thus only efficient firms able to surmount this problem enjoy continued growth.

In summary, evidence on how size impacts firm growth is mixed. However, emerging empirical evidence suggests small firms grow faster than large firms although this effect diminishes with increased size. In terms of productivity, large firms have higher productivity levels due to market selection and learning by doing effects, but could also have lower productivity resulting from bureaucracy associated with increased size. The stylised facts on the relationship between firm size, growth and productivity, which are robust across countries and time periods (Cabral, 2007; Gil, 2010), can be summarised as follows:

- Firms enter the market at a sub-optimal size below the industry average and consequently grow faster than the industry average.
- Small firms have lower likelihood of survival, but surviving small firms show higher growth rates.
- Firm size distribution is right skewed indicating the presence of more small firms than large firms.
- Large firms have higher productivity levels.

\textsuperscript{13} These variation in results, even within the same country, have been attributed to differences in size definition (number of employees \textit{versus} sales), size measurement (dummy \textit{versus} continuous variable), industries analysed and time period (Schiersch, 2013).
(ii) Firm Age

Beginning with Evans (1987a, 1987b), firm age has been found to impact on firm growth, with young firms showing higher growth rates than older firms. This lifecycle effect, however, decreases with age. Evans (1987a) employed a sample selection model to analyse a sample of 100 US manufacturing firms and found that firm growth, variability of growth and likelihood of failure decreases with age. This is consistent with Jovanovic’s (1982) learning model that firms learn their efficiency with time, so smaller and younger firms have higher probabilities of exit.

Park et al. (2010) using a sample selection model to analyse data on 7,889 Korean manufacturing firms between 1994 and 2003 found a negative firm-age growth relation. Conversely, Das (1995) found a positive effect of age on firm growth (sales growth) in the Indian computer hardware industry over 1983-1988. Data was estimated with the use of a fixed effects model. The finding in the Das (1995) study may be due to the analysis being restricted to an infant industry rather than a mature industry (the latter being the case with most studies). This may also be related to a developing country effect. Similarly, Elston (2002) observed a positive age-growth (employment) relationship for firms listed in the Neuer Markt, a division of the German stock exchange for the listing of firms in new industries such as information communication technologies and biotechnology from 1997-2002. The positive age effect in the fixed effects estimation is, however, washed away once cash flow is introduced into the model. This result may also be related to the relatively young age of firms in the sample, as age was defined in terms of the number of years since the initial public offering, while the Neuer Markt was only floated in 1997, as well as the relative newness of the industries in which firms were located. Aside from the findings of these two
studies, the general consensus in the literature is that firm age negatively impacts firm growth, with younger firms showing higher rates of failure and growth.

(iii) Location

Access to markets, specialized skills such as universities and research institutes, infrastructure and labor markets are critical to success in the firm, therefore location is an important factor in firm performance (Barbosa, 2011). Distance from markets may result in higher costs due to, for example, transportation costs, while proximity to research institutes or universities may bring about knowledge spillovers from joint collaboration, which may lead to higher innovative activity or provide firms with access to high skilled workers. Location in urban centres may promote firm growth due to urbanisation externalities, whereas small young firms may have reduced growth opportunities due to higher rents and wages inherent in such areas (Otto and Fornahl, 2009; Varum and Rocha, 2011). Thus, regional variations may pose as a potential source of growth disparities in firms.

The link between geographic location and the performance of firms has been examined by Audretsch and Dohse (2007). Using data for small technology-based firms in Germany over the period 1997-2002, findings from the two-stage Heckit estimation, indicated that a firm’s location in an agglomeration rich in knowledge resources has a positive impact on its performance (employment growth), with the impact being more significant in knowledge-intensive industries. Thus, the importance of location to firm performance is somewhat dependent on the industry within which the firm is located. Additionally, the extent to which location matters for firm performance may also be related to level of national development. For instance, Hardwick and Adams (2002) found that location outside London (a capital city) had no significant influence on firm growth in UK insurance firms, whereas Bigsten and
Gebreetesus (2007) found location in the capital city (Addis Ababa) increased firm growth in Ethiopian manufacturing firms.

(iv) Ownership

Firm ownership structure in terms of (i) public versus private ownership and (ii) nationality of ownership has been examined in the literature. Berle and Means (1932) first noted the diminishing influence of shareholders in their study of American corporations, as ownership was increasingly being separated from management and control. This finding formed the basis of the behavioural and managerial theories of the firm, which argued that firms often have several objectives, and managers may pursue objectives other than profit maximisation, for instance, sales maximisation (Marris, 1963, 1964; Cyert and March, 1963; Simon, 1957). According to the managerial theories of the firm proposed by Baumol (1959) and Marris (1963, 1964), managers may pursue maximisation of sales, rather than profits, due to the perks and prestige attached to managing large firms. This could cause conflict of interests between managers and owners (shareholders), as owners may be more concerned with the maximisation of profits. Thus, the specific effect of ownership structure on firm performance may be linked to the firm’s objectives as specified a priori by its managers and owners.

With regards to the effect of public ownership on firm performance, it has been argued that publicly-owned firms have better access to external funds than privately-owned firms and should, therefore, show higher performance (Mateev and Anastasov, 2010). Bigsten and Gebreetesus (2007) found publicly-owned firms grew faster than private firms in Ethiopian manufacturing firms, suggesting that such firms were not constrained by finance, while Mateev and Anastasov (2010) found no significant effect of public ownership on firm growth in the study of the determinants of growth in SMEs from Central and Eastern European
countries. Differences in results from both studies may be due to the country context, in the sense that Bigsten and Gebreetesus’ (2007) study is a within-country study in a developing economy, while Mateev and Anastasov’s (2010) study is based on cross-country data for transition economies and may be prone to bias resulting from limitations associated with cross-country studies such as measurement issues and data quality as outlined in Chapter 1. Furthermore, the impact of public ownership on firm performance may be more pronounced in emerging economies with a high degree of government intervention, since public ownership may promote political patronage in terms of access to capital financing and political support (Rasli et al, 2013).

Cuaresma et al (2012), in their study of firm performance differences between state-owned and private firms in Belarus, posited that observed firm growth (in terms of employment) in state-owned firms might be unsustainable and driven by inefficiencies in the allocation of resources. Their results indicated that state-owned firms were less efficient than their private counterpart firms due to labour hoarding, unproductive over-investment and soft budget constraints. In investigating the effect of public or state ownership on firm performance in Malaysian firms, Rasli et al (2013) argued the need to differentiate state ownership in terms of the primary investment objectives of the firm. Based on this argument, the authors identified two categories of state-owned firms: profit-oriented and non-profit oriented state-owned firms. Profit-oriented state ownership may exert a positive effect on firm performance (Tobin’s Q) due to stricter monitoring of the firm management so as to protect investments. Non-profit state ownership, on the other hand, does not exert significant effect on firm performance as firms may primarily pursue socio-economic objectives. Consequently, the absence of a profit-making objective makes the latter group of firms prone to free-rider problems, bureaucracies and political preferences in the appointment of management teams.
The role of ownership structure in terms of the firm’s legal form (i.e. whether the firm has limited or unlimited liability) and ownership concentration (in terms of the total amount of ownership held by shareholders controlling the firm) has also been examined. These influence the firm’s propensity to undertake risky projects, which impact its subsequent growth. Public firms and limited liability firms have been found to grow faster than other firms in German firms (Harhoff et al., 1998). Limited liability protects the entrepreneur’s assets in case of bankruptcy. Consequently, firms with unlimited liability structure may be unwilling to pursue more risky activities necessary to promote growth due to the risk of investing their personal wealth. By contrast, the total amount of ownership held by shareholders controlling the firm was found not to have a significant effect on firm growth in Italian SMEs (Becchetti and Trovato, 2002). Lappalainen and Niskanen (2012) observed that the ownership structure affects both the growth and the profitability of Finnish SMEs. Firms with high managerial ownership levels had higher profitability ratios and lower growth rates, whilst firms with high venture capital firm ownership ratios showed faster growth rates and lower profitability. Their results suggest that owner-managers are risk-averse and consequently do not invest in potential high-growth projects, whereas, venture capital firms seek investments with high growth potential.

With regard to the nationality of ownership, foreign participation in an industry is seen as beneficial to domestic firms due to the presence of technology spillovers. Foreign direct investment (FDI) is perceived to bring benefits such as job creation, new management techniques, innovation, exports and competition to the economy (Bailey and Driffield, 2007). The establishment of subsidiaries of foreign firms could result in the creation of local firms acting as domestic suppliers to the foreign firm. Technology spillovers and transfers can then occur either through linkages between multinational firms and local suppliers or through the
movement of workers from foreign to domestic firms (Javorcik and Spatareanu, 2005). The presence of multinationals in an industry could also stimulate competition, as rival domestic firms are forced to upgrade technology and product quality in order to compete favourably thereby increasing productivity, competitiveness and improving overall performance (Fotopoulos and Louri, 2004).

Conversely, multinational firms could also lead to ‘crowding out’ of domestic firms in the host economy, as their relatively larger size provides them with economies of scale. They can, therefore, suppress domestic competitors through lowering prices. By paying higher wages to local firms, they ‘cream-off’ the best hands, thus stifling competition (Buckley and Casson, 1991). Access to new technology, knowledge and skills may confer certain advantages on foreign firms which could translate into better performance through a more efficient use of resources relative to local firms in the host country (Caves, 2007). Access to internal capital from the parent firm or international capital markets may also cause foreign firms to be less vulnerable to macroeconomic shocks in the host economy.

Foreign firms have been found to be more productive, as well as showing higher growth (Fotopoulos and Louri, 2004 estimated selection and quantile regression models for Greek manufacturing firms; Oliveira and Fortunato, 2006a employed a System Generalised Methods of Moments (SYS-GMM) estimation model for Portuguese manufacturing firms) Halkos and Tzermes (2010) used efficiency analysis techniques to investigate whether the level of foreign ownership matters for firm performance in a sample of 353 foreign Greek manufacturing firms. Results confirm a positive effect of level of foreign ownership on foreign SMEs performance (efficiency).
On the other hand, Benfratello and Sembnelli (2006) found no significant effect of foreign ownership on productivity (Total Factor Productivity) after controlling for econometric issues (endogeneity\textsuperscript{14}) with the use of the SYS-GMM estimator in Italian firms. Similarly, findings from Varum and Rocha’s (2011) fixed effects estimations showed there was no significant difference in employment growth between foreign and domestic firms in Portuguese firms, while foreign firms showed lower sales growth than domestic firms. Nakano and Nguyen (2013) found that the effect of foreign ownership on firm performance (return on assets and Tobin’s Q) in Japanese publicly quoted electronics firms over the period 1998–2011, was dependent on the assumptions concerning unobserved firm characteristics which determine the estimation choice. A positive foreign effect was found using the fixed effects estimation model, while the foreign effect became insignificant when the possible correlation between firm effects and foreign ownership were controlled for with the use of a SYS-GMM model. Results from the Nakano and Nguyen (2013) study are based on a sample of publicly listed firms in a single industry and require further investigation with a more comprehensive sample of firms.

From the discussion above, empirical evidence on the impact of ownership on firm performance is mixed, but findings from a number of studies suggest that foreign ownership is positively linked to firm performance. However, the positive effect does not appear to hold when econometric issues such as endogeneity are taken into account. This suggests the need to adopt estimation methods which are suitable for dealing with these econometric issues. This is dealt with in more detail in the methods chapter of the thesis (Chapter 3).

\textsuperscript{14} Endogeneity may arise from unobserved variables (such as technology, entrepreneurial quality) not included in the model which may, however, be correlated with foreign ownership.
2.5.2 Firm Strategy

Firm strategy is a crucial determinant of firm performance given its important role in determining the firm’s ability to effectively use its resources and capabilities in response to changes in the external environment (Grant, 1991). This implies that the specific strategy adopted by a firm in competing with its rivals is also determined by its resources, capabilities and the operating environment, which in turn governs successful performance. A discussion on firm strategies such as innovation, financing constraints, trade, use of public support and training is presented in this section to refine our understanding of the impact of strategy on firm performance.

(i) Innovation

Based on the evolutionary theory of the firm, the firm’s internal capabilities can be transformed by undertaking innovative activities, thereby making it more flexible and adaptable to changing situations in the industry, while innovation allows the firm to achieve success and sustainable competitive advantage (Artz et al, 2010; A talay et al, 2013). Innovation could also make firms less sensitive to changes in the macroeconomic environment (Geroski and Machin, 1994). The firm’s competitive advantage is rooted in how quickly it is able to reconfigure its resources (i.e. its innovativeness) to changes in the external environment as argued by Teece et al (1997) in the evolutionary view of the firm. It therefore, follows that innovative firms would be more flexible, adaptable and thus less sensitive to changes in the macroeconomic environment which promotes improved performance.

However, empirical evidence to date largely indicates a positive relationship, albeit weak, between innovation and firm growth, while some other studies do not find any effect of
innovation on growth (Coad and Rao, 2008). Bottazzi et al (2001) studied the dynamics of the top 150 pharmaceutical firms in the world and do not find any significant contribution of a firm’s innovative output to growth performance, whereas a positive impact has been found in some studies (Hall, 1987, Yang and Huang, 2005). Giving the seeming mixed evidence, emerging facts from empirical studies on innovation and firm growth are summarised below.

**Industry and Firm Characteristics**

The positive impact of innovation on firm growth has been shown to occur only in a sub-set of fast growing firms. Freel (2000: p207) examined 228 small UK manufacturing businesses and based on findings concludes that rather than grow, ‘innovators are likely to grow more’ (i.e. innovators have a higher likelihood of experiencing particularly rapid growth). Similarly, Coad and Rao (2008) observed a weak relationship between sales growth and innovation (defined as an innovativeness index derived from the variance of patent intensity and R&D intensity) and found a significant impact only for a few fast-growing US high-tech firms. This is similar to findings obtained by Freel (2000) based on a quantile regression estimation. In a sample of Dutch firms, Stam and Wennberg (2009) employed OLS estimations and found that the initial level of R&D had no impact on employment growth in Dutch firms, however, a positive effect was found for high-tech and high growth firms.

**Innovation Timing**

Furthermore, the positive impact of innovative activity has been found to be related to innovation timing. This may be partly due to the time lag between a firm’s discovery of an innovation and the period when the innovation becomes commercially successful (Coad and Rao, 2008). In a sample of Austrian firms, Falk (2012) found a positive significant impact of initial R&D activity on employment and sales growth over the period 1995-2006 based on
results from Least Absolute Deviation (LAD) estimation. The positive effect, however, decreases over time. Using plant-level data for firms in Taiwan’s electronics industry, Liu et al (1999) found that on a yearly basis the impact of R&D on growth was less significant. However, R&D was found to have a long term positive effect on plant growth.

**Firm Characteristics and Investment Decisions**

Innovation effect depends on firm characteristics and investment decisions. Nunes et al (2013a) found a negative quadratic effect of R&D intensity on sales growth in Portuguese SMEs in the period 1999-2006. Positive effects of innovative activity occur at high levels of R&D investments, while a negative impact was seen at low levels of R&D intensities. Risks associated with R&D investments, particularly in small firms, mean growth is reduced when innovative attempts are not successful (Nunes et al, 2013a). Coad and Rao (2008) using quantile regressions also find innovative activity has a negative effect on the sales growth of US high tech firms at the lowest quantiles. The positive impact of innovation has also been shown to depend on firm size, patenting and persistence in patenting. Demirel and Mazzucato (2012), using the GMM estimator to analyse data on publicly quoted US pharmaceutical firms between 1950 and 2008, found R&D is important only for small firms who patent persistently for 5 years, while it hampers growth in large firms. The observed result may due to the fact that analysis is based on a sample of firms in the pharmaceutical industry where patenting is important to firm success. Additionally, Nunes et al (2013b) observed that the magnitude of the positive effect of innovation (R&D intensity) on firm growth (sales growth) is dependent on firm age in a sample of Portuguese SMEs over the period. Based on the SYS-GMM estimation results, the authors found that R&D intensity is more important for growth in older than in younger SMEs.
Process versus Product Innovation

It should be noted that a distinction is made between the ‘process of innovation’ and ‘product of innovative activity’, which may have differing effects on firm performance (Geroski and Machin, 1992: p80; Freel and Robson, 2004). Geroski and Machin (1994) argue that the process of innovation matters more than the product of innovation in the determination of the growth differential observed between innovative and non-innovative firms. The introduction of process or product innovation generates new sales resulting in higher profits for the innovator relative to its competitors. The innovating firm, however, enjoys this competitive advantage for as long as it is able to maintain exclusivity on the new idea (Geroski and Machin, 1992). On the other hand, the process of doing R&D transforms the internal capabilities of the innovating firm, which enhances its flexibility and adaptability, thus conferring long-lasting competitive advantage, which enables the firm to earn higher profits or to achieve faster growth relative to non-innovative firms (Geroski and Machin, 1992).

Calvo (2006) using a sample of 1,272 Spanish firms found that innovation had a positive effect on growth, but a greater magnitude was found for product innovation relative to process innovation. He also found that firms in high-tech and medium-tech industries grew faster than other manufacturing firms. Freel and Robson (2004) showed product innovation is positively related to employment growth in manufacturing and services SMEs in Scotland and Northern Ireland, while product innovation reduced growth in sales and productivity for manufacturing firms. In services firms, process innovation had a positive effect on sales.

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15Geroski and Machin (1992: p80) defined the ‘process of innovation’ in terms of the organisation of the firm’s R&D activities and how these are integrated with its other activities, while ‘product of innovative activity’ refers to specific product or process innovations produced in a R&D facility.

16According to the OECD Oslo manual (2005), product innovation involves the introduction of a good or service that is new or significantly improved, while process innovation involves the implementation of new or significantly improved methods, equipment or skills.
growth and productivity. The negative effect of productivity may be related to the time lag between when the product is introduced and when it becomes a commercial success.

**Issues related to Measurement and Methodology**

The mixed empirical evidence of innovative activity on firm growth may be attributed to divergence in innovation measures, as well as methodology (Coad and Rao, 2008). For instance, Colombelli et al (2013) found a positive effect of innovation on growth in French firms over the period 1992-2004. It should be noted that this result was sensitive to the type of models used. Innovation measures commonly employed in the literature include research output measures such as patenting and ‘counting of innovation’ introduced by firm. The former is valuable when the product of innovative activity leads to the introduction of new products to the market, while the latter provides useful information on commercially viable innovation products (Santarelli and P iergiovanni, 1996). Research input measures assess innovation in terms of the firm’s investments in innovative activity. Given that not all innovative activity results in innovation output or better performance, there has been a shift in focus to the innovation process and how innovation inputs are transformed into better performance (Crepon et al, 1998). Crepon et al (1998) identified three stages regarding the innovation/firm performance relationship:

(i) The firm’s decision to engage in R&D, and if it does, the magnitude of resources invested in R&D;

(ii) Analyse whether R&D leads to innovation output;

(iii) Analyse whether innovation output, commonly assessed by the share of new products in total sales, results in better economic performance.
Overall, the specific impact of innovation on firm performance in terms of growth depends on a number of factors; firm specific characteristics such as size, growth rate, level of investments and industry technology intensity. In studying the link between innovation and firm growth, there is a growing interest in measuring the innovation process and the channel through which innovation input is transformed into better performance (Crepon et al, 1998). Finally, the empirical literature demonstrates that innovation (R&D) is positively linked to productivity (Hall et al, 2009; Gil, 2010; Falk, 2012). Innovation increases firm productivity through time and cost savings gained from the introduction of new technology, products and processes (DTI, 2006). However, Brynjolfsson and Hitt (2000) suggested that large investments in ICT without complementary organisational changes or partial implementation could lead to productivity losses. Therefore, investments in innovation without complementary organisational changes may not result in productivity increases.

(ii) Financing Constraints

Empirical studies also suggest financial constraints as one of the factors influencing growth. A financial constraint is defined in terms of whether the firm has difficulties in accessing finance and has been measured by availability of external finance (leverage) and internal finance (cash flow), whether the firm has ever been turned down by a bank or has ever experienced difficulties in accessing finance (Becchetti and Trovato, 2002; Beck et al, 2005; Oliveira and Fortunato, 2006b; Angelini and Generale, 2008; Nunes et al, 2013b). The degree to which a firm is financially constrained matters, as this influences its capacity to undertake investments (e.g. investments in innovation and training) necessary to enhance its future performance. Consequently, a number of empirical investigations on the effect of financing constraints on firm growth have been undertaken. For instance, Becchetti and Trovato (2002) examined the role of external financing in the growth of Italian SMEs over the period 1989-
Results obtained from their study indicated that firms with higher availability of external financing (high leverage) had higher growth rates than low leverage firms, with the effect being more significant for smaller firms. Whilst, Oliveira and Fortunato (2006b), based on SYS-GMM estimations, observed that internal liquidity constraints (measured by cash flow) had a constraining effect on growth for Portuguese manufacturing firms over the period 1990-2001, with a more pronounced effect found in smaller and younger firms.

Additionally, Nunes et al (2013b) demonstrated, with the use of the SYS-GMM method, that internal (cash flow) and external financing (debt) are more important for growth in young Portuguese SMEs than in older SMEs, particularly young high-tech SMEs. On the whole, results from the empirical literature suggest that financing constraints are inversely related to firm size and age, with the effect more binding on smaller and younger firms. Small, young firms are commonly financially constrained due to reputation effects, which limit their ability to access external finance. This finding is consistent with the financing constraint model suggested by Cabral (1995) and Cabral and Mata (2003), as outlined previously in Section 2.4.2.

Nevertheless, analysis of the impact of financing constraints on firm performance is subject to some measure of bias, as many empirical analyses are survey-based and largely reliant on the firm’s perception of the degree of constraint. Firms may under-estimate or over-estimate their level of financial difficulties for a number of reasons which may be related to ensuring continued access to grants and subsidies or maintaining a personal sense of achievement. To overcome problems associated with the use of single measures of financing constraints (particularly for those measures self-reported by firms), Musso and Schiavo (2008) developed a synthetic index (based on seven variables namely; size, profitability, liquidity, cash flow
generating ability, solvency, trade credit and repaying ability). The use of this index in examining the effect of financing constraints on firm performance in a sample of French manufacturing firms over the period 1996-2004 allowed for different degrees of financing constraint to be considered in the study. The results indicated that access to external finance promotes firm growth (growth in sales, employment and capital stock), while the presence and degree of financing constraints was found to have a positive effect on both growth in Total Factor Productivity (TFP) and labour productivity.

Finally, it has been noted in the empirical literature that the effect of financing constraints on firm performance is related to the financial development of the economy in which firms operate (e.g. Beck et al., 2005; Aghion et al., 2007; Angelini and Generale, 2008). Given that issues pertaining to the development of the financial sector are linked to the macroeconomic conditions faced by the firm, the link between financial development and financing constraints is further explored in Section 2.5.4.

(iii) Trade

Empirical evidence shows that firms which pursue exporting strategies exhibit superior performance relative to non-exporting firms (e.g. Robson and Bennett, 2000; Becchetti and Trovato, 2002; Commander and Svejnar, 2007). By exporting to foreign markets, domestic firms are perceived to undergo a form of learning process leading to improvements in product quality, adoption of new technologies and skills, which lead to increased competitiveness, productivity gains and higher levels of firm performance (Becchetti and Trovato, 2002). There is, however, uncertainty in the literature about the nature of this superior performance. It is argued that, on the one hand, better performance by exporters may be due to firms entering export markets after attaining some measure of efficiency (self-selection). On the
other hand, it could be as a result of the learning process undergone by firms when they commence exporting (learning by exporting).

With increased globalisation, importing and two-way trade (both exporting and importing) have also become important in boosting firm performance. Exporters and importers have been found to be larger, more productive, more capital intensive and pay higher wages (Bernard et al., 2012). Due to fixed costs associated with trading, higher productivity firms are able to cover these costs, therefore, more likely to export and become more productive (Ahn, 2001; Haller, 2012). Imports provide firms with access to a wider range or better quality of inputs or technology embedded in imported intermediate and capital goods, which may result in improved quality of products, thus increasing the product value and impacting on turnover (Castellani et al., 2010). Two-way traders have also been found to show better performance than firms that export only due to the simultaneous impact of importing and exporting activities (Vogel and Wagner, 2010). Importing provides firms with access to better quality imported inputs, while exporting offers access to global markets.

(iv) Public Support

Given that firms, particularly small firms, are said to act as vehicles for economic growth and employment creation, public policies have been aimed at assisting firms in terms of grants, subsidies, tax credits and soft business support (Bernini and Pellegrini, 2011). This assistance is thought to influence firm performance positively, as it has been argued for example, that it enables firms to undertake capital-intensive investments, such as R&D activities, which they would otherwise have been unable to do (Bleda and del Río, 2013). However, empirical evidence is mixed, due to difficulties associated with separating the effects of public support from other factors that may influence performance, which may lead to overstating its effect.
when selection bias and endogeneity are not taken into account (Roper and Hart, 2005; Bernini and Pellegrini, 2011). Subsidies have been found to increase the growth of recipient firms; sales and employment growth in Japan (Eshima, 2003); and assets growth in Japan (Honjo and Harada, 2005). Mixed results have also been found in some other studies as detailed below.

Roper and Hart (2005) examined the impact of government assistance received in 1996-1998 on small firm performance over the period 1996 to 2000 in the UK using a probit regression model. They found that grant assistance had no significant effect on employment, sales and productivity growth of assisted firms when selection is controlled for. However, when selection is not considered, grant assistance is seen to have a significant positive effect on the employment growth of firms. Merito et al (2010) employed a non-parametric matching method with a regression method to correct for selection bias in analysing the impact of R&D subsidies on firm performance in a sample of Italian firms over the period 1998-2004. Findings showed there was no significant difference between grant recipients and non-grant recipients in terms of sales growth and labour productivity. Rather an increase in the employment of highly qualified workers was observed in SMEs suggesting that R&D subsidies encourage small firms to employ more skilled staff.

The above raises the question as to whether and to what extent subsidies or grants promote inefficiency in firms. Duch et al (2007) assessed the impact of public subsidies on value added growth in the period 2000-2002 in Catalonia (Spain). Assisted firms were found to exhibit higher value added growth than non-treated firms. In contrast, in a sample of Italian firms over the period 1996-2004, Bernini and Pellegrini (2011) found that public subsidies promoted in efficiency in assisted firms. Grant recipients showed higher growth in output,
employment and fixed assets, however, total factor productivity was lower in assisted firms. Their results suggest that the receipt of grants encouraged X-inefficiency in recipient firms. Consequently, recipient firms employed more workers than was efficient, since grant receipt was linked to employment creation.

As indicated above, government support for firms may increase the chances of survival, growth, productivity and profitability. Conversely, public support may have no real impact on firm performance as it may only act to prop up inefficient firms unable to survive in the long run without government assistance. It then follows that the use of varied measures of firm performance is critical to a successful evaluation of the effectiveness of public policy support for firms, as there may be differential effects on various measures of performance. There is also a need to take selection bias into account in order to obtain meaningful results.

(v) Training

Training is a key element of a firm’s investment in human capital. Accumulation of human capital is a driver of overall economic growth, while it represents a vital asset and source of competitive advantage at the firm-level (Penrose, 1959; Barney, 2001; del Valle and Castillo, 2009). On the one hand, training can help equip workers with skills which may potentially increase productivity and competitiveness, while on the other hand, training makes employees more flexible and adaptable (De Grippa and Sauermann, 2013). Investments in human capital increase labour productivity due to increased efficiency in the workplace.

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17 X-inefficiency occurs when the firm does not produce output at minimum costs due to a lack of competitive pressure, which may result in overstaffing (Sloman and Wride, 2009).
innovativeness in labour or excellent management skills, which may confer a competitive advantage on the firm leading to employment growth (Bryson and Nurni, 2011).

Empirical evidence on the link between training and firm performance is, however, mixed. Goedhuys (2007) found that training (whether the firm had formal training) increased sales growth for firms in a sample of Brazilian manufacturing firms. Aragon-Sanchez et al. (2003) analysed the effects of training on firm performance (effectiveness and profitability) in a study of 457 European SMEs and found evidence of a significant positive relationship between training and firm performance. Bryan (2006) found a weak effect of training on turnover growth in a sample of small manufacturing firms in Wales, while Bryson and Nurni (2011) observed investments in human capital (measured as off-the-job training of employees) have no impact on employment growth in a sample of UK firms over the period, 1998-2004. The type and context of training also matters: Jayawarna et al. (2007) found that formal training had a more significant effect on firm performance (turnover, employee growth and survival) than informal training in UK manufacturing SMEs. Boothby et al. (2010) also showed that Canadian manufacturing firms which adopt new technologies and provide corresponding training have higher productivity. This appears to suggest that training is somewhat related to innovation, thus in order for firms to derive productivity gains associated with the adoption of new technology, relevant training must be provided to its workforce.

While, a large part of the literature agrees on the positive impact of training on firm performance, there is also inconclusive evidence as to its effect (Jones et al, 2013). According to CEDEFOP (2011), this divergence in empirical evidence may be linked to issues related to:
• firm characteristics (e.g. firm size, industry),
• type of training (formal versus informal; whether training is done within or outside the firm),
• level of training or training intensity and
• econometric issues (such as endogeneity which may arise from reverse causality between firm performance and lack of data on variables such as the educational quality of employees, which may overstate the effect of training on firm performance).

2.5.3 The Entrepreneur

The entrepreneur is a key factor in the firm achieving a suitable level of performance (Penrose, 1959). The magnitude and direction of firm growth is somewhat dependent on the strategy adopted by the firm resulting from entrepreneurial characteristics. To date, there have been a significant number of studies dealing with entrepreneurial or owner-manager characteristics such as age, gender, previous work experience, education, motivation for owning a business, ownership of a second business, willingness to share equity, willingness to grow, membership of trade and professional associations, type of business strategies adopted (e.g. having a formal written business plan, the use of external advice, collaboration with external or organisations, use of exporting, diversification), as well as general market conditions (Storey, 1994; Barkham et al, 1996; McPherson, 1996; Robson and Bennett, 2000; Hardwick and Adams, 2002; Peneder, 2008; Wiklund et al, 2009; Littunen and Niittykangas 2010). The overriding conclusion of this literature is that entrepreneurial characteristics matter for firm performance through their effect on the strategies adopted by the firm in achieving successful performance.
2.5.4 Macroeconomic Environment

The review of the firm growth literature carried out in this section concerns itself specifically with the macroeconomic environment. This draws on the general macroeconomic literature and empirical firm growth studies, to provide key insights as to how firm performance may be influenced by macroeconomic conditions. According to the evolutionary theory of the firm discussed previously (Section 2.2.3), superior performance in firms is driven by their degree of responsiveness to changes in the macroeconomic environment within which they operate. Hence, macroeconomic variables should be considered in the study of firm performance. Nevertheless, empirical evidence on the linkage between macroeconomic conditions and firm performance is scant with studies focusing on the ‘what’ of this interaction rather than the ‘how’ which the current study aims to address. To this author’s knowledge, this is the first attempt to investigate the link between the macroeconomic environment and firm performance, and the channels through which this occurs. The discussion presented in the section that follows highlights key macroeconomic variables (defined in terms of economic growth, unemployment, inflation, interest rates, financial development and competitiveness) which directly impact on the performance of firms, as well as identifying the channels through which this interaction occurs. A distinction is made between macroeconomic factors related to the firm’s domestic markets and factors related to international markets. This approach provides useful insights on firm performance given the increasing globalisation of national markets.

(i) Macroeconomic Variables Related to Domestic Markets

The discussion in this section offers insights as to how the performance of firms is influenced by conditions in the domestic markets in which they operate. This examines the effect of GDP growth, inflation, unemployment, interest rates and the level of financial sector
development on firm performance. Economic growth is critical to ensuring continued successful performance in firms as higher growth implies higher aggregate demand, which stimulates firms to increase output and leads to further growth. This is affirmed by Beck et al (2005) who found a positive relation between GDP growth and firm growth (sales growth) in a sample of 4,000 firms covering 54 countries over the period 1995-1999. The study employed random effects estimation to investigate the effect of financial, legal and corruption problems on firm growth. A similar result was observed by Mateev and Anastasov (2011) who adopted the SYS-GMM method in a sample of 4,561 SMEs in 7 transition economies over the years, 2001-2005. The authors examined the effect of macroeconomic conditions (tax rate, real GDP growth rate and inflation) on firm growth (sales, employment and assets).

**Inflation**

Stable prices are important for firm performance, as price inflation makes it difficult to predict production costs and profits, thus hampering long range financial planning, so that firms may be unwilling or unable to undertake new projects (Basu et al, 2000; Baumol and Blinder, 2011). Furthermore, high inflation rates, when not accompanied by currency devaluation, may also lead to a loss of competitiveness in domestic firms facing export markets and those competing with imported goods (Leddin and Walsh, 1998; Buckley, 2004). Inflation rates also impact on real interest rates (nominal interest rate adjusted for inflation), with high inflation lowering real interest rates which reduces the cost of borrowing. This raises consumption and investment spending which may fuel speculation (Taylor, 2007; Mankiw, 2010).

Mahendra (2009) employed OLS regression to analyse the impact of macroeconomic stability (exchange rate volatility and inflation) on firm performance (sales growth) in a sample of
non-financial firms covering 5 countries over the period 2002-2007. The finding showed that inflation depresses growth in firms dependent on external finance. It should be noted that the above result does not indicate the specific impact of inflation on firm performance since inflation was interacted with the measure for external finance dependence. On the other hand, contrary to theoretical expectations, a positive inflation effect was observed by Beck et al (2005) and Mateev and Anastasov (2011) in their cross-country studies, which they suggested reflected the fact that sales growth was stated in nominal terms in their study.

**Unemployment and Interest Rates**

With respect to unemployment, high unemployment reduces aggregate demand (due to lower consumption and spending ensuing from loss of jobs and income), which is passed on to firms who may lower output or downsize further (Mankiw et al, 2013). Additionally, unemployment brings about a loss of tax revenues to the government (Harris, 2007) which may impose a higher tax burden on firms, with a subsequent increase in production costs and lower margins (Leddin and Walsh, 1998). Conversely, high interest rates increase borrowing costs which may discourage consumption, investments, as well as increase production costs thereby making firms less efficient and less competitive, whereas changes in interest rates impact on the exchange rate (if interest rates remain unchanged in other countries), which in turn affects firm competitiveness in the domestic country (Mankiw et al, 2013).

Zeitun et al (2007) investigated the impact of macroeconomic variables (inflation, nominal interest rate, changes in money supply, production manufacturing index, exports and availability of credit) on firm performance (return on assets (ROA) and Tobin’s Q) based on a sample of 167 Jordanian firms over the years 1989-2003. Results indicated unanticipated changes in interest rates had a negative impact on ROA, suggesting that a rise in interest rates
increases the cost of borrowing which impacts negatively on profits; whilst the production manufacturing index increased firm performance, an indication that production manufacturing growth increases firm performance through the firm’s ability to exploit increased opportunities available during a boom. These findings could be influenced by the level of economic development in the country, as the study is based on a developing country (Jordan) and need to be investigated within the context of a developed country. Moreover, the study by Zeitun et al. (2007) employed two measures which capture a single dimension of performance (profitability). ROA is a company account-based profit measure subject to limitations related to accounting treatment of tax and depreciation, as well as variations in capital intensity (Griffiths and Wall, 2007), while the Tobin’s Q is a market-based profit indicator, which is subjective and volatile since it is prone to fluctuations in investors’ feelings about expected profits of the firm (Lipczynski et al, 2005).

**Financial Sector Development**

As detailed earlier (Section 2.5.2), the availability of finance has been identified in the literature as a constraining factor in the growth of firms, particularly small and younger firms. However, the magnitude of the negative effect of financing constraint on the growth of firms in any economy has been linked to the development of its financial sector (Beck et al, 2005; Angelini and Generale, 2008). Thus, the financing constraint effect decreases with the country’s level of financial development. Aghion et al. (2007) employed the difference in difference estimation method to analyse the effect of financial development (measured as the ratio of domestic credit to private sector to GDP and the ratio of stock market capitalization to GDP respectively) on firm entry and post-entry growth in a sample of firms covering 16 countries. Results indicated that financial development had a growth-promoting effect on growth in industries with higher degree of dependence on external financing. This is
consistent with expectations that a well-developed financial sector promotes the growth of firms (specifically, small firms) through increased access to credit. Similarly, Angelini and Generale’s (2008) analysis of World Business Environment Survey (WBES) data indicated the tendency for the negative relationship between firm size and financial constraints to be stronger in developing countries, especially in countries which lack a well-developed financial system. They concluded that the significance of financial constraints tends to be inversely related to the development of the financial system. Having examined the impact of domestic macroeconomic conditions on firm performance, a discussion on factors related to the international macroeconomic environment is presented in the section which follows so as to provide insights on how these influence domestic firm performance.

(ii) **Factors related to International Competitiveness**

As national markets become increasingly integrated, firms not only compete with firms in the same domestic market, but also with other firms in international markets. Thus, the extent to which the firm remains competitive in global markets is greatly influenced by competitiveness in the national economy as a whole. In view of the above, it is important to take account of the interaction between firm performance and global macroeconomic conditions in the analysis of firm performance. International competitiveness entails comparing the achievements of different countries in increasing productivity, promoting innovation and boosting living standards (OECD, 2009). Furthermore, Porter (1990) argues that competitiveness is synonymous with productivity and productivity growth. Therefore, firms/countries with higher productivity than their competitors have a competitive advantage, which increases their chances of growth and survival. As a result, countries are concerned with increasing competitiveness relative to their competitors.
Measures of price competitiveness include unit labour costs (ULC) and the real effective exchange rate (REER), while factors related to non-price competitiveness include product quality, taste and variety (Benkovskis and Wörz, 2013). The ULC assesses the labour costs incurred in producing one unit of output. Hence, in order to increase competitiveness, the firm must increase labour productivity faster than its labour costs. Consequently, an increase in unit labour costs without a commensurate increase in productivity, may lead to higher prices of domestic goods relative to international competitors, which in turn may reduce the firm’s output due to lower demand in both domestic and international markets. It has been argued, however, that the ULC does not capture the ability of firms to compete in international markets on the basis of the quality of the goods and services offered (OECD, 2012). The REER, on the other hand, assesses the differences in price levels between a country and its trading partners. In contrast to the nominal effective exchange rate, the REER takes into account changes in the exchange rate and price levels, as it is measured either in terms of consumer prices or unit labour costs (OECD, 2009). An increase in the above indices (i.e. the REER and ULC) in the economy indicates a decline in the competitiveness of firms in that country.

According to Caglayan and Demir (2014), the effect of currency appreciations on firm performance in the domestic economy could manifest in two ways: (i) Currency appreciation makes exports less competitive and imports cheaper. Therefore, firms may experience poorer performance levels resulting from lower output demanded in both domestic and foreign markets. (ii) Lower import costs mean that firms highly dependent on imported inputs may face lower production costs, with a resultant increase in competitiveness and growth. Firms with a heavy foreign indebtedness may have their investment prospects improved through balance sheet effects. Results from Caglayan and Demir (2014) confirmed
the negative effect of real exchange rate appreciation and exchange rate uncertainty on productivity (real output per worker) based on SYS-GMM estimation in a sample of 1,000 manufacturing firms in Turkey over the period 1993-2005. The specific effects on productivity were, however, also dependent on the type of markets faced. A negative effect of real exchange rate appreciation was found for domestic-oriented firms, while a positive effect was observed in export-oriented firms. The results suggest that exporting firms have to increase productivity in order to remain in export markets in the wake of a currency appreciation. In a similar manner, Mahendra (2009) found that exchange rate volatility hampers firm growth in his sample of firms in 5 Asian countries.

To take account of international macroeconomic conditions, Oberhofer (2012) analysed the impact of European industry fluctuations (measured by industry growth) and domestic business cycles (measured by total manufacturing industry growth) on the employment growth of 86,000 firms in 14 European countries from 2000 to 2003 using Logit models. Results indicate that European industry growth had no effect on the probability of growth, while domestic manufacturing growth increased the probability of growth in only one year (2000) and reduced growth in other years of the study. The study assesses the probability of growth and is based on a single business cycle which may not be sufficient to fully capture the effect of the macroeconomic environment on firm growth. In contrast, this thesis measures actual growth and covers a longer time period (1991-2007), which includes two business cycles and allows the comparison of firm performance over both cycles. Drawing on general macroeconomic theory and the empirical literature, an examination of how changes in macroeconomic factors affect performance in firms has been carried out in this section. Having established a link between the macroeconomic environment and the performance of firms, it is important to analyse the channels through which the interactions occur.
(iii) Interaction between Firm Performance and Macroeconomic Conditions

This section presents a discussion on the channels through which macroeconomic conditions interact with firm performance. This identifies the channels (i.e. firm-specific characteristics and firm strategies) through which the macroeconomic environment is related to firm performance so as to refine our understanding of this subject.

**Firm-Specific Characteristics**

The extent to which the macroeconomic environment influences firm performance may be moderated by firm-specific characteristics such as firm size, growth rate, nationality of ownership, productivity and profitability. These firm characteristics, which determine the firm’s performance via its response to macroeconomic fluctuations, are discussed below.

Firms with higher growth rates in a boom have been found to be less responsive to changes in macroeconomic conditions, while slowly growing firms were shown to be more sensitive to macroeconomic shocks in a sample of quoted firms in the UK and US (Higson et al, 2002, 2004; Holly et al, 2013). This is explained by the fact that fast growing firms are already over-stretched and possess little spare capacity to meet the higher demand associated with recoveries, whereas, slowly growing firms possess excess capacity and are able to utilise the opportunities resulting from higher demand conditions (Higson et al, 2004). The above studies are, however, based on the use of non-parametric methods in the analysis of cross-sectional (overall) distributions of firm growth rates and do not consider firm-specific characteristics. Moreover, the inclusion of only quoted firms in the sample is a potential source of bias.
Firm size has also been shown to influence the responsiveness of firms to macroeconomic conditions. Hardwick and Adams (2002) adopted a weighted least squares approach in their study of UK insurance firms, over the period, 1987-1996. They found that small firms grew faster during economic booms, while larger firms grew more during recessions and recovery. Small firms have more capacity to exploit the benefits derived from increased output and spending during a boom, while large firms are better positioned to survive during a recession. Hardwick and Adams’ (2002) study is based on a single industry; further investigation is required to determine whether their finding is valid in other industries. The result should also be treated with caution as their analysis was based on fluctuations over one business cycle.

The nationality of ownership may also influence firm response to macroeconomic factors. Firms with foreign ownership may be more resilient to exchange rate fluctuations and changes in the macroeconomic environment due to access to higher quality imported intermediate goods, better technical know-how and the possibility of a large pool of internal finance from the parent firm or international capital markets (Desai et al, 2008; Caglayan and Demir, 2014). Other characteristics of the firm which determine the nature of its response to variations in the macroeconomic environment include access to internal and external financing, export or orientation, import dependence, productivity and profitability (Klein et al, 2003; Demir, 2013).

**Firm Strategy**

The macroeconomic environment impacts on firm performance through its effect on the strategies employed by firms to boost future performance. Strategy determines firm performance, as it informs how the firm exploits its resources in response to variations in the environment, in line with the evolutionary model of the firm. For instance, firms may respond
to a downturn in the economy either by shutting down operations, or adjusting investment (by downsizing or contracting), which feeds into the economy. Gulati et al. (2010) and the Economist Intelligence Unit (2009) noted that strategies employed by firms during economic downturns can be grouped into:

- offensive strategies (such as developing new products and services, R&D investment, entry into new geographic markets or customer segments) and
- defensive strategies (e.g. outsourcing/downsizing, offer lower prices, cost savings from suppliers).

Gulati et al. (2010) evaluated the effectiveness of these strategies in a sample of 4,700 U.S. public firms across three recessions (1980-2002). The results indicated that firms which simultaneously employed offensive and defensive strategies showed better performance after a recession relative to firms which adopted a single strategy. Results from an online survey of 234 global firms carried out by the Economist Intelligence Unit in 2009 also affirmed this finding. This suggests that firms which, for example, introduce new products and downsize or restructure concurrently, are better positioned to survive recessions. Additionally, strategies such as access to internal and external financing, export orientation and import dependence determine the effect of macroeconomic changes, such as exchange rate movements, on firm performance (Klein et al., 2003; Demir, 2013).

**Summary of Main Findings from Macroeconomic Firm Growth Studies**

Overall, the survey of firm growth studies, with specific emphasis on macroeconomic variables, undertaken in this section has highlighted several key points relevant to this research. These can be summarised as follows:
• Although a number of macroeconomic variables (e.g. GDP growth, inflation, interest rate and exchange rates) have been studied in the literature, the specific channels through which macroeconomic conditions influence firm performance have not been examined;

• The interaction between the macroeconomic environment and firm performance may be moderated by firm-specific characteristics such as firm size, growth, nationality of ownership, productivity and profitability;

• The macroeconomic environment impacts on firm performance through its effect on the strategies employed by firms to promote subsequent performance;

• Due to increasing globalisation, firm performance is influenced by both domestic and international macroeconomic conditions.

The above findings provide support for the use of the holistic multivariate model adopted in this thesis. In summary, based on the firm growth model suggested by Storey (1994), three categories of factors related to the firm, entrepreneur and firm strategy have been identified in the review of the international literature on the determinants of firm growth undertaken in this chapter. This growth model was extended to include factors related to the macroeconomic environment based on the premise that firms perform well to the degree to which they are able to respond to changes in the macroeconomic environment, whilst the firm’s strategy and its specific characteristics influence its response to these changes. A combination of all four categories of factors (i.e. firm, entrepreneur, strategy and macroeconomic environment) is, therefore, required to engender high performance in firms. The review identified a significant number of determining factors of firm performance (such as firm size, age, owner-manager characteristics and ownership) and highlighted a gap in the literature on the impact of the macroeconomic environment on firm performance which this research aims to fill.
This thesis overcomes many of the limitations associated with existing studies by analysing the performance of individual firms in terms of firm growth and productivity within the context of a single country (Ireland) over a long time period (1991-2007), as well as analysing the effect of the macroeconomic environment with the use of multiple macroeconomic variables (GDP growth rate, inflation, unemployment, competitiveness and availability of credit) on firm performance. The adoption of a holistic multivariate approach, which examines the linkage between firm-specific characteristics, strategy and the macroeconomic environment, provides insights on the specific impact of macroeconomic conditions on firm performance, as well as the channels through which this interaction occurs. In addition, it allows the differential effects of macroeconomic factors on different dimensions of firm performance to be investigated, thus increasing our understanding of firm performance drivers. Having analysed the factors which encourage growth in firms, it is also beneficial to examine those factors with the potential to depress growth. This offers insights on the factors necessary for ensuring continued growth in firms. A discussion of this issue is presented in the section that follows.

2.6 Barriers to Firm Growth

Various factors which influence firm growth have been outlined in the preceding section. In the same manner, some other factors hamper or act as barriers to the growth of a firm. Penrose (1995) argued that barriers to firm growth refer to constraints to the firm’s productive opportunities. These opportunities are constrained by the extent to which a firm is unable to perceive opportunities for growth and is unwilling or unable to pursue and respond to these opportunities. Other constraints as indicated by Penrose (1995) include entrepreneurial ambition or motivation (the probability of achieving growth is lower when a
firm’s manager(s) are not ambitious) and risk-taking abilities (the willingness of a firm to undertake new activities or enter new geographic locations or markets).

Barriers to growth analysed and discussed in the literature include finance, credit constraints, labour market issues, markets, lack of demand, legal constraints, tax burden, competition, innovation costs and trade costs (Storey, 1994; Barkham et al, 1996; Goedhuys and Sleuwaegen, 1999; Becchetti and Trovato, 2002; Beck et al, 2005; Krasniqi, 2007; Aghion et al, 2007; Piguillem and Rubini, 2013). Having examined several international firm growth studies, a review of Irish firm growth studies is necessary to determine if findings from other countries also hold true in the Irish context. A discussion on Irish firm growth research is presented in Section 2.7 to highlight determinants, methods of analysis and the observed findings in the various studies reviewed.

2.7 Firm Growth and Performance in Ireland

Given that Ireland is used as the locale of analysis for this study, a review of the literature on firm performance in Ireland is provided in this section so as to examine the determinants of firm performance, as well as to outline methodological issues related to Irish studies. This provides insights to the current state of Irish firm growth research, with a view to highlighting the lacuna which the current research aims to fill.

2.7.1 Grant Assistance

Grant provision has been an integral part of Irish policy to stimulate economic growth since 1952 (Girma et al, 2008). To be eligible for grant assistance, firms have to be export-facing, involved in high-tech industries, with export target markets or Irish internationally traded
industries and possess the ability to generate or maintain existing jobs (Girma et al, 2008). The question then is to what extent has grant assistance improved the performance of firms in Ireland? In line with international studies previously reviewed in this chapter (Section 2.5), evidence on the performance-enhancing effect of subsidies in Irish studies is inconclusive.

In their study of survival and growth of ‘high potential’ firms in Ireland, Hogan and Foley (1996: p 11) found a survival rate of 46 per cent in 239 start-up firms manufacturing and internationally traded services which received grant assistance from the Enterprise Development Programme from 1978-1992. Analysis in the study was solely descriptive. Only 9 per cent of the surviving firms were shown to be fast growth. These findings indicate a high failure rate among the firms which received grant assistance, while only a small proportion of firms in the sample were ‘super-growth’ firms. This suggests that policies aimed at selecting firms with high growth potential were not very effective going by the high failure rate (54 per cent). Therefore, an understanding of the factors governing the survival and growth of firms is essential for a successful targeting of ‘high performance’ firms through public policy.

The effect of grant assistance on small firm performance from 1991-1994 in Northern Ireland and Republic of Ireland was also examined by Roper and Hewitt-Dundas (2001). Comparing the performance of grant-assisted and non-assisted small manufacturing firms, Roper and Hewitt-Dundas (2001) found that assisted firms performed better in terms of higher growth in sales and employment, as well as profitability. Results from a probit model (which helped to control for selection bias), however, suggested that, grant assistance had no significant effect on either turnover growth or profitability of assisted firms over the sample period whereas firms in receipt of grants showed higher employment growth. These findings are consistent with Roper and Hart (2005) who observed no significant difference in performance between
grant recipients and non-grant recipients when selection is taken into account. These findings suggest the need to take selection bias (due to fast growth firms being more likely to apply for grants or targeted by grant agencies) into account in the evaluation of grant assistance so as to ensure the effect of grants on performance is not over-stated.

Girma et al (2004a) showed that grants increased employment and survival in Irish manufacturing using a matching technique and the difference in difference estimator over the period 1983-1998. On the other hand, Girma et al (2007) found that grants had no significant impact on productivity growth, rather grants which promote productivity-enhancing activities increased TFP growth. Girma et al (2007) investigated the effect of grants on total factor productivity (TFP) growth in Irish manufacturing firms with the use of the SYS-GMM estimator to control for selection and endogeneity over the period 1992-1998. The results suggest that grant type should be considered when evaluating grant effect on firm performance.

Mixed evidence on the effect of grant assistance from Irish studies in line with findings from the international studies previously reviewed in this chapter, suggests the need to take into account other factors such as type and magnitude of grants in the evaluation of grant assistance. Moreover, with the exception of Roper and Hewitt-Dundas (2001), the abovementioned studies are based on Forfás datasets which consist solely of data on

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18 This entails pairing each grant-recipient across a number of firm characteristics at each point in time with a non-grant recipient such that the performance of the grant recipient (or hazard pattern) can be studied to develop a counterfactual scenario for the grant-receiving plants (Girma et al, 2004a).

19 The difference in difference method is useful in the proper identification of the effect of grants on firm performance, which increases the precision of the evaluation process.

20 Forfás is Ireland’s policy advisory board for enterprise, trade, science, technology and innovation. It provides independent and rigorous research, advice and support in the areas of enterprise and science policy. It also works with IDA Ireland (responsible for foreign direct investment into Ireland), Enterprise Ireland (responsible for supporting indigenous businesses) and Science Foundation Ireland (supports research) to ensure the coherence of policies across the enterprise development agencies (Forfás, 2013).
agency-assisted firms. This fact is, however, not highlighted in the studies and may introduce bias into the analysis given the focus on evaluating the effectiveness of grant assistance.

2.7.2 Innovation

Innovation which is cited in the literature as an important factor in firm performance has also been included in firm growth studies in Ireland. Roper (1997b) using data from the Product Development Survey, an international survey of firms’ product innovation activity and strategy, examined the relationship between product innovation and firm growth in German, Irish and UK small firms. Product innovation was found to have a positive effect on turnover growth in all three countries, with innovative firms growing significantly faster than non-innovative firms. However, innovative activity in German firms was associated with increased productivity growth and reduced employment growth, while innovation strategies in UK and Irish firms were found to bring about both productivity and employment growth.

There has been a growing interest in the contribution of R&D activities to firm performance in Ireland, given that Irish industrial policy has over the years been targeted at attracting foreign investment particularly in high-tech industries based on the premise that foreign firms, which undertake high R&D activities in Ireland, are more likely to be embedded in the economy (Buckley and Ruane, 2006; Hewitt-Dundas et al, 2010). FDI is perceived to bring about the upgrading of technology, skills and product quality, increased competitiveness in the host economy (Garcia et al, 2013). However, the extent to which these benefits are reaped is dependent on the type of activities being located in the host country by the foreign firm, that is, low-tech, labour-intensive versus high-tech, R&D-intensive (O’Donnell and Blumentritt, 1999). High firm R&D expenditure and intensity is thought to increase the
probability of firm survival in addition to improving firm performance (Kearns and Ruane, 2001; Hewitt-Dundas et al, 2010).

The relationship between R&D activity and employment growth was examined by Ruane and Kearns (1997) in their study of Irish manufacturing firms over the period 1986-1996. Using survey data from Forfás, a firm was defined as R&D-active if it reported R&D expenditure at least once over the time period of the survey. The distinction was also made between foreign and Irish firms to determine if there were differences in their R&D/growth relationships. Findings from their descriptive analysis indicated that for both foreign and Irish firms, the incidence and scale of R&D had a positive effect on employment growth. In terms of exit patterns it was found that high-tech, R&D-active and high R&D spending firms in their sample were less likely to exit. R&D activities involve some degree of sunk costs which are forgone on exit, firms would therefore have better knowledge of the industry prior to entry thereby minimising the probability of failure.

To highlight the importance of multinationals undertaking R&D activities in the Irish economy, Kearns and Ruane (2001) compared the performance of foreign firms which undertake R&D investment in Ireland relative to multinationals which undertake no R&D investment. Using plant-level manufacturing data for the period 1986-1995, life table analysis and Cox duration models were estimated and results showed that whilst controlling for plant and sectoral characteristics, plant survival was positively related to size, level of technology in the sector of activity and the plant being R&D-active. In terms of employment, job losses were found to be greater and job persistence lower in the low-tech industries and among non-R&D spenders compared with R&D spenders. The results from these two studies suggest
undertaking R &D is beneficial to firms in Ireland in terms of its positive effect on employment and the probability of survival.

Modelling the innovation chain\textsuperscript{21} in manufacturing firms in Northern Ireland and Republic of Ireland, with the use of robust regression methods in a sample of 1,393 firms, Roper et al (2008) found that firms which undertake process or product innovation show faster growth in terms of sales and employment, while process innovation lowered productivity. Interestingly foreign ownership increased productivity, but reduced sales and employment growth, indicating that Irish firms increased sales and employment faster than foreign firms. Also remarkable is the result found that firms located in Northern Ireland had lower productivity and slower growth relative to Ireland. This result differs from that found by O’Farrell and Hitchens (1988) and reflects improvements in firm performance in Ireland over the years as a function of improved macroeconomic performance, providing a case for the inclusion of macroeconomic variables in firm performance analysis.

\textbf{2.7.3 Owner-Manager Characteristics}

Certain characteristics of a firm’s owner-manager(s) are thought to be instrumental to its overall survival and success especially for small firms. In small firms, the objectives of the owners of ten coincide with those of the firm, whilst ownership may be separated from management in large firms, with possible conflict of interests (O’Farrell and Hitchens, 1988, Kinsella et al, 1994). This is particularly so because characteristics such as age, gender, previous work experience, education, growth orientation, will influence the firm’s business objectives (growth, survival or profitability). These business objectives may determine the

\textsuperscript{21}The innovation value chain is defined as the... “process through which firms source the knowledge they need to undertake innovation, transform this knowledge into new products and processes, and then exploit their innovations to generate added value” (Roper et al, 2008: p961).
type of business strategies adopted (e.g. having a formal written business plan, the use of external advice, adoption of innovation, use of exporting, diversification, training) in response to changes in the macroeconomic environment and this in turn will exert significant influence on the firm’s overall performance.

A number of Irish studies (Walsh and Anderson, 1994; Kinsella et al, 1994; Roper, 1999; Ruane and Sutherland, 2007; Hynes, 2010) have investigated the impact of several owner-manager characteristics on firm performance. These include:

- Gender,
- Formal qualifications,
- Willingness to share equity,
- Previous work experience in large firm,
- Motivation (likely to be motivated by pull factors such as market opportunities),
- A large management team,
- Management training,
- Having a sales target,
- High capital requirement,
- Educational background of owner-manager.

Roper (1999) in his study of Irish small businesses estimated logistic regression models to examine the relationship between the performance of 1,853 small manufacturing firms in Northern Ireland and Republic of Ireland over the 1993–1994 period and their market and owner-managers’ characteristics in 1991. Assessing business performance in terms of profitability (return on assets), growth (turnover growth) and asset utilisation (sales to asset ratio), the explanatory variables were found to have differing influence on growth and
profitability. Roper (1999) observed only a weak association between turnover growth and return on assets of the sample firms in the short-term implying short-term increases in growth will have no profitability effect and vice versa. No evidence of persistence of growth rates above or below the average was observed, while persistence of profit rates was found in the very short term. This indicates that in the absence of other factors, previous growth performance is a poor indicator of future firm performance, with implications for policies targeted at picking ‘fast-growth’ or ‘high-potential’ firms.

2.7.4 Strategy

The relationship between strategic business initiatives and small firm performance has also been explored by Roper (1997a) using data for over 450 small manufacturing firms in Northern Ireland and the Republic of Ireland for the period 1991-1994. Assessing firm performance in terms of growth (employment and turnover growth), profitability (returns on assets, profit per employee) and asset utilisation (return on sales, sales to asset ratio), a Mann-Whitney test was used to compare the performance of firms which adopted strategic initiatives (such as introduction of new products, entry into new export markets, ISO 9000 quality certification, taking up of new Management Information System, centralisation of control and ownership) relative to non-adopting firms.

Overall, findings indicated that the choice of business strategy had a significant influence on the performance of small firms in the sample when measured by profitability and growth. However, the study was unable to establish a link between strategy choice and asset utilisation. In addition, no significant relation was found between growth and profitability. Although strategy choice was found to be an important factor in firm profitability and growth, adoption of a particular business strategy which has a positive effect on growth may
not necessarily have a positive linkage with profitability. For example, on one hand, the introduction of new products and the development of new export markets were found to have a positive influence on growth, but the profitability linkage was not very clear. On the other hand, strategies which centralised control or ownership were found to have positive effect on firm growth but a negative relationship with profitability. Roper (1997a) then suggested that a suitable choice of business strategies is dependent on a firm’s objectives (i.e. whether to solely pursue firm growth or profitability or to pursue both concurrently).

### 2.7.5 Firm Size

The role of sunk costs in the determination of firm size election and evolution has been highlighted by Walsh (2000) in his study which examined ex post employment growth and failure of small Irish manufacturing firms after entry into the European Community/European Union. Using data for small de novo (new) manufacturing firms for the period 1973-1994, Walsh (2000) estimated the effect of start-up size on employment growth controlling for the business cycle, life cycle, presence of sunk costs and the probability of survival. The Kaplan-Meier estimates for survivor functions show that de novo Irish businesses in endogenous sunk cost (R&D) industries have higher survival rates relative to exogenous sunk cost (homogenous goods) industries. Findings from his two step Heckman estimation model indicated that GL holds for firms in the endogenous sunk cost industries, while it is rejected for firms in exogenous sunk cost industries.

Explaining the observed findings, Walsh noted that firm expenditures on endogenous sunk costs should limit entry, exit and growth in the industry. When R&D is present in an industry, technological requirements and entry costs ensure that firms can afford little uncertainty.

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22 The Heckman (1979) selection model is useful in controlling selection bias as a 2 step consists of estimation of a regression equation and a selection equation.
concerning their post-entry performance. Therefore new firms will have knowledge of their relative efficiency *ex ante* as a result of which initial start-up sizes will be closer to the minimum efficient scale in the industry. Furthermore, firm turnover will be low and GL is expected to hold.

Hynes (2010) employed non-parametric tests to investigate the internal determinants of Irish small firm growth (employment, turnover and turnover per employee) based on a sample of 80 owner-managers over the period 1994-2005. Firm size, age and industry were found to influence firm growth in the sample.

### 2.7.6 Exporting

Ruane and Sutherland’s (2004) study of the impact of exporting on firm performance, distinguishing between foreign and domestic firms, provided evidence of the superior performance of exporters relative to non-exporters in Ireland. Using enterprise level panel data for Irish manufacturing enterprises, Ruane and Sutherland (2004) employed random effects regression techniques in their analysis and observed that foreign firms had higher performance (measured in terms of labour productivity, turnover and gross value added) relative to domestic firms over the period 1991-1998. They also found that domestic exporters showed superior performance compared to domestic non-exporters. Export intensity (ratio of export to turnover) was found to matter, as firms that had higher exports relative to output performed better when compared to firms that exported less. Evidence in support of self-selection was found for domestic firms (i.e. domestic firms with higher performance levels were more likely to export), while there was no evidence of improved firm performance after entry into export markets.
Girma et al (2004b) compared the performance of domestic plants, domestic exporters and domestic multinationals (i.e. Irish firms that invest abroad) in the Irish manufacturing industry using a non-parametric (Kolmogorov-Smirnov) test for the year 2000. Plant performance was assessed using labour productivity measures (sales per employee and value-added per employee) and profitability measures (net profit per employee). Findings indicated that there was no significant difference in plant performance between domestic exporters and non Exporters, while domestic multinationals were found to show higher performance relative to domestic exporters and non Exporters. This supports findings from international studies that multinationals have better performance due to superior technology, knowledge and skills (Caves, 2007; Oliveira and Fortunato, 2006a).

Haller (2012) investigated firm heterogeneity in terms of size, wages, capital intensity and productivity between domestic and foreign-owned firms that trade, making a distinction between firms that engage in intra-firm trade, firms that export only, firms that import only and firms that both export and import based on data for a sample of Irish manufacturing firms from 1996-2005. Findings indicated that firms which export and import, as well as firms engaging in intra-firm trade showed a higher productivity premium relative to firms that export only.

2.7.7 Ownership

O’Farrell and Hitchens (1988) carried out a comparative analysis of the competitiveness and performance of matched pairs of 83 small manufacturing firms in Scotland and the Mid-West of Ireland from 1982-1986. Findings from a sensitivity analysis showed Irish manufacturing firms had lower productivity (measured by sales per person and net output per person) relative to Scottish firms. Irish firms were found to have lower price and quality
competitiveness relative to firms in Scotland. This finding was attributed to the lack of skills, inadequate knowledge of machines and production processes, poor input quality, poor quality control and higher wages prevalent in Ireland. Based on empirical evidence from the surveyed firms, the study highlighted the significance of markets, training, competition, product quality and design to firm growth and competitiveness. The authors also highlighted the importance of foreign ownership in promoting firm performance. Of the 19 Irish firms seen to be quality competitive in the sample, 7 were found to be foreign-owned. The remaining 12 firms had Irish owners that had either previously trained or worked abroad or had received training from Irish-based multinationals (O’Farrell and Hitchens, 1988: p12). The observed poor firm performance may be related to prevailing conditions in the Irish economy during the study period, making a case for the inclusion of macroeconomic variables in firm performance analysis.

The relationship between exporting strategies, level of foreign participation in industry and firm performance was examined by Li et al. (2007) who investigated the nature of structural change in manufacturing employment growth in Ireland after entry into the European Community. Using data for manufacturing firms over the period 1972-2003, their study employed a Heckman selection regression model to examine the role of intra-industry linkages between exporting and de novo non-exporting firms. The study aimed to determine if industries with a bigger presence of exporting firms have a positive effect on the growth and survival of firms in the industry (i.e. evidence of backward linkages). Results obtained showed evidence of a negative relationship between size, industry export size and employment growth, as well as a positive relationship between size, age and survival consistent with findings from international studies.
The review of firm performance studies in Ireland carried out in this section has highlighted a number of key considerations for future research:

- A seeming bias for the manufacturing industry, with many of the studies based on manufacturing firm data. Given the increasing significant contribution of services to the Irish economy, as previously noted in Chapter 1, there is a need for research in this area to provide insights on firm behaviour in this industry.

- The use of employment growth as a measure of firm performance is also prominent, with few studies exploring the influence of various factors on different measures of firm performance. This may be related to the government’s policies aimed at generating employment in the economy. Ruane and Görg (1997) argued that the shift to a FDI-oriented policy stance in mid-1950s was motivated by the need to develop a viable manufacturing base capable of generating jobs to replace the declining number of agricultural jobs. Subsequently, job creation has become a key measure of success/failure of Irish industrial policy. Moreover, employment generation is a criterion in eligibility for grant assistance (Girma et al, 2008).

- Few of these studies have employed multivariate econometric analytical models and different measures of firm performance in the process of understanding firm performance, while many are based on the analysis of a small sample of firms.

- There is a dearth of studies investigating the impact of macroeconomic factors on firm performance.

In the context of the above, there is a clear need for a study of firm performance in Ireland based on both manufacturing and services industries, which employs rigorous econometric techniques to explore the relationship between macroeconomic factors and firm performance, while controlling for firm-specific and industry characteristics. This research aims to
investigate the determinants of firm performance by exploring the interaction between firm-specific characteristics, firm strategy and the macroeconomic environment. More specifically, the study adopts a multivariate approach which captures the multidimensionality of firm performance and allows for the identification of the differing effect of determinants on different aspects of firm performance. Moreover, the rigorous econometric analysis undertaken in this study, which employs a large panel dataset of 2,200 manufacturing and services firms in Ireland (obtained from the CSO) increases our understanding of whether and how firm performance differs across both industries. All of the above contributes to the literature on how firm performance is related to the macroeconomic environment within an Irish context.

2.8 Conclusion

A review of the literature on the theory of the firm and determinants of firm growth and productivity was carried out in this chapter. To provide a theoretical basis for the observed differences in firm performance as noted in the literature, a discussion on the theory of the firm was presented. This focused on the neoclassical, RBV and evolutionary theories. It was then argued that the evolutionary theory was the most suitable theory consistent with the objectives of this research, given its focus on the firm’s responsiveness to changes in the environment as its source of competitive advantage.

The origin of the firm growth debate was traced to GL which states that a firm’s initial size is independent of its growth, whilst a review of the firm growth debate highlighted mixed evidence regarding the validity of the law. Validity was confirmed in earlier studies but rejected in more recent studies. The various assumptions which must hold before the validity
of the law can be confirmed were also outlined. The ambiguity in empirical evidence is related to divergence in methods, datasets, country, time period and research focus. A stylised fact emerging from the literature, however, is a negative size-growth relation, with small firms showing higher growth rates relative to large firms.

Key approaches to the firm growth debate were outlined, while scale intensities, sunk costs and capital intensities, financing constraints and learning effects were suggested as factors driving the small firm growth phenomenon (Jovanovic, 1982; Ericson and Pakes, 1995; Cabral, 1995; Cabral and Mata, 2003, Mata and Portugal, 1994). Thus, firms located in industries with high sunk costs, high scale economies and capital intensities show higher growth due to survival bias as the probability of failure is higher in such industries. Furthermore, in line with the evolutionary view of the firm, small firms update knowledge of efficiency levels (costs) based on past experience in the learning models and consequently, successful firms grow, while less successful firms decline or exit.

Based on Storey’s (1994) suggested framework for the analysis of firm growth factors, the survey of empirical international studies highlighted the determinants of firm performance to include namely, firm size, age, innovation, location and government assistance (See Table 2.2 for a summary of Irish and international studies on firm performance). More specifically, the review of Irish studies on firm performance identified the seeming bias for studies on the manufacturing industry, as well as the need for rigorous econometric analysis which will take into account firm heterogeneity and the multiplicity of factors influencing firm performance. The lacuna of studies analysing GL from a temporal perspective was also noted.
Based on the analysis and discussion contained in this chapter, it can be seen that a holistic approach to the study of firm performance is relevant from both academic and public policy perspectives. Adopting such a holistic approach adds to our knowledge of the factors influencing firm performance and the exact channels through which this occurs. An understanding of the factors governing the survival, growth and overall performance of firms is essential for a successful targeting of ‘high performance’ firms through public policy.

To conclude, the review of the extant firm performance literature undertaken thus far has highlighted firm-specific characteristics, firm strategy and the macroeconomic environment as important drivers of firm performance. It has also identified a gap in the literature in relation to the effect of the macroeconomic environment on firm performance. Following on from this, the research questions emerging from this analysis, which will be tested empirically in Chapters 5 and 6, can be restated as follows:

(i) What is the impact of macroeconomic conditions on firm performance in Ireland in the period, 1991-2007?

(ii) What is the impact of the type of firm strategy adopted on firm performance in Ireland in the period, 1991-2007?

(iii) What is the impact of firm-specific characteristics on firm performance in Ireland in the period, 1991-2007?

Having highlighted the fact that ambiguity in empirical evidence may be related to the use of diverse methods and measures in empirical studies, a review of the literature will be carried out in Chapter 3 which follows so as to outline methodologies and measures commonly used in the literature. This serves to guide the choice of performance measures and estimation techniques to be employed later in the analysis that follows.
### Table 2.2: Overview of Empirical Studies investigating Firm Performance

<table>
<thead>
<tr>
<th>Study Authors</th>
<th>Country</th>
<th>Time Period</th>
<th>Industry</th>
<th>Firm Performance Measure</th>
<th>Drivers of Firm Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hart and Prais (1956)</td>
<td>UK</td>
<td>1885-1950</td>
<td>Manufacturing</td>
<td>Growth (market valuation)</td>
<td>Size (market valuation)</td>
</tr>
<tr>
<td>Simon and Bonini (1958)</td>
<td>US</td>
<td>1954-1956</td>
<td>Industrial firms</td>
<td>Growth (assets)</td>
<td>Size (assets)</td>
</tr>
<tr>
<td>Mansfield (1962)</td>
<td>US</td>
<td>1916-1957</td>
<td>Manufacturing</td>
<td>Growth (employment),</td>
<td>Size (employment, output), Innovation</td>
</tr>
<tr>
<td>Singh and Whittington (1975)</td>
<td>UK</td>
<td>1948-1960</td>
<td>Manufacturing, construction and services</td>
<td>Growth (assets),</td>
<td>Size (assets)</td>
</tr>
<tr>
<td>Evans (1987)</td>
<td>US</td>
<td>1976-1980</td>
<td>Manufacturing</td>
<td>Growth (employment),</td>
<td>Size (employment), Age, Number of firms</td>
</tr>
<tr>
<td>Roper (1997a)</td>
<td>Ireland, Northern Ireland</td>
<td>1991-1994</td>
<td>Manufacturing</td>
<td>Growth (employment and turnover growth), Profitability (returns on assets, profit per employee), Asset utilisation (return on sales, sales to asset ratio),</td>
<td>Strategic initiatives (e.g. introduction of new products, entry into new export markets</td>
</tr>
<tr>
<td>Robson and Bennett (2000)</td>
<td>UK</td>
<td>1997</td>
<td>Manufacturing and business services</td>
<td>Growth (employment, turnover, profitability per employee)</td>
<td>Age, Exporting, Skills level, Profitability per employee, High technology, Innovation, Use of external advice</td>
</tr>
<tr>
<td>Becchetti and Trovato (2002)</td>
<td>Italy</td>
<td>1995-1997</td>
<td>Manufacturing</td>
<td>Employment growth</td>
<td>Size (employment), Age, Financial pressure, Leverage,</td>
</tr>
<tr>
<td>Study Authors</td>
<td>Country</td>
<td>Time Period</td>
<td>Industry</td>
<td>Firm Performance Measure</td>
<td>Drivers of Firm Performance</td>
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<tr>
<td>Nunes and Serraqueiro (2009)</td>
<td>Portugal</td>
<td>1999-2003</td>
<td>Services</td>
<td>Growth (assets)</td>
<td>Size (assets), Leverage, Ownership</td>
</tr>
<tr>
<td>Bryson and Nurni (2011)</td>
<td>UK</td>
<td>1998-2004</td>
<td>All industries</td>
<td>Employment growth</td>
<td>Size, Age, Innovation, Human capital</td>
</tr>
<tr>
<td>Yasdanfar and Salman (2012)</td>
<td>Sweden</td>
<td>2007</td>
<td>Manufacturing and services</td>
<td>Growth(sales), Age, Size (employment), Industry affiliation</td>
<td>Analysis of Variance (ANOVA)</td>
</tr>
<tr>
<td>Bentzen et al (2012)</td>
<td>Denmark</td>
<td>1990-2004</td>
<td>All industries</td>
<td>Growth (turnover, net assets), Size (turnover, net assets)</td>
<td>Non-linear maximum likelihood method</td>
</tr>
</tbody>
</table>
Chapter 3: Methodological Approaches to Studying Firm Performance

3.1 Introduction

The main focus of this chapter is to discuss the research approach adopted in this thesis to investigate the determinants of firm performance. More specifically, this study employs a holistic multivariate model, which includes a macroeconomic control set, to analyse the drivers of firm performance (growth and productivity) in a sample of manufacturing and services firms in Ireland. The chapter aims to identify the data, measures and methods most suited to addressing the research questions in the thesis, which are based on a survey of the relevant literature. The review of the extant literature undertaken in Chapter 2 identified a range of factors acknowledged as drivers of firm growth and productivity, as well as a number of techniques adopted in the analysis of firm performance. However, despite the large volume of empirical studies, the process of firm performance is yet to be fully understood. This is primarily due to a number of factors such as heterogeneity in the performance of firms, divergence in research focus, determinants analysed, methodology, growth measures and sample sizes as previously indicated in Chapter 2. It is the issue of methodology that is the prime concern of the current chapter.

More specifically, the literature review highlighted the role of both internal (e.g. firm-specific) and external (industry-specific and macroeconomic) factors in enhancing firm performance. Therefore, given the multiplicity of factors governing firm performance, it is
important to take into account the effect of both internal and external variables, as well as adopt measures and methods most suitable for analysis. This will provide clearer insights as to the degree to which these factors impact the process of firm performance, as well as the channels through which this occurs. As outlined in Chapter 1, a study of the link between macroeconomic factors and firm performance is essential since macroeconomic changes influence the performance of firms, which in turn affect economic performance as a whole. Thus, the analysis of the determinants of firm performance carried out in the thesis contributes to our understanding of how the macroeconomic environment impacts upon firm performance.

However, given the wide range of methods in use in empirical research for analysing firm performance, there is a challenge with respect to determining the most suitable method to be employed in this research. The choice of research method(s) has a wide-ranging influence on the precision of results obtained from the sample, the ability to replicate and generalise results to the whole population from which the sample is taken. Hence, the decision as to what technique or method to be used in any empirical analysis must be taken with careful consideration given to the research objectives. Consequently, it is imperative that a survey of the relevant literature on methods and techniques employed in analysing the factors influencing firm performance be undertaken to draw out the strengths and limitations of the methods, as well as the contexts in which they are appropriate. Such a review will be valuable in determining the method most suitable for addressing the research objectives of this study.
Considering the above, this chapter presents a review of the methodologies and performance measures commonly used in analysing firm performance. The remainder of the chapter is organised as follows: the research philosophy, which informs the research approach adopted in the thesis, is outlined in Section 3.2, while Section 3.3 presents the variables to be examined in the empirical investigation undertaken. This provides a definition of the performance measures and determinants included in the firm performance model to guide the formulation of the research hypotheses to be tested in Chapter 6. The firm performance models to be estimated in the empirical chapters are specified in Section 3.4, while Section 3.5 deals with the choice of data source and provides a description of the Census of Industrial Production (CIP) and Annual Services Inquiry (ASI) datasets employed in the research. A review of the estimation techniques commonly adopted in the firm performance analysis literature is outlined in Section 3.6, while Section 3.7 concludes.

### 3.2 Research Philosophy

The research approach adopted in any research is largely influenced by the researcher’s philosophical assumptions which influence how the researcher views the world. There are two main philosophical assumptions in research: ontology and epistemology. Ontology refers to what the researcher perceives to be reality, while epistemology relates to the nature of knowledge the researcher holds about the world and the process through which the knowledge is developed (Saunder et al, 2007; Bryman and Bell, 2011).
The two main ontological positions are objectivism and subjectivism. Objectivism takes the position that social entities are independent of social actors, whereas subjectivism or constructionism refers to the meanings individuals attach to a social phenomenon or entity based on their own perceptions (Saunder et al, 2007). This implies interaction between social actors and social entities, in contrast to objectivism, whilst the knowledge gained from these interactions is constantly updated in response to individual experiences (Saunder et al, 2007).

Epistemology relates to the nature of knowledge and asks the question, “what it means to know?” (Scotland, 2012: p 9). The three main epistemological positions are: positivism, realism and interpretivism (Bryman and Bell, 2011). Positivists believe the principles of physical or natural science should be applied to the study of social phenomena and that the researcher should be objective about the research subject or topic (Johnson and Onwuegbuzie, 2004).

The research philosophical position adopted in this research is positivism given that the research entails data collection and analysis, with the aim of generating findings that are easily replicable. Positivism takes the ontological position of realism, which assumes the existence of a reality which is easily discovered and is independent of the researcher (Scotland, 2012). From a philosophical perspective, Scotland (2012) argued that positivism assumes objectivism, where the researcher is believed to be detached from the research subject, with no prior bias regarding the knowledge to be discovered. Howell (2013: p41) posited that “social science should be based on observation alone…” implying an emphasis on observable facts and data. Positivism is, therefore, focused majorly on facts and
data collected by observation in a value-free way with the use of a highly structured methodology that allows for statistical analysis and replication (Alvesson and Sköldberg, 2009; Scotland, 2012).

Furthermore, positivism aims to examine causal relationships to enable prediction and is, therefore, commonly associated with quantitative methods which allow for objectivity and reliability of results (Johnson and Duberley, 2000; Zawawi, 2007). Given that the research questions in the thesis involve investigating and predicting the interactions between firm performance and its determining factors, a quantitative approach is adopted in this research. The positivist stance is, however, not without criticism. Based on its assumption that the researcher is value-free, it has been argued that this philosophical position does not take into account the researcher’s ability to interpret their experiences and represent themselves (Cohen et al, 2011). Furthermore, its reliance on observable data and facts may neglect the occurrence of important phenomena that remain unobservable to the researcher (Alvesson and Sköldberg, 2009). Similarly, criticisms of quantitative methods include:

- The rigid methodological structure which preclude allowing alternative explanations of observed phenomenon (Zawawi, 2007);
- It ignores the meaning of events to people and does not provide how findings are related to everyday contexts;
- The concern with the analysis of the relationship between variables creates a static view of social life which is independent of the research subjects (Bryman, 2008).
Nevertheless, adoption of a positivist and quantitative approach is suitable for this research given its concern with understanding and predicting the influence of a number of factors on firm performance, with emphasis on the measurability of variables and transferability of findings. In addition, a deductive approach is adopted in the study to address the research questions outlined in Chapter 1. Deductive reasoning provides a way of testing theories related to firm growth by investigating the relationship between the variables identified in the literature review (Chapter 2) which can be operationalised (Creswell, 2009). The deductive approach begins with theory... “as the first source of knowledge”, hypotheses are then generated on the basis of the knowledge gained from theory (Eriksson and Kovalainen, 2008: p22).

Quantitative research methods common to the positivist position are experiments and surveys given the focus on predictability and replicability (Johnson and Duberley, 2000). Surveys allow the collection of data for a large sample of firms often with the use of questionnaires (Silverman, 2005), while experiments aim to determine the impact of a given treatment or intervention (e.g. receipt of grants) on an outcome (firm performance) controlling for external factors which may influence performance (Flick, 2006). It is somewhat difficult to create an experimental design (i.e. a controlled environment) which permits isolation of the effects of all other factors from the variable of interest (e.g. macroeconomic environment) which may influence firm performance. Thus, the current research is based on the use of longitudinal survey data which allows the tracking of firm performance across a number of years. This enables the study of how firm performance evolves over time, particularly in response to changes in macroeconomic conditions, thus increasing the generalisability of findings. A
more detailed discussion of the datasets is provided later in the chapter (Section 3.4). Moreover, given the large panel datasets analysed in the thesis, the use of quantitative methods in this research provides methodologically rigorous, reliable and verifiable large aggregates of data, as well as statistical testing of research hypotheses formulated from the review of the literature (Berg, 2001, Flick, 2006). Having addressed the research philosophy informing the empirical research in this thesis, the model of firm performance, which will be analysed empirically in Chapter 6, is discussed in the section that follows.

3.3 Modelling Firm Performance

To provide a background to the firm performance model analysed in this study, definitions and the rationale for the variables and measures included in the model are presented in this section. This is based on the framework for analysing the determinants of firm growth as proposed by Hynes (2006) in her review of Irish small firm growth research. As previously detailed in the preceding chapter, the suggested framework, based on Storey’s (1994) review of small firm growth studies, frames the determinants of growth into three categories: the entrepreneur, the firm and strategy. Nevertheless, having reviewed the extensive literature on firm performance (both international and Irish), a dearth of research on the link between the macroeconomic environment and firm performance was identified, as earlier detailed in Chapter 2, thus highlighting the novelty of the contribution of the current research.

To address this gap, Storey’s (1994) and Hynes’ (2006) framework is extended in the current study to incorporate the impact of the macroeconomic environment in which the firm
operates. However, variables related to the entrepreneur are not included in the framework adopted in this thesis for a number of reasons. This thesis concerns itself with filling the gap in the firm performance literature relating to the effect of the macroeconomic environment on firm performance, since a considerable amount of work has already been undertaken on entrepreneurial characteristics, particularly in the Irish context (Walsh and Anderson, 1994; Kinsella et al, 1994; Roper, 1999; Ruane and Sutherland, 2007; Hyres, 2010). Moreover, analysis in this thesis is based on the use of large longitudinal datasets (which precludes the inclusion of entrepreneurial variables due to the non-availability of data) rather than a cross-sectional survey of entrepreneurs.

In view of the above facts, the thesis does not concern itself with the entrepreneurial group of variables. The analysis of firm performance in manufacturing and services firms in Ireland is limited to addressing the question of what (how) firm characteristics, firm strategy and macroeconomic factors affect growth in employment, turnover and productivity. This adds to our understanding of firm performance by offering insights on the linkage between both internal and external factors of firm performance, as well as their impact on different dimensions of firm performance. Therefore, the framework, presented in Table 3.1 defines firm performance in terms of growth and productivity. Additionally, it summarises the determinants of firm growth into three categories: firm characteristics, firm strategy and the macroeconomic environment.

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23A more detailed discussion on datasets is presented later in Section 3.4 of this chapter.
Table 3.1: Summary of Determinants of Firm Performance

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Outcomes</th>
</tr>
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<tbody>
<tr>
<td><strong>Firm Characteristics</strong></td>
<td></td>
<td>Increase in:</td>
</tr>
<tr>
<td>Firm Size</td>
<td>Growth of Firm</td>
<td>Turnover</td>
</tr>
<tr>
<td>Industry</td>
<td></td>
<td>Employment</td>
</tr>
<tr>
<td>Ownership Structure</td>
<td></td>
<td>Productivity</td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td>Turner per employee</td>
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<tr>
<td><strong>Strategic Orientation</strong></td>
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<tr>
<td>Global Engagement</td>
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<tr>
<td>Use of Public Subsidies</td>
<td>Productivity Level</td>
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<tr>
<td>Workforce Training</td>
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<tr>
<td>Innovation</td>
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<tr>
<td><strong>Macroeconomic Environment</strong></td>
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<tr>
<td>Prices</td>
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<tr>
<td>Labour Market</td>
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<tr>
<td>Availability of Credit</td>
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<tr>
<td>Economic Growth</td>
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<td></td>
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<tr>
<td>Competitiveness</td>
<td></td>
<td></td>
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</tbody>
</table>

Source: Author’s elaboration of Hynes (2006: p95)

Table 3.1 shows the interrelationship among the various drivers of growth and productivity included in this framework. The arrows indicate that firm-specific characteristics and the macroeconomic environment influence the firm’s strategic orientation, which in turn determines its performance (defined in terms of growth and productivity). Consequently, the firm may achieve success in performance outcomes in terms of higher growth (in turnover, employment and productivity) and/or higher productivity levels (turnover per employee).
levels). Following on from this, a discussion of the performance measures and variables to be included in the model is provided in Section 3.3.2. First, definitions of the dependent variables (firm performance measures) are provided in the section that follows.

### 3.3.1 Measures of Firm Performance

Firm performance is multidimensional in nature with financial and non-financial measures (Figure 3.1), which capture different areas of performance (Yildiz et al, 2011). Although dimensions of performance are not interchangeable as noted by Santos and Brito (2012), financial and non-financial measures are somewhat interrelated, with elements of non-financial performance measures embedded in the firm’s financial performance. For instance, measures of firm competitiveness include profitability, productivity, which themselves are measures of firm performance (Biggeri, 2007, World Economic Forum, 2008). A firm may therefore attain competitiveness through productivity or employment growth and can subsequently improve performance by increasing productivity through innovation, product price and quality, which lead to sales growth resulting from increased demand for its goods and services (McKinsey Global Institute, 2010). In addition, non-financial performance measures such as competitiveness, quality of products and services and product innovation may be subjective as they are often based on the firm’s qualitative rather than quantitative assessment (Carton and Hofer, 2006).
There is a prevailing use of financial measures such as profitability, growth and productivity in the industrial organisation literature, which is possibly related to data availability, as well as the ease of measurement. Reliance on financial measures may also be connected to direct linkages between these measures and overall economic performance, as outlined in Chapter 1. For instance, increased firm-level productivity leads to improved incomes, increased GDP and higher economic growth (McKinsey Report, 2002), whilst low firm profitability and growth rates could reduce the probability of firm survival, particularly in highly competitive industries. This could mean increased government expenditure due to increased pressure on the social welfare system, spending on retraining of displaced workers, grants and subsidies to firms to attract or retain investments and loss of revenue from income tax, corporation tax and property tax among others. Additionally, firm growth is necessary to achieve sustainable
economic growth over the long term. Therefore, financial measures of firm performance are of immense interest to the industrial economist.

In view of the above, the use of financial measures is considered appropriate for this research given that these capture directly measurable aspects of firm performance, which facilitates a study of the effect of the macroeconomic environment on firm performance. Furthermore, financial measures are not prone to the subjective bias inherent in non-financial measures. The question then arises as to the choice of financial measures most valuable in this firm performance analysis. As previously noted in Chapters 1 and 2, it is suggested that the choice of performance measures be made based on those objectives most relevant to key stakeholders such as the firm, customers, employees and government (Richard et al, 2009). A discussion of the choice of performance measures adopted in the study follows.

**Financial Measures of Firm Performance**

It has been argued by Akta and Bulut (2008) and Gentry and Shen (2010) that company account-based financial performance measures (such as profit, return on investment and return on assets) reflect past (short-term) performance given that they assess the effect of firm strategies on performance, whereas, market-based measures such as market capitalisation give an indication of investors’ future performance expectations (long-term). Nevertheless, the use of company account-based measures is problematic due to issues such as definitional problems (accounting profit versus economic profit), differences in accounting conventions, treatment of depreciation, taxes and debts, variations in intensity of capital use and inflation (Griffiths and Wall, 2007; Gentry and Shen, 2010). On the other hand, the use of
market-based measures is subjective and volatile since they are prone to fluctuations in investors’ feelings about future profits of the firm (Lipczynski et al., 2005). The shortcomings associated with accounting-based and market-based measures, as well as the non-availability of data on these measures prevent their inclusion in this research. The next section examines the various measures that were employed in this firm performance research, with the aim of defining and discussing the rationale for choices made. The following measures will be discussed in turn: profitability, growth and productivity.

Profitability, growth and productivity have been suggested as essential dimensions of firm performance, given their relative significance to firm survival and growth (Bottazzi et al., 2008; Brännback et al., 2009; Santos and Brito, 2012). Profitability is crucial to the survival and growth of the business because the firm’s ability to grow is determined by its profit-generating ability (Brännback et al., 2009). However, its use in performance analysis is problematic due to the definitional issues associated with company account-based measures, as indicated above. Moreover, given that many firms operate in imperfectly competitive markets, Palic and Reeves (2011) argue that profitability measures are inappropriate measures of performance for such firms. Furthermore, a lack of data on this variable prevents its inclusion in this study. Hence, this research focuses on growth and productivity as measures of firm performance. Taking into account the above-mentioned facts, a discussion on firm growth and productivity is presented in the sections which follow.
(i) **Firm growth**

Growth is necessary for sustained competitiveness and profitability (Fitzsimmons et al, 2005) and illustrates past performance, which may impact future ability to generate profits (Brännback et al, 2009; Santos and Brito, 2012). Additionally, the rate at which a firm is able to increase output (turnover) or inputs such as number of employees also influences the extent of its productivity. There are difficulties inherent in the measurement of firm growth due to varied opinions on growth definitions. Divergence in definitions could be related to issues such as research focus, data availability, as well as heterogeneity in growth measures, growth measurement over time and in the processes by which firm growth occurs, as well as in the characteristics of firms (Delmar and Davidsson, 2003).

It is, however, important to define growth a priori as the interpretation of growth is dependent on its definition (Davidsson and Wiklund, 2006). A firm could be said to have grown when there is an increase in output (turnover/sales, profit), inputs (assets, number of employees) or market valuation and market share (Hart and Prais, 1956; Hymer and Pashigan, 1962; Evans, 1987; Barkham et al, 1996; Li et al, 2007; Morone and Testa, 2008; Daunfeldt and Elert, 2013). Furthermore, there is a need to specify how growth is defined by distinguishing between organic growth and acquisition since growth could occur either through the expansion of the firm’s activities (organic) or by diversification, merger and acquisition (Penrose, 1959; Davidsson et al, 2010).

The multiplicity of growth measures highlighted above, however, presents the researcher with a dilemma as to how growth is best measured. Since the choice of growth measures
should be informed by those objectives most relevant to key stakeholders and the researcher, firm growth is defined in terms of an increase in employment (input), turnover/sales (output) and productivity in this thesis. A detailed discussion on the rationale for the choice of these performance measures is provided in the section that follows. Although it is important to a priori define growth in terms of whether it is organic or acquisition in nature, it is not possible to differentiate between both growth types in this thesis due to data availability.

The use of employment as a growth measure provides information on the firm’s resource utilisation, while inclusion of a turnover measure is beneficial where there is interest in how much output is produced given the firm’s resource pool. Thus, concurrent use of sales and employment as performance measures in this analysis offers insights into different aspects of the firm’s performance (Hynes, 2010; Coad, 2010). Furthermore, inclusion of employment and turnover as growth measures takes into account industry factor intensity differentials, thus offering a more robust depiction of performance in firms which takes firm differences into account. Additionally, with the adoption of innovative processes, increases in output may not necessarily be achieved by more intensive use of labour input. The concurrent use of both measures is, therefore, beneficial. Moreover, the number of jobs created and retained by firms is of great interest to policy makers as this frequently informs the amount and type of grant provided to firms (Storey, 1994; Kinsella et al, 1994; Ledeber and Woodward, 2003; Bernini and Pellegrini, 2011). The creation of jobs has remained a major measure of the effectiveness of public support provided to firms.

Breznitz (2007; 2012) noted that beginning from Whitaker’s (1958) Economic Development report, the main goal of Irish policy has been and continues to be job creation. The creation of jobs has remained a major measure of the effectiveness of public support provided to firms.
valuable as it allows firms compare performance relative to competitors in terms of market shares.

**(ii) Productivity**

With increasing globalisation, productivity has become a crucial determinant of a firm’s growth, profitability and competitiveness (Papadogonas and Voulgaris, 2005; Luttmer, 2011). A firm able to produce more output with fewer resources relative to competitors gains a competitive advantage thus increasing its chances of growth and survival. Therefore, increases in productivity ensure the sustainability of micro-level competitiveness over the long term. Firm competitiveness is of particular interest in any economy as it influences overall economic productivity, living standards and competitiveness. Adoption of the productivity indicator also takes into account the objectives of other stakeholders such as consumers and employees since increases in productivity bring about lower prices and higher wages (Arnold, 2013; Kurihara, 2013). In addition, based on the principle of the growth of the fitter in evolutionary theory, developed from Nelson and Winter’s (1982) work, it is assumed that successful firms as indicated by profitability or productivity will survive and grow, while less viable firms will decline and exit (Coad, 2009). Therefore, a firm’s level of profitability and productivity are key factors in its survival and growth. Moreover, given the openness of the Irish economy due to its size and foreign direct investment (FDI) oriented policies, knowledge of firm-level productivity performance is useful to policy makers in determining policies to ensure Ireland remains a competitive location relative to other economies.

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25 More details on this to follow in Chapter 4.
Productivity measures in firm performance studies include partial productivity measures such as capital and labour productivity, which are commonly used due to ease of measurement and interpretation. However, these partial measures attribute changes in output to only one factor, neglecting other factors which may influence output (OECD, 2001). Total Factor Productivity (TFP), which measures the proportion of output that is not explained by either capital or labour inputs, offers a more complete assessment of productivity. Due to lack of data on capital stock, productivity is measured by labour productivity in this research. Labour productivity can be measured as a ratio of output per worker or output per number of hours worked. Freeman (2008) recommends the total number of hours worked as the best measure of labour input, since the use of total number of employed persons may mask variations in average hours worked. There is, however, often ambiguity regarding quality of hours-worked estimates. Hence, due to lack of data on the number of hours worked, output (turnover) per employee is used in this analysis as a measure of labour productivity in line with several studies (Syverson, 2011; Bartelsman et al, 2013).

It is important to study both productivity levels and growth as increases in productivity determine growth in output, income and living standards, while productivity levels illustrate the firm’s starting point which is essential for long-term performance based on the concept of path-dependence introduced in the discussion on the evolutionary theory provided in Chapter 2 (Section 2.2.3). Hence, the study examines both productivity growth and levels, which offers insights into productivity performance in Ireland and how this has evolved over the time period of the study.
In conclusion, following from the discussion above, firm performance is assessed by growth (employment, turnover and productivity) and productivity in this study. Turnover/sales is an indicator of a firm’s actual performance given its market share, while the number of employees is a measure of its potential productive capacity (Bottazzi et al., 2008). Similarly, productivity provides information on the firm’s competitiveness, indicating the efficiency of resource use. It should be noted that firm performance as defined by the growth measures (i.e. growth in employment, turnover and productivity) and the level of productivity are two distinct concepts. The growth measures assess the rate at which the firm is able to increase its size (employment and turnover respectively), as well as the efficiency with which it produces output with a given level of resources. Whilst, the level of productivity indicates the firm’s starting point in terms of the efficiency of resource use, which in turn determines the rate at which it subsequently increases productivity. It then follows that the inclusion of sales, employment and productivity (growth and levels) in this analysis offers knowledge of the different facets of firm performance, providing insights as to whether (and how) these are influenced by various determinants. In the context of the discussion above, Figure 3.2 provides a synopsis of the definitions of firm performance adopted in this thesis. Having addressed issues related to how firm performance is measured in this research, a discussion on the determinants of firm performance (as outlined in Table 3.1) follows.
3.3.2 Determinants of Firm Performance

This section provides a definition of the factors of firm growth and productivity (outlined in Table 3.1), as well as the research hypotheses to be tested in the empirical model adopted in this research. As previously detailed, these variables are summarised into three categories as suggested by Storey (1994) and Hynes (2006); factors relating to the firm, factors relating to the entrepreneur and factors relating to the firm’s strategy. To address one of the research objectives of this study, a fourth group of factors, macroeconomic factors, is included in the model. Furthermore, the discussion presented in this section guides the development of the research hypotheses to be tested empirically in Chapter 6.

Entrepreneurial characteristics such as owner-manager age, gender, education, motivation and experience may impact the firm’s performance outcome since the entrepreneur directs and manages the firm’s resources. Hence, the entrepreneur is a key factor in the
determination of the extent and direction of firm growth based on his motivation/ambition, as well as the design and implementation of the firm’s strategy (Penrose, 1995). However, as detailed previously in Section 3.3, this research does not focus on this category of determinants. A discussion is presented on the firm’s characteristics, strategy and the macroeconomic environment in which it operates and how these influence its subsequent growth. To begin with, factors related to the firm are defined and discussed.

(1) Firm Characteristics

A firm’s characteristics, such as its size, age, industry, are critical in any investigation of performance as these not only affect its performance, but also inform the quality of its response to changes in the operating environment. The firm-level characteristics considered in this study are Size, Industry, Location, Nationality of ownership and Labour productivity. Each of these will be discussed in turn.

(i) Firm Size

An investigation of the relationship between firm size and growth is of utmost importance in any firm performance study given the large number of studies motivated by Gibrat’s (1931) Law of Proportionate Effect (LPE) as discussed previously in Chapter 2. Although empirical evidence on the law’s validity is mixed, a stylised fact emerging in the extant literature is that growth is more pronounced in smaller firms, with the growth effect diminishing with increased size (Sutton, 1997; Cabral, 2007; Fotopoulos and Giotopoulos, 2010). A priori it is
therefore expected that a negative relationship between initial size and growth will be observed.

As previously outlined in Chapter 2, Jovanovic’s (1982) selection model posited that firms only gain knowledge of their efficiency level post-entry, thereby adjusting efficiency levels based on knowledge gleaned from previous periods. Following from this, efficient firms grow and survive, while less efficient firms decline or fail. As a result, productivity will vary across size classes and on average increase with firm size. Consequently, it is expected that a firm’s initial size will be negatively associated with growth, while there should be strong co-movement between initial size and productivity. Firm size is measured in terms of employment (total number of employees) and turnover (total sales).

(ii) Industry

Empirical evidence reveals that the industry matters in determining the degree of success attained by firms. Moreover, industries may differ in their responsiveness to macroeconomic changes. For instance, the food and beverages industry may be less sensitive to adverse changes in the macroeconomic environment relative to the computer/software industry. To this end, a number of variables are included to control for industry-specific characteristics. Industry dummies are included in the analysis to control for industry-specific differences. A distinction is made between high-technology and low-technology industries, manufacturing versus services in industry, with performance disparities in firms located within these industries. Firms in high-technology-intensive or knowledge-intensive industries are found to be larger, more productive and perform better than low technology-
intensive or knowledge-intensive firms due to rapid technological change, innovation and large investments in R&D expenditure required in such industries (Audretsch, 1995; Calvo, 2006; Coad, 2009; Ortega-Argilés et al, 2013). Therefore, a priori being part of a technology or knowledge-intensive industry will have a positive effect on firm performance.

Following on from this, an industry Minimum Efficient Scale (MES) variable is included to measure industry scale and competitive intensities. The larger the scale intensity, the more quickly a firm has to grow to attain the industry MES to avoid exit (Audretsch et al, 2004; Delmar and Wennberg, 2010). This implies that the minimum efficient scale in the industry in which a firm is located should have a positive effect on its performance. MES is measured as the size of the average firm (mean turnover) in the industry. Mean turnover is adopted in this study instead of mean industry employment used by Reichstein et al (2010) and Delmar and Wennberg (2010) so as to take into account possible differences in labour intensity across industries. With regard to industry growth, firms located in fast growing industries are expected to be more productive and grow more due to a lower degree of competition and the availability of more opportunities (Audretsch, 1995; Otto and Fornahl, 2009; Delmar and Wennberg, 2010). Therefore, a positive relationship between industry growth (measured as the log difference of total turnover in the industry) and firm performance is expected.

(iii) Location

Location is critical to firm performance given its possible impact on input costs, labour supply and output decisions. Proximity to markets, accessibility and infrastructure may lead
to lower input costs, as well as increased output, while proximity to research institutes or universities provides access to a pool of skilled labour which may stimulate higher performance in firms. In view of the above, considering its significant contribution to the Irish economy (accounting for 28 per cent share of total population, 27 per cent of total number of active firms and about 43 per cent of total numbers employed in Ireland in 2006 [CSO, 2007a: p40; CSO, 2013b]), it is expected that firms located in county Dublin and its environs will show better performance than firms in located in other counties. The location effect is captured in manufacturing firms with a categorical variable, where 1 = Border; 2 = Dublin; 3 = Mid-east; 4 = Midlands; 5 = Mid-west; 6 = South-east; 7 = South-west; 8 = West and Dublin is the reference category. On the other hand, the location effect is measured in services firms with the use of a dummy variable representing 1 if the firm is located in the Southern and Eastern region (SE) comprising Dublin, Mid-east, Mid-west, South-east and South-west regions and 0 if firm is located in the Border, Midland and Western (BMW) region.

(iv) Nationality of Ownership

Foreign ownership of companies exerts a significant effect on performance, with foreign firms being more successful relative to domestic firms in both Irish (Ruane and Sutherland, 2004; Roper et al, 2008) and international studies (Halkos and Tzermes, 2010). Foreign firms are commonly found to be larger in terms of employment, turnover and pay higher wages relative to indigenous firms (Fotopolous and Louri, 2004; Oliveira and Fortunato, 2006a; Mayer et al, 2010). It is therefore expected that foreign ownership should have a positive effect on performance. Assessing the impact of foreign ownership on firm performance...
within the Irish context is vital given the significant contribution of foreign firms to the Irish economy and the FDI-oriented industrial policy pursued by successive governments (Buckley and Ruane, 2006; Breznitz, 2007; Collins and Grimes, 2011). The effect of foreign ownership is captured with a dummy variable = 1 if firm is foreign-owned and takes a value of 0 otherwise.

(v) Initial Level of Productivity

Productivity, a measure of the firm’s efficiency in resource use, is critical to whether a firm succeeds or fails. It has been observed that firms with higher initial efficiency levels perform better relative to less efficient firms (Bartelsman and Doms, 2000; Bigsten and Gebreeyesus, 2007). Based on Jovanovic’s (1982) model and the evolutionary theory outlined in Chapter 2, a firm’s initial level of productivity (turnover per employee) should therefore have a positive effect on subsequent performance.

2) Firm Strategy

Businesses are faced with decisions of what strategy to adopt when dealing with changes in the milieu in which they operate. These strategies could involve decisions on exit, entry into new markets, investment in innovation, use of external financing and public support, training and diversification. Consequently, the firm’s strategy governs its response to changes in the macroeconomic environment and determines the extent to which the firm remains productive and profitable. Given the unique features of the Irish economy in terms of its openness and the significant role of public policy in attracting inward FDI, particularly in high-tech...
industries, the strategy variables considered most relevant to firm performance in the Irish context are innovation, trade, training and use of public support. More detailed information on the key features of the Irish economy is presented in Chapter 4 (Section 4.2). A discussion on the strategy variables outlined in Table 3.1 is presented in the material which follows.

(i) Innovation

Innovation is thought to stimulate better performance via several channels. Through investments in new technology and/or processes (radical innovation), a firm gains competitiveness relative to rivals particularly in highly competitive industries (Cleff et al., 2005; Barbosa et al., 2013). Innovative activities can also potentially transform the firm’s internal capabilities bringing about greater flexibility and adaptability to industry changes (Artz et al., 2010; Atalay et al., 2013). Thus, investments in innovation could strengthen the firm’s ability to better withstand adverse changes in the macroeconomic environment (Geroski and Machin, 1994). Lastly, the effect of innovation on firm performance can be linked to the concept of routines (e.g. R&D and exporting) highlighted in the evolutionary theory of the firm, as earlier detailed in Section 2.2.3. According to the evolutionary theory of the firm, routines (which are specific to the firm) confer on the firm some competitive advantage. However, the extent to which the firm is able to achieve sustainable competitive advantage is largely dependent on its ability to constantly update these routines in response to changes in its operating environment (Nelson and Winter, 1982; Teece et al, 1997; Salvato and Rerup, 2010).
Contrary to theoretical expectations, there is however, mixed empirical evidence on the effect of innovation on firm growth (Coad and Rao, 2008; Colombelli et al, 2013). This could be due to divergence in innovation measures, industry context, timing and methodology as previously discussed in Chapter 2. Innovation has been found to influence firm growth positively in many studies (Mansfield, 1962; Roper, 1997; Freel, 2000; Falk, 2012), while Bottazzi et al (2001) did not find a significant effect of innovativeness in worldwide pharmaceutical firms. Similarly, Klette and Forre (1998) found no clear-cut positive relationship between net job creation and R&D intensity in a sample of Norwegian manufacturing firms over the period 1982-1992. In contrast, Brouwer et al (1993) observed that growth of R&D intensity has a slightly negative impact on employment growth in 859 Dutch manufacturing firms over the period 1983–1988, while firms with a high share of product-related R&D were found to demonstrate above average employment growth. With respect to timing, Geroski and Machin (1992) found that the positive effect of innovation on firm performance in a sample of UK firms is realised very shortly after innovation takes place resulting in a large one-off increase in firm sales.

Following Crepon et al’s (1998) first stage in investigating the innovation/firm performance relationship, analysis is based on investigating the impact of a firm’s decision to engage in R&D on its performance, as well as determining whether and to what extent the amount of resources invested in R&D affects performance. Consequently, two innovation measures are included in the model: \( R&D \) measures the decision to engage in R&D, while \( R&D\_INTENSITY \) (R&D expenditure per turnover) measures the intensity of R&D. Following Nunes et al (2013) who observed that low levels of R&D intensity hamper firm
performance in Portuguese manufacturing firms, $R&D\_SPEND$ is included to measure the firm’s level of R&D intensity. Based on theory, a positive link between all innovation variables and firm performance is expected.

(ii) Trade

Exporting is a learning process for the firm which increases its competitiveness, productivity and overall performance (Becchetti and Trovato, 2002). Exports provide access to a global market, which is particularly important in the Irish context, given the size of the economy. Thus, it is expected that exporting activity will improve firm performance. Firms with high levels of imports may likely be more vulnerable to macroeconomic fluctuations (e.g. interest rate cuts and currency depreciations) which may increase production costs as imported inputs become more costly relative to domestic goods (Forbes, 2002). Higher production costs may affect output decisions, which in turn, impacts on performance in terms of growth and productivity. Therefore, imports could depress firm performance.

On the other hand, imports provide firms with access to a wider range or better quality of inputs which may result in improved quality of products, thus increasing the product value and impacting on turnover (Castellani et al, 2010). A positive link between importing and firm performance may then be expected. Thus the relationship between import activity and firm performance is not clear a priori. Two-way traders (i.e. firms which both export and import) have also been found to show better performance due to the simultaneous impact of importing and exporting activities (Vogel and Wagner, 2010; Haller, 2012). Importing provides firms with access to better quality imported inputs, while exporting offers access to
global markets. Hence, firms which engage in both exporting and importing should have higher productivity and growth. Trade is captured with a categorical variable which takes the values, 1= No trade; 2= Firm exports only; 3= Firm imports only and 4 if the firm both exports and imports.

(iii) Public Support

The case for government intervention in the provision of public support such as grants/subsidies to firms is predicated on market failure and systemic failure arguments (Sawyer, 1992; Woolthius et al, 2005; Bailey et al, 2012; Bleda and del Rio, 2013). It is argued that public policies such as these encourage firms to undertake investments they would otherwise not embark on. This is particularly relevant given Ireland’s historic use of public support to attract FDI. The link between public support and firm performance is, nonetheless, uncertain as some studies have found a positive effect (e.g. Honjo and Harada, 2005; Duch et al, 2007). However, when selection is taken into account, grant assistance has been shown to have no significant effect on performance (Roper and Hart, 2005; Merito et al, 2010). On the other hand, even when selection is considered, receipt of grants has been shown to have a positive impact on survival and employment growth in firms and a negative effect on productivity (e.g. Girma et al, 2004a; Bernini and Pellegrini, 2011). The use of public support is expected to have a positive effect on firm performance depending on the performance measure. The use of public support is captured with a dummy variable =1 if firm receives grants and takes a value of 0 otherwise.

26 Market failure is concerned with the allocation of resources to productive activities and is associated with risks and uncertainties, while the systemic failure approach focuses on the efficiency of the system as a whole. Consequently, market failure results in interventions aimed at mitigating the negative effect of identified barriers, whereas policy actions motivated by systemic failure deal with specific weaknesses of the entire system (European Commission, 2009).
(iv) Training

A firm’s workforce is a crucial part of its productive resources which confer on the firm certain advantages with which the firm can compete successfully in line with the resource-based view of the firm previously outlined in Chapter 2. Training is, therefore, a useful strategy in upgrading workers’ skills and knowledge to ensure the firm remains productive and retains its competitive edge. However, empirical evidence on the link between training and firm performance is mixed (as noted in Chapter 2). To capture learning mechanisms in firms, training is measured as a dummy variable = 1 if firm reports training costs and takes a value of 0 if otherwise. Following from this, it is expected that training will increase performance.

3) Macroeconomic Environment

The extent to which a firm succeeds in business is a function of its internal characteristics as noted previously and external factors such as industry-specific characteristics and government economic policy. Macroeconomic measures are instruments of economic policy owing to a government’s role in ensuring a conducive environment within which firms can operate successfully (McNamara and Duncan, 1995). Fluctuations in macroeconomic factors effect changes in prices and output level, thereby influencing firm decisions and strategy as illustrated in Chapter 1 ( Figure 1.1). Therefore, macroeconomic stability will engender improved performance in firms.
In their study of the effect of macroeconomic fluctuations on start-up firms, Audretsch and Acs (1994) suggested that the macroeconomic influences associated with the business cycle are GDP growth rate, unemployment rate and interest rate. Furthermore, the main macroeconomic objectives of many economies are to achieve high economic growth rates, low inflation and low unemployment rates (Wilkinson, 2005; Agarwal, 2010). Thus, a study of the impact of these three macroeconomic variables on firm growth is insightful since it contributes to our understanding of how changes in economic activity level, prices and the labour market influence firm performance.

Additionally, given the size and openness of the Irish economy, two measures of competitiveness (unit labour costs and real effective exchange rate) are included in this analysis to provide insights as to the interaction between national competitiveness and the performance of firms. In a similar vein, a measure of domestic credit growth is included, which takes into account the effect of the availability of credit on firm performance. Taking the above discussion into consideration, significant correlations between macroeconomic variables, for instance, inflation and nominal interest rates (Sexton, 2013), indicate a need to exercise care in the inclusion of variables to avoid multicollinearity issues which may potentially distort findings. Based on this, the macroeconomic variables included in this analysis are outlined as follows:

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27 This is discussed in detail in Chapter 4,
(i) **GDP Growth**

GDP growth rate is an important indicator of the level of economic activity and is a commonly used measure of economic growth. As will be shown later in Chapter 4, the period of analysis in this research, 1991-2007, was characterised by remarkably high GDP growth rates, with the Irish economy attaining full employment level of output. Thus, it is important to consider the link between GDP growth and firm performance in Ireland during the period. High GDP growth rates will encourage better performance in firms as more growth opportunities abound in a high-growth economy (Beck et al, 2005; Mateev and Anastasov, 2011). Higher levels of economic growth also increase business confidence encouraging long term investments, expansion and inward flow of FDI which boost business performance. Higher economic growth is associated with increased income levels which impact output via increased aggregate demand, which in turn affects turnover and employment. Hence, a positive link between real GDP growth and firm performance is anticipated. Economic growth is captured by annual real GDP growth rate.

(ii) **Unemployment**

A study of the link between unemployment rates and firm growth in Ireland is important given the rapid job creation rates during this period. The link between both variables is however not quite clear *a priori*. A negative demand shock causes output to contract resulting in lower demand for labour, which increases the level of unemployment in the economy (Mankiw et al, 2013). Thus, high unemployment rates may imply lower employment growth. Similarly, high unemployment rates bring about lower aggregate demand, followed by contraction of output, with additional knock-on effects on employment levels and turnover.
growth. In contrast, periods of high unemployment levels in the economy may correspond with increased employment. A large supply of workers willing to work at lower wages (particularly when unemployment benefits are non-existent or minimal) or start up their own firms may lead to a rise in employment (Baptista et al, 2006; Santarelli and Vivarelli, 2007; Gautié et al, 2010). Furthermore, a higher pool of unemployed workers could bid down wages, resulting in lower wage costs, higher employment, as well as an increase in output and productivity (Nell, 2005). It then follows that the unemployment rate may have a positive or negative effect on growth in employment, turnover and productivity. Unemployment is defined in terms of the annual unemployment rate.

(iii) Inflation

Given the variable inflation rates shown in Ireland during the Celtic Tiger period, the inclusion of an inflation variable in the analysis offers valuable insights. Inflation hikes up the cost of capital which may discourage borrowing and consequently affect investments in potential high-return capital projects. Long-term planning is also hampered since cost and profit projections become precarious, which may diminish the firm’s willingness/ability to undertake new investments (Basu et al, 2000). Inflation exerts a significant influence on corporate performance through its direct effect on production costs via input prices, as well as an indirect effect on outputs.

Higher input prices (including wage costs) increase producer costs leading to higher consumer prices, which in turn may lead to higher wage demands, further elevating business

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28 Inflation rates ranged from 3.19 per cent in 1991 to 1.64 per cent in 1999 and from 5.56 in 2000 to 3.05 per cent in 2007 (World Bank, 2012).
costs and prices, possibly resulting in a wage-price spiral (Tucker, 2010). Inflation also affects a country’s international trade by making imports cheaper and exports dearer relative to competitors (Buckley, 2004). Cheaper imports and high cost exports imply reduced domestic and international demand respectively, with implications for the welfare of local firms. The effect of inflation rates on real interest rates (nominal interest rate adjusted for inflation) is also important. High levels of inflation result in lower real interest rates which depress the cost of borrowing. This raises consumption and investment spending which may fuel speculation (Taylor, 2007; Mankiw, 2010). Thus, inflation is expected to have a dampening effect on firm growth and productivity. Inflation is measured using the annual inflation rate.

(iv) Competitiveness

Due to the size of the Irish economy, trade plays a significant role, with exports (imports) accounting for 80.4 (71.4) percent of GDP in 2007 (CSO, 2013c: p136). In view of the degree of openness, it is vital to consider the link between the international macroeconomic environment and the performance of firms in Ireland. As previously indicated in Chapter 1, the first growth phase in Ireland was driven by a rapid growth in exports while, there was a slowing down of export growth in the second growth period due to a rising domestic cost base, along with the resultant loss of international competitiveness29. Bearing this in mind, this study employs measures of price/cost competitiveness to assess the extent to which the performance of firms in Ireland was driven by global macroeconomic conditions. Two alternate measures of competitiveness (unit labour costs and the real effective exchange rate)

29 Issues relating to the loss of competitiveness in the second growth period are discussed in detail in Chapter 4.
are employed to analyse the effect of wage costs and exchange rate movements on firm performance.

The unit labour cost (average cost of labour per unit of output produced) determines the extent to which the firm is able to increase market share relative to its competitors (both domestic and international). Thus, an increase in the firm’s unit labour cost relative to those of its competitors will possibly lead to a loss of market share and a negative impact on its subsequent growth (Felipe and Kumar, 2011). It is therefore expected that firm performance will decline with increases in unit labour costs. Similarly, the real effective exchange rate index (REER) measures the country’s price or cost competitiveness relative to its main global competitors. A fall in this index indicates improvements in the country’s competitive position. The effect of a real exchange rate appreciation on firm performance is, however, not clear a priori. On the one hand, an appreciation of the exchange rate brings about cheaper imports and more expensive exports which in turn lead to a contraction of aggregate demand and firm productivity (Gupta et al, 2007; Desai et al, 2008). Conversely, a currency appreciation may cause higher firm growth, due to a decline in the cost of imported intermediate goods, or lower wage demands because of lower expected domestic prices (Caglayan and Demir, 2014).

(v) Financing Constraints

The role of financing constraints as a barrier to firm performance, particularly in small firms, is well noted in the firm performance literature (Lang et al, 1996; McPherson, 1996; Becchetti and Trovato, 2002; Beck et al, 2005; Angelini and Generale, 2008; Bottazzi et al,
2014). Thus, a measure of domestic credit growth is employed to assess the impact of the availability of credit on the subsequent performance of the firm. This approach is even more relevant in the Irish context, since Irish economic growth in the second growth period was driven by a remarkable growth in domestic credit which fuelled domestic demand and stimulated a bubble in the construction industry (Dineen et al, 2012)\(^{30}\). \textit{A priori} it is expected that a growth in credit would stimulate firm performance. The availability of credit is captured by domestic credit to the private sector as a percentage of GDP\(^{31}\).

Based on the discussion presented in this section on the determinants of firm performance, Table 3.2 presents a summary of the above-mentioned variables, as well as the variable definitions. Furthermore, in view of the empirical and theoretical evidence in the literature detailed above, the research hypotheses to be tested in Chapters 5 and 6 have been formulated and are presented in Table 3.3 with the expected signs.

In summary, based on Storey (1994) and Hyne's (2006) framework, a firm performance model relating firm performance to firm characteristics, strategy and macroeconomic environment was presented in this section. Given their relative importance to other firm performance measures as outlined above, firm growth and productivity are the measures of choice in this research. The choice of determinants to be analysed in the study is summarised into three categories based on the framework suggested by Storey (1994): factors relating to the firm, strategy and entrepreneur. To address the research question, the model was extended

\(^{30}\) This is further discussed in Chapter 4 (Section 4.4)

\(^{31}\) A similar analysis could also be undertaken in the case of household credit. However, given that household credit data is only available since 2003, it was deemed appropriate to undertake the analysis employing private sector credit.
to include macroeconomic variables and as previously outlined in Section 3.3, entrepreneurial factors are not included in this model. Having defined the firm performance measures and determinants of firm performance adopted in this study, along with the research hypotheses to be tested, the firm performance models to be estimated are specified in the section which follows.
<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Firm Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>Total number of employees</td>
</tr>
<tr>
<td></td>
<td>Total sales</td>
</tr>
<tr>
<td>Industry</td>
<td>Manufacturing: 2-digit Nace Rev. 1.1. classification (15-37)</td>
</tr>
<tr>
<td></td>
<td>Services: 2-digit Nace Rev. 1.1. classification (51-93)</td>
</tr>
<tr>
<td>Industry Minimum Efficient Scale</td>
<td>Ratio of turnover to number of firms in industry</td>
</tr>
<tr>
<td>Location</td>
<td>Manufacturing: 1=Border; 2=Dublin; 3=Mid-East; 4= Midlands; 5=Mid-West; 6=South-East; 7=South-West; 8=West</td>
</tr>
<tr>
<td></td>
<td>Services: 1=Southern and Eastern; 0= Border, Midlands and Western</td>
</tr>
<tr>
<td>Nationality of Ownership</td>
<td>1= Foreign; 0= Domestic</td>
</tr>
<tr>
<td>Initial Level Of Productivity</td>
<td>Turnover per employee in the previous period</td>
</tr>
<tr>
<td><strong>Firm Strategy</strong></td>
<td></td>
</tr>
<tr>
<td>R&amp;D</td>
<td>1= Firm undertakes R&amp;D; 0 = otherwise</td>
</tr>
<tr>
<td>R&amp;D Intensity</td>
<td>R&amp;D Expenditure per turnover</td>
</tr>
<tr>
<td>R&amp;D Spend</td>
<td>1= Firm has &gt; mean R&amp;D intensity; 0= otherwise</td>
</tr>
<tr>
<td>Trade</td>
<td>1= No trade; 2= Firm exports only; 3= Firm imports only; 4= Firm both exports and imports</td>
</tr>
<tr>
<td>Public Support</td>
<td>1= Firm received grant/subsidies; 0=otherwise</td>
</tr>
<tr>
<td>Training</td>
<td>1= Firm has training costs; 0 = otherwise</td>
</tr>
<tr>
<td><strong>Macroeconomic Environment</strong></td>
<td></td>
</tr>
<tr>
<td>GDP Growth</td>
<td>Annual growth rate in real GDP (%)</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>Annual average unemployment rate (%)</td>
</tr>
<tr>
<td>Inflation</td>
<td>Annual growth rate in consumer prices (%)</td>
</tr>
<tr>
<td>Competitiveness</td>
<td>Unit labour cost index (2000=100)</td>
</tr>
<tr>
<td></td>
<td>Real effective exchange rate index (2005=100)</td>
</tr>
<tr>
<td>Credit Growth</td>
<td>Domestic credit to private sector (% of GDP)</td>
</tr>
</tbody>
</table>
Table 3.3: Summary of Variables, Research Hypotheses and Expected Outcomes

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>RESEARCH HYPOTHESIS</th>
<th>EXPECTED SIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Macroeconomic Conditions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP growth</td>
<td>H1: GDP growth rate positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td>Inflation</td>
<td>H2: Inflation rate negatively affects firm performance</td>
<td>-</td>
</tr>
<tr>
<td>Unemployment</td>
<td>H3: Unemployment rate negatively affects firm performance</td>
<td>+/-</td>
</tr>
<tr>
<td>Competitiveness</td>
<td>H4: Competitiveness negatively affects firm performance</td>
<td>+/-</td>
</tr>
<tr>
<td>Availability of credit</td>
<td>H5: Availability of credit positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td><strong>Firm Strategy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trade</td>
<td>H6: Trade positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td>Training</td>
<td>H7: Training positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>H8: R&amp;D positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td>Public Support</td>
<td>H9: The use of subsidies positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td><strong>Firm-Specific Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm Size</td>
<td>H10: Initial firm size negatively affects firm growth</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>H11: Initial firm size positively affects firm productivity levels and growth</td>
<td>+</td>
</tr>
<tr>
<td>Productivity</td>
<td>H12: Initial level of productivity positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td>Nationality of ownership</td>
<td>H13: Foreign ownership positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td>Location</td>
<td>H14: Location in Dublin and its environs positively affects firm performance.</td>
<td>+</td>
</tr>
</tbody>
</table>
3.4 Firm Performance Model Specification

It is important from the outset to specify the models to be estimated as this guides the empirical analysis and informs the choice of estimation techniques. Consequently, the regression models estimated in investigating the determinants of firm growth and productivity within the context of firm-specific characteristics, firm strategy and the macroeconomic environment are specified in this section.

To test the firm size/growth relationship, the logarithm base specification of the model is usually given as:

$$\ln(S_{i,t}) = \beta_0 + \gamma_1 \ln(S_{i,t-1}) + \varepsilon_{i,t}$$  \hspace{1cm} (1)

Where $S_{i,t}$ is the size of firm $i$ in time $t$, $S_{i,t-1}$ is its size in a previous period and $\varepsilon_{i,t}$ is the disturbance term. Exponentiating both sides of the equation, GL is confirmed and valid if $\gamma_1$ equals 1, implying that initial firm size is not systematically related to firm growth. On the other hand, $\gamma_1<1$ indicates that small firms exhibit higher growth rates relative to their larger counterparts, whilst $\gamma_1>1$ infers large firms show faster relative growth than small firms (Chesher, 1979; Lotti et al, 2009; Piergiovanni, 2010).

After parameterising, equation (1) becomes

$$\Delta \ln(S_i) = \beta_0 + \beta_1 \ln(S_{i,t-1}) + \varepsilon_{i,t}$$  \hspace{1cm} (2)

Where $\Delta \ln(S_i) = \ln(S_{i,t}) - \ln(S_{i,t-1})$ and $\beta_1 = (\gamma_1 - 1)$. The parameter $\beta_1$ enables the testing of the validity of GL. Consequently, GL is valid when $\beta_1=0$; if $\beta_1<0$ smaller firms grow faster.
than larger firms, while the converse holds when $\beta_1 > 0$. Following Evans (1987a) and allowing for second-order expansion, equation (2) yields

$$\Delta \ln(S)_i = \beta_0 + \beta_1 \ln(S)_{i,t-1} + \beta_2 \ln(S)_{i,t-1}^2 + \varepsilon_{i,t}$$

(3)

To address the main research objective in this study, which is to analyse the determinants of firm growth, equation (3) is extended to incorporate those factors suggested in the literature review (Chapter 2) as drivers of firm growth. This yields the following equation:

$$\Delta \ln(S)_i = \beta_0 + \beta_1 \ln(S)_{i,t-1} + \beta_2 \ln(S)_{i,t-1}^2 + \beta_3 X_{i,t} + \varepsilon_{i,t}$$

(4)

Where $\Delta \ln(S)_i$ is growth of firm, $i$ in time $t$, $X_{i,t}$ is a vector of control variables consisting of firm characteristics, firm strategy and macroeconomic variables and $\varepsilon_{i,t}$ is the disturbance term.

To analyse the determinants of firm level productivity, a productivity regression model is further estimated:

$$Y_{it} = \beta_0 + \beta_1 \ln(S)_{i,t-1} + \beta_2 \ln(S)_{i,t-1}^2 + \beta_3 X_{i,t} + \varepsilon_{i,t}$$

(5)

Where $Y_{it}$ is labour productivity of firm, $i$ in time $t$, and all other variables remain as defined previously. As the nature of the relationship between size and growth/productivity is not very clear a priori, inclusion of a squared size term is appropriate in the first instance to avoid biased estimates as a result of misspecification error. This can then dropped from the analysis if found to be insignificant (Evans, 1987a; Bigsten and Gebreyesus, 2007). Having specified
the firm performance models to be estimated, a description of the datasets to be employed in addressing the research questions is detailed in the section which follows.

3.5 Datasets

A brief overview of the datasets used in the study is presented in this section. The empirical analysis of the factors governing firm performance in Ireland is based on firm-level panel data of manufacturing firms and services firms collected as part of the Census of Industrial Production (CIP) and Annual Services Inquiry (ASI) conducted by the CSO. A panel dataset is one that studies the same group of firms over time, providing multiple observations on each firm in the dataset (Hsiao, 2003). The use of panel data as opposed to pure cross-sectional or time-series data in economic research analysis confers a range of benefits. The presence of a large number of data points in a panel dataset implies more degrees of freedom, less collinearity of variables, increased econometric efficiency and allows better inferences to be made from the data, providing answers to critical economic questions (Hsiao, 2003; Gujarati, 2011). Moreover, panel data is suitable for study of change dynamics, allowing the detection and measurement of effects, which may otherwise be unobservable in pure cross-sectional or time-series data (Gujarati, 2011). However, multiple observations on individual firms at different points in time, may give rise to correlation of observations of the same firm at different points (Horowitz, 2009).

As noted in the review of the literature in Chapter 2 (Section 2.2), inherent firm heterogeneity means that some of the major factors essential for firm performance may remain
unobservable to researchers. Thus, panel datasets are also commonly subject to omitted variable bias resulting from the paucity of data on some time-invariant firm characteristics of interest to the researcher. Nevertheless, based on the above discussion on the benefits of panel data, its use in this analysis allows the same set of firms to be tracked over a number of years as opposed to cross-sectional data, which only provides a set of observations at a given point in time. In summary, panel data offers a clearer and better picture of the factors influencing firm performance in Ireland.

Prior to presenting a description of the datasets used in this analysis, a brief discussion of alternative sources of data is provided. This offers insights on the choices made by the researcher in determining the best sources of data for this research. Although conducting a cross-sectional survey for the purpose of this research provides an avenue to collect data on variables of importance to the analysis (such as firm age, entrepreneurial characteristics, capital and profitability), its use was ruled out by the researcher as data collected via this method may be subject to issues related to survey bias, representativeness and size of the sample. It is also not suited to dealing with the research question (what is the impact of macroeconomic conditions on firm performance in Ireland in the period, 1991-2007?) in the thesis since it only offers a snapshot of firm performance in Ireland, which does not take into account business cycle fluctuations. Moreover, time and financial constraints also influenced the decision not to conduct a survey. Having established that panel data offers the most benefits to this research in terms of facilitating the investigation of the evolution of firm performance over a time period, the researcher is faced with the decision of how to source
panel data (large enough to allow firm differences to be taken into account) needed to address the research questions.

Forfás (Ireland’s policy advisory board for enterprise, trade, science, technology and innovation) provides three sources of longitudinal panel data on firms in Ireland with the potential to prove valuable for this research:

- Annual employment survey (from 1972),
- Annual business survey of economic impact (from 1983)\(^ {32}\) and
- Grant payment database (from 1972).

These three data sources provide information on variables relevant to this research such as the nationality of ownership, sector of production, start-up year, level of employment and output, grant type, level of grant payment and year of grant payment (Girma et al, 2008).

Although the large datasets available from Forfás are rich sources of data dating back to 1972, which allows the tracking of firm performance pre and post-entry to the European Union, as well as during the period of poor macroeconomic performance in the 1980s, there are some limitations precluding their use in the research undertaken in the thesis. The datasets cover only manufacturing and internationally traded services firms, as well as firms which are clients of the Irish development agencies (i.e. firms in receipt of grants) which is a potential source of bias. Moreover, due to a Forfás’ policy review, the researcher was advised that the

\(^ {32}\)This survey replaced the Irish Economy Expenditure (IEE) survey also conducted by Forfás up to 1999 (Forfás, 2008)
Based on the above considerations, the decision to employ data collected from the CSO was made. To gain access to these data sources, the researcher and her supervisors had to apply to the CSO to be appointed as Officers of Statistics. Data access was renewable annually at the onset of the research and biennially in its latter stage. Furthermore, access to the data and analysis is restricted to on-site access only due to the CSO’s confidentiality policy. This necessitated frequent travel to the CSO’s office for data analysis. As part of the conditions associated with its confidentiality policy, all analyses had to be checked and approved by the Business Area Specialist responsible for each dataset to ensure there was no breach of confidentiality before being forwarded electronically to the researcher. Although both Business Area Specialists dealt with the researcher were extremely helpful, this policy sometimes led to delays, particularly during busy periods in the CSO. Having discussed the data choices made, the next section provides a description of the CIP and ASI datasets employed in this research. This provides insights as to the distinctive characteristics of both datasets.

### 3.5.1 Census of Industrial Production (CIP)

The CIP is an annual census of all manufacturing firms in Ireland with three or more persons engaged. It consists of two surveys, the census of industrial enterprises and the census of industrial enterprises.

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33 This study uses data from the Census of Industrial Enterprises. An enterprise is defined as the smallest combination of legal units that is an organisational unit producing goods or services, which benefits from a
industrial units. The CIP dataset offers some unique features. First, it provides comprehensive coverage of all manufacturing firms including small firms, more specifically micro-sized firms, with fewer than ten employees. Due to lack of comprehensive data on the latter group of firms, they are frequently overlooked in many firm performance studies (Reid, 2006). It is, however, important to include this group of firms in any analysis of firm performance in Ireland, given their significant population – 55 per cent of the total number of manufacturing firms in 2009 and 87 per cent of the total number of services firms in 2008 (Lawless et al, 2012). Secondly, the dataset is maintained with unique firm identifiers that allow firms to be tracked across years. Furthermore, sectoral classification is based on the use of the 4-digit Nomenclature Générale de s A ctivités É conomiques da ns l es C ommunautés E uropéennes revision (NACE REV.1.1) industry classification nomenclature. Finally, multiple observations on each firm across years mean variations in a firm’s size from the initial size at the beginning of the period can be observed. This allows the tracking of firm mobility across different size categories.

The original CIP dataset covers the years 1991 to 2007 inclusive, consisting of 78,599 observations on 11,319 firms in NACE sectors 10-41 over the period examined. Although the CIP survey began before 1991, data from periods prior to 1991 are not directly comparable with post-1991 data owing to a change in the classification of activity in 1991, while data from 2008 are not comparable with earlier data as previously outlined in Chapter 1 (Section 1.1). Hence the period of analysis is restricted to 1991-2007. Moreover, as earlier detailed in Chapter 1, the sample period is one of remarkably high economic growth in Ireland a degree of a utonomy i n d ecision making, especially for the allocation of its current resources (CSO, 2008a: p5).
consisting of two growth phases (an export-led growth phase and a credit-led domestic demand-driven growth phase) with different drivers, which allow the research questions in this thesis to be fully addressed.

Data Cleaning

Data cleaning on the data was carried out as follows. First, yearly data on all firms for the variables of interest were merged into a single dataset. Following on from this, firms in Mining and Quarrying (NACE industries 10-14) and Electricity, Gas and Water Supply (NACE industries 40-41) were excluded leaving 10,940 manufacturing firms in NACE industries 15-37 with 76,830 firm/year observations. The resulting dataset is an unbalanced panel as not all firms are present in all the years. Although the dataset is based on a census, a firm may not be present in all the years due to any one of the following reasons: the firm closes down; a foreign firm exits Ireland and reclassification of the firm to another industry (e.g. from manufacturing to services) due to a change in its predominant activity in the reporting period.

Given that the study aims to investigate growth performance, further cleaning of the data was undertaken. Firms with only one year of observations (2,404 firms) were dropped with a resultant sample of 74,426 observations on 8,536 firms. In total, only 1,538 firms (14 per cent of the total sample) are present in all the years examined. Furthermore, firms missing one year of employment and/or turnover data had the average value of the preceding and subsequent years imputed for the missing year. Firms were excluded where the missing values could not be imputed. A few firms were observed switching between industries in the
sample period. Reasons for switching include reporting error and/or a change in the firm’s predominant activity. Consequently, 243 firms observed to have switched industry classes were removed from the sample.

After the data cleaning outlined above and given the substantial difference in the total number of firms in the dataset and actual number of firms present in the dataset throughout the sample period, analysis of manufacturing firms is restricted to a balanced panel of 1,295 firms with 22,015 observations. Restricting analysis to firms present in all the years studied allows a study of factors governing sustainable firm growth in Irish industry. This also enables avoidance of selection bias in the sample. All monetary values are stated in thousand Euros.

3.5.2 Annual Services Inquiry (ASI)

The ASI is an annual enterprise survey covering all firms in NACE rev. 1.1 industries G, H, I, K and O which began in 1999. The dataset is unique in that it provides comprehensive coverage of all firms with twenty or more employees in these industries. However, the survey uses different sampling fractions that differ by size class, region and NACE industry in the random sampling of firms with less than twenty employees. A sampling rate of 1/10 is used for enterprises with less than 9 employees and a 4/9 sampling rate is used for enterprises with 10-19 employees (CSO, 2009). The dataset is an unbalanced panel since not all firms are

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34 All monetary values for the pre-Euro period (1991-2000) are converted to Euros at the European Central Bank conversion rate of €1 = 0.787564.
35 An enterprise is defined as the smallest legally independent unit (CSO, 2008b: p7).
36 These are Wholesale and Retail Distribution, Hotels and Restaurants, Transport Storage and Communications, Real Estate and Other Community Services respectively.
sampled in all the years considered and covers the years 1999-2007 inclusive, consisting of 107,836 observations on 55,562 firms over the period examined.

**Data Cleaning**

To clean the data, firstly, all yearly data on firms were merged into a single file. Following on from this, all firms with less than two years of observation were excluded to allow the estimation of growth, leaving 21,745 firms with 74,017 observations in the period 1999-2007. Since several variables of interest (e.g. exports and imports variables) relevant to the study were missing for the years, 1999 and 2000, analysis is restricted to the period 2001-2007, which also takes into account the fact that Irish economic growth slowed during this period relative to the earlier period, 1991-2000. This is discussed in more detail in Chapter 4. Consequently, there were 51,229 observations on 16,083 firms left in the dataset, with 978 firms present in all years for the period 2001-2007. Based on further data cleaning, firms with non-consecutive observations in the period of interest (i.e. \( N-1 \)) were removed from the panel as this discontinuity could potentially distort the analysis. This left 6,670 firms with 23,685 observations in the panel and 978 firms present in all the years.

Furthermore, firms missing one year of employment and/or turnover data, had the average value of the preceding and subsequent years imputed for the missing year. However, where this could not be done due to data being missing for two or more consecutive years, such firms were excluded from the dataset. Subsequent to this data cleaning, the panel was left with 22,569 observations on 6,271 firms in the period, 2001-2007, with 972 firms and 6,804
firm/year observations in all the years. Firms observed switching between industries\textsuperscript{37} in the sample period were also dropped from the sample leaving 905 firms present in all the years. Thus, analysis in the study is restricted to a balanced panel of 905 firms and 6,335 firm/year observations which allows the investigation of the drivers of sustainable growth in services firms in Ireland over the period 2001-2007. To summarise, Figure 3.3 outlines the CIP and ASI datasets after data cleaning.

\textbf{Figure 3.3 Summary of Datasets after Data Cleaning}

![Diagram of Datasets](image)

\textbf{3.5.3 Supplementary Data Sources}

The secondary sources of data used in this thesis are outlined in this section. Key features of the two main datasets employed in this research were outlined in the preceding sections. However, the above datasets do not include information on macroeconomic factors, a major component of this research. To address this shortcoming, annual data on all macroeconomic factors.

\textsuperscript{37} For instance, firms switching from NACE industry 51 (wholesale trade and commission trade) to NACE industry 52 (retail trade).
variables (with the exception of unit labour costs) were obtained from the World Bank’s (2012) World Development Indicator database. Data on unit labour costs were collected from the OECD database. Lastly, turnover was deflated using two-digit sectoral level output collected from the EU KLEMS database (EU KLEMS, 2011).

In summary, data collected from the CSO lacks information on variables provided by the Forfás datasets (such as firm age, profits, as well as grant type and amount). Moreover, the data does not include sole proprietors and firms with less than three employees in manufacturing. However, given the scale-intensive nature of manufacturing and considering the fact that the CIP dataset is a census, one can be confident that this dataset is representative of manufacturing firms in Ireland. In a similar vein, firms with less than 20 employees may be under-represented in the ASI datasets since due to lower scale intensities, the services industry is more likely to have a significant population of micro-sized and small-sized firms missing from the ASI dataset. Nevertheless, the CIP and ASI datasets offer some advantages in that both datasets cover firms in manufacturing and all services industries (i.e. both internationally traded and non-traded services), as well as grant and non-grant recipient firms. The datasets also cover micro-sized and small-sized firms which are important in the Irish context. Taken together, these enable the consideration of firm differences and eliminate selection bias arising from the inclusion of only grant-assisted firms in the analysis.

A description of the CIP (manufacturing) and ASI (services) datasets used in this research has been presented in this section, highlighting the unique characteristics of the datasets which allows the tracking of firms across the time period of the study 1991-2007. The temporal
nature of these data also allows heterogeneity of firm growth to be taken into account in the analysis. The other sources of macroeconomic and industry-level data employed in this study were also outlined. Following on from the discussion of GL presented in Chapter 2 (Section 2.4), a basic postulation of the law is lognormality of the firm size distribution, that is, firm size is a product of a randomly determined growth process. A graphical test of normality is applied to the panel data sets for manufacturing and services firms in Ireland to test the assumption of the lognormality of firm size distribution. Results are presented in the section which follows.

### 3.5.4 Graphical Tests of Normality

Normality of the firm size distribution is tested graphically using histograms which show the firm size distribution at the beginning and end of the period 1991-2007 for manufacturing and 2001-2007 for services. The test of normality serves to provide initial evidence on the third research question addressed in this study, that is, the impact of firm characteristics, specifically firm size on firm growth. In other words, normality tests help to test the hypothesis that initial size is negatively related to firm growth. Figure 3.4 presents histograms on the distribution of log employment and log turnover in manufacturing firms in Ireland, along with a kernel density function and the normal distribution plot for comparison. The solid and dashed lines represent the normal distribution plot and kernel density function (KDF) respectively. The kernel density provides smoother estimates of the data than the histogram, while the normal distribution serves as a benchmark for the purpose of comparison (Cameron and Trivedi, 2005). The choice of bandwidth matters, as this determines the smoothness of the kernel density functions. A large bandwidth reduces
variance by smoothing over a large number of data points, but bias can result from points being averaged in a manner that does not consider the specific shape of the distribution whilst, a small bandwidth offers more variance but lower bias (Cameron and Trivedi, 2005). Following Bottazzi et al (2011), the choice of bandwidth for the kernel density functions is made, based on the use of Silverman (1986) plug-in estimates (Wilcox, 2005).

Figure 3.4: Firm Size Distribution in Manufacturing firms, 1991-2007

Source: Author’s calculations from CIP dataset
The histograms show that the log size distribution deviates from normal, with a high peak and thick tails highly skewed to the right. The size distributions present right skewness which changes over time; log employment closely resembles the normal distribution in 2001, with a greater deviation in 2007. The size distribution of log turnover, however, shows more deviation from the normal distribution, becoming more similar in 2007 (Figure 3.4). The firm size distribution is also seen to become less skewed over time. Furthermore, slight bimodality is found in the employment distribution in 2001, however, this is no longer found in 2007. Rather, the presence of left truncation in the employment size distribution is seen in 2007. Bimodality suggests the existence of two distinct groups of firms in the distribution, however, over time, size differentials become less pronounced. This may also be related to a business cycle effect, with businesses below a certain threshold exiting the distribution in response to adverse changes in the environment.

Figure 3.5 shows the histograms on the distribution of log employment and turnover respectively for services firms for the years 2001 and 2007, along with a kernel density function and the normal distribution plot. Inspection of the histograms shows that, similar to manufacturing firms, the size distribution does not approximate the normal in services firms. The degree of skewness distribution is, however, lower in the services. In addition, the employment distribution shows a higher peak relative to sales distribution. There is little variation in employment distribution from 2001 to 2007, whereas, the turnover size distribution becomes bimodal in 2007.
Graphical tests of normality confirmed the non-normality of firm size distribution in both manufacturing and services firms. This finding remained robust to the use of both turnover and employment size measures. Skewness in the size distributions in both industries provides evidence of a large number of small firms and a few very large firms with manufacturing firms showing a higher degree of skewness. Furthermore, bimodality of the size distributions, which remained robust to varying the bandwidths of the kernel density function (i.e. one-half of the plug-in, the plug-in and two times the plug-in bandwidth estimates), is established, with bimodality being more pronounced in the services.

**Figure 3.5: Firm Size Distribution in Services Firms, 2001-2007**

- **Histogram and Kernel Density for Services Log Employment 2001**
  - Note: Kernel is Epanechnikov with bandwidth 0.15

- **Histogram and Kernel Density for Services Log Employment 2007**
  - Note: Kernel is Epanechnikov with bandwidth 0.15

- **Histogram and Kernel Density for Services Log Turnover 2001**
  - Note: Kernel is Epanechnikov with bandwidth 0.24

- **Histogram and Kernel Density for Services Log Turnover 2007**
  - Note: Kernel is Epanechnikov with bandwidth 0.24

Source: Author’s calculations from ASI dataset
Evidence of bi modality is consistent with findings by Bottazzi and Secchi (2005) for worldwide pharmaceuticals and Bottazzi et al (2011) in French manufacturing. Bimodality suggests the existence of two different groups of firms, an indication of performance heterogeneity within a given industry. Similarly, right skewness observed in the firm size distribution provides further evidence of performance differences within the manufacturing and services industries in Ireland. The above findings highlight the need for a study on the drivers of firm performance in Ireland which this research aims to fill. However, statistical tests of normality are required to confirm these findings; results are presented in Chapter 5 (Section 5.2.2). Having described the panel datasets to be analysed and applying graphical tests of normality to these datasets, the question of what methods to be employed in testing the empirical model presented in Section 3.3 arises. A discussion on empirical techniques employed in firm performance analyses is presented in the section which follows.

3.6 Estimation Methods adopted to analyse Firm Performance

This section presents a discussion on empirical methods frequently used in the firm performance literature which provide insights to guide the choice of estimation techniques best suited for investigating the determinants of firm performance. A number of methods have been adopted in the investigation of firm performance as noted above. Earlier studies (e.g. Mansfield, 1962; Hymer and Pashigan, 1962) used the Ordinary Least Squares (OLS) method while, beginning from the 1980s interest in dealing with econometric issues such as heteroskedasticity, sample attrition and measurement errors arose (e.g. Hall, 1987; Evans, 1987). Other techniques used in the firm performance literature include:
- Augmented Dickey Fuller Unit Root tests (Chen and Lu, 2003; Chu et al, 2007),
- Quantile regression (Freel, 2000; Fotopulous and Louri, 2004; Coad and Rao, 2008),
- Weighted Least Squares (Hardwick and Adams, 2002; Falk, 2008),
- Least Absolute Deviation (Falk, 2012),
- Analysis of Variance tests (Yazdanfar and Salman, 2012),
- Data Envelopment Analysis (Diaz and Sanchez, 2008),
- Stochastic Frontier Analysis (Badunenko, 2010),
- Probit regression (Roper and Hewitt-Dundas, 2001; Roper and Hart, 2005; Morone and Testa, 2008),
- Heckman Sample Selection model (Walsh, 2000; Le et al, 2007; Audretsch and Dohse, 2007; Park et al, 2010),
- Difference in Difference estimation (Girma et al, 2004a),
- Logit (Roper, 1999),
- Random Effects (Ruane and Sutherland, 2004; Beck et al, 2005; Varum and Rocha, 2011),
- Fixed Effects (Das, 1995; Elston, 2002; Nakano and Nguyen, 2013) and
- Generalised Method of Moments (Oliveira and Fortunato, 2006a; Benfratello and Sembnelli, 2006; Girma et al, 2007; M ateev and Anastasov, 2011; Demirel and Mazzucatom, 2012; Nakano and Nguyen, 2013).

Given the range of methods outlined above and the dearth of Irish firm performance studies employing rigorous econometric techniques as detailed in Chapter 2, the choice of estimation methods to be used to explore the relationship between macroeconomic factors and firm performance...
performance in this research requires careful consideration. However, prior to making a decision, it is beneficial to consider specific econometric problems which may make some methods more suitable than others. The following section presents a discussion of potential econometric concerns arising from the use of panel data in this analysis.

**Econometric Issues Emerging from Panel Data Use**

Several econometric issues may arise from the use of panel data, in examining the link between internal factors, external factors and firm performance, which must be fully considered in the choice of estimation techniques. These issues are given as follows:

- Potential endogeneity of some regressors such as labour productivity and R&D intensity given that causality may run in both directions;
- The presence of time-invariant firm characteristics (fixed effects), such as industry, which may be correlated with the explanatory variables;
- If growth in one period encourages (discourages) growth in another period, this may give rise to autocorrelation;
- Presence of heteroskedasticity due to variability of growth rates across time;
- Omitted variable bias arising from the non-availability of data on factors such as firm age, entrepreneurial characteristics; and
- The short time dimension and larger firm dimension of the panel dataset (N=1295 firms, T=17 for manufacturing; N=905 firms, T=7 for services).

Consequently, inconsistent and biased estimates may occur when these problems are not suitably dealt with, thus necessitating the use of suitable estimating techniques to deal with
the econometric issues such as those outlined above. A discussion of the estimation methods to be employed in dealing with these concerns now follows. Given the possible econometric issues inherent in this analysis as outlined above, the Ordinary Least Squares (OLS), Fixed Effects (FE) and the Generalised Method of Moments (GMM) methods are the methods most relevant to the investigation of firm performance in this research. A discussion on these methods is outlined in the section which follows. Table 3.4 presents a summary of the strengths and limitations of each method.

(1) Ordinary Least Squares (OLS) versus Fixed Effects (FE) models

The assumptions of the OLS include the following: expected value of the error term is zero; no correlation between the explanatory variables and error term; constant variance of the error terms (homoskedasticity); no correlation between error terms (no autocorrelation); no perfect linear relationship between the explanatory variables- no multicollinearity (Verbeek, 2008). OLS is, thus, valuable for analysis when these assumptions remain valid and there is no concern for endogeneity and unobserved heterogeneity of variables arising from missing data. However, in firm performance models with omitted variables, correlation of dependent (firm performance) and explanatory variables (its drivers) or dynamic panel data models (containing lagged dependent variable as an explanatory variable), the Gauss-Markov properties (Best Linear Unbiased Estimator) break down, producing biased and inconsistent OLS estimates, requiring the use of other estimation methods to overcome its limitations.
<table>
<thead>
<tr>
<th>Method</th>
<th>Strengths</th>
<th>Limitations</th>
</tr>
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<tbody>
<tr>
<td>Ordinary Least Squares</td>
<td>• Useful when no concern with autocorrelation, heteroskedasticity, endogeneity.</td>
<td>• Provides biased inconsistent estimates in estimation of dynamic panel data;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Not robust to autocorrelation, heteroskedasticity, endogeneity.</td>
</tr>
</tbody>
</table>
| Fixed Effects       | • Robust in presence of omitted variables;  
• Allows study of variables that vary with time.                                                                                                                                                       | • Subject to bias in estimation of dynamic panel data;  
• Not robust to autocorrelation;  
• Does not allow inclusion of time-invariant variables.                                                                                           |
| DIFF-GMM            | • Provide unbiased, efficient and consistent estimates in the presence of endogeneity and unobserved heterogeneity;  
• Robust to heteroskedasticity and autocorrelation;  
• Allows use of internal instruments;  
• Allows inclusion of time-invariant variables.                                                                                                           | • Subject to weak instrument problem in highly persistent series where lagged levels of the regressors are poor instruments.                                                                            |
| SYS-GMM             | • Provide unbiased, efficient and consistent estimates in the presence of both endogeneity and unobserved heterogeneity;  
• Robust to heteroskedasticity and autocorrelation;  
• Allows use of internal instruments;  
• Allows inclusion of time-invariant variables.                                                                                                           | • Provides biased estimates when instruments are weak or too many instruments included in analysis.                                                                                                           |

The Fixed (FE) model which overcomes the shortcomings of the OLS is invaluable where the researcher is interested in investigating the effect of factors of firm performance that vary over time. The fixed effects model assumes that unobserved (unmeasured) firm characteristics (fixed effects are contained in the error term) which may concurrently influence both firm performance and its other drivers, do not change over time. It, therefore, provides a means of controlling for unobserved heterogeneity (firm differences), where the heterogeneity is time-invariant and correlated with the explanatory variables in the firm performance model (Gujarati, 2011). This is based on the premise that if the unobserved variable (e.g., entrepreneurial characteristics) remains constant over time, it can be assumed
that subsequent changes in firm performance may be due to the effect of factors other than
the omitted variable (Stock and Watson, 2007). However, FE models do not perform well
where there is little or no variability in firms across time. Therefore, where there is an interest
in studying the effect of time-invariant variables such as industry on firm performance, the
FE model is not useful as such variables are excluded from the model.

Finally, the FE model assumes that there is no autocorrelation of error terms for each firm
over time, thus the FE provides inconsistent estimates in the presence of autocorrelation
(Gujarati, 2011). In addition, the inclusion of lagged dependent variables (e.g. lagged values
of growth or productivity) as explanatory variables, presents a potential source of bias when
the fixed effects method is employed in estimating dynamic panel data. ‘Dynamic panel bias’
or ‘Nickell bias’ arises from the lagged dependent variable being correlated with the fixed
effects in the error term, that is, a correlation between performance in previous period(s) and
omitted (unmeasured) drivers of firm performance (Coad, 2010; Roodman, 2009a). Consequently, the use of instrumental variables techniques such as the Generalised Method
of Moments estimators is required to overcome this limitation. This is discussed in the
section that follows.

(2) Generalised Methods of Moments (GMM)

As outlined earlier, an econometric issue that may arise in investigating the determinants of
firm performance with the use of panel data is endogeneity (which occurs when the error
term is correlated with one or some of the explanatory variables) arising from:
omitted variable bias (this occurs when there are unmeasured variables which are correlated with both firm performance and one or more of its drivers);

• errors in measurement of variables;

• simultaneity between firm performance and one or more of its determinants (reverse causality).

Nevertheless, endogeneity in the firm performance model is a violation of one of the assumptions of the OLS (i.e. the error term must not be correlated with the explanatory variables) and estimates obtained in such a model using the OLS technique will be biased and inconsistent, a indication that the OLS is not a suitable method for dealing with this problem. Although the FE model is valuable in controlling for unobserved firm heterogeneity that may determine firm performance, it does not deal with the endogeneity resulting from the lagged value of growth or productivity being correlated with some of the explanatory variables.

To deal with this problem, correction of endogeneity requires instrumental variables (instruments), which though not related to the error term, are capable of providing information about the independent variables. The Difference GMM (DIFF-GMM) and System GMM (SYS-GMM) proposed by Arellano and Bond (1991) and Blundell and Bond (1998) allow the use of instrumental variables, which offer further information about the potentially endogenous explanatory variable, as well as providing a convenient framework for obtaining unbiased, efficient and consistent estimates in the presence of both endogeneity...
of explanatory variables and unobserved heterogeneity (Oliveira and Fortunato, 2006a; Coad, 2007).

(i) SYS-GMM versus DIFF-GMM

Roodman, (2009a) noted that the SYS-GMM and DIFF-GMM estimators are useful in panel data analysis when the following assumptions are valid:

- Current values of the dependent variable (firm growth and productivity) are influenced by the past values;
- Presence of randomly distributed fixed effects, indication of unobserved heterogeneity;
- Endogenous explanatory variables (explanatory variables correlated with the error term);
- Heteroskedasticity and serial correlation in the error terms;
- Error terms are uncorrelated across firms;
- Regressors may be predetermined but not strictly exogenous (predetermined variables have their current and past values, but not necessarily future values correlated with the error term while strictly exogenous variables are not correlated with past and current values of the error term);
- Small number of time periods of available data;
- The only available instruments are ‘internal’ that is, based on lagged values of instrumented variables.

The DIFF-GMM entails first difference transformation of the data (i.e. subtracting the past values of variables from their current values) to remove fixed firm-specific effects since these remain constant over time, while past levels of the transformed dependent variable are used as instruments (Bun and Windmeijer, 2010). The lagged dependent variable remains potentially endogenous, while any predetermined regressors become potentially endogenous after this transformation. Longer lags of the explanatory variables nevertheless remain uncorrelated to the error term and available as instruments (Roodman, 2009a). The DIFF-GMM estimator is, however, plagued by a weak instrument problem in highly persistent series (for instance, when current firm performance is determined by performance in the previous period) where lagged levels of the regressors are poor instruments for the first differenced regressors. The SYS-GMM performs better in such cases, however, the DIFF-GMM’s poor performance improves with the number of time periods available (Blundell and Bond, 1998).

The SYS-GMM estimator, on the other hand, involves simultaneous estimation of the firm performance model in first differences and levels, with two distinct sets of instruments generated for both equations (Garnero et al, forthcoming). The SYS-GMM estimates equations in first-differences, from which the firm-specific effects have been removed by the transformation (similar to the DIFF-GMM), with lagged values of first differences of the endogenous variables as valid instruments, while the differenced equations are combined with equations in levels with the lagged values as instruments (Oliviera and Fortunato, 2006a).
The SYS-GMM allows for the addition of time-invariant regressors as opposed to the DIFF-GMM and the FE models (Garnero et al., forthcoming). A limitation of the SYS-GMM estimator is that it may become inconsistent in the presence of too many instruments. Proliferation of instruments may weaken the Hansen test of over-identification and cause invalid results to be presented as valid (Roodman, 2009b). The Hansen test is a test of joint validity of all instruments, with the null hypothesis that the instruments are exogenous (thus providing information on structural stability in the model). It is, however, not robust in the presence of too many instruments.

Based on the above discussion, OLS, FE and SYS-GMM estimators are adopted in estimating all firm performance models in the current study. Although results from the OLS and FE estimations are presented, emphasis is on the SYS-GMM estimation results. The latter estimator allows controlling for possible correlation between the dependent variable (firm performance) and the error term (unobserved firm-specific characteristics) in order to correct any potential endogeneity that may arise in investigating the determinants of firm performance. For instance, it could be that R&D investments increase firm growth and productivity, while it is also possible that only fast growing, productive firms possess the capability to undertake R&D. Using GMM method to control for possible endogeneity between firm growth and R&D investment, Yang and Huang (2005) investigated the relationship between R&D, firm size (employment), and employment growth rate for a panel of Taiwanese electronics firms over the period of 1992–1998. R&D intensity was assumed to be predetermined. Findings showed that R&D had a significant positive effect on firm growth, with the effect being more pronounced in smaller firms, while a negative relationship
between size and growth was observed. These findings should be regarded with some measure of caution due to the short duration of the study, as well as the fact that selection bias is not taken into account. Therefore, the effect of surviving growing firms may be overestimated in the analysis. The use of panel data for only one industry (electronics) could also affect findings.

Endogeneity between foreign ownership and firm performance has also been noted in the literature as previously outlined in Chapter 2 (Section 2.5.1), with foreign ownership having no effect on firm performance when endogeneity is controlled for (Benfratello and Sembenelli, 2006; Nakano and Nguyen, 2013). These findings seem to suggest that the impact of foreign ownership on firm performance may be overstated when endogeneity is not considered. Moreover, the SYS-GMM allows inclusion of independent variables (such as industry) which do not change over time and remains robust in presence of autocorrelation and heteroskedasticity, producing unbiased, efficient and consistent estimates. Overall, the SYS-GMM estimation method is a suitable technique for dealing with the econometric issues arising from research earlier outlined. Having determined that the SYS-GMM is appropriate for dealing with the research questions identified in Chapter 1, key issues, arising from the use of the SYS-GMM, are related to the choice of instruments and the problem of too many instruments. A discussion on these issues is thus undertaken below.

(ii) Selection of instruments

The selection of instruments informs how well the GMM estimator performs. As previously discussed, a valid instrument may be related to the explanatory variables, but must not be
related to the error term. The availability of instruments which provide information about the endogenous explanatory variable whilst satisfying the above condition is, however, difficult due to data limitations in economic models (Nakano and Nguyen, 2013). The SYS-GMM deals with this problem by allowing the selection of instruments from within the model, using lags of explanatory variables as instruments. However, the choice of instruments depends on the assumptions made by the researcher as to whether variables of interest are predetermined, endogenous or exogenous (Yang and Huang, 2005; Oliveira and Fortunato, 2006a; Girma et al, 2007).

(iii) Dealing with Proliferation of Instruments

Another issue arising from the use of the SYS-GMM is the problem of too many instruments. The availability of internal instruments means the SYS-GMM is prone to instrument proliferation, which may weaken the Hansen test and erode the consistency of the estimator (Roodman, 2009b; Merhrhoff, 2009). In other words, the GMM provides more efficient estimates when lag depth is limited and fewer instruments are employed (Windmeijer, 2005). To minimise the instrument proliferation problem, Merhrhoff (2009) suggested the following methods based on results obtained from Monte Carlo simulations:

- Factorisation of instrument sets which involves the application of Principal Component Analysis (PCA) to the instrument set and using the extracted PCA scores as instruments. This compresses information on the instrument to lower the number of instruments with minimal loss of information;
- Collapsing of instruments; and
• Limiting lag depths of instruments, that is, reducing the number of lags used, as deeper lags are weaker instruments.

Bontempi and Mammi (2012), using Monte Carlo simulations, as well as empirical data, also noted that factorisation of the instrument matrix provides the best SYS-GMM estimates compared to limiting the lag depth and collapsing the instrument matrix. Following Merhrhoff’s (2009) suggestion, instrument matrices are collapsed to improve consistency. Collapsing the instrument set creates one instrument for each variable and lag distance rather than for each time period, variable and lag difference, thus reducing the instrument counts and computational demands by decreasing the width of the instrument matrix (Roodman, 2009a). Various lag lengths of variables were experimented with as instruments to derive the most consistent estimates based on Hansen test results in selection of preferred models. As earlier indicated, the Hansen test is a test of the null hypothesis that instruments are exogenous. Although it is not robust in the presence of too many instruments, it remains robust to heteroskedasticity and autocorrelation unlike the Sargan test which also tests the validity of instruments. The Sargan test is, however, not robust to heteroskedasticity and autocorrelation. Given the characteristics of the Hansen test as earlier indicated, the choice of econometric results presented in Chapter 6 is, therefore, based on the Hansen test results.

The selection of estimation technique has been discussed in this section, examining the pros and cons of the OLS, FE and GMM methods. Given the short time dimension (T) and a longer firm dimension (N) of the panel data, set as well as the econometric issues inherent in the use of panel data outlined above, the SYS-GMM was highlighted as a suitable estimator.
in dealing with the ‘dynamic panel bias’ inherent in fixed effects estimations. Moreover it remains robust in the presence of autocorrelation and heterogeneity. Furthermore, the SYS-GMM estimator is appropriate in addressing potential endogeneity that may arise between firm performance and its determinants (such as R&D intensity and foreign ownership), as well as unobserved firm-specific effects that may arise from missing data on key variables. It also allows for the inclusion of time-invariant variables allowing for their effect on firm performance to be studied. However, this becomes inconsistent with instrument proliferation, indicating a need to exercise caution in generating instruments. Overall, the use of the SYS-GMM in investigating the impact of macroeconomic conditions on firm performance in Ireland not only fills the gap in the Irish firm performance literature by providing rigorous econometric analysis of firm performance over a period of varied macroeconomic conditions, but moreover contributes to the international literature by providing insights on the interaction between the internal and external factors of firm performance.

### 3.7 Conclusion

Various measures and methodologies commonly used in the evaluation of firm performance were examined this chapter. Given the wide range of measures and methods in use in the literature, it was argued that the choice of firm performance methods is dependent on the focus of the research. Given the major objective of this research which is the analysis of the determinants of firm performance in Ireland (with emphasis on testing and predicting the research findings), the philosophical stance of the research was stated as positivism which focuses on the use of observable data collected in a value-free way to examine causal
relationships among firm performance determinants. Following on from this, a quantitative research approach was adopted which is closely linked to the positivist position and is useful in the prediction of findings.

In highlighting the multidimensionality of firm performance, a distinction was made between financial and non-financial firm performance measures. Although both measures capture different areas of performance, the use of financial measures was shown to be beneficial, as non-financial measures are still somewhat embedded in financial measures. Firm growth (employment, turnover and productivity) and productivity (turnover per employee) were deemed to be appropriate performance measures for this research due to a number of factors. These measures capture important aspects of the firm’s performance and are important to the success of other firm performance measures. For instance, firm growth is important for survival, competitiveness and profitability, while productivity is important for sustained growth and competitiveness. Moreover, the impact of changes in macroeconomic conditions on these two variables is easily measurable. In addition, it was shown that the use of these measures meets key objectives of various stakeholders such as firms, policy makers, consumers and employees.

The model of firm performance to be analysed in Chapter 6 was presented. This framed the determinants of firm performance into three categories: the entrepreneur, firm and strategy based on the framework suggested by Hynes (2006). Given that a key objective of this thesis is to provide a study of the effect of the macroeconomic environment on firm performance, macroeconomic factors were incorporated into this framework, while entrepreneurial factors
were omitted as this is not the focus of the study. Based on the firm performance model, a discussion on the determinants of firm performance to be analysed in this research was presented to guide the development of the research hypotheses to be tested empirically in Chapter 6.

A brief discussion of the datasets (ASI and CIP datasets obtained from the CSO; macroeconomic variables collected from the World Bank World Development Indicators and the OECD databases; deflators obtained from the EU KLEMS database) employed to answer the research questions was provided. This highlighted unique features of the datasets which allows tracking of firm performance over the sample period, as well as the study of the temporal nature of firm growth.

Given the wide array of estimation techniques identified in the literature, the OLS, FE and SYS-GMM estimators were selected as most relevant to estimate the firm performance model presented in this chapter, with the SYS-GMM being the measure of choice based on its ability to allow the researcher to control for endogeneity and unobserved heterogeneity in the data. The use of all three estimation techniques allows testing of the sensitivity of empirical findings to performance measures used, as well as providing insights into the nature of the relationship between firm characteristics, firm strategy, macroeconomic factors and firm performance.

In conclusion, the research approach adopted in the investigation of firm performance undertaken has been detailed in this chapter. This entailed a review of the relevant firm
performance literature which identified the multiplicity of methods and measures employed in empirical studies. The chapter also provided the rationale for the researcher’s choice of data and firm performance measures and methods adopted in this thesis. Additionally, based on empirical and theoretical evidence from the literature, the research hypotheses to be tested in the empirical chapters (Chapters 5 and 6) were outlined. On the strength of the discussion presented in this chapter, this study employs the OLS, FE and SYS-GMM estimation methods to investigate the drivers of firm performance (growth in employment, turnover and productivity, as well as productivity levels) with the use of datasets for manufacturing and services firms obtained from the Irish CSO over the period 1991-2007.

To situate this research within the context of the time period of study, a discussion on the Irish economy is presented in Chapter 4, with specific emphasis on the rapid economic growth period.
Chapter 4: Ireland’s Macroeconomic Performance (1991-2007)

4.1 Introduction

This chapter presents key characteristics of the Irish economy and analyses Ireland’s macroeconomic performance, including the drivers of economic growth during the period 1991-2007. Given that the main objective of the thesis is to analyse the impact of macroeconomic conditions on firm performance in Ireland over the period 1991-2007, a review of the prevailing macroeconomic conditions during the sample period is vital to provide a background for the subsequent empirical analyses of the determinants of firm performance carried out in Chapters 5 and 6. Furthermore, a discussion of the underlying causes of growth provides an understanding of the nature of economic growth (in terms of sustainability) achieved during the period and the implications for firm performance. Analysis of firm performance is restricted to the period 1991-2007, which was characterised by remarkably high growth in Ireland resulting in an economic transformation from high unemployment to full employment. This allows the analysis of an economy in a boom and a bubble.

Ireland is an interesting locale given the spectacular economic growth rates displayed during the 1990s and up to 2007, the magnitude of which has led to its transformation from the ‘poorest of the rich’ to ‘Europe’s shining light’ (The Economist, 1988; 1997). Ireland’s success in attracting Foreign Direct Investment (FDI), among other factors, also contributed

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to the high growth experienced during this period, as will be shown in subsequent sections. However, two distinct growth phases have been identified; the 1990s, a period of export-led sustainable growth and 2001-2007, a period of economic growth fuelled by external borrowing from abroad and culminating in an unsustainable property bubble (Dineen et al, 2012; Dineen and Lenihan, 2011). Analysing and identifying the specific drivers of economic growth during the two growth phases provides insights as to whether firm performance differentials exist across both periods. Knowledge on the characteristics of the Irish economy and the drivers of its growth during the sample period is important in informing the subsequent empirical analyses in the thesis.

Given the above context, this chapter seeks to examine key features of the Irish economy, as well as the sources of rapid economic growth experienced during the ‘Celtic Tiger’ period, with a view to providing an understanding as to whether (how) the differences in growth drivers during the period may potentially influence the performance of firms in Ireland. The remainder of the chapter is set out as follows: Section 4.2 outlines important features of the Irish economy, which highlight its openness, as well as the significant contribution of the services industry and multinationals, with implications for the empirical analyses in Chapters 5 and 6. Section 4.3 examines the sources of growth during the first growth phase (1991-2000) and second growth period (2001-2007) respectively. In identifying the growth drivers in both periods, the performance of firms, in terms of employment and turnover, is also examined. Section 4.4 concludes. The discussion in the chapter provides a backdrop to the research questions in this thesis, as well as contributing to the firm performance literature through insights gained from analysing firm performance in the Irish economy within the
context of two distinct growth periods. This will be detailed in the empirical chapters 5 and 6. To begin with, the main attributes of the Irish economy are examined in Section 4.2.

### 4.2 Key Features of the Irish Economy

The key characteristics of the Irish economy crucial to this analysis are outlined in this section. A discussion on these features is relevant based on the knowledge it provides regarding important considerations in the Irish economy that must be taken into account in this empirical investigation of firm performance in Ireland. Ireland is a small open economy which has gradually transformed to a modern knowledge economy, with a large foreign presence in its industries, mostly an outcome of FDI promotion policies pursued by successive governments (Teague, 2009; Whelan, 2013). More specifically, the Irish economy is characterised by a high degree of openness and significant multinational activity, particularly in high-tech industries. Services firms and the small business sector are also major players in the economy with increasing economic contributions over time. These major characteristics of the economy are discussed in turn in the sections which follow.

**(i) Openness**

Due to its size (population of 4,239,848 in 2006 [CSO, 2007a: p40]), Ireland is very open with a large volume of trade in goods and services. During the period 1991-2007, there was a rapid growth in trade, with exports accounting for 57.4 percent of Gross Domestic Product (GDP) in 1991 and rising to as high as 99.6 percent of GDP in 2001 and 80.4 percent of GDP by 2007 (CSO, 2013c: p136). Similarly, the share of imports in GDP was 52.4 percent.
in 1991, 84.2 percent in 2001 and 71.4 percent in 2007 (CSO, 2013c: p136). Export and import shares were much higher by the end of the 1990s, while trade growth slowed down in the 2000s. Trade, however, remains a significant part of the economy. In fact, trade volumes have steadily risen since 2008. Irish exports as a percentage of GDP ranked second highest in the European Union (EU) after Luxembourg, while its imports as a percentage of GDP were the seventh highest in the EU in 2011 (CSO, 2012a: p26). The growth in trade can be linked to increased globalisation and investment in the 1990s and early 2000s (National Competitiveness Council, 2009). With increased foreign direct investment (FDI) inflows during this period, Ireland was strategically positioned on the global production chain to serve mainly as an export platform, such that, firms engaged mostly in the transformation of imported intermediate inputs into manufactured goods which were later exported (Lane and Ruane, 2006). Consequently, there was a simultaneous rise in both exports and imports, with export growth outpacing imports. Moreover, export promotion has been at the forefront of Irish industrial policy, with entry into export markets as a major performance indicator for grant receipt (Grimes and White, 2005; Girma et al, 2008; Walsh and Whelan, 2011).

(ii) Economic structure

In terms of economic structure, the services industry in Ireland is the largest industry in line with trends in other developed economies. A steady growth in its contribution to the economy was seen during the period of analysis, with its share of total employment increasing by as much as 73 per cent between 1997 and 2005 (Figure 4.1). In contrast, industrial employment in Ireland grew by 16 per cent from 1994 to 1997, but experienced a sharp decline of 24 per

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38 There was a gradual decline in trade from 2003 to 2007. Exports fell from 99.6 percent of GDP in 2001 to 83.7 per cent in 2003, while imports decreased from 84.2 per cent in 2001 to 67.3 percent in 2003 (CSO, 2013c: p136). A more detailed discussion on the slowdown of export growth is provided in Section 4.3.2.
cent between 1997 and 1998. Thereafter, industry employment remained largely unchanged from 1998 to 2007, while agricultural employment decreased steadily over the period 1994 to 2007 (Figure 4.1).

In terms of its contribution to output, the services industry accounted for 56 per cent of total GDP in 1995 and 57 per cent in 1998, whereas agriculture and industry contributed 5 per cent and 38 per cent of GDP respectively in 1998 (CSO, 2000: p88, p149). In 2007, the services industry generated 62 per cent of Net Domestic Product (NDP), with computer services accounting for almost one-third of all service exports in this period (Bielenberg and Ryan, 2013: p118, p119). However, O’Hearn (2003) argued that most of the output growth during the 1990s was concentrated mainly in manufacturing (specifically, the US-dominated...
manufacturing industries—computers, electronic engineering and pharmaceuticals), whilst employment growth was strongly fuelled by growth in the services industry. The increasing significance of the services industry in the Irish economy can be attributed to a sectoral shift from agriculture and manufacturing to services, in line with global trends, as well as a blurring of the distinction between manufacturing and services, as more manufacturing firms in Ireland engage in more services-related activities (Forfás, 2006; Barry and Bergin, 2012).

(iii) Multinational Activity

Another key characteristic of the Irish economy is the significant presence of foreign-owned firms (mostly US firms), particularly in high-tech industries (such as chemicals, electrical machinery and equipment). The output share of foreign multinationals increased from 53 per cent to 78 per cent between 1991 and 2000, the export share of total exports in the Irish economy grew from 74 per cent to 91 per cent, while the employment share of total employment rose from 44 to 48 per cent during the same period (Department of Jobs, Enterprise and Innovation, 2003: p67). Cassidy and O’Brien (2005: p77) noted that foreign-owned firms accounted for 95 per cent of total growth in manufacturing exports in Ireland and 63 per cent of growth in total exports in the 1990s. By 2006, the foreign share of total output generated in Ireland had grown to 84 per cent (over €50 billion) relative to the share of indigenous firms which was less than €10 billion (Bielenberg and Ryan, 2013: p94). In contrast, the employment gap between indigenous (151,610) and foreign firms (153,510) was less pronounced (Bielenberg and Ryan, 2013: p94). The dominance of foreign-owned firms in the internationally traded services industry is also noteworthy, with an employment share of 63 per cent in the international and financial services industry in 2001 (Department
of Jobs, Enterprise and Innovation, 2003). Accordingly, by 2006, 80 per cent of the financial services firms in Dublin had non-Irish owners (Bielenberg and Ryan, 2013: p114).

The disparity between the output and employment performance of foreign firms and the attending significant productivity differential requires analysis. Indeed, multinationals in Ireland have been shown to be larger (in terms of output and employment), have higher labour productivity, employ more skilled workers and spend more on R &D relative to indigenous firms (Barry et al, 1999; Ruane and Sutherland, 2004). However, it has been argued that the large productivity differentials between foreign and Irish firms should be interpreted with caution, since these may be related to transfer pricing practices adopted by foreign firms in a bid to take advantage of the low corporation tax rate prevalent in Ireland (Arora and Gambardella, 2005; Forfás, 2006). Hence, Forfás (2006) suggested that performance in foreign firms should be regarded in the following context:

- The primary purpose of multinationals locating in Ireland is for its use as an export base, thus of necessity foreign firms must be export-oriented;
- Indigenous firms often act as sub-suppliers to foreign firms who in turn export;
- Transfer pricing practices over-state the export performance of foreign firms.

39 Transfer pricing refers “to the setting of prices for transactions between associated enterprises involving the transfer of property or services” (United Nations, 2013: p2). A transfer price is the amount charged by a part of a firm for a product, asset or service supplied to another part of the same firm (United Nations, 2013). The practice of transfer pricing enables firms, such as multinationals, to take advantage of differences in tax rates between countries. Consequently, firms report lower profits in countries with high tax rates and hike up profits in countries with lower rates of tax, as in the case of Ireland.
(iv) Indigenous firms

After highlighting the strong performance of foreign firms in Ireland during the period 1991-2007, it is necessary to examine indigenous firm performance in the same period for the purpose of comparison, as well as to identify trends in the industry. Irish-owned firms were largely concentrated in the food, beverages and tobacco (F&B) industry, as well as the paper and publishing industry. Full-time employment in indigenous manufacturing and internationally traded services increased by 33 per cent between 1991 and 2001 (Department of Jobs, Enterprise and Innovation, 2003: p90). Furthermore, significant employment growth, driven mostly by successes in the indigenous software industry, was shown in the international and financial services industry, with employment growing from 4,469 in 1990 to 25,221 in 2002 (Department of Jobs, Enterprise and Innovation, 2003: p98). The growth in employment in the international and financial services industry was also driven by rising employment in the International Financial Services Centre (IFSC). The IFSC was launched in Dublin in 1987, with the aim of diversifying the Irish economy from manufacturing to attract financial services firms through offering a low tax rate (10 per cent at the time), skilled labour, lower costs relative to the major European financial centres and market access to the EU as sweeteners to firms (Begley et al, 2005). By 2005, the numbers employed in the IFSC stood at 20,000, that is, 40 per cent of the total employment in financial services (Bielenberg and Ryan, 2013: p114).

The emergence of the indigenous software industry, based on linkages with foreign firms in the information and communication technology (ICT) industry has been noted as Ireland’s success story in developing an indigenous industry from inward FDI (Begley et al, 2005;
Buckley, 2010). According to the Department of Jobs, Enterprise and Innovation (2003: p99), the number of indigenous software firms increased from 290 in 1991 to about 770 in 2000. Resultantly, employment grew from just 3,800 in 1991 to 14,000 in 2000, while revenues also rose from €191 million to €1.4 billion in the same period. The software industry has also been export-oriented, with exports accounting for 60 per cent of revenues generated in 2000. However, employment in the software industry declined by approximately 10 per cent in 2002 (Department of Jobs, Enterprise and Innovation, 2003: p99) owing to a global economic downturn and rising domestic cost base which is discussed in detail in Section 4.4.

(v) Sectoral Concentration

In line with public policy aimed at shifting emphasis to high-tech manufacturing (Buckley and Ruane, 2006; Bianchi and Labory, 2011), the output and employment growth experienced in the 1990s was largely due to growth in the chemicals, medical devices and information and communication technology (ICT) industries, with the chemicals and ICT industries accounting for 90 per cent of the employment and output growth shown between 1995 and 2000 (Department of Jobs, Enterprise and Innovation, 2003: p67; Murphy, 2006). Between 2000 and 2006, total industrial output (including building) increased by 34 per cent, while output of high-tech industries dominated by foreign-owned firms (Reproduction of recorded media, Chemicals, Computers, and Electrical machinery and equipment) grew by 47 per cent (CSO, 2007b: p145). A similar sectoral concentration occurred in the services industry; the industries, however, varied over the period of analysis. Although employment in the services industry over the period 1994-1997 was largely concentrated in education and health, followed by wholesale and retail trade industry, the strongest employment growth was
shown in financial and other business services (17.8 per cent), education and health (17.3 per cent), as well as transport, storage and communications (16.3 per cent) industries during this period (Figure 4.2).

**Figure 4.2: Services Employment in Ireland, 1994-1997**

![Services Employment in Ireland, 1994-1997](image)

Source: CSO Database Direct, ILO Persons aged 15 years and over in Employment (1994-1997) by Sex, Economic Sector and Year

The wholesale and retail trade and human health and social work industries had the largest employment share during the period 1998-2007 (Figure 4.3). During the period 1998 and 2002, employment growth in the services was driven mainly by growth in the following industries: human health and social work (40 per cent), administrative and support services (29.4 per cent) and transportation and storage (27.3 per cent) as illustrated in Figure 4.3. On
the other hand, the highest employment growth in the period 2002-2007 was seen in administrative and support services (47.3 per cent), human health and social work (36.6 per cent), professional, scientific and technical activities (35.1 per cent). In general, the above figures indicate a heavy dependence on a few industries which leaves the economy vulnerable to shocks within these industries as will be shown shortly.

Figure 4.3: Services Employment in Ireland, 1998-2007

![Services Employment in Ireland, 1998-2007](image)

Source: CSO Database Direct, Persons aged 15 years and over in Employment (Thousand) by Sex, NACE Rev 2 Economic Sector and Quarter

As noted previously, most of the growth in output and exports experienced in the Irish economy in the 1990s was driven by the remarkable performance in high-tech industries dominated by foreign-owned, particularly US firms. To further demonstrate the key role...
played by foreign-owned high-tech firms in Ireland’s economic growth, Murphy (2000: p15) showed that five major high-tech industries (cola concentrates, chemicals, pharmaceuticals, computers and computer software) accounted for 43 per cent of net manufacturing output and 11 per cent of total manufacturing employment in 1993, while these five industries contributed 53 per cent of total output and 14 per cent of total manufacturing employment in 1996. On the other hand, the three largest exporters in Ireland in 1998 (Intel, Microsoft and Dell, which are all US-owned) contributed 22 per cent of merchandise exports and 18 per cent of total exports (Kirby, 2003: p26). By 2000, multinationals accounted for 96 per cent of total turnover in the chemicals industry and 25.6 per cent of total manufacturing turnover in Ireland (CSO, 2014a). Based on the above evidence, it could then be argued that the output growth achieved in Ireland in the 1990s was driven by, and dependent on, inward FDI located in a small number of manufacturing industries, whilst most of the employment growth was located in the services industry. Hence, the localisation of FDI in selected high-tech industries and over-reliance on FDI originating from the US left the country vulnerable to global shocks within these industries, as well as to a downturn in the US economy (Murphy, 2006; Andreosso-O'Callaghan and Lenihan, 2011).

The sectoral concentration of multinationals located in Ireland and their significant presence can be traced to the FDI-oriented industrial policy of the Irish government targeted at attracting foreign investment into Ireland. More specifically, the role played by IDA Ireland (the agency responsible for the promotion of foreign inward investment) can also be highlighted (Danson et al, 2002). The IDA has been credited for its foresight and success achieved in predicting and targeting selected growth industries in high-tech industries such as
computers, computer software, pharmaceuticals and chemicals (Murphy, 2000; Collins and Grimes, 2008), thus providing Ireland with first-mover advantage in these industries. Moreover, Murphy (2000) further argued that the industrial policy pursued by the IDA in targeting the aforementioned industries in the 1970s and 1980s meant a number of US firms already had some of their operations located in Ireland. Thus, the country was well positioned to take advantage of the revolution in these industries in the 1990s. In fact, Ireland’s ability to attract FDI, particularly US-originating FDI, has been attributed to efficiency agglomeration and demonstration effects40 (Murphy, 2000; Barry et al, 2003). For instance, O’Hearn (2003) noted that Intel’s decision to locate in Ireland in 1990 attracted almost every major player in the ICT industry, such that by the late 1990s, companies such as Dell, Apple, Hewlett-Packard, Microsoft, Lotus and Oracle had operations in Ireland. A similar agglomeration of foreign firms also occurred in the pharmaceutical industry (O’Hearn, 2003). Furthermore, Barry et al (2003) provided empirical evidence suggesting efficiency agglomeration and demonstration effects were, indeed, important determinants of US firm entry into Ireland over the period 1973-1996.

Multinationals continue to play a major role in the Irish economy, employing about 280,000 persons and generating turnover of €159.5 billion in 2009 (CSO, 2012b: p33, p36). In 2009, total employment in the economy was over 1.3 million persons, while total turnover was €359.4 billion during this year (CSO, 2012b: p6), implying that foreign firms accounted for about 22 per cent and 44 per cent of total employment and turnover respectively.

40 On the one hand, new foreign firms may be attracted to the country because they can increase efficiency by locating close to other firms (efficiency agglomeration effects). On the other hand, new firms may also be attracted because of demonstration effects, in other words, the presence of existing foreign firms sends signals to prospective firms on the attractiveness and reliability of the host economy (Barry et al, 2003).
(vi) Small Business Sector

The small business sector is important in the Irish economy, with an increasing contribution to employment and output over time. Small businesses, defined as firms with less than 50 employees, accounted for 97 per cent of the total number of firms in Ireland in 2005, showing a 50 per cent increase in the number of small firms between 1995 and 2005 (Small Business Forum Report, 2006: p3). In terms of employment, the contribution of small firms to private sector non-agricultural employment in 2005 was 54 per cent, representing a growth of approximately 79 per cent between 1995 and 2005 (Small Business Forum Report, 2006: p3). In 2003, small firms contributed over 70 per cent, 40 per cent and 34 per cent to the total GVA in construction, services (excluding financial services) and indigenous manufacturing industries respectively (Small Business Forum Report, 2006: p5). These figures highlight the fact that small firms show lower GVA relative to the numbers employed, suggesting the need for policy targeted at improving productivity in this sector. In fact, it has been noted that productivity in small firms in Ireland is lower relative to similar-sized firms in other countries (Small Business Forum Report, 2006; Department of Jobs, Enterprise and Innovation, 2003). The lower productivity in small firms in the Irish economy is due to the predominance of micro-sized firms, which contribute significantly to breaking up regional disparities and promoting innovative activity.

The remarkable growth performance in the small business sector in Ireland during this period of analysis is related to a widening of Irish policy focus from manufacturing and internationally traded services to include small and micro-sized firms, as well as non-traded services (Small Business Forum Report, 2006). Additionally, small firm performance has
been boosted by a number of steps taken by policymakers to support small businesses. These include the disbursement of loans and grants, lowering the threshold for firms to qualify for the 12.5 percent corporation tax on trading income, reduction of the higher tax rate of personal income tax to 42 percent, as well as the establishment of City and County Enterprise Boards, following policy recommendations outlined in the 1994 Task Force on Small Business report to encourage the growth and survival of small firms (Department of Jobs, Enterprise and Innovation, 2003).

The neglect of the non-traded services industry in Ireland has also been highlighted by the Small Business Forum (2006) and the Department of Jobs, Enterprise and Innovation (2003), with enterprise policy focused on supporting the manufacturing and internationally traded services industries due to their perceived wealth-generating abilities. The absence of data on the non-traded industry, however, makes it difficult to estimate their economic contributions. Nevertheless, based on data from the Revenue Commissioners’ register of employers and businesses, the Department of Jobs, Enterprise and Innovation (2003: p107) estimated that the number of firms in the non-traded services industry in Ireland possibly stood at approximately 250,000 in 2001. Therefore, it is informative to analyse the performance of firms in the non-traded services industry in order to fill the data gap, as well as provide useful insights for policy makers.

(vii) Regional Disparities

High economic growth in the Irish economy during the 1990s resulted in widening disparities at the regional level (Garnier, 2003). Rudy and Collins (2011) noted that considerable
differences in terms of population, employment growth and infrastructure had existed between the Eastern core of the country (including Dublin, the capital city) and the Western and North-Western periphery. However, the classification of the country into two Nomenclature of Territorial Units for Statistics (NUTS2) regions: Southern and Eastern (SE) and Border, Midlands and Western (BMW), and the disaggregation into NUTS3 regions (consisting of eight regions) further accentuated these differences, with the SE region being relatively more prosperous than the BMW region (Drudy and Collins, 2011). These disparities are highlighted in Figure 4.4, which illustrates significant performance differences between the SE and BMW regions in terms of number of local units, employment and gross output produced by industrial local units in 2007.

Figure 4.4: Industrial Regional Performance in Ireland, 2007

![Bar chart showing industrial regional performance in Ireland, 2007](chart)

Source: CSO Database Direct, Industrial Local Units by Persons Engaged, Region, Statistical Indicator and Year

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41 A local unit is defined as an enterprise or part thereof situated in a geographically identified place (CSO, 2008a:p5).
Figure 4.4 shows that the SE region had more than two times the number of local units, more than two times the numbers employed and almost six times the gross output produced in the BMW region in 2007. The significant difference between employment and output in the two regions is noteworthy. As detailed previously, high-tech industries dominated by foreign firms made significant contributions to Irish economic performance during the Celtic Tiger period. Thus, the superior performance in the SE region during the period of analysis can be linked to the fact that the majority of firms in Ireland in high-tech industries dominated by foreign-owned firms (e.g. computer hardware and components and computer software) are clustered around the Dublin area (Barry, 2008a). Furthermore, White (2004) in his investigation of the embeddedness of foreign software firms in Ireland over the period 2000-2001, noted that almost 70 per cent of foreign software firms were located in county Dublin. Taking the above into consideration, the large divergence between employment and output observed in the two regions is probably related to the transfer pricing practices of foreign firms, as detailed earlier.

Additionally, FDI served as a mechanism to reduce regional disparities through the creation of jobs in declining areas, which aided the dispersion of manufacturing employment across the regions and away from traditional manufacturing bases such as Dublin and Cork (Ruane and G örg, 1997). Morgenroth and O ’Malley (2003) pointed out that regional growth in manufacturing performance varied with changes in the share of foreign-owned industrial employment. Thus, regions with an increase in their share of foreign-owned industrial employment showed the fastest overall manufacturing growth. This finding further highlights the significant role of FDI in determining regional performance in Ireland. Public policy,
through tax incentives schemes, (between 1986 and 2000, 11 such schemes were established) was used to stimulate new housing developments in main cities, seaside resorts, small towns and rural areas; this helped reduce the disparities between the SE and BMW regions. Whereas from 2000, deliberate attempts were made by the government, through the implementation of policies such as the National Development Plan (2002-2006) and the National Spatial Strategy (2002-2020), to direct investments to the less prosperous regions so as to promote more balanced regional development (Garnier, 2003; White, 2004; Drudy and Collins, 2011). Following on from this, Ireland appears to have achieved some measure of success as regards regional development, with almost 60 per cent of new greenfield projects and 85 per cent of R&D investments occurring outside Dublin in 2006 (IDA, 2006: p8).

The observed firm performance difference between the core and peripheral regions in Ireland is also possibly related to regional variations in wages. According to the efficiency wage model, the firm’s labour productivity is dependent on the wage rate paid by the firm (Arnold, 2013). In other words, paying higher wages drive higher productivity in the firm’s employees. Regional wage differences may, therefore, influence firm performance, such that firms in high-wage regions may face higher operating costs, which may impact on their subsequent performance. However, the lack of data on regional wages in Ireland precludes analysis of the role of regional wage variation in gendering heterogeneity in firm performance in this research.

The discussion in this section has identified key characteristics in the Irish economy during the period 1991-2007 including the services industry, foreign-owned, high-tech firms and the
small firm sector. Performance variations at the regional level in terms of employment and output were also highlighted. Based on their significant impact on Ireland’s economic performance within the period of analysis, it is essential that these key features of the Irish economy must be considered in the empirical analysis to be undertaken in Chapters 5 and 6. Having identified some major features of the Irish economy crucial to the analysis of firm performance with which this thesis is concerned, a discussion on the so-called ‘Celtic Tiger’ era follows which examines the factors responsible for the rapid macroeconomic growth shown during the years 1991-2007, as well as identifying two distinct growth periods with implications for structural changes within the Irish economy. This increases our understanding of the macroeconomic conditions within which firms operated in the Irish economy—a key focus of this thesis.

4.3 The Celtic Tiger Period (1991-2007)

A discussion of the Celtic Tiger period is presented in this section. The section highlights two distinct growth periods (1991-2000 and 2001-2007), the drivers of growth, as well as the factors responsible for Ireland’s economic transformation. This provides insights on the macroeconomic context within which firms operated during the period of this study. Ireland’s transformation from a high unemployment to a full employment economy can be linked to spectacular growth rates in the 1990s. Although the period, 1991-2007 was characterised by high growth rates, two distinct sub-periods can be identified, each of which is characterised by different sources of growth; 1991-2000, a period of export-led sustainable growth and 2001-2007, a period of domestic consumer-led growth, stimulated by net external borrowing,
which gave rise to a property bubble. This is illustrated in Figures 4.5 and 4.6 which show macroeconomic trends in the Irish economy during the period 1991-2007.

Between 1991 and 2000, the economy grew at an annual average rate of 7.1 per cent, averaging 9.1 per cent between 1995 and 2000, which gave rise to the moniker, ‘Celtic Tiger’ (Figure 4.5). However, during the period 2000-2007, the average growth rate, though still relatively high, was much lower at 5.6 per cent per annum (Figure 4.6). The impressive economic growth has since proved to be unsustainable, with Irish real GDP contracting by 4.8 per cent per annum between 2008 and 2011, while real GNP declined by 9.5 per cent per annum (ESRI, 2013). Though growth rates in both sub-periods were still moderately high, the above figures highlight two different growth patterns in the Irish economy which will be analysed in Sections 4.3.1 and 4.3.2.

Prior to the acceleration of Ireland’s GDP growth (driven by export growth) beginning from 1993, the Irish economy was in a recession in the 1980s due to high budget deficits, large government debts, high interest rates and high tax rates (Baker, 1999; Haughton, 2008). As a result of this rapid growth, Ireland was able to catch up with other rich economies in the EU. Irish real national income per head rose from 65 per cent of the EU-15 average at the beginning of the 1990s to above parity by the end of the next decade, while unemployment declined from 17 per cent in the late 1980s – double the EU average – to 4 per cent – half the EU average – by the end of the 1990s (Barry, 2008b: p198). Although economic prosperity was experienced during the 1990s, the foundation of this remarkable success can be traced primarily to the fiscal adjustment plan launched in 1987 by the Irish
government, in conjunction with the major political parties, as well as a social partnership agreement that was put in place (Lane, 2011).

**Figure 4.5: Key Macroeconomic Trends in the Irish Economy, 1991-2007**


**Figure 4.6: Key Macroeconomic Trends in the Irish economy, 1991-2007**

Overall, there was a rapid creation of jobs in the economy during the period 1991-2007. The number of persons employed in the economy rose steadily over the entire period. The employment growth rate in the 2000s was, however, significantly lower. Data from the Irish Labour Force survey and the Quarterly National Household survey indicate that employment of persons aged 15 years and over, grew by 46.9 per cent between 1991 and 2000, whereas, during the period 2001-2007, employment growth was much lower at 22.5 per cent. In addition, disaggregation of employment growth by industry (Figure 4.2) indicates this rapid increase in employment was driven mainly by strong growth in the services industry, particularly from 1997, as outlined previously. Whilst a decline in the numbers employed in industry was noticeable from 2002, which remained constant to the end of the period. Similarly, the agricultural industry witnessed a decrease in the number of persons employed. These figures reflect the changing structure of the Irish economy in line with other developed countries.

Although, the services industry witnessed significant growth in employment during this period, O’Hearn (2003) and Kirby (2010) noted that most of the growth in the services was concentrated in low-wage industries, although certain new industries included high-wage jobs. Moreover, this employment growth was associated with the increased use of flexible employment types (such as part-time work, temporary and fixed contract work). In 1990, less than 8 per cent of total employment was in part-time jobs. However, by 2000, the proportion of part-time jobs had risen to 17 per cent (O’Hearn, 2003: p42). Given, the different economic growth phases highlighted above, the sources of growth in the Irish economy and the implications for the performance of firms during these distinct periods are now examined.
and discussed in the sections which follow. This provides insights as to whether the nature of macroeconomic growth matters for firm performance.

4.3.1 Export-led boom (1991-2000)

This section analyses the first growth phase 1991-2000, so as to identify the underlying causes of growth during these years. The 1991-2000 sub-period was characterised by accelerated GDP growth, falling unemployment rates (from 1993), low inflation and declining real interest rates. As earlier shown (Figure 4.5), the first growth phase was a period of remarkably high growth in GDP stimulated by increased export volumes (Figure 4.7) and a large inflow of FDI (largely from US firms and fuelled by renewed growth in the US economy during this period). More specifically, Figure 4.8 illustrates the significant growth in FDI inflow into Ireland between 1997 and 2000. The large inflow of FDI during this period was largely driven by the introduction of the Single European Market in 1992, which offered US firms access to a larger European market of approximately 400 million, along with a boom in the US economy (Kirby, 2010).

The export boom during this growth phase was driven by foreign-owned firms, particularly in high-tech industries such as chemicals and pharmaceuticals, with foreign firms showing a 23 per cent annual growth rate in manufacturing exports relative to a 6 per cent growth rate in indigenous firms (Cahill and O’Donnell, 2010: p11). By 1996, foreign firms accounted for 47 per cent of employment in manufacturing and internationally traded services, mainly in high-tech industries such as ICT, pharmaceuticals, medical technologies and chemicals (European Commission, 2008). Given the size of the Irish economy and the poor economic performance
experienced in the 1980s, this export-led growth phase was important in the sense that access to larger global markets provided an avenue for firms in Ireland to increase output, profits and productivity, which then translated into rapid growth in the overall economy. Moreover, as previously detailed in Section 4.2, the high export performance is also linked to the strategic decisions made by foreign firms to use Ireland as an export platform.

**Figure 4.7: Annual Change in the Volume of Irish GDP and Goods Exports**

- **Irish GDP volume change (annual, %)**
  - 1987 - 2007

- **Growth in Irish merchandise exports (annual, %)**
  - 1987 - 2007

Sources: CSO Database Direct, National Income and Expenditure; External Trade
Nevertheless, the Irish economy remained competitive, with moderate price and wage inflation due to successful negotiation of social partnership agreements by the government (Honohan, 2009). Having examined economic performance during the first growth phase, the question arises as to what factors aided the remarkable economic performance shown during this period. This issue is addressed in the next section.

Based on the discussion above, a combination of factors has been identified in the literature which promoted rapid growth during the export-led growth phase (Begley et al., 2005; European Commission, 2008; Sweeney, 2008; Norris and Coates, 2010). These include:
• Introduction of the European Single Market and devaluation of the Irish currency in 1992\textsuperscript{42};

• Access to European Union structural funds and cohesion fund useful in improving physical infrastructure;

• Irish industrial and tax policies which offered low corporation tax rates and capital grants to stimulate inward FDI;

• Competitiveness and wage moderation resulting from good management of public finance and social partnership agreements between the government, employers and trade unions;

• A young well-educated English-speaking work force.

The above-mentioned factors all served to promote the growth of FDI, particularly US-originated investment, attracted by the platform presented by locating in Ireland to launch into European markets. The increased activity of foreign-owned firms, in turn brought about a rapid growth in exports, which was a major driver of Irish economic growth during the 1990s. Following on from the above, two prime hypotheses have been suggested to explain the Celtic Tiger period; delayed convergence to Western European levels implying long term adjustment (Ó Gráda, 2002; Honohan and Walsh, 2002) and the regional boom view which makes the country vulnerable to external shocks in the long run (Barry, 2002). According to the delayed convergence perspective, given that Ireland lagged behind other Western European countries in terms of growth, from the mid-1980s, its ability to utilise its educated workforce...
unemployed labour, ensure fiscal stability, wage moderation and industrial peace, coupled with the use of a generous corporation tax regime, introduction of the single European market and a boom in the US economy, ensured it was well positioned to catch up with the rest of Europe (Ó Gráda, 2002; Honohan and Walsh, 2002). This implies that Irish economic growth will remain sustainable to the extent to which Ireland continues to adopt Europe-wide best-practices (Barry, 2002). On the other hand, the regional boom view explains the remarkable growth of the 1990s in terms of Ireland’s role as an export base with high international mobility of labour. Thus, the same factors which served to stimulate rapid growth in the Irish economy (i.e. the large inflow of FDI looking to access the single European market and the long boom in the US economy) also make it vulnerable to external shocks (Barry, 2002).

Beginning from 1993, there was a rapid decline in unemployment with increasing growth in real GDP as shown in Figure 4.5. Overall, total employment rose by 541,750 jobs (46.9 per cent) over the ten-year period (1991-2000), fuelled by growth in the services industry (employment in this industry grew by 48.1 per cent between 1994 and 2000, while manufacturing and agricultural employment declined by 8 per cent and 13 per cent respectively).43 In terms of firm performance, manufacturing turnover grew by over 200 per cent, rising from €28.7 billion in 1991 to €96.8 billion in 2000, while employment growth was more moderate at 30.4 per cent, rising from 194,433 jobs in 1991 to 253,504 jobs in 2000 (CSO, 2013d). Likewise, employment in the services increased by 6.7 per cent between 1999 and 2000, while turnover increased by 22.4 per cent during the same period 44 (CSO, 2013e). However, a shift in the drivers of Irish growth from exports to domestic demand

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44 Data on the services from the CSO’s Annual Services Inquiry (ASI) is only available since 1999.
occurred from 2000, with implications for economic performance and the performance of firms. This signalled the beginning of the second growth phase which is detailed in the next section.

4.3.2 Credit-led Boom (2001-2007)

As earlier indicated, Irish economic growth dynamics changed in the latter part of the period 2001-2007, with economic performance driven by access to cheap credit which stimulated domestic demand and resulted in a growth in the construction industry. This was a radical shift from the export-led growth of the 1990s. In fact, construction growth was so considerable that Dineen and Lenihan (2011) argued that a deduction of the contribution of the construction industry to national output would reveal that the Irish economy was effectively in recession post-2000. Additionally, the period was characterised by moderately high real GDP growth (relative to the 1990s), low unemployment, high inflation and negative real interest rates, as highlighted earlier in Figures 4.5 and 4.6.

Figure 4.9 shows the contribution of differing economic sectors to GVA in the period 1995 to 2007. There was a steady rise in total GVA from all sectors during the period. As previously noted, the services industry accounts for the largest proportion of GVA, followed by manufacturing. More specifically, the building and construction industry’s share of total GVA steadily rose from €4.3 billion (6%) in 1998 to a peak of €16.2 billion (11%) in 2006 (Figure 4.9). It can also be seen in Figure 4.9, that growth in the manufacturing industry remained static from 2002. To further illustrate the rising importance of the construction
industry in the same period, Figure 4.10 indicates the growth in construction employment share, which increased from 6.6 per cent in 1990 to a peak of 12.6 per cent in 2006.

**Figure 4.9: Gross Value Added at Factor Cost by Industry of Origin, 1995-2007**

![Gross Value Added at Factor Cost by Industry of Origin, 1995-2007](chart1.png)

Source: CSO Database Direct, National Income and Expenditure Accounts

**Figure 4.10: Contribution of Construction Industry to Total Employment 1990-2007**

![Contribution of Construction Industry to Total Employment 1990-2007](chart2.png)

Sources: CSO Database Direct, Labour Force Survey; Quarterly National Household Survey
The decline in manufacturing employment performance and the corresponding increase in the services and construction industries, highlighted above require further analysis. According to Lane (2004), since nominal interest rates are fixed at the European level, an increase in domestic inflation corresponds to a reduction in real interest rates, which further drives up domestic demand as seen in the case of Ireland. Thus, the bubble in the construction industry was boosted by low interest rates (due to adoption of the euro), population growth (from increased immigration), employment growth, increases in disposable income and indiscriminate bank lending, which further stimulated the demand for housing and drove up house prices (Hay, 2009; Drudy and Collins, 2011). Concurrently, price and wage increases driven by growth in domestic demand resulted in the loss of Irish competitiveness, as unit labour costs soared in comparison to other countries (Figure 4.11). In the early 1990s, Irish unit labour costs were higher than in the UK, US and Germany. By the mid-1990s, labour costs had fallen below German levels, though still higher than in the UK and US (Ireland’s major trading partners). However, post-2000 Irish labour costs began to trend upwards.

Furthermore, rising domestic prices contributed to the decline in competitiveness. Inflation was 16 percent over the period 2000-2004 relative to an EU average of 9 percent (CSO, 2005: p14). With regard to input prices, the Small Business Forum report (2006: p12) noted that electricity costs increased by 40 percent between 2001 and 2004, while a further increase in tariffs for SMEs was approved by the Commission for Energy Regulation in 2006. The rapid rise in waste disposal costs was also highlighted in the 2006 Small Business Forum report. The average landfill gate fee was shown to have risen from €30 in 1999 to €135 in 2005, making it one of the highest in the EU (Small Business Forum report, 2006: p12).
Higher wage and input costs imply higher production costs which would potentially hike up the cost of Irish goods and services relative to its trading partners.

Figure 4.11: Country Comparison of Nominal Unit Labour Costs, 1991-2007

Appreciation of the euro against the dollar during 2000-2002 further worsened Ireland’s competitive position leading to the crowding out of exports, while consumer-led demand generated increased imports, with a resultant declining trade balance (Figure 4.12). The euro decreased in value against the US dollar by 16 per cent at its introduction between 1999 and 2001. It appreciated, however, by almost 40 per cent over the next three years to stand at 17 per cent, above the 1999 value in 2004 (CSO, 2005: p25). To further illustrate the loss of Irish competitiveness in the second growth phase, Figure 4.13 shows movements in the real effective exchange rate (REER) over the period 1991-2007. Beginning from 2000, there is a steady rise in the REER index (Figure 4.13). An increase in this index indicates a worsening
of the country’s competitive position relative to its trading partners. As earlier indicated, the adoption of the euro brought about low interest rates, which in conjunction with rising inflation rates resulted in negative interest rates from 1998 to 2006 (Figure 4.6). Taken together, these factors contributed to steady growth in Irish domestic credit, with domestic credit rising from 43.7 per cent in 1991 to 199.2 per cent of GDP in 2007 (Figure 4.13). The increased availability of credit stimulated the domestic demand for housing which, in turn, fuelled a bubble in the construction industry.

**Figure 4.12: Trade and Current Account Balances as % of GNP, 1995-2007**

![Trade and Current Account Balances as % of GNP, 1995-2007](image)

Source: CSO Database Direct, Balance of International Payments, National Income and Expenditure, Quarterly National Accounts

Note: Trade balance relates to exports and imports of goods and services, excluding factor income flows.
In essence, the poor Irish export performance shown post-2000 was the resultant effect of weaker global demand conditions, a slowdown in the global ICT industry (this industry has a significant foreign presence in Ireland as previously outlined in Section 4.2) and lower competitiveness of the economy due to price and wage increases, as well as the stronger value of the euro (Cassidy and O’Brien, 2005). Following on from the discussion above, the factors identified in the literature as driving Irish economic performance during the period 2001-2007 are as follows:

- The adoption of the Euro in 2002, which brought about a lowering of Irish interest rates and a corresponding growth in domestic credit;
- Loss of competitiveness resulting from price and wage increases;
- Irish industrial policy aimed at attracting inward FDI. This left the country vulnerable to the relocation decisions of a number of foreign firms in response to the loss of economic competitiveness.
The factors outlined above fuelled lower performance in exports and manufacturing, as well as the strong growth in the services and construction industries shown in the Irish economy post-2001. Total manufacturing employment shrank from 248,614 in 2001 to 222,963 jobs in 2007, representing a decrease of 10.3 per cent (CSO, 2013d). Additionally, there was a slowdown in manufacturing turnover performance, with turnover increasing by only 22.7 per cent in this period relative to the remarkable turnover growth in the first growth phase (CSO, 2013d). On the other hand, turnover in the services industry almost doubled in the same period, rising from €104.2 million in 2001 to €205.8 million in 2007, employment growth was more moderate at 46.1 per cent, rising from 642,965 in 2001 to 939,385 jobs in 2007 (CSO, 2013e). Analysis of total manufacturing employment growth by nationality of ownership reveals a larger decline in foreign-owned firms, with employment contracting from 122,483 jobs in 2001 to 102,975 (15.9 per cent) in 2007, while employment in Irish-owned firms decreased by 4.85 per cent from 126,109 jobs to 119,988 in the same period (CSO, 2007b). Based on the data presented above, it can be seen that the decline in industrial employment growth from 2002 was offset by growth in the services industry, as well as credit-led consumer demand-driven growth in the construction industry, thus accounting for the somewhat high GDP growth rates exhibited during the period.

According to Collins and Grimes (2008), the poorer performance of exports and industry after the global economic downturn in 2000 was due to the reorganisation of some FDI-led industries in Ireland resulting in a shift from manufacturing to services and high-tech manufacturing. For instance, the upgrading of the ICT industry from lower value-added activities (such as assembly), to higher value-added operations such as high-tech components.
and high skill ICT services activities (Barry and van Egeraat, 2005). Loss of competitiveness coupled with rising competition from cheaper locations such as Eastern Europe and Asia led to plant closures and downsizing in some industries (such as microcomputer assembly) due to the shifting of foreign production operation to lower wage economies (Collins and Grimes, 2008; Barry and van Egeraat, 2008). In fact, Figure 4.8 shows a sharp decline in FDI net inflows into Ireland from 2000-2001 and from 2002-2004. A change in the composition of the FDI flows also occurred, with service-based FDI accounting for 66 per cent of US FDI by 2000, whereas in 1994, manufacturing made up more than 50 per cent of the total FDI stock (Bielenberg and Ryan, 2013: p152).

Moreover, the high growth shown in the services industry was a result of the government’s policy move to upgrade Ireland on the global value chain by seeking new investments from firms in ICT-intensive industries or existing firms willing to move more knowledge-intensive operations to Ireland (Begley et al, 2005).

As noted previously in Section 4.2, the launch of the IFSC in Dublin, which aimed to establish Ireland as a major destination for traded financial services (Clarke and Hardiman, 2012) also fuelled growth in this industry. Thus, the IFSC became a key actor in the services industry accounting for 40 per cent of total financial services employment in 2005 (Bielenberg and Ryan, 2013: p114). In addition, significant lowering of the corporation tax rate in the services industry in the early 2000s also boosted subsequent performance (Barry and van Egeraat, 2005). As detailed previously (Section 4.2), other key industries responsible for the remarkable growth in the services industry after 2001, are administrative and support
services, human health and social work, as well as professional, scientific and technical activities. The significant decline in foreign manufacturing employment in Ireland relative to indigenous employment over the period 2002-2007, illustrates the responsiveness of foreign firms to changes in their operating environments and their unwillingness to continue with unprofitable operations in host economies either by relocating to more competitively priced locations (Görg and Strobl, 2003b) or by moving to higher value-added activities as observed in Ireland.

Given that the Irish housing bubble was financed mainly by reckless lending by the banks, it was inevitable that the ensuing crash of the property markets would impact heavily on the banks, with huge losses for the banking industry (Clarke and Hardiman, 2012). The country officially entered into a recession in 2008 as a result of the international financial crisis, which led the government to guarantee all Irish bank deposits, recapitalise the banking sector and culminated in a €85 billion EU-IMF bailout in 2010 (Norris and Coates, 2010). While rising public expenditure had been followed by a corresponding rise in revenue since the 1990s, a fiscal deficit began to emerge in 2007 due to declining revenue resulting from the contraction in the property sector (Figure 4.14). The government deficit had since risen to €2,861 million in the third quarter of 2013, that is, 6.8 per cent of GDP (CSO, 2014b), a far cry from the budget surpluses recorded during the so-called Celtic Tiger period.
A changing tax structure in the 1990s (with the lowering of personal income tax rates as a result of successive wage negotiations) and shifting emphasis to other sources of tax revenue (such as corporation tax, stamp duties and capital gains tax), meant that the government was overly dependent on property tax-related revenue and was thus, poorly positioned when asset prices crashed and tax revenues collapsed (Honohan, 2009). The above factors have contributed to the rising budget deficit recorded since 2007.

Kanda (2010) noted that the 2008 recession was as a result of shocks to Ireland’s foreign trade, financial industry and housing market. The author further argued that the shocks to the financial industry and foreign trade were linked mainly to the global crisis at the time, while the housing market shocks were driven by events within the Irish economy. As earlier...
detailed, rising price and wage inflation, as well as the appreciation of the euro led to a loss of competitiveness which resulted in a slowdown of export growth over the period 2001-2007. In addition, the growing demand for loans which helped to fuel the housing bubble had been previously funded by foreign borrowings by Irish banks. However, as a result of the global banking crisis in 2008, Irish banks were no longer able to source funds from international financial markets; this resulted in the government guarantee in order to prevent the collapse of the financial system (Honohan, 2009).

4.4 Conclusion

The key characteristics of the Irish economy, as well as the sources of rapid economic growth experienced during the so-called Celtic Tiger period have been discussed in this chapter. The importance of the services, small firms, high-tech industries and multinational firms in the Irish economy was also highlighted in terms of their contribution to overall economic performance. Analysis of economic growth during the period 1991-2007 reveals two distinct growth phases, with different sources of growth. 1991-2000 was a period of export-driven growth characterised by accelerated growth in GDP, low interest rates and low inflation. Economic growth in 2001-2007, on the other hand, was driven by a credit-led domestic demand-driven bubble in the construction and property industry. This growth phase was unsustainable (since it was driven by artificially inflated housing prices and relied heavily on bank lending) and culminated in a recession in 2008.
The employment performance of firms in the Irish economy during the period of analysis was also examined to provide insights as to whether (how) macroeconomic performance determines firm performance. Disaggregating the time period into the two growth phases (1991-2000 and 2001-2007) indicated firm performance differentials across the period. Employment growth was higher in the first growth phase (46.9 per cent) relative to the second phase (22.5 per cent), while total employment in the economy grew by 85 per cent over the entire period, 1991-2007. Furthermore, during the export-led sustainable growth phase, employment growth was more pronounced in the services industry, while manufacturing employment grew at a moderate pace up to 1997 (See Figure 4.4).

In relation to the nationality of ownership, the employment share of foreign firms increased from 44 per cent in 1991 to 48 per cent in 2000, while foreign output grew from 53 per cent in 1991 to 78 per cent in 2000 (Department of Jobs, Enterprise and Innovation, 2003: p67). By contrast, in the domestic demand-driven growth phase, total manufacturing employment was found to have declined, with foreign-owned firms showing the greatest contraction in employment (15.9 per cent), while Irish-owned employment shrank by 4.85 per cent (CSO, 2007b). Poor manufacturing performance shown during this period was due to plant closures, downsizing and a shift to services in response to the loss of competitiveness sustained during this period as outlined earlier in Section 4.3.

The above findings provide evidence that employment growth during the period of economic growth in Ireland was driven by very strong performance in the services industry, thus

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illustrating the benefit of sectoral analysis in investigating firm performance in Ireland. Moreover, a cursory examination of firm performance over the entire period suggests a steady growth in employment and turnover. However, disaggregation into the two growth phases indicates performance differentials across both sub-periods, with lower growth performance shown in the consumer demand-led growth phase. This suggests that macroeconomic conditions drive firm performance. Additionally, factors such as the changing economic structure (shift from manufacturing to services) influenced firm performance in the period.

Given that growth in the Irish economy during the two growth periods was shown to be driven by different factors, it then follows that differences in the sources of growth during the period under review (1991-2007) has had an impact on the performance of firms within this period. Consequently, the empirical analysis of firm performance in Ireland to be undertaken in Chapters 5 and 6 of this thesis will benefit from a disaggregation of the time period to provide a better understanding of the impact of macroeconomic conditions on firm performance. Furthermore, given the significant contribution of multinationals, small firms and the services industry (including non-traded services) to the economy, it is valuable to include these in the analyses to be carried out. To this end, results from the descriptive analysis of the determinants of firm performance in Ireland are outlined in Chapter 5.

5.1 Introduction

The chapter presents descriptive and non-parametric analyses of firm performance in Ireland over the period, 1991-2007, based on panel data from two comprehensive datasets (Census of Industrial Production-CIP and Annual Services Inquiry-ASI for manufacturing and services firms respectively) obtained from the Irish Central Statistics Office (CSO) as detailed in Chapter 3. The analysis undertaken in this chapter not only presents the data in a graphical form, but also adopts a non-parametric approach with the use of formal tests of normality. This approach allows for the identification of a relationship between the variables of interest (e.g. firm growth and size). It is, however, not possible to establish causality between variables, thus, the descriptive and non-parametric analyses serve to provide a better depth of understanding for subsequent econometric analyses.

Furthermore, following on from the discussion in Chapter 4 which identified two distinct growth phases in the Irish economy within the period of analysis (1991-2000 and 2001-2007), this analysis serves to provide initial evidence on two of the research questions (RQ) outlined in Chapter 1; **RQ1**: What is the impact of macroeconomic conditions on firm performance in Ireland in the period, 1991-2007? and **RQ3**: What is the impact of firm-specific characteristics on firm performance in Ireland in the period, 1991-2007?
Disaggregation into the two growth periods offers insights not only on the link between firm performance and macroeconomic conditions (i.e. whether performance varies across both growth phases), but also on the probable relationship between firm-specific characteristics and firm performance which can then be further tested using econometric techniques in Chapter 6.

The chapter is organised as follows: Section 5.2 provides an analysis of firm performance (employment, turnover and productivity) based on the CIP and ASI datasets for the manufacturing and services industry respectively over the period, 1991-2007. The use of statistical tests of normality, as well as probability matrices contributes to our understanding of the relationship between firm-specific characteristics (such as size) and firm performance, and the macroeconomic environment and firm performance. In addition, based on the insights drawn from the discussion on the Irish economy presented in Chapter 4, analyses of the distribution in the manufacturing and services industries in Ireland, in terms of size, industry, location, nationality of ownership and trade status, is carried out to identify sources of heterogeneity in firms in Ireland which may influence their performance. Section 5.3 summarises key findings from the descriptive analyses undertaken in the chapter and concludes.

5.2 Descriptive Analysis of Firm Performance

The discussion in this section is based on a descriptive analysis of panel data from the CIP for the period 1991-2007 and the ASI for the period 2001-2007. The manufacturing sample is
also subdivided into two periods; 1991-2000 (a period characterised by very strong Irish GDP growth rates). As discussed in Chapter 4, Irish economic growth during this period was export-led and sustainable based on strong competitiveness, and 2001-2007 (characterised by lower GDP growth rates). Economic growth during this period was driven by consumer demand fuelled by net external borrowing and was largely located in the construction/housing industries, which masked decreasing competitiveness. A disaggregation of the sample into two sub-periods, allows for an investigation of firm performance during a sustainable growth phase and an unsustainable growth phase in the Irish economy.

This section presents a description of the data, as well as graphical and statistical tests of normality for the entire time period 1991-2007, to determine whether firm performance (measured in terms of employment, turnover and productivity, which are essential for future growth, survival, competitiveness and job creation as outlined earlier in Chapter 3) is related to firm size and other firm characteristics. The sample period is further split into the two sub periods identified in Chapter 4 to examine what differences, if any, exist in the results obtained. A distinction is also made between manufacturing and services industries in this analysis. As outlined in earlier chapters, although there is a large body of international empirical studies on firm performance, only a few studies have focused on the services industry, particularly the non-traded services industry within the Irish context. Given emerging evidence on the relative importance of the services industry to developed economies, accounting for approximately 70 per cent of employed persons in the EU-27 and about 77 per cent of employment in Ireland in 2011 (Eurostat, 2012), tracking the growth patterns of firms in this industry is of great interest.
As earlier detailed in Chapter 2 (Section 2.4.1), a negative firm-size growth relation has been commonly observed for manufacturing industries which are generally characterised by large scale economies and high capital intensity. As a result, firms with poor growth are faced with increased costs lowering their likelihood of survival (Piergianni et al, 2003). However, those firms able to survive, subsequently, show higher growth rates relative to larger firms. Gibrat’s Law (GL) has been generally observed to be valid for small firms able to grow quickly to achieve the minimum efficient scale (MES) in a given industry, as well as in industries with low sunk costs, where scale economies and capital intensity do not matter much (Piergianni et al, 2003). It then follows, therefore, that growth patterns may differ between manufacturing and services, which should be taken into account in the growth analysis.

Teruel-Carrizosa (2010) in his study of Spanish manufacturing and service SMEs, found that the service industry employs more workers, has a larger number of firms and consequently, a lower minimum efficient scale relative to manufacturing. It is, therefore, beneficial to undertake a separate analysis of the determinants of firm growth for manufacturing and services industry, given the unique characteristics of the individual industries outlined above. Moreover, empirical findings seem to suggest that firm performance does differ between the two industries (Audretsch et al, 2004; Teruel-Carrizosa, 2010). As detailed previously in Chapter 3, the data on manufacturing and service firms in Ireland is not directly comparable, due to differences in time periods for which data is available (the ASI data is only available for the period 2001-2007, whereas the CIP covers the period 1991-2007), and the employment threshold used for sampling firms in the ASI survey (the ASI is a census of all
services firms with 20 or more employees and a random sample of services firms with less than 20 employees, while the CIP is a census of all manufacturing firms). Nevertheless, a comparison of performance in the two industries is undertaken to determine what differences, if any, exist in these industries in line with the international literature. A look at the data presented in Table 5.1 indicates the services industry is larger than manufacturing industry in terms of employment, turnover and number of firms.

Table 5.1: Key Measures in Manufacturing and Services in Ireland, 1991-2007

<table>
<thead>
<tr>
<th></th>
<th>Manufacturing</th>
<th>Services*</th>
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<tbody>
<tr>
<td>Number of Firms</td>
<td>4,231</td>
<td>5,298</td>
</tr>
<tr>
<td>Number of Employees</td>
<td>194,433</td>
<td>222,963</td>
</tr>
<tr>
<td>Turnover (Millions Euro)</td>
<td>28,652</td>
<td>124,769</td>
</tr>
<tr>
<td>Gross Value added (Millions Euro)</td>
<td>10,228</td>
<td>37,482</td>
</tr>
<tr>
<td>Turnover per Employee</td>
<td>0.15</td>
<td>0.56</td>
</tr>
<tr>
<td>Gross Value added per Employee</td>
<td>0.05</td>
<td>0.17</td>
</tr>
<tr>
<td>Employee per firm</td>
<td>45.95</td>
<td>42.08</td>
</tr>
</tbody>
</table>

Note: *The services data is only available for the period 1999-2007

However, manufacturing firms are more productive in terms of turnover per employee and gross value added per employee. The productivity differential between both industries is related to the labour-intensive nature of the services industry relative to manufacturing (Uppenberg and Strauss, 2010). The services industry is also characterised by a lower MES, with an employee per firm ratio of 9.37 in 2007 relative to a manufacturing ratio of 42.08 in 2007. This is an indication of lower scale economies in the services. The lower scale economies

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economies are also confirmed by higher entry rates, with the number of service firms increasing by 94 per cent between 1999 and 2007, while number of manufacturing firms had grown by only 25 per cent in 2007. The significant rise in the number of firms in the services industry also illustrates the growing importance of this industry to the Irish economy during this period, as detailed earlier in Chapter 4.

Additionally, a comparison of the sample data employed in this analysis with the larger dataset outlined in Table 5.1, shows that the manufacturing sample represents 30.6 per cent and 24.4 per cent of the total population of manufacturing firms in Ireland in 1991 and 2007 respectively, whilst the services sample represents 0.97 per cent of the total population of services firms in Ireland in 2007. Based on the differences between the manufacturing and services industry highlighted above, performance in both industries is analysed and discussed separately in subsequent sections. A summary of mean sizes and growth rates for manufacturing firms is presented in Table 5.2 and Table 5.3, while Table 5.4 outlines mean sizes and growth rates in the services industry.

(i) Manufacturing Firms

Inspection of the manufacturing data reveals significant skewness in the data, as evidenced by the large variations between mean and median sizes—evidence of large variability in firm sizes (Tables 5.2 and 5.3). This wide variation in firm size implies heterogeneity in the performance of manufacturing firms consistent with the literature (e.g. Caves, 1998; Bartelsman and Doms, 2000). The skewness in turnover is however, more pronounced than that of the employment size distribution, suggesting the existence of larger differences in
turnover performance relative to employment performance in manufacturing firms in Ireland over the period 1991-2007. A comparison of the sub-periods, 1991-2000 and 2001-2007 for manufacturing shows a contraction of employment and turnover, with average employment growth declining from about 3.6 per cent in 1991-2000 to 0.1 per cent in 2001-2007 (Tables 5.2 and 5.3). There was also a considerable decline in mean turnover growth from 6.34 per cent to 2.72 per cent (Tables 5.2 and 5.3).

Table 5.2: Employment, Turnover and Productivity in Manufacturing, 1991-2000

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</thead>
<tbody>
<tr>
<td>Mean Employment</td>
<td>58.25</td>
<td>60.96</td>
<td>63.4</td>
<td>66.61</td>
<td>71.12</td>
<td>72.34</td>
<td>76.01</td>
<td>78.59</td>
<td>79.23</td>
<td>82.48</td>
<td>70.9</td>
</tr>
<tr>
<td>Median Employment</td>
<td>19.00</td>
<td>20.00</td>
<td>20.00</td>
<td>22.00</td>
<td>24.00</td>
<td>24.00</td>
<td>26.00</td>
<td>26.00</td>
<td>27.00</td>
<td>27.00</td>
<td>27.00</td>
</tr>
<tr>
<td>Mean Turnover</td>
<td>110.3</td>
<td>128.4</td>
<td>132.5</td>
<td>155.4</td>
<td>180.8</td>
<td>191.8</td>
<td>210.6</td>
<td>235.1</td>
<td>266.7</td>
<td>303.0</td>
<td>191.5</td>
</tr>
<tr>
<td>Mean Labour Productivity</td>
<td>1.18</td>
<td>1.2</td>
<td>1.17</td>
<td>1.27</td>
<td>1.32</td>
<td>1.38</td>
<td>1.41</td>
<td>1.44</td>
<td>1.51</td>
<td>1.56</td>
<td>1.34</td>
</tr>
<tr>
<td>Export share (%)</td>
<td>26.25</td>
<td>26.16</td>
<td>26.73</td>
<td>27.64</td>
<td>27.61</td>
<td>27.65</td>
<td>27.4</td>
<td>27.23</td>
<td>27.65</td>
<td>27.13</td>
<td>27.13</td>
</tr>
<tr>
<td>Import share (%)</td>
<td>46.65</td>
<td>37.86</td>
<td>36.66</td>
<td>36.87</td>
<td>37.97</td>
<td>37.54</td>
<td>36.43</td>
<td>35.53</td>
<td>36.77</td>
<td>38.03</td>
<td>38.03</td>
</tr>
<tr>
<td>Employment Growth (%)</td>
<td>2.77</td>
<td>3.91</td>
<td>5.1</td>
<td>4.99</td>
<td>3.72</td>
<td>4.57</td>
<td>3.66</td>
<td>2.04</td>
<td>1.62</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>Turnover Growth (%)</td>
<td>5.38</td>
<td>1.02</td>
<td>13.1</td>
<td>7.1</td>
<td>8.6</td>
<td>5.55</td>
<td>2.8</td>
<td>5.78</td>
<td>7.72</td>
<td>6.34</td>
<td></td>
</tr>
<tr>
<td>Productivity Growth (%)</td>
<td>2.66</td>
<td>-2.89</td>
<td>8.01</td>
<td>2.05</td>
<td>4.87</td>
<td>1.03</td>
<td>-0.92</td>
<td>3.74</td>
<td>6.16</td>
<td>2.75</td>
<td></td>
</tr>
</tbody>
</table>

Note: Turnover is stated in '000 Euro.
Source: Author’s calculations from the Census of Industrial Production, 1991-2007 dataset.
Table 5.3: Employment, Turnover and Productivity in Manufacturing, 2001-2007

<table>
<thead>
<tr>
<th></th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Employment</td>
<td>83.49</td>
<td>82.82</td>
<td>81.63</td>
<td>82.55</td>
<td>82.75</td>
<td>82.82</td>
<td>83.7</td>
<td>82.82</td>
</tr>
<tr>
<td>Median Employment</td>
<td>27.00</td>
<td>26.00</td>
<td>26.00</td>
<td>26.00</td>
<td>25.00</td>
<td>26.00</td>
<td>26.00</td>
<td>26.00</td>
</tr>
<tr>
<td>Mean Turnover</td>
<td>305</td>
<td>381.3</td>
<td>415.4</td>
<td>445.3</td>
<td>469.7</td>
<td>484.7</td>
<td>521.3</td>
<td>431.8</td>
</tr>
<tr>
<td>Median Turnover</td>
<td>21.01</td>
<td>20.91</td>
<td>21.51</td>
<td>22.94</td>
<td>24.14</td>
<td>25.82</td>
<td>26.73</td>
<td></td>
</tr>
<tr>
<td>Mean Labour Productivity</td>
<td>1.57</td>
<td>1.61</td>
<td>1.75</td>
<td>1.85</td>
<td>1.97</td>
<td>2.1</td>
<td>2.17</td>
<td>1.86</td>
</tr>
<tr>
<td>Export share (%)</td>
<td>30.57</td>
<td>31.72</td>
<td>31.19</td>
<td>30.11</td>
<td>29.82</td>
<td>28.39</td>
<td>29.02</td>
<td>30.12</td>
</tr>
<tr>
<td>Import share (%)</td>
<td>37.19</td>
<td>37.44</td>
<td>35.85</td>
<td>37.79</td>
<td>41.48</td>
<td>38.23</td>
<td>40.24</td>
<td>38.32</td>
</tr>
<tr>
<td>Employment Growth (%)</td>
<td>-0.71</td>
<td>-0.57</td>
<td>-0.72</td>
<td>0.23</td>
<td>-0.98</td>
<td>1.76</td>
<td>0.15</td>
<td>0.12</td>
</tr>
<tr>
<td>Turnover Growth (%)</td>
<td>-4.24</td>
<td>-0.88</td>
<td>6.05</td>
<td>4.26</td>
<td>3.46</td>
<td>6.14</td>
<td>4.24</td>
<td>2.72</td>
</tr>
<tr>
<td>Productivity Growth (%)</td>
<td>-3.37</td>
<td>-0.47</td>
<td>6.83</td>
<td>3.97</td>
<td>4.6</td>
<td>4.28</td>
<td>3.98</td>
<td>2.83</td>
</tr>
</tbody>
</table>

Note: Turnover is stated in '000 Euro.
Source: Author’s calculation from the Census of Industrial Production, 1991-2007 dataset.

The negative growth in employment, turnover and productivity shown by manufacturing firms over the years 2001-2003 is noteworthy. This period corresponds to a slowdown in the Irish economy, a reflection of factors such as the bursting of the dotcom bubble, a slowdown in global economic growth with a resultant contraction of export growth, as well as a contraction of domestic aggregate demand due to lower personal consumption (Department of Finance, 2003). However, there was an increase in employment, turnover and labour productivity in absolute terms over the two periods.

(ii) Services Firms

Table 5.4 outlines the mean sizes and growth rates for the services industry over the period, 2001-2007. A comparison of performance in both manufacturing and services also follows. Examination of the data on services reveals skewness in the size distribution similar to manufacturing, with considerable variations between mean and median sizes over the sample
period. This suggests large variations in the performance of services firms. Average firm sizes increased over the period in both manufacturing and services.

Table 5.4: Employment, Turnover and Productivity in Services, 2001-2007

<table>
<thead>
<tr>
<th></th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Employment</td>
<td>145.8</td>
<td>146.8</td>
<td>145</td>
<td>146.4</td>
<td>155.1</td>
<td>161.5</td>
<td>167.6</td>
<td>152.6</td>
</tr>
<tr>
<td>Median Employment</td>
<td>42.00</td>
<td>42.00</td>
<td>42.00</td>
<td>43.00</td>
<td>45.00</td>
<td>46.00</td>
<td>47.00</td>
<td>43.90</td>
</tr>
<tr>
<td>Mean Turnover</td>
<td>193.1</td>
<td>204.9</td>
<td>212.7</td>
<td>198.1</td>
<td>200.6</td>
<td>208.4</td>
<td>228.3</td>
<td>206.6</td>
</tr>
<tr>
<td>Median Turnover</td>
<td>33.65</td>
<td>33.13</td>
<td>33.65</td>
<td>34.54</td>
<td>34.27</td>
<td>36.12</td>
<td>37.29</td>
<td>34.66</td>
</tr>
<tr>
<td>Mean Labour Productivity</td>
<td>1.9</td>
<td>1.84</td>
<td>1.86</td>
<td>1.75</td>
<td>1.61</td>
<td>1.51</td>
<td>1.56</td>
<td>1.72</td>
</tr>
<tr>
<td>Mean Export</td>
<td>28.39</td>
<td>38.04</td>
<td>54.81</td>
<td>39.91</td>
<td>39.36</td>
<td>37.13</td>
<td>35.07</td>
<td>38.96</td>
</tr>
<tr>
<td>Mean Import</td>
<td>41.64</td>
<td>52.01</td>
<td>59.43</td>
<td>36.91</td>
<td>51.52</td>
<td>66.19</td>
<td>59.05</td>
<td>52.4</td>
</tr>
<tr>
<td>Employment Growth (%)</td>
<td>2.75</td>
<td>0.83</td>
<td>1.03</td>
<td>2.51</td>
<td>3.39</td>
<td>0.93</td>
<td>1.91</td>
<td></td>
</tr>
<tr>
<td>Turnover Growth (%)</td>
<td>-3.02</td>
<td>1.85</td>
<td>2.84</td>
<td>1.35</td>
<td>1.98</td>
<td>4.31</td>
<td>1.55</td>
<td></td>
</tr>
<tr>
<td>Productivity Growth (%)</td>
<td>-5.77</td>
<td>1.02</td>
<td>1.73</td>
<td>-1.01</td>
<td>-1.48</td>
<td>3.37</td>
<td>-0.36</td>
<td></td>
</tr>
</tbody>
</table>

Note: Turnover, Exports and Imports stated in '000 Euro.
Source: Author’s calculations from the Annual Services Inquiry, 1999-2007

Furthermore, comparing performance in both manufacturing and services over the period 2001-2007, services firms outperformed manufacturing firms in terms of employment growth (1.91 per cent), while manufacturing turnover growth (2.72 per cent) is higher. This finding is consistent with O’Hearn (2003) who noted that output growth during the period of rapid economic growth in Ireland was driven by growth in manufacturing, while employment growth was fuelled by growth in the services, (as detailed earlier in Chapter 4). Moreover, firms in the services employ a higher number of personnel, about 70 persons more than manufacturing, while manufacturing firms generate higher mean turnover (430 000 Euros) over the period (Tables 5.3 and Table 5.4). Consequently, manufacturing firms are more
productive, showing higher levels of productivity relative to the services (Tables 5.3 and Table 5.4). This mirrors the finding by Teruel-Carrizosa (2010) for Spanish manufacturing and services SMEs. Turnover growth in the services was also negative in 2002, an outcome of the downturn in the economy at the time as outlined previously in Chapter 4. The negative productivity growth performance in the services industry over the period 2001-2007 is also noteworthy (Table 5.4). This poor productivity growth performance may be linked to the fact that the strong employment growth shown in the services industry during this period was not associated with a commensurate growth in output.

Summary

Overall, examination of the mean sizes and growth rates in the sample of manufacturing and services firms in Ireland has provided evidence of considerable size distribution consistent with empirical evidence from other countries (Cabral, 2007; Gil, 2010). In addition, an evaluation of performance across the two sub-periods, 1991-2000 and 2001-2007, showed that manufacturing firms had lower and negative growth rates in the latter period, coinciding with a period of lower GDP growth in the Irish economy. This finding suggests that firm performance varies with changes in macroeconomic conditions. Finally, a comparison of manufacturing and services performance over the period 2001-2007, highlights performance differences. Manufacturing firms showed better performance in terms of turnover and productivity growth, while services firms employed more workers in the same period. The findings above reflect differences in scale intensities between manufacturing and services firms. Given the observed heterogeneity of firms noted in the literature review in Chapter 2, (and also observed for the sample of firms in the current
study, further analyses are required to better explore the sources of performance differentials. The firm size distribution is now analysed in terms of certain firm characteristics such as size, industry, region and ownership. All of which are potential sources of heterogeneity in performance.

5.2.1 Analysis of Firm Size Distribution

As previously discussed in the literature review chapter, there is considerable heterogeneity across firms arising from various sources which include firm-specific characteristics (such as size, age, technological intensity and nationality of ownership), innovative activity and labour composition (Barrios et al, 2005; Benfratello and Razzolinni, 2007; Castellani and Giovannetti, 2010). In view of the multiplicity of factors which may cause differences across firms, it is essential to highlight potential sources of heterogeneity in firms in Ireland in order to identify factors which influence their subsequent performance. To this end, heterogeneity in the firm size distribution is analysed in terms of firm characteristics which include size, ownership, location, and trade status. Furthermore, heterogeneity in firms even within the same narrowly defined industries (Caves, 1998; Bartelsman and Doms, 2000) implies that performance within a given industry (e.g. manufacturing) should also be analysed to provide insights on whether (how) performance varies across industries. Thus, the manufacturing and services industries are disaggregated into industries, with a view to analysing the performance of firms within the industries in terms of size and growth. First, the size distribution is examined in terms of size across both manufacturing and services. To examine firm characteristics across size classes, the sample is disaggregated into size classes based on the firm size at the beginning of the period. Four size categories are
identified based on the European Commission (2003) definitions: micro-sized firms (1-9 employees), small firms (10-49 employees), medium-sized firms (50-249 employees) and large firms (>250 employees). This definition is in line with other Irish studies (e.g. Task Force on Small Business Report, 1994; CSO, 2008c; Hynes, 2010). The firm size distribution in manufacturing is now analysed.

(i) Size distribution in manufacturing by size class

The manufacturing size distribution based on industry classification is presented in Table 5.5. Splitting manufacturing firms into size classes by industry further reveals a skewed size distribution, characterised by a few medium and large firms with many micro and small firms. SMEs account for 69 per cent of the total number of firms in the sample broken down as follows: small firms (51 per cent) and medium firms (18 per cent), whereas micro firms constitute 26 per cent of the total number of firms. This is consistent with evidence in the literature (Lotti and Santarelli, 2004; Coad, 2007; Gil, 2010).
### Table 5.5: Classification of Manufacturing Firms by Industry and Size Classes

<table>
<thead>
<tr>
<th>Industry</th>
<th>Micro</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Products &amp; Beverages (15)</td>
<td>38</td>
<td>105</td>
<td>65</td>
<td>18</td>
<td>226</td>
</tr>
<tr>
<td>Textiles (17)</td>
<td>8</td>
<td>37</td>
<td>4</td>
<td>0</td>
<td>49</td>
</tr>
<tr>
<td>Wearing Apparel; Leather &amp; Leather Products (18,19)*</td>
<td>5</td>
<td>16</td>
<td>3</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Wood &amp; Wood Products (20)</td>
<td>29</td>
<td>37</td>
<td>9</td>
<td>0</td>
<td>75</td>
</tr>
<tr>
<td>Pulp, Paper &amp; Paper products (21)</td>
<td>4</td>
<td>20</td>
<td>14</td>
<td>0</td>
<td>38</td>
</tr>
<tr>
<td>Publishing &amp; Printing, Reproduction of Recorded Media (22)</td>
<td>54</td>
<td>77</td>
<td>13</td>
<td>5</td>
<td>149</td>
</tr>
<tr>
<td>Chemicals &amp; Chemical Products (24)</td>
<td>10</td>
<td>41</td>
<td>26</td>
<td>10</td>
<td>87</td>
</tr>
<tr>
<td>Rubber &amp; Plastic Products (25)</td>
<td>12</td>
<td>47</td>
<td>15</td>
<td>1</td>
<td>75</td>
</tr>
<tr>
<td>Other non-metallic mineral products (26)</td>
<td>25</td>
<td>47</td>
<td>13</td>
<td>4</td>
<td>89</td>
</tr>
<tr>
<td>Basic Metals (27)</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Fabricated Metal Products except Machinery &amp; Equipment (28)</td>
<td>55</td>
<td>63</td>
<td>15</td>
<td>1</td>
<td>134</td>
</tr>
<tr>
<td>Machinery &amp; Equipment n.e.c. (29)</td>
<td>30</td>
<td>50</td>
<td>9</td>
<td>7</td>
<td>96</td>
</tr>
<tr>
<td>Office Machinery &amp; Computers; Radio, Television &amp; Communication Equipment &amp; Apparatus (30, 32)*</td>
<td>0</td>
<td>1</td>
<td>8</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Electrical Machinery &amp; Apparatus n.e.c. (31)</td>
<td>8</td>
<td>14</td>
<td>11</td>
<td>2</td>
<td>35</td>
</tr>
<tr>
<td>Medical, Precision &amp; Optical Instruments, Watches &amp; Clocks (33)</td>
<td>10</td>
<td>17</td>
<td>7</td>
<td>9</td>
<td>43</td>
</tr>
<tr>
<td>Motor Vehicles, Trailers &amp; Semi-trailers (34)</td>
<td>8</td>
<td>18</td>
<td>4</td>
<td>1</td>
<td>31</td>
</tr>
<tr>
<td>Other Transport Equipment (35)</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Manufacturing n.e.c.; Coke, Refined Petroleum Products &amp; Nuclear Fuel; Tobacco Products (36,37,23,16)*</td>
<td>41</td>
<td>57</td>
<td>11</td>
<td>3</td>
<td>112</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>342</td>
<td>656</td>
<td>231</td>
<td>66</td>
<td>1295</td>
</tr>
</tbody>
</table>

Source: Author’s calculation from CIP dataset, 1991-2007

Note: *Due to CSO confidentiality policy the following industries with 2 digit Nace Rev.1.1 codes, Wearing Apparel; Leather & Leather Products (18,19); Office Machinery & Computers; Radio, Television & Communication Equipment & Apparatus (30, 32); Manufacturing n.e.c.; Coke, Refined Petroleum Products & Nuclear Fuel; Tobacco Products (36,37,23,16) are aggregated.

The largest concentration of manufacturing firms is located in the Food and Beverages (17 per cent), Publishing and Printing (12 per cent) and Fabricated Metal Products industries (10 per cent) respectively. Furthermore, the highest proportion of micro-sized firms (16 per cent) can be found in the Fabricated Metal Products industry accounting for 41 per cent of the total number of firms in this industry, while the largest concentration of large firms is observed in
Food and Beverages (27 percent), Chemicals and Chemical products (15 percent) and Medical, Precision and Optical instruments industry (14 percent). The significant presence of large firms in the high-tech industries (NACE codes 24, 29-35) should also be noted, accounting for 48 percent of the total number of firms in these industries. This finding is consistent with Delmar and Wennberg (2010) who also found that the high-tech manufacturing industry in Sweden was dominated by large firms over the period 1989-2002.

Next, the size distribution in services is analysed by industry.

(ii) Size distribution in services by size class

The distribution of firms in the services industry by size class and industry is outlined in Table 5.6. A disaggregation of firms in the services industry into size classes reveals a highly skewed distribution; 90 percent of firms in the services are SMEs broken down as: small firms (55 percent) and medium firms (35 percent), while 3 percent of the firms are micro firms. However, the services firm size distribution is somewhat more concentrated in the middle, with small and medium firms accounting for 90 percent of total firms, contrasting with 69 percent observed for manufacturing firms. The smaller firm sizes observed for services firms (relative to manufacturing firms) suggests the presence of lower scale economies in the services sample as highlighted earlier in Section 5.1. Micro-sized firms also account for a lower proportion of the services firm distribution (3 percent) relative to manufacturing (26 percent). This observation should however be treated with caution, as the ASI survey consists of a census of all enterprises with 20+ employees and a random stratified
sample of enterprises with less than 20 employees as detailed previously\(^6\). This implies that firms with less than 20 employees could possibly be under-represented in the sample, which might introduce some bias into the analysis.

### Table 5.6: Classification of Service Firms by Industry and Size Classes

<table>
<thead>
<tr>
<th>Industry</th>
<th>Micro</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel (50)</td>
<td>1</td>
<td>65</td>
<td>17</td>
<td>1</td>
<td>84</td>
</tr>
<tr>
<td>Wholesale trade and commission trade, except of motor vehicles and motorcycles (51)</td>
<td>2</td>
<td>104</td>
<td>54</td>
<td>7</td>
<td>167</td>
</tr>
<tr>
<td>Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods (52)</td>
<td>13</td>
<td>67</td>
<td>50</td>
<td>18</td>
<td>148</td>
</tr>
<tr>
<td>Hotels and restaurants (55)</td>
<td>2</td>
<td>80</td>
<td>102</td>
<td>3</td>
<td>187</td>
</tr>
<tr>
<td>Transport, storage and communications (60,62,63,64)*</td>
<td>1</td>
<td>26</td>
<td>16</td>
<td>8</td>
<td>51</td>
</tr>
<tr>
<td>Real estate activities (70)</td>
<td>1</td>
<td>7</td>
<td>3</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Renting of machinery and equipment without operator and of personal and household goods (71)</td>
<td>0</td>
<td>8</td>
<td>4</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>Computer and related activities (72)</td>
<td>1</td>
<td>9</td>
<td>7</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>Research and development (73)</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Other business activities (74)</td>
<td>7</td>
<td>82</td>
<td>54</td>
<td>17</td>
<td>160</td>
</tr>
<tr>
<td>Recreational, cultural and sporting activities (92)</td>
<td>1</td>
<td>35</td>
<td>12</td>
<td>1</td>
<td>49</td>
</tr>
<tr>
<td>Other service activities (93)</td>
<td>2</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>497</td>
<td>320</td>
<td>57</td>
<td>905</td>
</tr>
</tbody>
</table>

Source: Author’s calculation from ASI dataset, 2001-2007
Note: *Due to CSO confidentiality rules, NACE industries 60, 62, 63 and 64 are aggregated. Figures in parentheses are 2-digit NACE Rev.1.1 codes.

The Hotels and Restaurants, Wholesale Trade, Other Business Activities industries account for 21 per cent, 18 per cent and 18 per cent of total firms respectively, whereas Retail Trade

\(^6\)A sampling rate of 1/10 is used for enterprises with less than 9 employees and a 4/9 sampling rate is used for enterprises with 10-19 employees (CSO, 2009).
has the largest population of micro firms (42 per cent) and large firms (32 per cent). There are no micro firms represented in Renting of machinery and Research and Development industries, while only one micro firm is located in the Transport, Storage and Telecommunications and Computer and Related Activities industries respectively. Entry into industries such as Air Transport, Post and Telecommunications is commonly regulated by the government, with firms requiring operating licenses and permits which may raise investment costs. This may limit the entry of micro firms, which are usually prone to financial constraints. Upfront investment required in developing new products/technology, as well as the costs associated with protection of intellectual property such as patents and trademarks may also deter the entry of new firms, particularly, small firms in to industries such as Research and Development. The analysis of the firm size distribution by size category in terms of industry classification has revealed significant skewness in both manufacturing and services industries. It is therefore valuable to also examine other sources of heterogeneity that may potentially influence performance outcomes in firms in Ireland.

(iii) Size distribution by ownership

Given the relative importance of foreign firms in the Irish economy (accounting for 22 per cent and 44 per cent of total employment and turnover respectively in 2009 [CSO, 2012b: p6, p33]), a comparison of Irish and foreign firms is essential to determine what differences exist between both groups of firms. Here, ownership is defined in terms of nationality of ownership, where a firm is defined by the CSO as foreign based on the nationality of ownership of 50 per cent of the share capital. To begin with, the classification of firms by industry, size class and nationality of ownership is examined. This offers insights on the
variations in the distribution of foreign and domestic firms in terms of industry and size class. Figure 5.1 highlights the sectoral concentration of foreign and domestic manufacturing firms in Ireland over the period 1991-2007.

Indeed, 122 of the 214 foreign manufacturing firms (57 per cent) in the sample are found in high-tech industries. The foreign high-tech firms are largely concentrated in office machinery and computers, chemicals, and medical devices industries accounting for 72.7 per cent, 56.3 per cent and 55.8 per cent of the total number of firms in the industries respectively (Figure 5.1). This finding provides supporting evidence on the sectoral concentration of foreign manufacturing firms in high-tech industries as discussed previously in Chapter 4 (Section

Figure 5.1: Classification of Manufacturing Firms by Industry and Ownership

Source: Author’s calculation from CIP dataset, 1991-2007
4.2. Furthermore, disaggregation of the sample by size class and nationality of ownership indicates that foreign manufacturing firms are more likely to be found in the medium and large size class (Figure 5.2).

**Figure 5.2: Classification of Manufacturing Firms by Size Class and Ownership**

![Classification of Manufacturing Firms by Size Class and Ownership](image)

Source: Author’s calculation from CIP dataset, 1991-2007

Based on Figure 5.2, it can be observed that about 73 percent of large manufacturing firms have foreign ownership, while about 87 percent and 97 percent of micro-sized firms and small firms are Irish-owned. This illustrates variations in mean sizes between foreign and domestic firms in Ireland. Figure 5.3 presents the manufacturing size distribution by nationality of ownership. This further accentuates the size differences between foreign-owned and domestic manufacturing firms, where size is defined in terms of mean turnover and mean employment. Large size differentials can be observed from Figure 5.3, consistent with empirical evidence that foreign firms tend to be larger, more productive and pay higher wages (Girma et al., 2001; Oliveira and Fortunato, 2006a). This is also in line with findings.
by Ruane and Sutherland (2004) for manufacturing and internationally-traded services firms in Ireland.

**Figure 5.3: Size Distribution in Manufacturing by Ownership**

![Size Distribution in Manufacturing by Ownership](image)

Source: Author’s calculations from CIP dataset
Note: Employment is stated in numbers, while turnover is in ‘000 Euro.

Most noticeable, however, is the large gap between Irish and foreign turnover, which Arora and Gambardella (2005) suggested may be due to accounting purposes rather than higher value added, given the nature of multinational operations located in Ireland as indicated in Chapter 4 (Section 4.2). To examine whether a size differential exists within the services, mean firm sizes in the services industry are also analysed by nationality of ownership. Similar to manufacturing, the distribution of services firms in terms of industry, size class and nationality of ownership is examined. Figure 5.4 outlines the distribution of services firms by industry and nationality of ownership.
The sectoral concentration of foreign firms is less pronounced in the services, with the largest numbers found in the knowledge-intensive industries: computer and related activities (27.8 per cent), air transport (25.5 per cent) and research and development (100 per cent)\(^{47}\), as well as in the less knowledge-intensive industry: wholesale trade (Figure 5.4). In contrast, the other activities in the industry are completely dominated by micro-sized and small Irish-owned services firms (See Table 5.6). Having examined the distribution of services firms based on industry and nationality of ownership classification, the size distribution in terms of size categories and nationality of ownership is analysed. Figure 5.5 presents a breakdown of services firms by size class and nationality of ownership.

\(^{47}\)It should be noted that after data cleaning, which involved the exclusion of firms found switching between size classes, as detailed previously in Chapter 3 (Section 3.4.2), there were only two foreign firms left in the sample in this industry.
Similar to manufacturing, size differences between foreign and domestic firms can be observed in the sample, with the largest proportion of foreign services firms found in the medium (15.6 per cent) and large (36.8 per cent) size categories (Figure 5.5). This size effect is, nonetheless, less pronounced relative to manufacturing. To further demonstrate variations in sizes between foreign and domestic services firms, Figure 5.6 highlights significant differences in the employment and turnover size performance of foreign and domestic firms in the services industry. First, Figure 5.6 reveals size disparities between manufacturing and services, with manufacturing firms earning more turnover, while firms in the services industry, on average, employ more workers as noted earlier in the chapter. This further demonstrates differences in scale intensities between both industries. A foreign-domestic dichotomy can also be found in the services industry, which is somewhat different in nature to manufacturing. Although foreign services firms had larger employment and turnover performance, the foreign employment gap is larger compared to manufacturing, while the
turnover gap is smaller, though still substantial (Figure 5.6). Heterogeneity in firm sizes in firm sizes by location is examined below.

**Figure 5.6: Size Distribution in Services Industry by Ownership Type**

![Size Distribution in Services Industry by Ownership Type](image)

Source: Author’s calculations from ASI dataset
Note: Employment is stated in numbers, while turnover is in ‘000 Euro.

**(iv) Size Distribution by Location**

Location is important to firm success since it determines access to markets, labour, and specialised knowledge and inputs (Barbosa, 2011). Firms located in certain regions and cities perform better than others due to some advantage (such as availability of skilled labour, large market and cheap inputs) inherent in the location. Therefore, the size distribution is now analysed in terms of location based on NUTS 3 and NUTS 2 level of classifications for manufacturing and services respectively. Location data for the services industry is only available at the NUTS 2 level. The Nomenclature of Territorial Units for Statistics (NUTS) is a regional classification code used in delineating regions in Ireland for statistical purposes. NUTS 2 regions comprises of Border, Midland and Western (BMW) and Southern and
Eastern (SE) regions. At the NUTS 3 level, the SE region comprises of Mid-east, Mid-west, South-east, South-west and Dublin regions, while the BMW region consists of the Border, Midland and Western regions. Regional differences in mean manufacturing firm sizes are highlighted in Figure 5.7.

**Figure 5.7: Size Distribution in Manufacturing by Location**

![Bar chart showing size distribution in manufacturing by location](image)

Source: Author’s calculations from CIP dataset
Note: Employment is stated in numbers, while turnover is in '000 Euro.

Employment levels are comparable across regions. A wide disparity in terms of turnover is, however, shown between the South-west and other regions, indicating the South-west region (Counties Kerry and Cork) is more productive with respect to output (Figure 5.7). This disparity may be related to the fact that the region is the headquarters of a significant number of large multinationals in high-tech industries such as ICT, Biopharma/Pharma and Medical Technologies (IDA Ireland, 2013). Multinationals in the South-west region include Pfizer, GlaxoSmithKline, and Johnson & Johnson in the Pharmaceuticals industry, as well as Apple, EMC and McAfee in the ICT industry (IDA Ireland, 2013).
Similar to manufacturing, Figure 5.8 shows wide variations in services employment and turnover between the SE and BMW regions. This may also be related to the presence of a large number of multinationals in the SE region (Dublin and the South-west region are located within the SE region, as noted earlier). The SE region, specifically Dublin, is home to a number of major multinationals in the financial services, international services and digital media industries such as Google, eBay, Amazon and Yahoo. Moreover, the International Financial Services Centre (IFSC) in Dublin is home to about 400 financial services firms, which include global firms such as Citigroup, ING and AON Insurance (IDA Ireland, 2013). These findings suggest regional disparities matter in the analysis of firm performance in Ireland as highlighted in Chapter 4 (Section 4.2).

Figure 5.8: Size Distribution in Services by Location

![Diagram showing size distribution in services by location (2001-2007)]

Source: Author’s calculations from ASI dataset
Note: Employment is stated in numbers, while turnover is in ‘000 Euro.
Size distribution by trade status

Trade is an important part of the Irish economy, given the size of the economy, as well as the significant trade activities of multinationals in the country. Traders (i.e., firms who either export or import or do both) have been found to be larger and more productive than non-traders in Ireland (Haller, 2012; Gleeson and Ruane, 2009). Given, the relative importance of trade to the Irish economy, the firm size distribution of manufacturing and services is analysed in terms of trade status, to highlight heterogeneity in firm sizes across firms with varying trade status.

Two-way traders who both export and import are considerably larger, followed by firms who export only in the manufacturing industry (Figure 5.9). The wide disparity in turnover between two-way traders and other groups of firms is quite noteworthy and possibly linked to the operations of multinationals using Ireland as an export platform, as well as importing intermediate inputs or capital goods from affiliates. However, based on available data, it is not possible to differentiate intra-firm trade (purchase of intermediate goods from affiliates abroad) from other trade categories (Haller, 2012).
The size distribution in the services industry, in terms of trade status, is provided in Figure 5.10. With respect to employment, two-way traders and importers are comparable in size, whilst non-trading firms and exporters have similar average sizes. As with manufacturing, a significant gap in the turnover of two-way traders and other firms is shown, while importers are larger than exporters.
Summary

Based on the size heterogeneity observed in the analysis of firm size distribution by industry classification, the dispersion in sizes was analysed in terms of ownership, location and trade status. This revealed a remarkable gap between foreign and domestic firms, particularly in terms of turnover. Wide size disparities in terms of location and trade status were also highlighted, with considerable differences in mean sizes shown between the South-west and other regions, as well as between the SE and BMW regions. With regard to trade status, a large size differential was found between two-way traders and other trade categories. These results were quite similar across both manufacturing and services and seem to suggest that multinational operation in Ireland is a likely contributory factor to the observed size differences across regions and trade status.
(1) **Mean Employment and Turnover by Industry in Manufacturing Firms**

Having examined heterogeneity across two industries (manufacturing and services) in terms of size, nationality of ownership, location and trade status, it is appropriate to investigate intra-industry differences. An examination of intra-industry performance reveals performance in individual industries, which may otherwise be missed when aggregate industry performance is considered. It has been argued, that the larger the MES in a given industry, the more quickly a firm has to grow to attain the industry MES in order to survive (Audretsch et al, 2004; Delmar and Wennberg, 2010). Accordingly, firms in industries with a large MES (i.e. employee per firm and turnover per firm) will show higher growth performance. Analysing the mean sizes across industries, therefore, contributes to our knowledge as to how size variations may impact on subsequent firm performance. Following on from this, the performance of firms in two-digit industries for both manufacturing and services industries is considered in the discussion which follows. First, the size distribution of firms is examined followed by their growth performance.

Figure 5.11 presents a sectoral breakdown of mean sizes (employee per firm and turnover per firm) by 2-digit manufacturing industry classification, which reveals remarkable differences across the industries. Office machinery and computers had the largest mean size of 565 employees per firm, generating an average turnover of €2.9 million per firm (Figure 5.11). The chemicals industry had a mean turnover of about €1.5 million per firm, and an average of 135 employees, whilst medical devices had a mean of 189 employees with a average turnover of €299,290.
The Food and beverages industry had 105 employees per firm and a mean turnover of €421,670. The smallest mean size in terms of employment and turnover was found in the textiles and fabricated metal products industries, with about 30 employees per firm and an average turnover of €23,870 and €30,900 respectively. The small mean sizes found in these two industries may be related to the predominance of small and micro-sized firms, accounting for 92 percent and 88 percent of the total number of firms in the textiles and fabricated metal products industries (Table 5.5). However, it should be noted that aggregation of the
Office Machinery and Computers, Radio, Television and Communication Equipment and Apparatus industries may overstate their contribution. Nevertheless, this finding indicates a high degree of concentration of firms in the two aggregated industries, with only 11 firms represented in both industries (Table 5.5). Similarly, the medical devices and other transport industries show a high concentration of firms with 43 firms and 12 firms respectively. The high degree of concentration in these industries is possibly due to the higher capital intensity associated with these high-tech industries which may limit the number of firms able to gain entry into such industries.

Moreover, Figure 5.11 also illustrates the significant contribution of high-tech industries (Chemicals, Office Machinery and Computers, and Medical Devices) to output and employment in Ireland, in terms of average numbers employed and turnover generated, as highlighted earlier in Chapter 4 (Section 4.2). The remarkable divergence between employment and turnover in the high-tech industries is also noteworthy. This is related to the transfer pricing practices of multinational firms predominantly located in these industries, as indicated earlier in Chapter 4. Having examined mean sizes across manufacturing industries, the mean employment and turnover growth in individual industries is analysed in the next section. This offers insights as to whether growth differentials exist across industries during the two growth phases (1991-2000; 2001-2007).
Mean Manufacturing Employment and Turnover Growth by Industry

An analysis of manufacturing growth by industry over the period of analysis reveals performance differences across the two sub-periods. In the first part of the period (1991-2000), all industries show high growth rates in terms of employment and turnover growth (Figure 5.12), with the exception of wearing apparel and leather products which showed declining employment growth, a reflection of competition from low-cost locations in Asia and Eastern Europe and the shift to higher value added and services activities in the Irish economy (See discussion in Chapter 4).

Figure 5.12: Mean Employment and Turnover Growth in Manufacturing, 1991-2000

Source: Author’s calculations from CIP dataset

Note: Due to confidentiality policy, the following industries with 2 digit Nace Rev.1.1 codes: Wearing Apparel; Leather & Leather Products (18, 19); Office Machinery & Computers; Radio, Television & Communication Equipment & Apparatus (30, 32); Manufacturing n.e.c.; Coke, Refined Petroleum Products & Nuclear Fuel; Tobacco Products (36, 37, 23, 16) are aggregated.
The highest growth in turnover during the period 1991-2000 is found in the office machinery and computers industry, which appears to support the argument that firms in industries with large MES show higher growth rates, as detailed earlier. Overall, the best performers in this growth phase were the high-tech industries, which were identified in Chapter 4 as the major drivers of Irish economic growth during this period. In the latter part of the period (2001-2007), the manufacturing industry demonstrates worsening performance, with downsizing occurring in almost all industries (except food and beverages, chemicals, other non-metallic and fabricated metal) as detailed in Figure 5.13. The chemicals industry was the best performer reflecting the importance of this high-tech industry in the Irish economy. As detailed previously in Chapter 4 (Section 4.3), the poor manufacturing performance experienced during this credit-led domestic demand-driven growth phase was due to plant closures, downsizing, and a shift to services resulting from the loss of cost competitiveness in the Irish economy.
The discussion presented above has highlighted performance differences across firms in the manufacturing industry when broken down into 2-digit industries. It was also shown that firm performance in terms of employment and turnover growth varied with macroeconomic performance, with firms showing poorer performance in the domestic demand-driven growth phase relative to the export-led growth phase. Going forward, a sectoral disaggregation is also carried out for the services industry to provide insights on whether performance disparities can also be found within industries in the services.
(3) Mean Size and Growth by Industry in Services Firms

Figure 5.14 outlines firm size performance in the services industry in Ireland over the period 2001-2007. The industries with the largest average size in terms of employment and turnover are transport, storage and communications (this result should be interpreted with caution since it is an aggregation of four industries as noted below), wholesale trade and retail trade. However, in contrast to manufacturing, the higher number of firms in the above services industries provides evidence of lower scale intensities and lower concentration of firms in the services (See Table 5.6). A large disparity between employment and turnover is also noticeable in the transport, storage and communications, wholesale trade and motor vehicle trade industries.
Haller (2011) using the ASI dataset to examine whether domestic firms benefit from foreign competition over the period 2001-2007, noted that only a small number of foreign-owned firms located in wholesale and retail trade; transport, storage and communication and real estate, renting and business activities, make significant contributions to total employment and output in these industries. Hence, the observed employment-output gap may be related to the activities of foreign firms in these industries. In terms of growth performance, the sectoral disaggregation shows heterogeneity in growth across the industries during the period. The retail trade and renting of machinery industries had the highest increase in employment, while research and development and other services industries had declining employment. Hotels...
and restaurants, real estate and motor vehicle trade showed the lowest decrease in turnover, while other business activities and other service activities industries had the best turnover growth performance.

Figure 5.15 Mean Employment and Turnover Growth in Services, 2001-2007

Source: Author’s calculations from ASI dataset, 2001-2007
Note: Due to CSO confidentiality rules, NACE industry Land Transport (60), Air Transport (62), Supporting and auxiliary transport activities (63) and Post and telecommunications (64) are aggregated.

With regard to performance in the knowledge-intensive industries, (based on the OECD high-tech classification), renting of machinery and other business activities show high growth performance. However, the employment growth shown in renting of machinery industry is not commensurate with turnover growth achieved within the same period. Overall, the analysis of firm performance by industry in the services industry has identified performance variations within individual industries, similar to manufacturing. Given the lack of
comparable data on the performance of firms during the first growth period in Ireland, it is not possible to determine whether the observed performance in the services industry during the second growth period is related to the prevailing macroeconomic conditions in the Irish economy. However, based on the discussion presented in Chapter 4 (Section 4.3.2), it is likely that the declining growth showed in some of the industries may be related to macroeconomic performance.

**Summary**

In conclusion, the descriptive analysis of firm size distribution in the manufacturing and services industries in Ireland undertaken in this section has highlighted heterogeneity in firm sizes, with a few large firms and many small firms in the sample in line with evidence from other countries (Lotti and Santarelli, 2004; Gil, 2010). Considerable variations in performance between foreign and indigenous firms, across regions, industries and trade status were also observed. In addition, the industrial disaggregation in both manufacturing and services industries provided evidence of performance heterogeneity even within the same industry, as indicated by the substantial differences found between employment and turnover in several of the industries. Consequently, the observed large size dispersions imply that foreign firms, firms located in the South-west region (SE region for services firms), high-tech and knowledge-intensive firms, as well as firms which both export and import produce more output and employ more workers. Following from this, the observed skewness in the firm size distribution suggests the assumption of lognormality may not be valid in this sample of manufacturing and services firms in Ireland. This implies that firm growth is determined by
firm size and GL may not be confirmed in the sample. However, formal tests of normality, as outlined in Section 5.2.2, are required to confirm this.

5.2.2 Testing for Log Normality of Size Distribution

Graphical tests undertaken in Chapter 3 (Section 3.5.4) have provided initial evidence of non-normality of the size distribution in both manufacturing and service firms, signifying GL is not valid in the sample. Statistical tests are now required for additional testing of the normality assumption. To this end, skewness, kurtosis and Shapiro-Francis normality tests are undertaken in this section. Results are reported in Tables 5.7 and 5.8 for the manufacturing and services industries respectively.

| Table 5.7: Skewness, Kurtosis and Shapiro-Francia Normality Tests- Manufacturing |
|-----------------------------------|-----------------|------------------|-----------------|-----------------|
| Skewness                        | Kurtosis       | Shapiro-Francia  |
| Log Employment                  | 0.6268         | 3.1216           | 0.9744          | 21.559          | 0.182           | 0.4278          |
| Log Turnover                    | 0.7326         | 3.6182           | 0.9660          | 28.617          | 0.183           | 0.4275          |
| Observations                    |                |                  | 22015           |                 |                 |                 |

Source: Author’s calculations from CIP dataset.

| Table 5.8: Skewness, Kurtosis and Shapiro-Francia Normality Tests- Services |
|-----------------------------------|-----------------|------------------|-----------------|-----------------|
| Skewness                        | Kurtosis       | Shapiro-Francia  |
| Log Employment                  | 1.2039         | 6.8253           | 0.9134          | 96.150          | 2.995           | 0.0014          |
| Log Turnover                    | 0.7126         | 4.225            | 0.9716          | 31.489          | 2.800           | 0.0026          |
| Observations                    |                |                  | 6335            |                 |                 |                 |

Source: Author’s calculations from ASI datasets.
The statistical tests confirm the size distribution deviates from the normal for log employment and log turnover with kurtosis greater than 3 and skewness greater than zero in manufacturing and services firms, indicating right skewness and thicker tails\(^{48}\). However, the distribution of log size for manufacturing firms more closely resembles a normal distribution in comparison to the log size distribution for services. This further substantiates the finding from disaggregating the sample into size classes in Section 5.2.1, that 90 percent of the services firms are SMEs, while SMEs constitute 69 percent of the manufacturing sample. The statistical test for manufacturing firms fails to reject the null hypothesis of normality in the employment and turnover size distribution with p-values of 0.42 and 0.43 respectively (Table 5.7).

On the other hand, the observed size distributions for log employment and log turnover in services do not conform to the lognormal distribution, as the null hypothesis of normality is rejected with p-values of 0.001 and 0.002 respectively (Table 5.8). Although, this result is a violation of the hypothesis that firm size is randomly determined, this, however, only provides indirect evidence that GL is not valid in the sample and further tests are required. To sum up, the statistical tests of normality carried out in this section support the skewness of the firm size distribution observed in Section 5.2.1 for both manufacturing and services industries. This is in line with emerging evidence on the right skewness of the firm size distribution, indicating the presence of more small firms than large firms (Caves, 2007; Gill, 2010). To further test the validity of GL in the sample, the mobility of firms across size classes is examined in the section below.

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\(^{48}\)A distribution is normal if skewness and kurtosis equal zero and three respectively.
5.2.3 Firm Mobility: Matrix of Size Distribution

To examine the ability of firms to move within different size classes, firm mobility across size classes is calculated. This provides initial evidence on the relation between size and firm growth which contributes to understanding of the firm growth process. First, a transition matrix for services is presented, following which mobility patterns in manufacturing firms are examined. In addition, to determine if firm mobility is influenced by the business cycle, mobility patterns over the entire sample period (1991-2007), as well as over the disaggregated sub-periods (1991-2000; 2001-2007) are analysed.

(i) Firm mobility patterns in services

Based on the initial size class at the beginning of the period (2001), Table 5.9 shows the number of services firms that move into other size categories at the end of the period. In general, a large proportion of firms in the industry remained in the same size category at the end of the period. These are as follows: 71 per cent (micro firms), 80 per cent (small firms), 83 per cent (medium firms) and 93 per cent (large firms) respectively. The implication of the above finding is that only very few firms in the distribution actually grow. The greatest amount of mobility was observed among small and medium-sized firms, with 26 per cent (18 per cent) of micro-sized (small) firms and 5 per cent of medium-sized firms moving one size class up in 2007.

The largest amount of decline of firm mobility to the next lower size class at the end of the period was seen in the medium and large size category—indicating 12 per cent of medium-sized firms and 5 per cent of large firms experienced lower growth during the period. A
comparison of the number of firms in each size category at the beginning and end of the period indicates that the largest decline is observed in the small firm size class (11 per cent) and the largest increase is seen in the large firm category (25 per cent). Moreover, none of the first two size classes, small and medium-sized firms, were able to move to the large firm category.

Overall, results from the probability matrix show a high probability of decline in micro-sized and small services firms, although higher growth probabilities are observed for those micro-sized and small firms able to survive to the end of the period, consistent with findings in the literature (Mansfield, 1962; Jovanovic, 1982; Evans, 1987; Li et al, 2007; Oberhofer, 2012; Daunfeldt and Elert, 2013). Furthermore, large firms are found to have the lowest probability of growth, consistent with decreasing returns to scale. Given the differences between the services and manufacturing as previously highlighted in Section 5.2, firm mobility patterns in manufacturing are examined next.
Table 5.9: Transition Matrix of Service Firms by Size Category

<table>
<thead>
<tr>
<th>Size at Beginning of Sample Period</th>
<th>1-9</th>
<th>10-49</th>
<th>50-249</th>
<th>250+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size at End of Sample Period</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-9</td>
<td>22</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>31</td>
</tr>
<tr>
<td>(.71)</td>
<td>(.26)</td>
<td>(.03)</td>
<td>(.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-49</td>
<td>9</td>
<td>397</td>
<td>91</td>
<td>0</td>
<td>497</td>
</tr>
<tr>
<td>(.02)</td>
<td>(.80)</td>
<td>(.18)</td>
<td>(.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-249</td>
<td>0</td>
<td>38</td>
<td>264</td>
<td>18</td>
<td>320</td>
</tr>
<tr>
<td>(.00)</td>
<td>(.12)</td>
<td>(.83)</td>
<td>(.05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>250+</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>53</td>
<td>57</td>
</tr>
<tr>
<td>(.00)</td>
<td>(.02)</td>
<td>(.05)</td>
<td>(.93)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>444</td>
<td>359</td>
<td>71</td>
<td>905</td>
</tr>
</tbody>
</table>

Note. The numbers in parentheses give the ratios of firms in the size class of the row that reached the size class of the column at the end of the given period. The numbers not in parentheses give the number of firms in each size class.

(ii) Firm mobility patterns in manufacturing

Over the period 1991-2007, panel A (Table 5.10) provides evidence of downsizing for manufacturing firms in the small, medium and large size categories; with 9 per cent, 14 per cent and 13 per cent of small, medium-sized and large firms respectively moving to the next lower size class at the end of the period. High growth probability of micro-sized and small firms is also confirmed, with 42 per cent (23 per cent) of micro-sized (small) firms moving up to the next higher size class in 2007 and 17 per cent for medium-sized firms. The above finding is consistent with a priori expectations that small firms show higher growth rates than large firms. Only a small fraction of small firms (0.01 per cent) were able to transit to the large size class. No micro-sized firms made this transition.
Panels, B and C, in Table 5.10 show the evolution of firm mobility across two time intervals; 1991-2000 and 2001-2007. This reveals variations in firm behaviour over the two periods. About 42 per cent of micro-sized firms, 19 per cent of small firms and 13 per cent of medium-sized firms moved to the next higher size class in 2000, while 5 per cent, 7 per cent and 12 per cent of small, medium-sized and large firms respectively moved down to the next lower class. (Table 5.10, panel B). Only one small firm and no micro firm made the transition into the large size class by the end of the period.

Although the highest growth probabilities are still observed among micro-sized and small firms similar to the previous period, panel C shows a decline in the number of firms moving up to the next size class in 2001-2007; 22 per cent, 9 per cent and 8 per cent for micro, small and medium firms respectively. This is an indication of lower growth during economic downturns. The higher probability of growth shown by micro-sized and small firms in the sample during the second growth phase is in line with Hardwick and Adams (2002) who found that small firms in the UK insurance industry showed higher growth rates during a boom period. A larger amount of downsizing is also observed during this period; 9 per cent, 13 per cent and 12 per cent for small, medium and large firms respectively. None of the micro-sized and small firms was able to move into the large size class during this period.
Table 5.10: Transition Matrix of Manufacturing Firms by Size Category

<table>
<thead>
<tr>
<th>Size at Beginning of Sample Period</th>
<th>Size at End of Sample Period</th>
<th>1-9</th>
<th>10-49</th>
<th>50-249</th>
<th>250+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Transition of size by employment, 1991-2007:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-9</td>
<td></td>
<td>190</td>
<td>144</td>
<td>8</td>
<td>0</td>
<td>342</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.56)</td>
<td>(0.42)</td>
<td>(0.02)</td>
<td>(0.00)</td>
<td></td>
</tr>
<tr>
<td>10-49</td>
<td></td>
<td>58</td>
<td>442</td>
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<td>7</td>
<td>656</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.09)</td>
<td>(0.67)</td>
<td>(0.23)</td>
<td>(0.01)</td>
<td></td>
</tr>
<tr>
<td>50-249</td>
<td></td>
<td>0</td>
<td>33</td>
<td>158</td>
<td>40</td>
<td>231</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00)</td>
<td>(0.14)</td>
<td>(0.68)</td>
<td>(0.17)</td>
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<tr>
<td>250+</td>
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<td></td>
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<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.12)</td>
<td>(0.88)</td>
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</tr>
<tr>
<td>Total</td>
<td></td>
<td>248</td>
<td>619</td>
<td>323</td>
<td>105</td>
<td>1295</td>
</tr>
</tbody>
</table>

| B. Transition of size by employment, 1991-2000: | | | | | | |
| 1-9                              |                              | 195  | 144   | 3      | 0    | 342   |
|                                  |                              | (0.57) | (0.42) | (0.01) | (0.00) |       |
| 10-49                            |                              | 34   | 500   | 121    | 1    | 656   |
|                                  |                              | (0.09) | (0.67) | (0.23) | (0.01) |       |
| 50-249                           |                              | 0    | 16    | 184    | 31   | 231   |
|                                  |                              | (0.00) | (0.07) | (0.80) | (0.13) |       |
| 250+                             |                              | 0    | 0     | 7      | 59   | 66    |
|                                  |                              | (0.00) | (0.00) | (0.11) | (0.89) |       |
| Total                            |                              | 229  | 660   | 315    | 91   | 1295  |

| C. Transition of size by employment, 2001-2007: | | | | | | |
| 1-9                              |                              | 190  | 55    | 0      | 0    | 245   |
|                                  |                              | (0.78) | (0.22) | (0.00) | (0.00) |       |
| 10-49                            |                              | 58   | 522   | 59     | 0    | 639   |
|                                  |                              | (0.09) | (0.82) | (0.09) | (0.00) |       |
| 50-249                           |                              | 0    | 42    | 253    | 25   | 320   |
|                                  |                              | (0.00) | (0.13) | (0.79) | (0.08) |       |
| 250+                             |                              | 0    | 0     | 11     | 80   | 91    |
|                                  |                              | (0.00) | (0.00) | (0.12) | (0.88) |       |
| Total                            |                              | 248  | 619   | 323    | 105  | 1295  |

Note. The numbers in parentheses give the ratios of firms in the size class of the row that reached the size class of the column at the end of the given period. The numbers not in parentheses give the number of firms in each size class.

Summary

Overall, evidence of limited size mobility is found, with 65 percent of manufacturing firms and 80 percent of services firms remaining in their given size classes over the period.
Nevertheless, when yearly intervals are considered, the proportion of manufacturing firms who stayed in the same size classes increased to 72 per cent and 80 per cent for the periods 1991-2000 and 2001-2007 respectively. This supports findings that only a small proportion of firms actually expand (Freel, 2000; Coad, 2007) and provides preliminary evidence that firms experience lower growth during downturns, with the effect more pronounced in medium-sized firms. A comparison of firm mobility over the two sub-periods also corroborates the fact that firms are more likely to grow (decline) during periods of expansion (contraction).

Comparing mobility patterns in manufacturing and services over the period 2001-2007, reveals that services firms are more likely to move up to higher size classes, while the probability of moving to a lower size class is higher for manufacturing. This could be related to scale intensity differentials between both industries. Lower scale economies and sunk costs in the services industry imply firms are able to increase growth, whilst high scale intensities and sunk costs in manufacturing are likely to hamper firm growth. Overall, the probability matrices above show that the likelihood of decline decreases with firm size. Nevertheless, those firms able to survive experience sustained growth. This finding is consistent with the literature as stated previously. In addition, growth rates decline with increases in size. These results provide initial evidence that firm size exerts a negative effect on growth and a positive impact on the probability of survival. However, direct statistical tests of the relationship between growth and size are required to confirm this relation.
5.2.4 Pattern of Firm Growth Rates

To determine what types of firms in the manufacturing and services industries in Ireland are most likely to succeed, the pattern of firm growth rates and productivity levels is examined in this section. First, mean firm growth rates are computed by size classes for the period. Here, firm growth is defined as the logarithmic difference of size\(^{49}\) in two consecutive years, while productivity growth is defined as the logarithmic difference of labour productivity (turnover per employee) in two consecutive years. The mean growth rates of employment, turnover and productivity are presented by size in Table 5.11. Secondly, a comparison is undertaken to determine if any similarities/differences in manufacturing and services growth patterns exist. These results are also presented in Table 5.11.

\(^{49}\)Size is measured as log employment and log turnover respectively.
Table 5.11: Growth and Variability of Growth by 1991/2001 Size Class in Manufacturing and Services Firms, 2001-2007

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Mean Employment Growth:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>0.34 (0.25)</td>
<td>-0.43 (0.22)</td>
<td>0.44 (0.20)</td>
<td>-1.1 (0.18)</td>
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<tr>
<td></td>
<td>245</td>
<td>639</td>
<td>320</td>
<td>91</td>
</tr>
<tr>
<td>Services</td>
<td>7.4 (0.43)</td>
<td>2.2 (0.22)</td>
<td>0.90 (0.26)</td>
<td>1.4 (0.29)</td>
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<td></td>
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<td>57</td>
</tr>
<tr>
<td><strong>Mean Turnover Growth:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>0.76 (0.32)</td>
<td>2.47 (0.37)</td>
<td>4.78 (0.37)</td>
<td>2.45 (0.24)</td>
</tr>
<tr>
<td></td>
<td>245</td>
<td>639</td>
<td>320</td>
<td>91</td>
</tr>
<tr>
<td>Services</td>
<td>2.3 (0.22)</td>
<td>1.4 (0.27)</td>
<td>1.06 (0.23)</td>
<td>5.09 (0.23)</td>
</tr>
<tr>
<td></td>
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<td>320</td>
<td>57</td>
</tr>
<tr>
<td><strong>Mean Productivity Growth:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>0.38 (0.39)</td>
<td>2.90 (0.39)</td>
<td>4.34 (0.37)</td>
<td>3.61 (0.23)</td>
</tr>
<tr>
<td></td>
<td>245</td>
<td>639</td>
<td>320</td>
<td>91</td>
</tr>
<tr>
<td>Services</td>
<td>-5.13 (0.48)</td>
<td>-0.82 (0.31)</td>
<td>0.09 (0.29)</td>
<td>3.72 (0.22)</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>497</td>
<td>320</td>
<td>57</td>
</tr>
</tbody>
</table>

Source: Author’s calculations from CIP and ASI datasets, 1991-2007

Note. * Size classification is based on initial size at the beginning of sample period, 1991 for manufacturing firms, 2001 for service firms. bThe figures given in parentheses correspond to the standard deviations of growth rates in each size category. The first row of numbers not in parentheses are the mean growth rates expressed as percentages while the second row of figures represent the number of firms in each size class.

Employment growth in the services industry declined with size, with the lowest growth rate found in medium-sized firms. Likewise, turnover growth decreased with size up to a certain size threshold. Consequently, large service firms had the highest growth rate. Conversely, productivity growth rates increased with size indicating large firms have higher productivity growth. Similar growth patterns were observed in manufacturing. Employment growth decreased with size, with medium-sized firms showing the worst performance. Turnover growth, however, increased with size up to a certain threshold, as a result of this, medium-sized firms showed the lowest growth.
The above findings for both manufacturing and services firms are in line with evidence in the literature that growth is more pronounced in smaller firms, with the growth effect diminishing with increased size (Sutton, 1997; Cabral, 2007; Fotopoulos and Giotopoulos, 2010). In a similar vein, productivity growth increased with size, with a diminishing effect over time. This is consistent with the passive learning model suggested by Jovanovic (1982), wherein efficient firms grow, whilst less efficient firms decline or fail. Heterogeneity in growth rates is also found among micro-sized and small firms based on high standard deviations across manufacturing and services. This provides further evidence in support of performance heterogeneity among firms as noted earlier. Across industries, the services industry performed better in terms of employment growth, a reflection of the labour intensive nature of the services and shifting emphasis to services industries in the economy. Manufacturing firms, however, showed higher growth in terms of turnover and productivity. A comparison of manufacturing mean growth rates across time periods is presented in Table 5.12. This shows growth rates for the entire sample period, as well as sub-periods to determine whether firm growth is sensitive to changes in the business cycle.
Table 5.12: Growth and Variability of Growth by Size Class in Manufacturing, 1991-2007

<table>
<thead>
<tr>
<th></th>
<th>1991/2001 Size Class&lt;sup&gt;a&lt;/sup&gt;</th>
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<tr>
<td></td>
<td>1-9</td>
<td>10-49</td>
<td>50-249</td>
<td>250+</td>
</tr>
<tr>
<td>Employment Growth:</td>
<td></td>
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</tr>
<tr>
<td>1991-2000</td>
<td>4.72 (0.26)</td>
<td>3.55 (0.21)</td>
<td>2.59 (0.18)</td>
<td>1.72 (0.14)</td>
</tr>
<tr>
<td></td>
<td>342</td>
<td>656</td>
<td>231</td>
<td>66</td>
</tr>
<tr>
<td>2001-2007</td>
<td>0.34 (0.25)</td>
<td>0.43 (0.22)</td>
<td>0.44 (0.20)</td>
<td>-1.17 (0.18)</td>
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<tr>
<td></td>
<td>245</td>
<td>639</td>
<td>320</td>
<td>91</td>
</tr>
<tr>
<td>1991-2007</td>
<td>2.87 (0.26)</td>
<td>1.98 (0.21)</td>
<td>1.20 (0.19)</td>
<td>-0.03 (0.15)</td>
</tr>
<tr>
<td></td>
<td>342</td>
<td>656</td>
<td>231</td>
<td>66</td>
</tr>
<tr>
<td>Turnover Growth:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1991-2000</td>
<td>7.33 (0.32)</td>
<td>6.25 (0.30)</td>
<td>5.15 (0.19)</td>
<td>6.20 (0.19)</td>
</tr>
<tr>
<td></td>
<td>342</td>
<td>656</td>
<td>231</td>
<td>66</td>
</tr>
<tr>
<td>2001-2007</td>
<td>0.76 (0.32)</td>
<td>0.25 (0.37)</td>
<td>0.48 (0.37)</td>
<td>2.45 (0.24)</td>
</tr>
<tr>
<td></td>
<td>245</td>
<td>639</td>
<td>320</td>
<td>91</td>
</tr>
<tr>
<td>1991-2007</td>
<td>5.06 (0.31)</td>
<td>4.74 (0.35)</td>
<td>4.56 (0.22)</td>
<td>3.97 (0.21)</td>
</tr>
<tr>
<td></td>
<td>342</td>
<td>656</td>
<td>231</td>
<td>66</td>
</tr>
<tr>
<td>Productivity Growth:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1991-2000</td>
<td>2.64 (0.36)</td>
<td>2.69 (0.31)</td>
<td>2.56 (0.20)</td>
<td>4.48 (0.17)</td>
</tr>
<tr>
<td></td>
<td>342</td>
<td>656</td>
<td>231</td>
<td>66</td>
</tr>
<tr>
<td>2001-2007</td>
<td>0.38 (0.39)</td>
<td>2.90 (0.39)</td>
<td>4.34 (0.37)</td>
<td>3.61 (0.23)</td>
</tr>
<tr>
<td></td>
<td>245</td>
<td>639</td>
<td>320</td>
<td>91</td>
</tr>
<tr>
<td>1991-2007</td>
<td>2.18 (0.36)</td>
<td>2.77 (0.37)</td>
<td>3.57 (0.22)</td>
<td>4 (0.20)</td>
</tr>
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<td></td>
<td>342</td>
<td>656</td>
<td>231</td>
<td>66</td>
</tr>
</tbody>
</table>


Note: * Size classification is based on initial size at the beginning of sample period 1991 and 2001 respectively. The figures given in parentheses correspond to the standard deviations of growth rates in each size category. The first row of numbers not in parentheses are the mean growth rates expressed as percentages while the second row of figures represent the number of firms in each size class.

Over the period 1991-2007, the highest growth rates were found among micro-sized and small firms. Whilst, employment and turnover growth rates decreased with size, with large firms showing negative employment growth. This is an indication that firm growth is somewhat related to size, thus providing preliminary evidence that GL is not supported in the sample. This is in line with findings from other countries, as detailed previously. In contrast, there is evidence that productivity growth increases with size over the period. Taken
together, the above results confirm the hypotheses detailed in Chapter 3 (Section 3.3.2), that the initial firm size has a negative effect on subsequent firm growth and a positive effect on productivity growth and level.

A disaggregation of the sample period into intervals; 1991-2000 and 2001-2007 unveils some interesting findings. Growth rates were significantly lower in 2001-2007 across all growth measures, an indication that successes recorded in the construction industry during the construction-led boom in Ireland actually masked poor performance in other industries. In the period 1991-2000, evidence of a systematic negative relationship between firm growth and size is found, with employment and turnover growth decreasing with size. The relationship between firm size and turnover growth, however, appears to be U-shaped, with medium-sized firms showing the lowest growth rate. Productivity was also observed in this period to increase with size.

In contrast, the negative size-growth link is less pronounced in 2001-2007, with the highest employment growth rates observed in medium-sized firms (50-249 workers). The mean employment growth rate for large and small manufacturing firms is negative indicating that small and large firms are more likely to downsize during economic downturns. This suggests that owing to their size advantage, large firms adjust to economic shocks by downsizing to remain productive. Similarly, small firms increase productivity by downsizing to avoid failure. Turnover growth patterns show growth rates decreased with size. This was, however, non-linear manner, as small and medium-sized firms showed the lowest growth rates. This seems to imply that small and large firms increase productivity by contracting output during
lean periods, with large firms being more responsive and performing better. Productivity growth patterns remained consistent with the previous period, with growth rates increasing with size. Productivity, however, appears to decline once a certain size class is reached. These results provide evidence on the research question relating to the impact of the macroeconomic environment on firm growth performance.

Summary

In summary, the analysis of growth rates across industries, size classes and time periods carried out in this section revealed certain facts: a negative relationship between firm size and growth which decreases with size; productivity growth is positively related to size, but the positive effect diminishes once a certain size class is reached; firm growth patterns vary with the business cycle, with firms showing poor performance during contractions in the economy. Firm response to macroeconomic changes differs by size, for instance, small and large manufacturing firms respond by downsizing workers. Having analysed firm growth rates, firm performance in terms of labour productivity is examined in the next section to determine whether productivity differences exist across different size classes.

5.2.5 Labour Productivity Performance

The analyses of mean growth rates in Section 5.2.3 revealed growth differences across size categories, industries and time period. To further determine if productivity levels vary across size categories, a labour productivity distribution for manufacturing and services is presented in Table 5.13. A positive productivity-size association is shown which is robust across time periods and industries. However, in the services industry, productivity decreases once a
certain size threshold is reached. Disaggregating into sub-periods revealed that productivity is higher in manufacturing firms during the period 2001-2007. This suggests that, possibly due to the presence of higher scale intensities and sunk costs, manufacturing firms increase productivity during contractions to avoid exit.

Table 5.13: Productivity Distribution by Size Class in Manufacturing and Services

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Manufacturing:</strong></td>
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<tr>
<td>1991-2000</td>
<td>0.78 (1.32)</td>
<td>1.04 (1.85)</td>
<td>2.21 (3.95)</td>
<td>4.23 (8.28)</td>
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<td></td>
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<td>231</td>
<td>66</td>
</tr>
<tr>
<td>2001-2007</td>
<td>0.98 (2.02)</td>
<td>1.29 (2.10)</td>
<td>3.39 (9.34)</td>
<td>6.71 (13.86)</td>
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<td></td>
<td>245</td>
<td>639</td>
<td>320</td>
<td>91</td>
</tr>
<tr>
<td>1991-2007</td>
<td>0.86 (1.65)</td>
<td>1.15 (1.96)</td>
<td>2.70 (6.74)</td>
<td>5.25 (4.25)</td>
</tr>
<tr>
<td></td>
<td>342</td>
<td>656</td>
<td>231</td>
<td>66</td>
</tr>
<tr>
<td><strong>Services:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001-2007</td>
<td>1.16 (1.64)</td>
<td>1.42 (2.15)</td>
<td>2.30 (11.90)</td>
<td>1.36 (1.96)</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>497</td>
<td>320</td>
<td>57</td>
</tr>
</tbody>
</table>

Note. a Size classification is based on initial size at the beginning of sample period 1991 and 2001 respectively. b The figures given in parentheses correspond to the standard deviations of growth rates in each size category. The first row of numbers not in parentheses are the mean growth rates expressed as percentages, while the second row of figures represent the number of firms in each size class.

5.3 Conclusion

The aim of this chapter was to present results from the descriptive and non-parametric analyses of performance in manufacturing and services firms in Ireland using panel data obtained from the Irish CSO over the period 1991-2007. Specifically, the key focus is identifying performance trends within the period, as well as providing initial evidence on the link between firm-specific characteristics (such as size), the macroeconomic environment and
firm performance. Findings from the analyses undertaken in this chapter also offer a better understanding for the subsequent econometric analyses of firm performance undertaken in the chapter which follows. Firm performance in the analysis is measured in terms of growth (employment, turnover and productivity) and productivity levels which are essential for future growth, survival, competitiveness and job creation as previously detailed in Chapter 3.

Descriptive analyses of growth rates and productivity levels were undertaken which revealed performance differences across size categories, industries and time periods, providing empirical evidence of performance heterogeneity among firms. Furthermore, following on from the discussion of Gibrat’s (1931) Law of Proportionate Effect (LPE) presented in Chapter 2, graphical and non-parametric statistical tests of normality were employed to test the LPE assumption of lognormality. Nevertheless, the results reject the hypothesis of lognormality of the firm size distribution in the services and manufacturing firms in Ireland over the period 1991-2007. Moreover, the firm size distribution was found to be skewed, suggesting the presence of many small firms and a few large firms. This is an indication of heterogeneity in firm performance and the non-validity of GL in the sample.

Consequently, employment and turnover growth was shown to decrease with firm size, evidence that small firms grow faster than large firms. This effect however decreases with size. Conversely, productivity level and productivity growth increases with size, with large firms showing higher productivity levels and growth. Finally, firm performance is affected by the business cycle, with firms contracting during lean periods. A casual examination of firm performance over the entire sample suggests steady improvements in
performance. However, disaggregating the sample period into two sub-periods corresponding to different phases of growth in the Irish economy (i.e. the export-led growth period, 1991-2000 and domestic demand-fuelled growth period, 2000-2007), reveals performance differences, particularly in the early 2000s. This finding provides initial support for the econometric analysis undertaken in this thesis to investigate the effect of a transition between a sustainable and unsustainable growth phase on firm performance in Ireland. This further increases our understanding of the link between the macroeconomic environment and firm performance and the channels through which this occurs.

The above analyses have provided preliminary evidence on the research question relating to the impact of firm characteristics on firm performance in Ireland over the period 1991-2007. The findings suggest that firm size is a determinant of firm performance (i.e. growth and productivity). In addition, it has been shown that size differentials are related to industry, location, ownership and trade status. This implies that firm characteristics such as industry, location and nationality of ownership are drivers of firm performance. The results also suggest that firm performance varies with macroeconomic conditions, which offers initial evidence on the research question relating to the effect of the macroeconomic environment on firm performance. Econometric tests are, however, needed to verify these results. To this end, results from econometric tests of the firm performance models are presented and discussed in Chapter 6. The estimation results offer insights on the nature of the size-firm performance relationship identified in the preliminary results from the descriptive analyses carried out in this chapter. Additionally, they provide further evidence on the specific impact of the macroeconomic environment on firm performance, thus contributing to the body of
knowledge on firm performance. Finally, adopting the econometric approach which follows is relevant, so as to establish a causal relationship between firm performance and its determinants.

6.1 Introduction

The aim of this chapter, based on secondary panel data obtained from the Irish Central Statistics Office (CSO), is to provide an econometric analysis relating firm performance to firm-specific characteristics, strategy and elements of the macroeconomic environment. Analysis is based on the use of two distinct panel datasets, consisting of a cross-section of 2,200 manufacturing and services firms over the time period 1991-2007. More specifically, the chapter seeks to employ econometric techniques (ordinary least squares, fixed effects and system generalised methods of moments) to address the research objectives and questions, as well as test the hypotheses detailed earlier in this thesis; that is, whether (and how) firm-specific characteristics, strategy and macroeconomic conditions influence growth in employment, turnover and productivity, as well as productivity levels. The system generalised method of moments is, however, the main estimation method in this study. Additionally, results from the ordinary least squares (OLS) and fixed effects (FE) estimation methods are also reported. Inclusion of OLS and FE results is appropriate in examining the robustness of results across different estimation methods. The descriptive analyses, undertaken in the preceding chapter, can afford some indication of causation, but for the most part this is based on a non-parametric approach – the findings are not statistically validated. Nonetheless, the econometric parametric investigation undertaken in this chapter is informed and supported by the descriptive analyses.
Additionally, the chapter builds on the firm growth models à la Storey (1994) and Hynes (2006) (which groups the determinants of firm growth in three categories: the entrepreneur, firm and strategy) as introduced in Chapters 2 and 3. The firm growth model is extended to include variables related to the macroeconomic environment, so as to allow an investigation of the impact of macroeconomic conditions on firm performance (defined in terms of growth and productivity). Thus, the analysis of firm performance in manufacturing and services firms in Ireland presented in this chapter addresses the question of what (how) firm characteristics, firm strategy and macroeconomic factors affect firm performance?

To recap, having examined the theoretical and empirical evidence in the literature (Chapter 2), Table 6.1 presents the research questions to be answered in this chapter (as outlined previously in Chapter 1), together with the hypotheses formulated in Chapter 3. The variables to be tested are also outlined in Table 6.1 (as defined earlier in Chapter 3). The application of a holistic multivariate modelling approach to the empirical study undertaken in this chapter, helps to fill the gap in the firm performance literature relating to the impact of macroeconomic conditions on firm performance (as highlighted in Chapter 2). The use of such a holistic model not only makes a significant methodological contribution to the knowledge of firm performance drivers in the firm performance literature (encapsulating growth and productivity for the purpose of this research), but also provides empirical evidence on the link between firm performance and the macroeconomic environment. An overview of findings from the descriptive analyses undertaken in the previous chapter is presented in the section which follows. This provides a context for the more robust
parametric approach adopted in this chapter to analyse the determinants of firm performance in manufacturing and services firms in Ireland over the period 1991-2007.
### Table 6.1 Research Questions and Hypotheses

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<th>Research Question</th>
<th>Variable</th>
<th>Research Hypothesis</th>
<th>Expected Sign</th>
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<td><strong>Macroeconomic Conditions</strong></td>
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</tr>
<tr>
<td>What is the impact of macroeconomic conditions on firm performance in Ireland in the period, 1991-2007?</td>
<td>GDP growth</td>
<td>H1: GDP growth rate positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Inflation</td>
<td>H2: Inflation rate negatively affects firm performance</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Unemployment</td>
<td>H3: Unemployment rate negatively affects firm performance</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>Competitiveness</td>
<td>H4: Competitiveness negatively affects firm performance</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>Availability of Credit</td>
<td>H5: Availability of credit positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td><strong>Firm Strategy</strong></td>
<td>Trade</td>
<td>H6: Trade positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Innovation</td>
<td>H8: Innovation positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Public Support</td>
<td>H9: The use of subsidies positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td><strong>Firm-specific Characteristics</strong></td>
<td>Firm Size</td>
<td>H10: Initial firm size negatively affects firm growth</td>
<td>-</td>
</tr>
<tr>
<td>What is the impact of firm-specific characteristics on firm performance in Ireland in the period, 1991-2007?</td>
<td>Productivity</td>
<td>H11: Initial firm size positively affects firm productivity levels and growth</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Nationality of ownership</td>
<td>H12: Initial level of productivity positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Location</td>
<td>H13: Foreign ownership positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td>H14: Location in Dublin and its environs positively affects firm performance</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Productivity</td>
<td>H15: Industry minimum efficient scale and growth influence firm performance positively</td>
<td>+</td>
</tr>
</tbody>
</table>
6.1.1 Summary of Results from Descriptive Analyses of Firm Performance in Ireland

As detailed previously in Chapter 1 (Section 1.1), the point of departure of the analysis in this chapter is Gibrat’s Law of Proportionate Effect (LPE), which states that the growth rate of a firm is independent of its initial size (Santarelli et al., 2006). The implications of the LPE, as highlighted in Chapter 2 (Section 2.4), are as follows:

- The independence of firm growth and size; that is, every firm has an equal opportunity to grow irrespective of their initial size.
- Lognormality of firm size distributions; that is, the logarithm of firm size has a normal distribution, with a mean of 0 and a standard deviation of 1.
- The absence of growth persistence; that is, growth in one period should not encourage (discourage) growth in subsequent periods (Fotopoulous and Giotopoulos, 2010).

Following on from the assumptions detailed above, the descriptive analyses carried out in Chapter 5 highlighted a number of interesting findings relevant to the econometric analysis undertaken in the current chapter. The results are outlined as follows:

i. A negative relationship between firm size and growth was found, which appeared to diminish with size, indicating that small firms showed higher growth rates relative to larger firms. This suggests Gibrat’s Law is not valid in the sample of manufacturing and services firms.

ii. Gibrat’s assumption of lognormality of the firm size distribution was also rejected in the sample of manufacturing and services firms in Ireland, based on graphical and statistical tests of normality. Rather, the firm size distribution was found to be highly
skewed, with many small firms and a few large firms coexisting together. This provides evidence of divergence in performance.

iii. Firm size was shown to be positively correlated with the level and growth of productivity, implying that large firms were not only more productive, but also increased productivity faster than their smaller counterparts.

iv. With regard to performance heterogeneity, large dispersion in sizes (employment and turnover) was found across industries, trade status, location and ownership. Consequently, foreign firms, firms which engage in both exporting and importing, high-tech and knowledge-intensive firms, as well as firms located in the South-west region (Southern and Eastern region for services) had larger average sizes.

v. Lastly, disaggregating the sample period into two sub-periods (1991-2000, an export-led growth phase and 2001-2007, a credit-led domestic demand-driven growth phase) revealed performance differences across both periods, which suggests that firm performance varies with macroeconomic conditions.

The remainder of the chapter is organised as follows: Section 6.2 outlines the firm performance estimation method and statistical software employed in the analysis, while Section 6.3 analyses summary statistics and diagnostic test results. Section 6.4 presents analysis and discussion of the estimation results, whereas Section 6.5 presents results from the tests of robustness. The persistence of growth is investigated in Section 6.6. Section 6.7 concludes.
6.2 Firm Performance Estimation Method and Statistical Software

The estimation techniques and statistical software employed in this empirical investigation of firm performance are outlined in this section. This detail facilitates replicability of the study. Given the potential econometric issues (e.g., endogeneity, autocorrelation and heteroskedasticity) that may arise from the use of panel data, as highlighted previously in Chapter 3 (Section 3.5), Ordinary Least Squares (OLS), Fixed Effects (FE) and System Generalised Methods of Moments (SYS-GMM) estimation methods are employed in analysing all the firm performance models. Analysis is, however, based mainly on the SYS-GMM estimation results, which takes into account a probable relationship between firm performance (growth and productivity) and its drivers (such as labour productivity and research and development intensity). The latter estimation method is also suitable for dealing with unobserved/unmeasured variables (such as firm age and entrepreneurial characteristics) in the error term. In other words, the use of the SYS-GMM estimation method helps the researcher control for endogeneity and unobserved heterogeneity.

Furthermore, as detailed earlier in Chapter 3, the SYS-GMM not only supports the inclusion of firm performance determinants (such as industry) which do not vary over time, but also remains robust in the presence of autocorrelation and heteroskedasticity, producing unbiased, efficient and consistent estimates. In addition, all statistical analyses were performed using the statistical software package Stata version 11 due to its capability in handling large complex data sets (Pevalin and Robinson, 2009). Moreover, the availability of Stata user-written code[^50] is useful in statistical analyses, as well as the interpretation and presentation of

[^50]: Examples of Stata syntaxes in relation to the GMM estimation are included in the appendices.
results. Finally, it allows for documentation of statistical procedures and results (Gordon, 2012).

### 6.2.1 Stata SYS-GMM estimation command

The firm performance SYS-GMM models are estimated using Stata’s `xtabond2` command, with the two-step robust small option, which provides Windmeijer-corrected cluster-robust errors and small sample adjustment. One-step GMM estimators employ weight matrices that are orthogonal to the estimated parameters, while the two-step GMM estimator weighs the moment conditions by a consistent estimate of their covariance matrix (Windmeijer, 2005). The two-step estimator is efficient since it is robust to heteroskedasticity and autocorrelation. The reported standard errors, however, tend to be severely downward biased in small samples such that inferences made from these standard errors may be unreliable (Arellano and Bond 1991; Blundell and Bond 1998; Baltagi, 2008). The use of Windmeijer (2005) finite-sample correction to the covariance matrix reduces the problem of biased standard errors common to the two-step SYS-GMM by producing more precise results, thus making it more efficient than the one-step SYS-GMM (Roodman, 2009a), while the `small` option reports $t$ statistics instead of $z$ statistics and an $F$ test in place of a Wald chi-squared test.

Furthermore, the `xtabond2` command allows a number of options such as the inclusion of two groups of instruments using the gmm-style and iv-style options:

- The gmm-style instruments include all variables considered to be endogenous and/or predetermined, while the iv-style instruments include all strictly exogenous variables in the model.
- The equation ( ) subopt ion of the `xtabond2` command aids proper handling of predetermined variables used as iv-style instruments in SYS-GMM (Roodman,
Consequently, ‘level’ is specified for the equation ( ) sub option for the iv-style instruments in all equations. Following Roodman (2009a), lag 1 and longer is specified for predetermined variables, while lags 2 and longer are specified for endogenous variables.

Having outlined the Stata commands employed in the SYS-GMM estimations, the results obtained are analysed and discussed in subsequent sections.

6.3 Firm Performance in Ireland: Descriptives and Model Diagnostics

This section presents summary statistics (such as means and standard deviation) and results from econometric diagnostic tests of the data. The diagnostic tests are designed to detect econometric issues (such as heteroskedasticity, multicollinearity and autocorrelation) related to violations of the classical linear regression model assumptions, which may arise in the estimation of firm performance models. Summary statistics, on the hand, provide a basic description of the datasets, summarising the key features. First, a summary of the variables employed in the analyses is provided in the section which follows.

6.3.1 Firm Performance Model: Descriptives and Summary Statistics

In this section, summary statistics for the dependent and explanatory variables in relation to each of the two discrete panel datasets introduced in Chapter 3, that is, the Census of Industrial Production (CIP) for manufacturing and the Annual Services Inquiry (ASI) for services firms are outlined over the period 1991-2007. This summarises the data and serves to highlight its main features. A distinction is made between manufacturing and services
performance due to the differences in scale economies, capital intensity and sunk costs in both industries, as earlier highlighted in Chapter 5 (Section 5.2). Moreover, the growing importance of the services industry in the economy (accounting for about 70 percent of employed persons in the EU-27 and 77 percent of employment in Ireland in 2011 [Eurostat, 2012]), makes it imperative to identify the drivers of firm performance in the services industry, as well as to determine if performance varies across the manufacturing and services industries. As noted previously in Chapter 3 (Section 3.4.2), due to data availability, the analysis of firm performance in the services industry is limited to the period 2001-2007. To begin with, the mean and standard deviations of the variables are presented in Table 6.2 for manufacturing and Table 6.3 for the services industry, along with the variable definitions and expected signs. The standard deviation shows the degree to which variables vary from their mean values. Thus, the higher the standard deviation, the greater is the distance from the mean.
Table 6.2 Description of Variables, Means and Standard Deviations in Manufacturing Firms, 1991-2007

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Expected Sign</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable: Firm Performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMPLOYMENT GROWTH</td>
<td>Employment growth- Logarithm difference of employment in consecutive years</td>
<td>0.02</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>TURNOVER GROWTH</td>
<td>Turnover/Sales growth- Logarithm difference of turnover/sales in consecutive years</td>
<td>0.05</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>PRODUCTIVITY GROWTH</td>
<td>Logarithm difference of labour productivity (turnover per employee) in consecutive years</td>
<td>0.03</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY</td>
<td>Logarithm of labour productivity in current period</td>
<td>1.56</td>
<td>4.25</td>
<td></td>
</tr>
<tr>
<td><strong>Firm-specific variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOG EMPLOYMENT$_{t-1}$</td>
<td>Logarithm of employment in previous period</td>
<td>-</td>
<td>3.35</td>
<td>1.26</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT$_{t-1}$)$^2$</td>
<td>Square of logarithm of employment in previous period</td>
<td>+</td>
<td>12.83</td>
<td>9.7</td>
</tr>
<tr>
<td>LOG TURNOVER$_{t-1}$</td>
<td>Logarithm of total turnover in previous period</td>
<td>-</td>
<td>3.22</td>
<td>1.83</td>
</tr>
<tr>
<td>(LOG TURNOVER$_{t-1}$)$^2$</td>
<td>Square of logarithm of total turnover in previous period</td>
<td>+</td>
<td>13.7</td>
<td>15.0</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY$_{t-1}$</td>
<td>Logarithm of labour productivity in previous period</td>
<td>+</td>
<td>-0.13</td>
<td>0.87</td>
</tr>
<tr>
<td>LOCATION</td>
<td>1=Border; 2=Dublin; 3=Mid-East; 4= Midlands; 5=Mid-West; 6=South-East; 7=South-West; 8=West</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>1= Foreign; 0= Domestic</td>
<td>+</td>
<td>0.17</td>
<td>0.37</td>
</tr>
<tr>
<td>INDUSTRY</td>
<td>2-digit Nace Rev. 1.1. classification (15-37)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>Minimum efficient scale measured as ratio of turnover to number of firms in industry</td>
<td>+</td>
<td>290.43</td>
<td>510.93</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>Logarithm difference of total turnover in industry</td>
<td>+</td>
<td>0.08</td>
<td>0.09</td>
</tr>
<tr>
<td><strong>Strategy variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRADE</td>
<td>1= No trade; 2= Firm exports only; 3= Firm imports only; 4= Firm both exports and imports</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRAINING</td>
<td>1= Firm has training costs; 0 = otherwise</td>
<td>+</td>
<td>0.54</td>
<td>0.50</td>
</tr>
<tr>
<td>R&amp;D INTENSITY</td>
<td>1= Firm reports R&amp;D expenditure; 0 = otherwise</td>
<td>+</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>R&amp;D SPEND</td>
<td>Ratio of R&amp;D Expenditure to total turnover</td>
<td>+</td>
<td>0.55</td>
<td>16.34</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>1= Firm has &gt; mean R&amp;D intensity; 0= otherwise</td>
<td>+</td>
<td>0.09</td>
<td>0.29</td>
</tr>
<tr>
<td><strong>Macroeconomic Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td>Annual growth rate in real GDP (%)</td>
<td>+</td>
<td>6.49</td>
<td>2.76</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>Annual average unemployment rate (%)</td>
<td>+/-</td>
<td>8.29</td>
<td>4.56</td>
</tr>
<tr>
<td>INFLATION</td>
<td>Annual growth rate in consumer prices (%)</td>
<td>-</td>
<td>3.05</td>
<td>1.32</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>Real effective exchange rate index, 2005=100</td>
<td>-</td>
<td>92.6</td>
<td>7.06</td>
</tr>
<tr>
<td>CREDIT GROWTH</td>
<td>Domestic credit to private sector (%)</td>
<td>+</td>
<td>99.9</td>
<td>47.7</td>
</tr>
</tbody>
</table>

Table 6.3: Description of Variables, Means and Standard Deviations in Services Firms.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Expected Sign</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable: Firm Performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMPLOYMENT GROWTH</td>
<td>Employment growth - Logarithm difference of employment in consecutive years</td>
<td>0.02</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>TURNOVER GROWTH</td>
<td>Turnover/Sales growth - Logarithm difference of turnover/sales in consecutive years</td>
<td>0.02</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>PRODUCTIVITY GROWTH</td>
<td>Logarithm difference of labour productivity (turnover per employee) in consecutive years</td>
<td>-0.004</td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY</td>
<td>Logarithm of labour productivity in current period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Firm-specific variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOG EMPLOYMENT(_{t-1})</td>
<td>Logarithm of employment in previous period</td>
<td>-</td>
<td>3.94</td>
<td>1.08</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT(_{t-1}))^2</td>
<td>Square of logarithm of employment in previous period</td>
<td>+</td>
<td>16.72</td>
<td>10.22</td>
</tr>
<tr>
<td>LOG TURNOVER(_{t-1})</td>
<td>Logarithm of total turnover in previous period</td>
<td>-</td>
<td>3.66</td>
<td>1.49</td>
</tr>
<tr>
<td>(LOG TURNOVER(_{t-1}))^2</td>
<td>Square of logarithm of total turnover in previous period</td>
<td>+</td>
<td>15.63</td>
<td>13.05</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY(_{t-1})</td>
<td>Logarithm of labour productivity in previous period</td>
<td>+</td>
<td>-0.28</td>
<td>1.11</td>
</tr>
<tr>
<td>LOCATION</td>
<td>1=Southern and Eastern; 0= Border Midlands and Western</td>
<td>+</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>1= Foreign; 0= Domestic</td>
<td>+</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>INDUSTRY</td>
<td>2-digit Nace Rev. 1.1. classification (51-93)</td>
<td>+</td>
<td>206.57</td>
<td>244.85</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>Minimum efficient scale measured as ratio of sales to number of firms in industry</td>
<td>+</td>
<td>206.57</td>
<td>244.85</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>Logarithm difference of total turnover in industry</td>
<td>+</td>
<td>0.02</td>
<td>0.09</td>
</tr>
<tr>
<td><strong>Strategy variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRADE</td>
<td>1= No trade; 2= Firm exports only; 3= Firm imports only; 4= Firm both exports and imports</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRAINING</td>
<td>1= Firm has training costs; 0 = otherwise</td>
<td>+</td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td>R&amp;D</td>
<td>1= Firm reports R&amp;D expenditure; 0 = otherwise</td>
<td>+</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>R&amp;D INTENSITY</td>
<td>Ratio of R&amp;D Expenditure to total turnover</td>
<td>+</td>
<td>0.08</td>
<td>0.99</td>
</tr>
<tr>
<td>R&amp;D SPEND</td>
<td>1= Firm has &gt; mean R&amp;D intensity; 0= otherwise</td>
<td>+</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>1= Firm received subsidies; 0=otherwise</td>
<td>+/-</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td><strong>Macroeconomic Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td>Annual growth rate in real GDP (%)</td>
<td>+</td>
<td>5.57</td>
<td>0.74</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>Annual average unemployment rate (%)</td>
<td>+/-</td>
<td>4.39</td>
<td>0.23</td>
</tr>
<tr>
<td>INFLATION</td>
<td>Annual growth rate in consumer prices (%)</td>
<td>-</td>
<td>3.78</td>
<td>1.13</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>Real effective exchange rate index, 2005=100</td>
<td>-</td>
<td>97.09</td>
<td>8.15</td>
</tr>
<tr>
<td>CREDIT GROWTH</td>
<td>Domestic credit to private sector (%)</td>
<td>+</td>
<td>143.79</td>
<td>36.75</td>
</tr>
</tbody>
</table>

In relation to the dependent variables, mean growth rates in the sample are quite low ranging from 2 to 5 percent in manufacturing (Table 6.2) and -0.4 per cent to 2 per cent in the services industry (Table 6.3). It is, however, important to bear in mind that the period of analysis for the services industry (2001-2007) corresponds to the consumer-demand driven growth phase in the Irish economy. This second growth phase is characterised by poorer economic performance relative to the first export-led growth phase, as outlined in Chapter 4. Moreover, Table 5.3 (Chapter 5) reveals that mean growth rates in manufacturing ranged from -0.1 percent to 2.8 percent in the period 2001-2007, an indication that firm performance in Ireland during this growth phase was generally low across both industries. Additionally, the standard deviations for all growth variables are significantly larger than the means for both manufacturing and services firms. This finding of high growth variability provides further evidence of heterogeneity in performance consistent with the skewed firm size distribution observed in Chapter 5.

The proportion of foreign-owned firms is higher in manufacturing (17 per cent) than in the services (11 per cent), while 27 per cent of manufacturing firms engaged in R&D (defined in terms of the firm’s decision to invest in R&D) during this period compared to 2 per cent in the services industry. In terms of training, 54 per cent of the firms in manufacturing and 21 per cent of services firms engaged in formal training. Finally, only 1 per cent of the total number of services firms received subsidies, while 17 per cent of manufacturing firms reported receipt of subsidies. The above figures suggest that manufacturing firms were more likely to be foreign-owned, invest in R&D, engage in formal training and were in receipt of subsidies in the period of the study. This further highlights the differences between manufacturing and services firms. Again, it is imperative that these results be interpreted in the context of prevailing macroeconomic conditions and differing time periods.
Definition of Variables

Having examined the mean growth performance and the main features of the data, the variables to be analysed are defined. LOCATION is a categorical variable derived from the Nomenclature of Territorial Units for Statistics (NUTS) 3 statistical region classification across eight regions to capture urbanisation and localisation externalities for the manufacturing industry. As previously referred to in Chapter 2 (Section 2.5.1), location, particularly in urban areas, provides firms with access to infrastructure, specialised skills, as well as to larger labour and product markets. The reference category for this variable is Dublin, the capital city of Ireland with a population of 1,187,176, representing a 28 per cent share of the total population in 2006 (CSO, 2007a: p40). Moreover, in terms of economic contribution, county Dublin accounted for 27 per cent of the total number of active firms and about 43 per cent of the total numbers employed in Ireland in 2006 (CSO, 2013b).

Regional data is only available at the NUTS2 statistical region classification in the ASI. Thus, LOCATION is a dummy representing 1 if a services firm is located in the Southern and Eastern region (SE) (which encompasses the Dublin, Mid-East, Mid-West, South-East and South-West regions) and 0 if firm is located in the Border, Midland and Western (BMW) region. In view of the economic importance of Dublin as outlined earlier, services firms which report locations in both regions are treated as being located in the Southern and Eastern region. Moreover, regional disparities between the two regions have been noted, with the SE being relatively more prosperous than the BMW region (Drudy and Collins, 2011). Adopting this approach makes it possible to determine whether and how regional differences influence firm performance.
INDUSTRY is a categorical variable based on 2-digit Nomenclature Générale des Activités Économiques dans les Communautés Européennes (NACE) 1.1 industry classification. The industry variable ranges from NACE code 15 to 37, with NACE 37 as the omitted category for manufacturing; and NACE code 50 to 93, with NACE industry, Other Service Activities (93) as the reference category for services firms. Due to CSO confidentiality policy, NACE codes 36, 37, 23 and 16 (Manufacturing n.e.c.; Coke, Refined Petroleum Products & Nuclear Fuel; Tobacco Products); 18 and 19 (Wearing Apparel; Leather & Leather Products); 30 and 32 (Office Machinery & Computers; Radio, Television & Communication Equipment & Apparatus); 60, 62, 63 and 64 (Transport, storage and communications) are aggregated.

NATIONALITY OF OWNERSHIP is a dummy measure representing 1 if the firm has foreign ownership. TRADE is a categorical variable to measure if performance differences exist between firms which engage in trade and non-traders, with NO TRADE as the base category. Due to a lack of data on patenting activity, and product and process innovation, innovative activity is assessed in terms of R&D investments. Following Crepon et al (1998), R&D measures the decision of the firm to invest in R&D. This is a binary variable which takes the value 1 if the firm reports R&D expenditure and a value of 0 otherwise. R&D INTENSITY is the ratio of the firm’s R&D expenditure to total turnover. Following Nunes et al (2013a) who found that the impact of R&D intensity on sales growth is dependent on the level of R&D intensity in Portuguese SMEs, a dummy variable, R&D_SPEND, is included in the model to measure the effect of the level of R&D intensity on firm performance. Thus, R&D_SPEND is a dummy representing 1 if a firm has higher than average R&D intensity. TRAINING is a dummy representing 1 if the firm reports training costs. This measures the effect of a firm’s decision to undertake training on subsequent performance.

51 Foreign ownership is defined by the CSO as the nationality of the owners of 50 per cent or more of the share capital in a firm.
SUBSIDIES is a dummy measuring the impact of the receipt of public subsidies on firm performance. However, based on the available data on subsidies, it is not possible to identify the amount of subsidies and the types of subsidies received by firms during the period of analysis. Subsidies are defined in the CIP as operating subsidies, which include export refunds, employment subsidies and exclude capital grants, once-off non-payable grants and tax rebates (CSO, 2012c). The A SI defines these as total subsidies received by the firm including private and government grants (CSO, 2012d).

**Macroeconomic Variables**

Following on from the analysis of Irish macroeconomic performance undertaken in Chapter 4, several macroeconomic variables were tested. These include annual growth rate in real GDP (GDP growth), annual average unemployment rate (unemployment), annual growth rate in consumer prices (inflation), competitiveness (defined in terms of unit labour costs and the real effective exchange rate), domestic credit growth, real interest rate and the annual export growth rate as illustrated in Figure 6.1. Two alternative forms of these variables were tested – the change, and the three-year moving average.\(^52\) However, only those macroeconomic variables with robust statistically significant effects have been included in the reported results. Unless specified to the contrary, the level of the variables, as defined, is reported in the econometric estimation results. Following studies such as Beck et al (2005) and Mateev and Anastasov (2010), all macroeconomic variables are derived from country-level data, since all firms operating in Ireland face the same set of domestic macroeconomic circumstances. As stated above, a large number of macroeconomic variables have been considered in the study. However, it was not possible to use regional data given its non-

\(^{52}\) The finance and growth literature suggests the use of averages to abstract for the effect of the business cycle (e.g. Levine, 1997; Beck et al, 2005). Hence, a 3-year moving average of the macroeconomic variables was taken and estimated.
availability in the Irish context. Having summarised the data, the relationship between the variables of interest are examined with the use of correlation matrices in the next section. This offers insights as to what extent the variables to be studied are related.

Figure 6.1 Macroeconomic Variables

![Macroeconomic Variables Diagram]

**Correlation between Variables**

The correlation matrices presented in Table 6.4 and Table 6.5 provide pair-wise correlation coefficients for all the variables in the manufacturing and services datasets respectively. This provides us useful information on the direction and strength of the relationship between variables. Moreover, examining the correlation coefficients facilitates the detection of multicollinearity in the sample, that is, a perfect linear relationship between the explanatory variables.
Table 6.4 Correlation Matrix of Variables-Manufacturing firms, 1991-2007

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<td>(8) Lag Log labour productivity</td>
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<td>0.108</td>
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Author’s calculations from CIP dataset, 1991-2007
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<td>(17) R&amp;D intensity</td>
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<tr>
<td>(18) R&amp;D spend</td>
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<td>0.098</td>
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<td>(19) Trade</td>
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<tr>
<td>(20) GDP</td>
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<td>0.000</td>
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Author’s calculations from CIP dataset, 1991-2007
### Table 6.5 Correlation Matrix of Variables- Services firms, 2001-2007

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<td>(2) Turnover growth</td>
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<td>(7) Square lag turnover</td>
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<td>(8) Lag Log labour productivity</td>
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<td>-0.127</td>
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<td>0.025</td>
<td>0.015</td>
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<td>0.006</td>
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<td>0.021</td>
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<td>0.044</td>
<td>0.049</td>
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<td>-0.024</td>
<td>0.004</td>
<td>-0.029</td>
<td>-0.030</td>
<td>0.021</td>
<td>0.025</td>
<td>0.056</td>
<td>0.019</td>
<td>0.013</td>
<td>0.019</td>
<td>0.111</td>
<td>-0.001</td>
<td>0.025</td>
</tr>
<tr>
<td>(18) R&amp;D spend</td>
<td>-0.021</td>
<td>-0.075</td>
<td>0.008</td>
<td>0.027</td>
<td>0.026</td>
<td>0.014</td>
<td>0.021</td>
<td>-0.007</td>
<td>0.088</td>
<td>0.014</td>
<td>0.009</td>
<td>0.030</td>
<td>-0.015</td>
<td>0.059</td>
</tr>
<tr>
<td>(19) Trade</td>
<td>-0.009</td>
<td>0.037</td>
<td>0.020</td>
<td>0.099</td>
<td>0.097</td>
<td>0.362</td>
<td>0.329</td>
<td>0.393</td>
<td>-0.212</td>
<td>0.197</td>
<td>0.254</td>
<td>0.196</td>
<td>-0.046</td>
<td>0.097</td>
</tr>
<tr>
<td>(20) GDP</td>
<td>-0.017</td>
<td>0.047</td>
<td>0.075</td>
<td>0.013</td>
<td>0.005</td>
<td>0.005</td>
<td>0.012</td>
<td>-0.006</td>
<td>-0.000</td>
<td>0.151</td>
<td>0.037</td>
<td>0.000</td>
<td>-0.001</td>
<td>-0.303</td>
</tr>
<tr>
<td>(21) Unemployment rate</td>
<td>0.017</td>
<td>-0.052</td>
<td>-0.054</td>
<td>-0.021</td>
<td>-0.017</td>
<td>-0.001</td>
<td>-0.016</td>
<td>0.008</td>
<td>0.000</td>
<td>-0.376</td>
<td>-0.046</td>
<td>-0.000</td>
<td>-0.003</td>
<td>0.5196</td>
</tr>
<tr>
<td>(22) Inflation</td>
<td>0.020</td>
<td>-0.055</td>
<td>-0.059</td>
<td>-0.022</td>
<td>-0.017</td>
<td>-0.001</td>
<td>-0.016</td>
<td>0.009</td>
<td>-0.000</td>
<td>-0.378</td>
<td>-0.043</td>
<td>0.000</td>
<td>-0.002</td>
<td>0.5294</td>
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</table>

Author’s calculation from ASI dataset, 2001-2007
Table 6.5: Correlation Matrix of Variables – Services firms, 2001-2007
(continued)

<table>
<thead>
<tr>
<th></th>
<th>(15)</th>
<th>(16)</th>
<th>(17)</th>
<th>(18)</th>
<th>(19)</th>
<th>(20)</th>
<th>(21)</th>
<th>(22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(15) Subsidies</td>
<td>1</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(16) R&amp;D</td>
<td>-0.012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(17) R&amp;D intensity</td>
<td>-0.001</td>
<td>0.381</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(18) R&amp;D spend</td>
<td>-0.006</td>
<td>0.845</td>
<td>0.449</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(19) Trade</td>
<td>0.037</td>
<td>0.032</td>
<td>0.014</td>
<td>0.025</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(20) GDP</td>
<td>0.014</td>
<td>-0.075</td>
<td>-0.013</td>
<td>-0.048</td>
<td>-0.013</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(21) Unemployment</td>
<td>-0.012</td>
<td>-0.005</td>
<td>0.002</td>
<td>0.018</td>
<td>0.013</td>
<td>-0.306</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(22) Inflation</td>
<td>-0.013</td>
<td>0.001</td>
<td>0.003</td>
<td>0.023</td>
<td>0.017</td>
<td>-0.376</td>
<td>0.9972</td>
<td>1</td>
</tr>
</tbody>
</table>

Author’s calculations from ASI dataset, 2001-2007

In general, correlation between variables is largely quite low. However, as expected strong c o-movement i s observed between the size measures; employment and turnover (0.91 for manufacturing and 0.68 for services), while the size measures also show strong positive correlations with their square terms. This suggests that a firm’s employment performance is strongly related to its turnover performance. High correlation between variables is an indication of possible multicollinearity issues in the sample. Consequently, tests for multicollinearity are carried out in subsequent sections.

**Correlation between Dependent (Growth) Variables**

Across both manufacturing and services, all growth measures are correlated, with co-movements between employment and turnover growth, indicating firms employ more workers as output increases. Productivity growth is, however, negatively (positively) related to employment (turnover) growth consistent with decreasing returns to scale.

In other words, firm productivity decreases with increased use of inputs (workers), whereas output increases as the firm gains efficiency over time in the use of resources.
Similarly, strong (low) co-movement between labour productivity and turnover (employment) is observed, which suggests that productivity increases with firm size in manufacturing. On the other hand, in the services industry, labour productivity is positively correlated with turnover and inversely associated with employment. This implies that productivity increases with increased output (turnover) consistent with increasing returns to scale, while productivity decreases with increased input (employment) use consistent with decreasing returns to scale. Finally, firm size (measured by employment and turnover) and growth (i.e. employment and turnover growth) are found to be negatively related, providing weak evidence that firm size is dependent on growth in both manufacturing and services firms.

**Correlation between Explanatory Variables**

Noteworthy is the almost perfect collinearity between inflation and unemployment (0.997), and R&D and R&D spend\(^{53}\) (0.845) in the sample of services firms. The former provides a possible indication that multicollinearity may be an issue in the model. The strong relationship between inflation and unemployment may be related to the time period of the study, 2001-2007. The bubble during this period was associated with price and wage increases, which led to an erosion of competitiveness and rising unemployment in some industries, as previously detailed in Chapter 4 (Section 4.4). Thus, a test for multicollinearity is undertaken and the results are presented in Section 6.3.2.

\(^{53}\) R&D and R&D spend measure the firm’s decision to invest in R&D and the level of R&D intensity respectively.
Summary

In summary, the descriptive statistics presented in this section have offered the following insights on the nature of manufacturing and services firm performance in the sample during the period of analysis.

- Evidence of performance heterogeneity within a given industry, in line with evidence from other countries (Caves, 1998; Bartelsman and Doms, 2000; Caves, 2007) was found as demonstrated by the high variability of growth. This proved to be robust to the use of turnover and employment size measures in both manufacturing and services industries and suggests that high performing firms co-exist successfully with poor performers.

- A weak negative firm size-growth relation. This implies that small firms grow faster than larger firms, thus GL may not be valid in the sample;

- The nature of the relationship between firm size and productivity was seen to vary with productivity measure (i.e. productivity growth or productivity levels), size measure and industry.

Results from these descriptive statistics above are broadly consistent with findings from the analyses carried out in the preceding chapter. Nevertheless, more rigorous empirical analyses (such as is undertaken in the material which follows), are needed before these results can be confirmed. Potential econometric issues arising from the use of panel data (as indicated in Chapter 3) necessitate the use of diagnostic tests for multicollinearity, heteroskedasticity and autocorrelation as a first step. This is dealt with in the section which follows.
6.3.2 Firm Performance Model Diagnostics

Prior to estimating the regression models, diagnostic tests (such as the Breusch-Pagan test for heteroskedasticity and Wooldridge test for autocorrelation) were carried out to detect possible problems with autocorrelation, multicollinearity and heteroskedasticity, as discussed in Chapter 3 (Section 3.5). First, the data were tested for outliers, which are observations with large residuals relative to other observations that can distort OLS estimates, particularly if these are influential (Gujarati, 2011). In testing for outliers, Stata’s predict command was used to generate studentised residuals. Outliers were detected, however, no influential outliers were found after testing. Consequently, to prevent a potential loss of information, no observations were omitted from the sample. The assumptions of OLS, as previously discussed in Chapter 3 (Section 3.5) are as follows:

- Expected value of the error term is zero;
- No correlation between the explanatory variables and error term; that is, constant variance of the error terms (homoskedasticity);
- No correlation between error terms (no autocorrelation);
- No strong collinear relationship between explanatory variables - no multicollinearity (Verbeek, 2008).

Based on these assumptions, the OLS estimators are BLUE: best linear unbiased estimators (Gujarati, 2011). Thus, after running the first set of OLS regressions using the variables presented in Table 6.2 and Table 6.3 for manufacturing and services

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54 A residual is the difference between the predicted and observed values of a variable, while a studentised residual is a ratio of the residual and its estimated standard deviation.
55 Influential outliers refer to observations which when excluded from the estimation bring about a significant change in the coefficient estimates.
respectively, several tests were performed. First, the validity of the assumption of constant variance of the error terms was tested, followed by tests to determine whether error terms are correlated, as well as to assess the degree of multicollinearity in the regressions.

(i) Heteroskedasticity

A key assumption of OLS is constant variance of the error terms. Heteroskedasticity, therefore, is a violation of this assumption and distorts OLS estimates due to biased standard errors (Verbeek, 2008). In addition, $t$ and $F$ tests become unreliable causing misleading inferences to be drawn regarding the statistical significance of the estimated regression coefficient (Gujarati, 2011). The Breusch-Pagan test is a Lagrange multiplier (LM) test commonly used in the detection of heteroskedasticity, a problem usually found in cross-sectional data series. The test is computed by regressing the squared residuals on the explanatory variables. An alternative test is the White test, a more general and flexible test, which regresses the squared residuals on all regressors, squared terms and cross-products of these regressors (Gujarati, 2011).

The Breusch-Pagan/Cook-Weisberg test is run to test the null hypothesis of constant variance. Based on results presented in Table 6.6 and Table 6.7, the null hypothesis is rejected at the 5% significance level. This confirms the presence of heteroskedasticity in the sample for both manufacturing and services industries. To correct this problem, robust standard errors are estimated and reported for all regressions. Robust standard errors, which are valid in the presence of heteroskedasticity, assume that the variance of the residual can be estimated as a
diagonal matrix of the squared residual, thus improving the reliability of estimation results.

Table 6.6 Breusch Pagan/Cook-Weisberg Test for Heteroskedasticity in Manufacturing Firms

<table>
<thead>
<tr>
<th>$H_0$: Constant Variance</th>
<th>$\chi^2(1)$</th>
<th>Prob $&gt; \chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables: Fitted values of employment growth</td>
<td>3340.00</td>
<td>0.000</td>
</tr>
<tr>
<td>Variables: Fitted values of turnover growth</td>
<td>32175.66</td>
<td>0.000</td>
</tr>
<tr>
<td>Variables: Fitted values of productivity growth (turnover as size measure)</td>
<td>4036.22</td>
<td>0.000</td>
</tr>
<tr>
<td>Variables: Fitted values of productivity growth (employment as size measure)</td>
<td>19548.61</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 6.7 Breusch-Pagan/Cook-Weisberg test for Heteroskedasticity in Services Firms

<table>
<thead>
<tr>
<th>$H_0$: Constant Variance</th>
<th>$\chi^2(1)$</th>
<th>Prob $&gt; \chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables: Fitted values of employment growth</td>
<td>429.08</td>
<td>0.000</td>
</tr>
<tr>
<td>Variables: Fitted values of turnover growth</td>
<td>3367.61</td>
<td>0.000</td>
</tr>
<tr>
<td>Variables: Fitted values of productivity growth (turnover as size measure)</td>
<td>1864.94</td>
<td>0.000</td>
</tr>
<tr>
<td>Variables: Fitted values of productivity growth (employment as size measure)</td>
<td>6.07</td>
<td>0.014</td>
</tr>
</tbody>
</table>

(ii) Multicollinearity

Given the potential correlation between explanatory variables in the model, multicollinearity is tested for using the collin command in Stata. All explanatory variables to be investigated in this study (industry and location dummies inclusive) are tested with the collin command, which reports Variance Inflation Factor (VIF), Tolerance, Eigen Values, R-squared and Condition Index (CI). The results for the VIF
and Condition Index for both turnover and employment size measures are outlined in Table 6.8 and Table 6.9.

<table>
<thead>
<tr>
<th>Table 6.8 Collinearity Diagnostics (Manufacturing)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Turnover</strong></td>
</tr>
<tr>
<td>VIF</td>
</tr>
<tr>
<td><strong>SIZE_{t-1}</strong></td>
</tr>
<tr>
<td>(SIZE_{t-1})^2</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY</td>
</tr>
<tr>
<td>FOOD&amp;BEVERAGES</td>
</tr>
<tr>
<td>TEXTILES</td>
</tr>
<tr>
<td>WEARING APPAREL&amp;LEATHER</td>
</tr>
<tr>
<td>WOOD PRODUCTS</td>
</tr>
<tr>
<td>PULP&amp;PAPER</td>
</tr>
<tr>
<td>PUBLISHING&amp;PRINTING</td>
</tr>
<tr>
<td>CHEMICALS</td>
</tr>
<tr>
<td>RUBBER</td>
</tr>
<tr>
<td>NON-METALLIC</td>
</tr>
<tr>
<td>BASIC METALS</td>
</tr>
<tr>
<td>FABRICATED METALS</td>
</tr>
<tr>
<td>MACHINERY</td>
</tr>
<tr>
<td>OFFICE MACHINERY</td>
</tr>
<tr>
<td>ELECTRICAL</td>
</tr>
<tr>
<td>MEDICAL</td>
</tr>
<tr>
<td>MOTOR VEHICLES</td>
</tr>
<tr>
<td>OTHER TRANSPORT</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
</tr>
<tr>
<td>BORDER</td>
</tr>
<tr>
<td>MID-EAST</td>
</tr>
<tr>
<td>MIDLAND</td>
</tr>
<tr>
<td>MID-WEST</td>
</tr>
<tr>
<td>SOUTH-EAST</td>
</tr>
<tr>
<td>SOUTH-WEST</td>
</tr>
<tr>
<td>WEST</td>
</tr>
<tr>
<td>EXPORT</td>
</tr>
<tr>
<td>IMPORT</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
</tr>
<tr>
<td>TRAINING</td>
</tr>
<tr>
<td>SUBSIDIES</td>
</tr>
<tr>
<td>R&amp;D</td>
</tr>
<tr>
<td>R&amp;D INTENSITY</td>
</tr>
<tr>
<td>R&amp;D SPEND</td>
</tr>
<tr>
<td>GDP</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
</tr>
<tr>
<td>INFLATION</td>
</tr>
<tr>
<td><strong>Mean VIF</strong></td>
</tr>
<tr>
<td><strong>Condition Number</strong></td>
</tr>
</tbody>
</table>
Table 6.9 Collinearity Diagnostics- Services

<table>
<thead>
<tr>
<th></th>
<th>Turnover</th>
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<th>Employment</th>
<th></th>
</tr>
</thead>
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<tr>
<td></td>
<td>VIF</td>
<td>Condition Index</td>
<td>VIF</td>
<td>Condition Index</td>
</tr>
<tr>
<td>SIZE_{t-1}</td>
<td>13.48</td>
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<td>11</td>
<td>1.00</td>
</tr>
<tr>
<td>SIZE_{t-1}^2</td>
<td>11.24</td>
<td>1.98</td>
<td>10.89</td>
<td>2.03</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY_{t-1}</td>
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<td>2.41</td>
<td>2.41</td>
<td>2.44</td>
</tr>
<tr>
<td>MOTOR VEHICLES</td>
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<td>9.73</td>
<td>2.50</td>
</tr>
<tr>
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<td>2.67</td>
</tr>
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<td>RETAIL</td>
<td>19.29</td>
<td>2.69</td>
<td>18.88</td>
<td>2.72</td>
</tr>
<tr>
<td>HOTELS</td>
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<td>2.86</td>
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<td>47.29</td>
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<td>47.15</td>
<td>2.95</td>
</tr>
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<td>REAL ESTATE</td>
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<td>2.96</td>
</tr>
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<td>2.97</td>
</tr>
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<td>3.19</td>
<td>1.18</td>
<td>3.22</td>
</tr>
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<td>OTHER BUSINESS</td>
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<td>3.56</td>
<td>10.51</td>
<td>3.59</td>
</tr>
<tr>
<td>RECREATION</td>
<td>4.23</td>
<td>3.66</td>
<td>4.15</td>
<td>3.68</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>1.79</td>
<td>4.14</td>
<td>1.79</td>
<td>4.17</td>
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<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
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<td>4.85</td>
<td>41.14</td>
<td>5.15</td>
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<td>NATIONALITY OF OWNERSHIP</td>
<td>1.25</td>
<td>5.27</td>
<td>1.24</td>
<td>5.77</td>
</tr>
<tr>
<td>LOCATION</td>
<td>1.12</td>
<td>7.17</td>
<td>1.12</td>
<td>6.02</td>
</tr>
<tr>
<td>EXPORT</td>
<td>1.17</td>
<td>10.79</td>
<td>1.17</td>
<td>10.92</td>
</tr>
<tr>
<td>IMPORT</td>
<td>1.29</td>
<td>17.19</td>
<td>1.29</td>
<td>17.43</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>1.54</td>
<td>24.54</td>
<td>1.54</td>
<td>24.43</td>
</tr>
<tr>
<td>GDP</td>
<td>2.26</td>
<td>32.74</td>
<td>2.26</td>
<td>37.37</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>3.13</td>
<td>37.59</td>
<td>3.13</td>
<td>42.93</td>
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<tr>
<td>INFLATION</td>
<td>1.94</td>
<td>75.02</td>
<td>1.94</td>
<td>75.74</td>
</tr>
</tbody>
</table>

| Mean VIF            | 8.93     |                      | 8.69       |                      |
| Condition Number    | 481.27   |                      | 484.92     |                      |

The VIF measures the effect that each regressor has on the variances of other regression coefficients, while the CI measures the degree of singularity (perfect multicollinearity) between explanatory variables (Verbeek, 2008; Kennedy, 2003). As a rule of thumb, a CI greater than 30 indicates strong multicollinearity, while a VIF greater than 10 signals significant multicollinearity (Kennedy, 2003). Results based on the VIF and CI values are, however, inconclusive in both samples of firms. Mean
VIF is 2.28 and 2.84 in the manufacturing turnover and employment models respectively—much lower than the criterion of 10 (Table 6.8). On the other hand, CI values of 43.09 and 57.67, for turnover and employment respectively, are much higher than the recommended value of 30. Similarly, mean VIF values of 8.93 and 8.69 for turnover and employment in the services industry respectively are below the recommended threshold, suggesting multicollinearity may not be an issue in these models (Table 6.9). The CI results however, indicate the presence of multicollinearity given the CI values of 481.27 for turnover and 484.92 for employment respectively. Following on from these results, multicollinearity may likely pose a source of concern in the models.

(iii) Autocorrelation

As previously indicated, a major assumption of OLS is that the error terms are not correlated, that is, current errors should be uncorrelated to past errors. Failure to adjust the variance or standard errors for autocorrelation could lead to biased estimators. Standard errors may become unreliable, while the \( t \) and \( F \) tests may no longer be valid (Gujarati, 2011). Stata’s `xtserial` command, which implements the Wooldridge test of autocorrelation in panel data, is employed for autocorrelation (an inherent problem common to time-series data). This test uses the residuals from a regression in first differences (Drukker, 2003). The results outlined in Table 6.10 and Table 6.11 reject the null hypothesis of no first order autocorrelation. Autocorrelation is, therefore, confirmed in the model. Robust standard errors are estimated and reported to correct this problem.
### Table 6.10 Wooldridge Test for Autocorrelation in Panel Data-Manufacturing

<table>
<thead>
<tr>
<th></th>
<th>F(1,1294)</th>
<th>Prob&gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMPLOYMENT GROWTH</td>
<td>318.69</td>
<td>0.000</td>
</tr>
<tr>
<td>TURNOVER GROWTH</td>
<td>216.45</td>
<td>0.000</td>
</tr>
<tr>
<td>PRODUCTIVITY GROWTH (turnover size measure)</td>
<td>247.06</td>
<td>0.000</td>
</tr>
<tr>
<td>PRODUCTIVITY GROWTH (employment size measure)</td>
<td>247.32</td>
<td>0.000</td>
</tr>
</tbody>
</table>

### Table 6.11 Wooldridge Test for Autocorrelation in Panel Data-Services

<table>
<thead>
<tr>
<th></th>
<th>F(1,904)</th>
<th>Prob&gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMPLOYMENT GROWTH</td>
<td>407.53</td>
<td>0.000</td>
</tr>
<tr>
<td>TURNOVER GROWTH</td>
<td>154.92</td>
<td>0.000</td>
</tr>
<tr>
<td>PRODUCTIVITY GROWTH (turnover size measure)</td>
<td>33.08</td>
<td>0.000</td>
</tr>
<tr>
<td>PRODUCTIVITY GROWTH (employment size measure)</td>
<td>279.59</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Overall, the diagnostic tests suggest the firm performance models are not free from bias introduced by autocorrelation and heteroskedasticity, while tests for multicollinearity are not conclusive. Heteroskedasticity and autocorrelation are common problems in panel data due to its cross-sectional and time-series nature. However, these problems can be corrected with the use of robust standard errors. Robust standard errors relax the assumption that errors are independent and identically distributed (iid). Therefore, all models are estimated with robust standard errors. Moreover, the SYS-GMM estimator employed in the study is robust to heteroskedasticity and autocorrelation. In the case of multicollinearity, this is a sample...
phenomenon, which may be caused by a lack of data in the sample. Whilst a high degree of multicollinearity may have an adverse effect on regression results, this is by no means inevitable. If regression equations have low estimated standard errors and high $t$ ratios, the presence of multicollinearity in the sample is not worrisome. Having dealt with the econometric issues arising from the use of panel data in this analysis, results obtained from the estimation of equation (4), specified earlier in Section 6.2, are presented and analysed in the section which follows.

6.4 Determinants of Firm Performance in Ireland: Estimation Results

Given that issues related to the model specification, econometric concerns and diagnostics associated with the detection of heteroskedasticity, autocorrelation and multicollinearity have been dealt with, it is now appropriate to estimate the firm performance models specified in Section 6.2. Consequently, the determinants of firm performance in the manufacturing and services industries in Ireland are investigated in this section. To start with, an extended model is analysed to determine the impact of firm-level characteristics, firm strategy and the macroeconomic environment on turnover growth. Following from this, the same treatment is applied to the employment and productivity growth models, as well as the productivity level models. The use of alternative growth measures (employment, turnover and productivity) allows for testing the sensitivity of the estimated results to the choice of growth measures. Only statistically significant variables are analysed and discussed in this section. All discussions are based on the SYS-GMM models (except where specified), while sample Stata syntaxes for the SYS-GMM estimations are presented in Appendix
B. A discussion on the choice of instruments for the SYS-GMM models is presented below.

**Selection of Instruments**

As previously detailed in Chapter 3 (Section 3.5), successful use of the SYS-GMM estimator largely depends on the selection of valid instruments. A valid instrument may be related to the error term, but must not be related to the explanatory variables. Additionally, the SYS-GMM allows for the use of lags of explanatory and dependent variables as instruments. However, the decision on the instruments to be used depends on the assumptions made by the researcher as to whether the variables of interest are predetermined, endogenous or exogenous. Alternative specifications of all firm performance models were estimated with varying lags of turnover, employment, labour productivity and R&D intensity as instruments.

Turnover and employment are assumed to be endogenous (due to possible correlation between the firm’s size in the previous period and its growth in the current period). In contrast, labour productivity and R&D intensity are assumed to be predetermined. For instance, a firm’s past and current growth in turnover, employment or productivity may not necessarily be driven by its level of productivity and the amount invested in R&D in the current period. These may, however, influence its future growth. The choice of estimation results to be reported is made based on results from the Hansen test, which assesses the validity of instruments. Additionally, to minimise instrument proliferation, which may potentially reduce the consistency of results, the instruments matrix is collapsed in all models (Roodman, 2009a; Merhrhoff, 2009; Bontempi and Mammi, 2012). Following on from the discussion above, all reported results are based
on the use of the first three legs of R&D intensity as instruments, except where specified. Having outlined the selection process for the instruments used in this analysis, the determinants of turnover and employment growth in manufacturing and services firms are investigated in the next section.

6.4.1 Determinants of Turnover and Employment Growth

In this section, results from the extended turnover and employment growth models are presented. These examine the relationship between firm-specific characteristics, firm strategy, the macroeconomic environment and turnover/employment growth in manufacturing and services firms over the period 1991-2007. First, manufacturing turnover and employment growth performance is investigated over the entire period. A similar analysis for manufacturing firms in 1991-2000, and for manufacturing and services firms over the period 2001-2007 follows.

The estimated regression equations are given as:

\[
\text{TURNGROWTH} = \beta_0 + \beta_1 \ln \text{TURNOVER}_{i,t-1} + \beta_2 \ln(\text{TURNOVER}_{i,t-1})^2 + \beta_3 \ln(\text{LABPROD})_{i,t-1} + \beta_4 \text{INDUSTRY} + \beta_5 \text{IND\_GROWTH} + \beta_6 \text{IND\_MES} + \beta_7 \text{NATIONALITY} + \beta_8 \text{LOCATION} + \beta_9 \text{EXPORT} + \beta_{10} \text{IMPORT} + \beta_{11} \text{TRAINING} + \beta_{12} \text{SUBSIDIES} + \beta_{13} \text{R\&D\_INTENSITY} + \beta_{14} \text{D\_SPEND} + \beta_{15} \text{GDP} + \beta_{16} \text{UNEMP\_RATE} + \beta_{17} \text{INFLATION} + \beta_{18} \text{REER} + \beta_{19} \text{CREDIT} + \epsilon_{i,t}
\]

\[
\text{EMPGROWTH} = \beta_0 + \beta_1 \ln \text{EMP}_{i,t-1} + \beta_2 \ln(\text{EMP}_{i,t-1})^2 + \beta_3 \ln(\text{LABPROD})_{i,t-1} + \beta_4 \text{INDUSTRY} + \beta_5 \text{IND\_GROWTH} + \beta_6 \text{IND\_MES} + \beta_7 \text{NATIONALITY} + \beta_8 \text{LOCATION} + \beta_9 \text{EXPORT} + \beta_{10} \text{IMPORT} + \beta_{11} \text{TRAINING} + \beta_{12} \text{SUBSIDIES} + \beta_{13} \text{R\&D\_INTENSITY} + \beta_{14} \text{D\_SPEND} + \beta_{15} \text{GDP} + \beta_{16} \text{UNEMP\_RATE} + \beta_{17} \text{INFLATION} + \beta_{18} \text{REER} + \beta_{19} \text{CREDIT} + \epsilon_{i,t}
\]
Where, $\text{TURNGRWTH}$ and $\text{EMPGRWTH}$ are measured as the logarithmic difference of turnover and employment respectively in two consecutive periods. Size is measured in terms of turnover and employment.


Estimation results from the analysis of manufacturing employment and turnover growth are presented in Table 6.12. All available lags of R&D intensity and labour productivity are used as instruments in the turnover and employment growth models reported here. Results from the Hansen test fail to reject the null hypothesis that the above instruments are valid in the two growth models. Whilst, results of the second-order test of autocorrelation do not reject the null hypothesis of no second order serial correlation in the turnover growth model, this is rejected in the employment growth model. The latter finding implies that the SYS-GMM estimation for employment growth is inconsistent. The effects of the determining variables (firm characteristics, strategy and the macroeconomic variables) on turnover and employment growth are analysed in turn. To begin the analysis, the effect of firm characteristics on manufacturing turnover and employment growth in 1991-2007 is examined in the section which follows.

(i) Firm-specific Characteristics

In this sub-section, the impact of firm characteristics on manufacturing turnover and employment growth over the period 1991-2007 is investigated. This provides insights into whether firm size, initial level of productivity, industry characteristics, location and nationality of ownership matter for turnover and employment growth.
### Table 6.12: Determinants of Turnover and Employment Growth in Manufacturing, 1991-2007

<table>
<thead>
<tr>
<th></th>
<th>Turnover Growth</th>
<th>Employment Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>FE</td>
</tr>
<tr>
<td><strong>LOG TURNOVER</strong>,t</td>
<td>-0.161***</td>
<td>-0.604***</td>
</tr>
<tr>
<td><strong>(LOG TURNOVER),t</strong></td>
<td>(0.011)</td>
<td>(0.007)</td>
</tr>
<tr>
<td><strong>LOG EMPLOYMENT</strong>,t</td>
<td>0.023***</td>
<td>0.069***</td>
</tr>
<tr>
<td><strong>(LOG EMPLOYMENT),t</strong></td>
<td>(0.002)</td>
<td>(0.001)</td>
</tr>
<tr>
<td><strong>LOG LABOUR PRODUCTIVITY</strong>,t</td>
<td>-0.091***</td>
<td>-0.131***</td>
</tr>
<tr>
<td><strong>INDUSTRY GROWTH</strong></td>
<td>0.176***</td>
<td>0.096***</td>
</tr>
<tr>
<td><strong>INDUSTRY MINIMUM EFFICIENT SCALE</strong></td>
<td>-0.009***</td>
<td>-0.000***</td>
</tr>
<tr>
<td><strong>NATIONALITY OF OWNERSHIP</strong></td>
<td>-0.018***</td>
<td>-0.021*</td>
</tr>
<tr>
<td><strong>IMPORT</strong></td>
<td>0.010</td>
<td>-0.000</td>
</tr>
<tr>
<td><strong>EXPORT-IMPORT</strong></td>
<td>0.044***</td>
<td>0.008</td>
</tr>
<tr>
<td><strong>TRAINING</strong></td>
<td>-0.001</td>
<td>-0.006*</td>
</tr>
<tr>
<td><strong>SUBSIDIES</strong></td>
<td>-0.020***</td>
<td>0.003</td>
</tr>
<tr>
<td><strong>R &amp; D</strong></td>
<td>0.009*</td>
<td>0.033***</td>
</tr>
<tr>
<td><strong>R &amp; D INTENSITY</strong></td>
<td>-0.004***</td>
<td>-0.004***</td>
</tr>
<tr>
<td><strong>R &amp; D SPEND</strong></td>
<td>0.004</td>
<td>-0.009</td>
</tr>
<tr>
<td><strong>GDP</strong></td>
<td>0.007***</td>
<td>0.006***</td>
</tr>
<tr>
<td><strong>UNEMPLOYMENT RATE</strong></td>
<td>0.004**</td>
<td>-0.004***</td>
</tr>
<tr>
<td><strong>INFLATION</strong></td>
<td>0.006**</td>
<td>0.002</td>
</tr>
<tr>
<td><strong>REAL EFFECTIVE EXCHANGE RATE</strong></td>
<td>0.002***</td>
<td>0.001*</td>
</tr>
<tr>
<td><strong>CREDIT</strong></td>
<td>0.000</td>
<td>0.000***</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>-0.120**</td>
<td>0.854***</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>20,720</td>
<td>20,720</td>
</tr>
<tr>
<td><strong>R-squared</strong></td>
<td>0.208</td>
<td>0.531</td>
</tr>
<tr>
<td><strong>F-test</strong></td>
<td>22.86(0.000)</td>
<td>915.60(0.000)</td>
</tr>
<tr>
<td><strong>Breusch-Pagan test</strong></td>
<td>32217</td>
<td></td>
</tr>
<tr>
<td><strong>Number of firms</strong></td>
<td>1,295</td>
<td>1,295</td>
</tr>
<tr>
<td><strong>Hansen test</strong></td>
<td>2.696(0.456)</td>
<td>13.80(0.319)</td>
</tr>
<tr>
<td><strong>m1</strong></td>
<td>-6.727</td>
<td></td>
</tr>
<tr>
<td><strong>m2</strong></td>
<td>1.527</td>
<td></td>
</tr>
<tr>
<td><strong>Instruments</strong></td>
<td>47</td>
<td></td>
</tr>
</tbody>
</table>

*** Significant at 1%, ** significant at 5%, * significant at 10%.

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the Hansen test and F test. Full results with industry and location dummies included are available on request from the author. All macroeconomic variables are estimated in levels.
In general, the explanatory power of the OLS models is low (0.208 and 0.35 for employment and turnover growth respectively). Thus, firm growth appears to be a random process in line with Geroski (2000). The explanatory power, however, increases to 0.531 and 0.784 for employment and turnover growth respectively (Table 6.12, Columns 2 and 5) when fixed effects (unobservable firm-specific characteristics) are included in the model. The latter finding implies that firm growth in the manufacturing industry is mainly driven by unobservable factors which do not vary over time (Daunfeldt et al, 2012).

**Firm Size**

Firm size is statistically significant and GL is rejected in both growth models. A negative size-growth relationship is observed, an indication that small manufacturing firms grow more than their larger firm counterparts. The statistically significant coefficient on the square of log turnover (employment) is, however, positive indicating a convex size-growth relation. This implies that turnover (employment) growth decreases with increased size until a certain size threshold is reached. This is consistent with the evolutionary theory outlined in Chapter 2 (Section 2.2.3), where the firm’s starting point or initial characteristics matters. Firms enter the industry at a sub-optimal size and have to grow quickly above the industry average growth rate in order to attain the Minimum Efficient Scale (MES) and avoid exit (Cabral, 2007; Gil, 2010). Those firms able to survive show higher growth rates, while unsuccessful firms decline or exit the industry. This finding is in line with evidence from the literature which rejects GL (e.g. Oliveira and Fortunato, 2006 in Portuguese manufacturing; Petrunia, 2008 in Canadian manufacturing and retail industries and Teruel-Carrizosa, 2010 in Spanish manufacturing and services firms).
Initial Level of Productivity

In line with the evolutionary theory of the firm previously outlined in Chapter 2 (Section 2.2.3), the initial productivity level is statistically significant in the two growth models. However, contrary to *a priori* expectation, a negative link between the initial level of productivity and turnover growth was observed, implying that manufacturing firms with lower initial levels of productivity experience turnover growth faster than more productive firms. This suggests a convergence effect. Based on column 3 (Table 6.12), a 1 percent increase in the initial level of labour productivity brings about as much as an 8.3 percent decrease in turnover for manufacturing firms. This result may be related to the ‘shadow of death effect’, which refers to the empirical evidence found where firms having lower productivity levels in the immediate years prior to exiting the market (Griliches and Regev, 1995: p193). Firms entering the industry with low productivity levels have to grow quickly to reach the industry minimum size to avoid failure. It then follows that less productive firms, which do not grow, fail, while those able to survive, show higher growth rates.

In contrast, the positive statistically significant coefficient on labour productivity in the employment growth model provides evidence that, firms with higher initial levels of productivity grow faster than less productive firms. This is in line with Jovanovic’s (1982) model of passive learning, which argues that firms only gain knowledge of their true efficiency after entry into a given industry and adjust their sizes accordingly. This finding also suggests elements of market selection at play, wherein resources are reallocated from less productive to more productive firms through growth differences, consistent with the evolutionary theory of the firm (Bigsten and Gebreeyesus, 2007).
Industry Growth and Nationality of Ownership

The industry growth and nationality of ownership variables were statistically significant in the employment and turnover growth models. As expected, firms located in fast growing industries showed faster employment and turnover growth implying a low competition effect\(^{56}\) and the availability of more opportunities in a given industry. The above finding is consistent with results from Audretsch (1995) for US manufacturing firms, and Otto and Fornahl (2009) for Western German manufacturing firms. The positive industry growth effect was, however, more significant in the turnover growth model. Indigenous manufacturing firms were found to be more likely, on average, to increase turnover and employment than their foreign firm counterparts. This may be related to the size differential found between foreign and Irish-owned firms in Chapter 5 (Figure 5.3). Foreign firms locating in Ireland may enter a given industry at a size close to their optimal size and may, therefore, experience lower growth. Irish-owned firms, on the other hand, are significantly smaller than their foreign firm counterparts and may, therefore, experience higher growth, as they grow to attain the industry MES. This finding is consistent with Roper et al (2008) who found that foreign ownership hampered turnover and employment growth in manufacturing firms in the Republic of Ireland and Northern Ireland over the period 1991-2002. The effect of nationality of ownership on turnover growth was weaker at the 10 per cent significance level.

\(^{56}\) A high concentration of firms in an industry increases competitive pressure on firms within that industry. This strong competition leads to higher failure rates of firms in the industry, while their growth rates decline (Otto and Fornahl, 2009).
Location

Location was also found to be statistically significant for manufacturing turnover and employment growth. In the turnover growth model, only the Southeast dummy had a weak negative statistically significant effect. Thus, manufacturing firms located in the Dublin area are marginally more likely to grow turnover relative to firms in the Southeast region. Location in Dublin (the capital city) provides firms with access to a larger market, educated labour, professional services (O’Leary, 2007; Barbosa, 2011). The above finding may also be related to the fact that majority of the firms in Ireland in high-tech industries dominated by foreign-owned firms (for instance, computer hardware and components and computer software) are clustered around the Dublin area (Barry, 2008a). Conversely, manufacturing firms located in the Border, Mid-east, Midland, Mid-west and West regions showed better employment performance than firms located in the Dublin region. Taken together, the findings could mean that manufacturing firms in Dublin are, on average, relatively more high-tech/high-labour productivity and capital-intensive/labour-extensive than in other locations. It may also be related to a tendency for high-tech, capital-intensive firms to reduce or displace labour.

Industry

A strong significant industry effect was observed, with six (in the employment growth model) and eleven (in turnover growth model) of the eighteen manufacturing industry dummies being statistically significant. Firms in four high-tech industries (chemicals, machinery, electrical and medical devices industries) were seen to expand turnover faster, with the chemical industry being the best performer. The wearing apparel and leather industry was less successful. Firms in the high-tech industries (electrical and
machinery industries) employ more workers, as do firms in the low-tech industries: wearing apparel, textiles, rubber and fabricated metals industries. The latter finding is possibly a reflection of the labour-intensive nature of these traditional industries. The strong performance shown by high-tech firms and the concurrent poor turnover performance in traditional industries reflects the shift from low value-added to high value-added manufacturing activity, as well as the likely success achieved in the selective targeting of high-tech industries by Irish industrial policy as previously outlined in Chapter 4 (Barry and van Eggeraat, 2005; Ruane and Buckley, 2006; Bianchi and Labory, 2011).

Scale intensities in the manufacturing industry had a statistically significant effect on turnover and employment growth, with a weaker effect found for turnover growth. Nonetheless, contrary to expectation, these have a limiting effect on firm growth. This finding implies that manufacturing firms in industries with high scale intensities experience lower turnover and employment growth. Following Reichstein et al (2010) and Delmar and Wennberg (2010), the MES is proxied by the size of the average firm in a given industry. However, in contrast to the aforementioned studies, mean turnover, as opposed to mean employment, is adopted to take account of possible differences in labour intensity across industries as detailed previously in Chapter 3.

The MES controls for entry barriers and competitive in tensities in an industry (Reichstein et al, 2006). Thus, the higher the industry MES is, the higher the entry barriers in the industry. As previously detailed, the larger the scale intensity, the more quickly a firm has to grow to attain the industry MES so as to avoid exit (Audretsch et al, 2004; Delmar and Wennberg, 2010). Following on from the above, firms able to
enter the industry, which do not grow sufficiently to attain the MES, may decline or exit the industry. The next section analyses the impact of firm strategy on subsequent performance.

(ii) Firm Strategy

The prime focus here is the link between the strategy adopted by the firm and its performance. This examines the impact of training, R&D, receipt of grants/subsidies on the firm’s employment and turnover growth. Exporting, two-way trade (both exporting and importing), use of grants/subsidies and R&D intensity were statistically significant in the turnover growth model. Similarly, two-way trade, training, use of grants/subsidies, R&D, R&D intensity and R&D spend had a statistically significant effect on employment growth. These strategy variables are analysed in turn.

Trade

The findings indicate that trade is important for manufacturing firm growth. Manufacturing firms which engage in two-way trade (i.e. both exporting and importing) were found to grow employment and turnover faster than firms which do not trade. Similarly, exporting only was shown to have a positive effect on turnover growth. The effect of both exporting and importing on turnover growth was, however, slightly more pronounced than exporting only. Firms with only exporting activity increased manufacturing turnover by 3.3 percent, while two-way trading increased manufacturing turnover growth by 4.1 percent on average. This is similar to findings by Haller (2012) who found a trade premium for two-way traders for manufacturing firms in Ireland from 1996-2005. Vogel and Wagner (2010) also observed a higher
premium for two-way traders, followed by firms which export only in the case of
German manufacturing firms.

Due to the relatively small size of the Irish economy (with a population of 4.24
million in 2006 [CSO, 2007a]), firms in Ireland which export have access to global
markets and are, therefore, able to increase output and market share. With the large
presence of multinational firms in Ireland, many foreign firms may split production
stages across countries, in line with fragmentation of production theories (Grossman
and Rossi-Hansberg, 2008). In addition, given Ireland’s role as an export platform in
the global production chain, as earlier noted in Chapter 4 (Section 4.2), many foreign-
owned firms engage in the transformation of imported intermediate inputs into
manufactured goods, which are then exported. Two-way trade, therefore, becomes
more important than exporting or importing only for such firms. The former strategy
not only provides access to global markets, but also offers improved access to higher
quality imported capital goods and intermediate products.

**R&D**

Employment growth in manufacturing firms is hampered by the firm’s R&D investment decision. The negative effect of the R&D decision variable could be due to a ‘creative destruction effect’ (Schumpeter, 1942). The introduction of new technology/processes could result in firms employing fewer workers, if the technology cannot be adapted to existing jobs (Aghion and Howitt, 1994). Harrison et al (2008) argued that although there is a tendency for process innovation to reduce or

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57 R&D is defined in terms of the firm’s initial decision to invest in R&D, whilst R&D intensity is defined as the ratio of the firm’s R&D expenditure to turnover. R&D spend is assessed in terms of the firm having higher than average R&D intensity.
displace labour for a given level of output, the size of such displacement effect will
depend on the extent to which the process innovation increases labour or capital.
Similarly, the rate at which the firm increases turnover and employment declines with
increases in R&D investment. High risks associated with innovative activity mean
that firms may show poor performance when large investments in R&D do not yield
commercial success (Freel, 2000, Nunes et al, 2013a).

Nunes et al (2013a) also found a negative relation between R&D intensity and sales
growth in Portuguese SMEs. This effect was, however, quadratic, indicating that the
magnitude of the impact of R&D intensity on firm growth depends on the level of
R&D intensity. Nevertheless, R&D SPEND, which measures the impact of the level
of R&D intensity, was found to have a statistically significant effect on employment
growth only. The positive effect of R&D spend on employment growth indicates that
manufacturing firms, with higher than average R &D intensity, show higher
employment growth rates. This could mean that large R&D investments may require
the firm to employ more workers with specialised skills to enable it to derive the
maximum benefits from its innovative activity, thus increasing its employment levels.
Finally, the effect of the macroeconomic environment on manufacturing turnover and
employment growth is examined in the section which follows.

(iii) Macroeconomic Variables
As indicated previously, several other macroeconomic variables were estimated in
addition to those reported in Table 6.12. These include unit labour costs, to assess the
impact of rising wages and the resulting loss of competitiveness, as well as export
growth to take account of the rapid growth in exports in Ireland during the period of
analysis (particularly during the first growth phase). However, estimation results for these omitted variables are not reported here as they were not statistically significant and did not contribute to the explanatory power of the models.

All macroeconomic variables show statistically significant positive coefficients in the manufacturing turnover growth model. Similarly, all macroeconomic variables, with the exception of the real effective exchange rate (REER) and the availability of credit variables are statistically significant for employment growth. This suggests that the macroeconomic environment matters for employment and turnover growth in manufacturing firms.

**GDP and Unemployment**

Consistent with a priori expectations, GDP and manufacturing employment (turnover) growth are positively correlated indicating that firms are more likely to create more jobs and produce more output in an economy with greater growth opportunities and higher aggregate demand. This is similar to findings by Beck et al (2005) in their survey of the effect of legal, financial and corruption problems on firm growth based on firm-level data for 54 countries. A positive significant effect of unemployment on manufacturing employment and turnover growth is also found. High levels of unemployment provide firms with a pool of workers willing to work at lower wages (Gautié et al, 2010). Thus, firms may likely employ more workers and increase output during periods of high unemployment in the economy.
**Inflation**

As expected, inflation has a negative effect on employment growth. During the latter part of the sample period (2001-2007), the Irish economy lost international competitiveness. Irish inflation was higher than the average for the euro area. Higher inflation and increasing wage costs meant an erosion of competitiveness and rising unemployment in some industries. Contrary to the above finding, inflation was found to have a positive effect on turnover growth. The latter finding may be related to the prevailing real interest rates in Ireland during the period of analysis. There was a sharp decline in real interest rates, beginning from 1996, with interest rates becoming negative during the period 1998 to 2006 (See Figure 4.6 in Chapter 4). As detailed in Chapter 4 (Section 4.3.2), low/negative real interest rates in Ireland, during this period owed much to membership of the euro. Ireland was growing strongly with relatively high inflation (Ireland was an outlier in this respect), while Germany and France experienced low/moderate growth and low inflation. Low euro interest rates were largely based on economic conditions in Germany and France. Hence, Ireland experienced the unusual occurrence of low interest rates at a time of relatively high inflation. Following on from the above, lower real interest rates will likely stimulate consumption and investment spending through borrowing (Taylor, 2007; Mankiw, 2010). The increase in aggregate demand should lead to growth in firms’ turnover. This result is similar to findings by Becks et al (2005) and Mateev and Anastasov (2011).

**Real Effective Exchange rate and Availability of Credit**

Contrary to expectations, appreciation of the REER index was found to increase turnover growth. A rise in the REER index makes exports less competitive and
imports cheaper. Cheaper imports mean that firms dependent on imported inputs may face lower production costs in the aftermath of an appreciation of the REER index (Caglayan and Demir, 2014). Additionally, many foreign-owned manufacturing firms located in Ireland transform imported intermediate inputs into output which is then exported, as detailed previously in Chapter 4. Taken together, the above suggest that the positive effects of an increase in the REER on imports may offset its negative effects on exports in manufacturing firms which engage in two-trade, thus bringing about higher turnover growth. It is possible that cheaper imported input costs, as a result of exchange rate appreciation, could allow firms to lower output prices, and increase demand. If aggregate demand was broadly elastic, this would lead to increased turnover. A growth in domestic credit was found to stimulate growth in turnover, albeit a weak significant effect, in line with a priori expectations.

Summary

In summary, the results show that firm-specific characteristics (firm size, the initial level of productivity, industry growth, minimum efficient size and nationality of ownership), firm strategy (two-way trade, use of grants/subsidies and R&D intensity) and the macroeconomic environment (GDP growth, inflation and unemployment) are important determinants of employment and turnover growth in manufacturing firms in 1991-2007. In addition to the above drivers, exporting, availability of credit and the REER index were significant drivers of turnover growth, while training, R&D and R&D spend were important for employment growth during the same period.

Manufacturing turnover and employment growth is examined in the next section over the growth periods 1991-2000 and 2001-2007 to establish whether the results vary
over the business cycle. Turnover and employment growth for services firms is also investigated over the period 2001-2007.

(2) Turnover and Employment Growth across Two Growth Phases

The 1991-2007 time-period was truncated, to investigate structural breaks in the data between the two sub-periods, 1991-2000 and 2001-2007. The key focus of this section, therefore, is to determine whether there are performance differences between these periods. This further increases our understanding of how the macroeconomic environment influences the growth performance of firms. Overall, the period 1991-2007 represented very strong macroeconomic growth in Ireland (as measured by both real GDP and GNP). However, within this period, two very different growth phases can be identified, and the transition between them attended a significant change in the structure of the Irish economy. A sustainable export-led boom gave way to an unsustainable credit-led property price bubble, financed by net external borrowing, after 2000 (See Chapter 4 for discussion). In reality, the Irish economy could be considered to have been in a recession post-2000 if the contribution of the construction industry were deducted from gross output (Dineen and Lenihan, 2011).

Descriptive analyses undertaken in Chapter 5 provided preliminary evidence of performance differences between the two growth phases, 1991-2000 and 2001-2007. Thus, estimating the econometric specifications for these two sub-periods, enables testing for structural changes or shifts in the data between these periods. Moreover,

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58 The Chow test can be used to test for structural breaks in the data. This is a summary statistics which tests the hypothesis of a structural break in the dataset. This thesis goes further, where the empirical estimations are undertaken for the two sub-periods 1991-2000 and 2001-2007. The analysis takes into account structural breaks in the data by highlighting significant differences in statistical significance, variable sign and magnitude of coefficients.
controlling for macroeconomic variables (such as GDP growth, unemployment, inflation, unit labour costs, credit growth, real exchange rates), it is possible to determine whether the estimated parameters for the firm-specific and strategy variables are structurally different across the two distinct growth phases. To the best of the author’s knowledge, this is the first attempt at investigating the performance of firms in Ireland, taking account of the two distinct growth phases in the so-called Celtic Tiger period. The drivers of manufacturing turnover and employment growth performance in 1991-2000 are examined in the next section.


Results from the estimation of turnover and employment growth in manufacturing firms over the period 1991-2000 are reported in Table 6.13. Instruments were confirmed valid based on the Hansen test in both models and the test for second order serial correlation rejected the null hypothesis of the absence of second order serial correlation in both growth models. Findings are broadly similar to results from the overall sample period in terms of variable signs and statistical significance, with a few exceptions which are discussed below.

Training and R&D spend were found to be statistically significant in addition to the significant determinants outlined previously in the analysis of turnover growth in 1991-2007, whereas variables such as nationality of ownership, unemployment, availability of credit and the REER index were no longer statistically significant in this first growth phase. Similarly, besides the other significant variables found in the employment growth model for the overall sample period, importing was found to be
significant. Two-way trade, R&D intensity, GDP and unemployment, however, lost statistical significance compared to the wider period.

The findings indicate that training had a depressing effect on turnover growth, while growth in turnover increases with the level of R&D intensity. Importing also had a negative effect on employment growth, implying that firms which engaged in imports employed fewer workers than firms which do not trade. The weaker significant effect found for the macroeconomic variables is noteworthy. GDP and inflation were found to stimulate turnover growth, while inflation had a dampening effect on employment growth.
### Table 6.13: Determinants of Manufacturing Turnover and Employment Growth, 1991-2000

<table>
<thead>
<tr>
<th></th>
<th>Turnover Growth</th>
<th>Employment Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>FE</td>
</tr>
<tr>
<td>LOG TURNOVER, t1</td>
<td>-0.179***</td>
<td>-0.770***</td>
</tr>
<tr>
<td></td>
<td>0.025***</td>
<td>0.090***</td>
</tr>
<tr>
<td>LOG EMPLOYMENT, t1</td>
<td>-0.411***</td>
<td>-0.945***</td>
</tr>
<tr>
<td></td>
<td>0.053***</td>
<td>0.131***</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY, t1</td>
<td>-0.070***</td>
<td>-0.073***</td>
</tr>
<tr>
<td></td>
<td>0.026***</td>
<td>0.005</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.341***</td>
<td>0.122***</td>
</tr>
<tr>
<td></td>
<td>0.059***</td>
<td>0.033**</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>-0.000***</td>
<td>-0.000***</td>
</tr>
<tr>
<td></td>
<td>0.000***</td>
<td>0.000***</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.005</td>
<td>-0.007</td>
</tr>
<tr>
<td></td>
<td>0.011</td>
<td>0.009</td>
</tr>
<tr>
<td>EXPORT</td>
<td>0.034***</td>
<td>0.028**</td>
</tr>
<tr>
<td></td>
<td>0.005</td>
<td>-0.010*</td>
</tr>
<tr>
<td>IMPORT</td>
<td>-0.011</td>
<td>0.009</td>
</tr>
<tr>
<td></td>
<td>-0.016***</td>
<td>0.006</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>0.028***</td>
<td>0.018**</td>
</tr>
<tr>
<td></td>
<td>0.001</td>
<td>-0.014**</td>
</tr>
<tr>
<td>TRAINING</td>
<td>-0.037***</td>
<td>-0.037***</td>
</tr>
<tr>
<td></td>
<td>-0.049***</td>
<td>-0.013**</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>-0.018**</td>
<td>0.019***</td>
</tr>
<tr>
<td></td>
<td>-0.023**</td>
<td>0.005**</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>-0.100</td>
<td>0.034***</td>
</tr>
<tr>
<td></td>
<td>-0.005</td>
<td>-0.005</td>
</tr>
<tr>
<td>R &amp; D INTENSITY</td>
<td>-0.007**</td>
<td>-0.013***</td>
</tr>
<tr>
<td></td>
<td>-0.001</td>
<td>-0.001</td>
</tr>
<tr>
<td>GDP</td>
<td>0.007***</td>
<td>0.005***</td>
</tr>
<tr>
<td></td>
<td>0.002</td>
<td>0.000</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>-0.001</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>-0.001</td>
<td>-0.001</td>
</tr>
<tr>
<td>INFLATION</td>
<td>0.010***</td>
<td>0.004*</td>
</tr>
<tr>
<td></td>
<td>-0.004*</td>
<td>-0.002**</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>-0.001</td>
<td>-0.002**</td>
</tr>
<tr>
<td></td>
<td>-0.001</td>
<td>-0.001</td>
</tr>
<tr>
<td>CREDIT</td>
<td>-0.000</td>
<td>0.001</td>
</tr>
<tr>
<td>Constant</td>
<td>0.333***</td>
<td>1.368***</td>
</tr>
<tr>
<td></td>
<td>0.830***</td>
<td>1.648***</td>
</tr>
<tr>
<td>Observations</td>
<td>11,655</td>
<td>11,655</td>
</tr>
<tr>
<td></td>
<td>11,655</td>
<td>11,655</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.190</td>
<td>0.612</td>
</tr>
<tr>
<td>Breusch-Pagan test</td>
<td>11628</td>
<td>2202</td>
</tr>
<tr>
<td>Number of firms</td>
<td>1,295</td>
<td>1,295</td>
</tr>
<tr>
<td>Hansen test</td>
<td>m1</td>
<td>-6.401</td>
</tr>
<tr>
<td>m2</td>
<td>3.091</td>
<td>4.437</td>
</tr>
</tbody>
</table>

*** Significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. Values in parentheses represent the p-values for the F-test and Hansen test. Industry dummies are dropped from the FE model as these do not vary over time. Full results with industry and location dummies included are available on request from the author. All macroeconomic variables are estimated in levels.

It is, however, important to note that firm growth in Ireland during this period may have been driven by other factors such as demand conditions in the economies of its major export markets. Manufacturing and services employment and turnover growth

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performance over the credit-led consumer demand-driven growth phase, 2001-2007 are analysed in the section which follows.

(ii) Manufacturing and Services Turnover and Employment Growth (2001-2007)

The main focus here is to analyse the determinants of employment and turnover growth for manufacturing and services firms in Ireland over the period 2001-2007. Data on R&D and subsidies are only available in the ASI dataset from 2005 for the services industry. The period of analysis in the services growth models is, therefore, restricted to the years from 2005-2007 (inclusive). Due to the relatively short time period, a limited number of lags are available, consequently tests for second order serial correlation could not be carried out in this services model. However, turnover and employment growth in the services sample for the wider period 2001-2007 was also estimated in models which exclude the strategy variables for which data were not available (i.e. R&D and subsidies).

The Hansen test confirms the validity of the first three lags of R&D intensity as instruments, while the absence of second order serial correlation is confirmed in the 2001-2007 manufacturing and services growth models. Estimation results are detailed in Table 6.14 for manufacturing firms in 2001-2007 and Tables 6.15 and 6.16 for the services industry in 2001-2007 and 2005-2007 respectively. The estimation results for both manufacturing and services firms are quite similar in terms of variable signs and statistical significance compared to previous findings from the analysis of manufacturing turnover performance over the entire sample period 1991-2007 and the first growth phase 1991-2000.
Table 6.14 Determinants of Manufacturing Turnover and Employment Growth 2001-2007

<table>
<thead>
<tr>
<th>Instruments</th>
<th>Turnover Growth</th>
<th>Employment Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>FE</td>
</tr>
<tr>
<td>LOG TURNOVER&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.167***</td>
<td>-0.811***</td>
</tr>
<tr>
<td>(LOG TURNOVER&lt;sub&gt;t-1&lt;/sub&gt;)&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.023***</td>
<td>0.090***</td>
</tr>
<tr>
<td>LOG EMPLOYMENT&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.409***</td>
<td>-0.970***</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT&lt;sub&gt;t-1&lt;/sub&gt;)&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.052***</td>
<td>0.131***</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.114***</td>
<td>-0.078***</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.109***</td>
<td>0.041</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>-0.000</td>
<td>-0.000***</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.011***</td>
<td>-0.017***</td>
</tr>
<tr>
<td>NUMBER OF FIRM</td>
<td>0.038*</td>
<td>0.021</td>
</tr>
<tr>
<td>BREUSCH-GORONI TEST</td>
<td>0.040***</td>
<td>0.007</td>
</tr>
<tr>
<td>REDUCED FORM</td>
<td>0.066***</td>
<td>0.011</td>
</tr>
<tr>
<td>TRAINING</td>
<td>0.044***</td>
<td>0.017**</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>-0.010</td>
<td>0.020*</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>0.034***</td>
<td>0.034***</td>
</tr>
<tr>
<td>R &amp; D INTENSITY</td>
<td>-0.001*</td>
<td>0.000</td>
</tr>
<tr>
<td>R &amp; D SPEND</td>
<td>-0.032**</td>
<td>-0.031***</td>
</tr>
<tr>
<td>GDP</td>
<td>-0.015*</td>
<td>-0.007</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>0.411**</td>
<td>0.214*</td>
</tr>
<tr>
<td>INFLATION</td>
<td>-0.040**</td>
<td>-0.022*</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>-0.013**</td>
<td>-0.007*</td>
</tr>
<tr>
<td>CREDIT</td>
<td>0.002***</td>
<td>0.001***</td>
</tr>
<tr>
<td>Constant</td>
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<td>1.054***</td>
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<tr>
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<tr>
<td>R-squared</td>
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<td>0.367</td>
</tr>
<tr>
<td>F-test</td>
<td>6.944(0.000)</td>
<td>514(0.000)</td>
</tr>
<tr>
<td>Brecus-Pagan test</td>
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</tr>
<tr>
<td>Number of Firms</td>
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<td>1,295</td>
</tr>
<tr>
<td>Hansen test</td>
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</tr>
<tr>
<td>m1</td>
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</tr>
<tr>
<td>m2</td>
<td>1.820</td>
<td></td>
</tr>
<tr>
<td>Instruments</td>
<td>47</td>
<td></td>
</tr>
</tbody>
</table>

** Significant at 1%, *** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parentheses. m1 and m2 are t-tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p-values for the F test and Hansen test. Industry dummies are dropped from the FE model as these do not vary over time. Full results with industry and location dummies included are available on request from the author. All macroeconomic variables are estimated in levels.
Table 6.15 Determinants of Services Turnover and Employment Growth 2001-2007

<table>
<thead>
<tr>
<th>Turnover Growth</th>
<th>Employment Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OLS</strong></td>
<td><strong>FE</strong></td>
</tr>
<tr>
<td>LOG TURNOVER, t1</td>
<td>-0.248***</td>
</tr>
<tr>
<td>(0.035)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>(LOG TURNOVER, t)²</td>
<td>0.028***</td>
</tr>
<tr>
<td>(0.004)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>LOG EMPLOYMENT, t1</td>
<td>-0.498***</td>
</tr>
<tr>
<td>(0.029)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT, t)²</td>
<td>0.052***</td>
</tr>
<tr>
<td>(0.003)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY, t1</td>
<td>-0.040***</td>
</tr>
<tr>
<td>(0.011)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>(INDUSTRY GROWTH</td>
<td>0.229***</td>
</tr>
<tr>
<td>(0.063)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>(INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>-0.000</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>(NATIONALITY OF OWNERSHIP</td>
<td>0.002</td>
</tr>
<tr>
<td>(0.011)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>LOCATION</td>
<td>0.005</td>
</tr>
<tr>
<td>(0.007)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>EXPORT</td>
<td>-0.028</td>
</tr>
<tr>
<td>(0.021)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>IMPORT</td>
<td>0.017***</td>
</tr>
<tr>
<td>(0.007)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>(EXPORT-IMPORT</td>
<td>0.024**</td>
</tr>
<tr>
<td>(0.010)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>TRAINING</td>
<td>0.036***</td>
</tr>
<tr>
<td>(0.008)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>GDP</td>
<td>-0.019**</td>
</tr>
<tr>
<td>(0.008)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>0.229**</td>
</tr>
<tr>
<td>(0.104)</td>
<td>(0.067)</td>
</tr>
<tr>
<td>INFLATION</td>
<td>-0.014</td>
</tr>
<tr>
<td>(0.015)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>-0.000</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>CREDIT</td>
<td>0.001***</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
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<tr>
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<tr>
<td>(0.444)</td>
<td>(0.285)</td>
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<tr>
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<tr>
<td>R-squared</td>
<td>0.245</td>
</tr>
<tr>
<td>F-test</td>
<td>8.141(0.000)</td>
</tr>
<tr>
<td><strong>Note:</strong> Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as $N(0,1)$ under the null of no serial correlation. Values in parentheses represent the p-values for the F test and Hansen test. Industry dummies are dropped from the FE model as these do not vary over time. Full results with industry dummies included are available on request from the author. All macroeconomic variables are estimated in levels. ** *** significant at 1%, ** significant at 5%, * significant at 10%</td>
<td></td>
</tr>
</tbody>
</table>
Table 6.16 Determinants of Services Turnover and Employment Growth 2005-2007

<table>
<thead>
<tr>
<th></th>
<th>Turnover Growth</th>
<th>Employment Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>FE</td>
</tr>
<tr>
<td>LOG TURNOVER(_{it})(^2)</td>
<td>-0.191*** (0.028)</td>
<td>-0.926*** (0.014)</td>
</tr>
<tr>
<td>LOG EMPLOYMENT(_{it})(^2)</td>
<td>0.022*** (0.003)</td>
<td>0.101*** (0.001)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY(_{it})(^2)</td>
<td>-0.028*** (0.010)</td>
<td>-0.013 (0.012)</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.292*** (0.076)</td>
<td>0.036 (0.033)</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>0.000 (0.000)</td>
<td>-0.000** (0.000)</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.009 (0.016)</td>
<td>-0.010 (0.016)</td>
</tr>
<tr>
<td>LOCATION</td>
<td>0.000 (0.000)</td>
<td>0.000 (0.010)</td>
</tr>
<tr>
<td>EXPORT</td>
<td>0.006 (0.030)</td>
<td>0.009 (0.030)</td>
</tr>
<tr>
<td>IMPORT</td>
<td>0.009 (0.009)</td>
<td>-0.001 (0.013)</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>0.016 (0.013)</td>
<td>-0.004 (0.011)</td>
</tr>
<tr>
<td>TRAINING</td>
<td>0.031*** (0.011)</td>
<td>-0.004 (0.006)</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>0.003 (0.028)</td>
<td>-0.051** (0.020)</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>0.018 (0.027)</td>
<td>-0.031 (0.024)</td>
</tr>
<tr>
<td>R&amp;D INENSITY</td>
<td>-0.004 (0.004)</td>
<td>-0.007** (0.004)</td>
</tr>
<tr>
<td>R&amp;D SPEND</td>
<td>-0.049 (0.037)</td>
<td>0.007 (0.027)</td>
</tr>
<tr>
<td>GDP</td>
<td>0.000 (0.013)</td>
<td>-0.020** (0.013)</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>0.131 (0.412)</td>
<td>0.047 (0.874)</td>
</tr>
</tbody>
</table>

***significant at 1%, **significant at 5%, *significant at 10%
Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as \(\chi^2\) under the null of instrument validity with \(p\)-values reported in parentheses. m1 is the test for first order serial correlation in the first-differenced residuals, asymptotically distributed as \(F(0,1)\) under the null of no serial correlation. Values in parentheses represent the \(p\)-values for the F test and Hansen test. Industry dummies are dropped from the FE model as these do not vary over time. Full results with industry dummies included are available on request from the author. All macroeconomic variables are estimated with the levels.
In relation to manufacturing turnover growth, nationality of ownership, importing, R&D, unemployment, availability of credit and the REER index were statistically significant compared to the first growth phase. Similarly, two-way trade and GDP had statistically significant effects on manufacturing employment growth in this period relative to the first growth phase. With regard to services employment and turnover growth, the effects of firm size, its square term and the initial level of productivity were similar to the finding for manufacturing firms in terms of statistical significance and variable signs. Thus, the results also confirm that GL is not valid in the sample of services firms, with small services firms growing faster than their larger firm counterparts.

Although the convex relationship between initial firm size and growth holds for services and manufacturing firms in this period, it is important to note the size differentials between these two groups of firms. In 2001-2007, small manufacturing firms increase employment faster than larger firms up to a threshold of about 51 workers, when employment begins to decline, whereas the threshold for services firms is about 114 workers during the same period. The employment threshold differentials observed for both manufacturing and services industries reflect differences in scale intensities between the two industries, as highlighted previously in Chapter 5.

**Industry**

In comparing performance over the two sub-periods, the higher turnover growth rate in the second growth period across manufacturing industries is noteworthy. In general, manufacturing firms located in high-tech industries such as chemicals, electrical, medical and optical devices and machinery industries had higher turnover growth, on
the average, in the period 2001-2007 compared to the first sub-period. Similarly, in low-tech industries, such as food and beverages, turnover growth was also found to have risen over the period. Whilst, employment growth in the food and beverages industry was higher in the second growth period, employment growth in other traditional manufacturing industries such as rubber, and pulp and paper products was lower. The latter finding is a possible reflection of the poor manufacturing employment performance during the period as detailed earlier in Chapter 4.

In relation to the services sample, all industry dummies had positive statistically significant effects on turnover growth, while only the hotels and renting machinery industry dummies had positive significant effects on employment growth in 2001-2007. These findings imply that firms in all services industries showed higher turnover growth relative to the other services activities industry (which is the reference category). Similarly, firms in the hotels and renting machinery industries employed more workers than firms in the other services activities industry.

**Industry Characteristics**

Industry growth had a positive statistically significant impact on manufacturing and services turnover growth across the two sub-periods, with a larger effect found for services firms. The magnitude of industry growth effect on manufacturing turnover growth was, however, lower in the second growth period (13.1 percent) relative to the first growth phase (35.3 percent). This suggests reduced productive opportunities were available to manufacturing firms during the slowdown of economic growth post-2000. In reality, declining manufacturing performance (due to a shift from low value-added to high value-added manufacturing, as well as the...
relocation of Irish operations to cheaper locations by many foreign-owned firms) during this period was asked by the growth in services and construction industries, as outlined previously in Chapter 4 (Section 4.3.2).

**Nationality of Ownership**

Foreign ownership had a negative statistically significant effect on manufacturing turnover and employment growth in 2001-2007 similar to the finding for 1991-2007. This implies that foreign manufacturing firms had lower turnover and employment growth relative to Irish manufacturing firms in 2001-2007. In contrast, no significant foreign ownership effect was seen in the services sample over the periods 2001-2007 and 2005-2007. The increase in the magnitude of the effect of nationality on manufacturing employment growth from 2.6 per cent in 1991-2000 to 5.1 per cent in 2001-2007 is worthy of interest (Tables 6.13 and 6.14).

The poorer performance shown by foreign manufacturing firms during the second growth phase is related to a number of factors stemming from the loss of competitiveness in the Irish economy as detailed previously in Chapter 4. These factors include plant closures, downsizing due to the relocation of operations to more competitive locations, as well as upgrading to higher value-added activities in some industries with significant foreign presence—for instance, the information communications technology industry (Collins and Grimes, 2008; Barry and van Egeraat, 2008). This finding demonstrates the sensitivity of foreign firms to changes in the operating environments and their unwillingness to continue with unprofitable operations in host economies by relocating to more competitively priced locations.
(Görg and Strobl, 2003b), diversifying operations or upgrading to higher value-added activities (Collins and Grimes, 2011).

**Location**

In terms of location, location in the Border, Mid-west and West regions had a positive statistically significant effect on manufacturing employment growth in 2001-2007 similar to the previous finding for 1991-2007. This implies that manufacturing firms located in these regions showed higher employment growth relative to firms in the Dublin region. This result is possibly due to higher operational costs associated with locating in Dublin and may also be related to ease of accessibility. For instance, the central location of the Midlands provides easy access to major cities such as Dublin and Galway, as well as international airports and seaports. Thus, firms are able to increase employment without the additional costs associated with higher wages and rents in areas such as Dublin. Additionally, significant growth in employment is found for manufacturing firms located in the West region during the second growth phase. This may be related to ease of accessibility, as well as the emergence of multinational firms in life sciences (medical technologies), ICT and engineering (IDA Ireland, 2013).

**Trade**

Importing had a positive statistically significant effect on manufacturing turnover and employment growth, and services turnover growth in 2001-2007 compared to the absence of a statistically significant effect found for manufacturing for the overall period 1991-2007 and the first growth phase 1991-2000, as well as for services firms in 2005-2007. Moreover, importing had a negative effect on manufacturing
employment growth in the first growth period. This implies that firms which import only showed higher turnover and employment growth relative to firms which do not trade. The above finding may be related to the fact that economic growth in Ireland during this period was fuelled by credit-led consumer demand which generated increased imports, as detailed earlier in Chapter 4 (Section 4.3.2).

Two-way trade had a positive significant effect on manufacturing and services turnover growth in the second growth phase. Manufacturing firms, which engaged in both exporting and importing, had higher turnover growth (5.6 per cent) in 2001-2007 compared to 2.5 per cent for the first growth period, and 4.1 per cent in the wider period (Tables 6.14). Similarly, two-way trade increased turnover growth in services firms by 2.7 per cent relative to non-traders (Table 6.15). Overall, trade was found to be more important for turnover and employment performance in manufacturing and services firms during the second growth phase. Thus, manufacturing and services firms which both export and import showed a higher turnover performance relative to non-traders, followed by firms which import only. This finding provides evidence of the importance of trade to firm performance in Ireland given its role as an export platform for multinational firms. The results suggest that, compared to the first growth phase, the higher turnover growth performance found for some manufacturing industries (such as electricals, chemicals, medical and optical devices, and food and beverages) during the credit-led growth phase in Ireland, may have been likely driven by trade. As outlined earlier and in the context of the size and open nature of the Irish economy, trade provides firms with access to better quality intermediate inputs and larger global markets. Consequently, firms which engage in trade may gain new knowledge and skills which stimulate superior performance.
Training

Training had a positive statistically significant effect on turnover and employment growth for both manufacturing and services in the second growth phase compared to the overall period. Manufacturing firms which trained employees showed better turnover performance in 2001-2007 relative to firms with no training programmes, while training depressed turnover in 1991-2000. This is an indication that training is a relevant strategy for manufacturing firms during the second growth period. Training increases productivity by making workers more flexible and adaptable to changing conditions, as well as increasing skills and knowledge of innovative processes.

Grants/Subsidies

The effect of grants/subsidies on turnover growth was statistically significant for manufacturing firms in 1991-2000, whereas this was not statistically significant for manufacturing and services firms in 2001-2007 and for manufacturing firms in 1991-2007. Hence, manufacturing firms which received grants/subsidies showed lower turnover growth during the first growth phase.

R&D

With regard to innovative activity, the R&D variable (which measures the effect of the firm’s decision to invest in R&D) has a statistically significant effect for manufacturing firms across both sub-periods. A negative effect on turnover growth was observed in 1991-2000, whilst a positive effect was found in 2001-2007, similar to the overall period 1991-2007. This finding suggests that a manufacturing firm’s decision to invest in R&D during the second phase boosted subsequent turnover growth. Firms with higher than average investments in R&D (R&D spend)

**Macroeconomic Environment**

Overall, GDP had a negative statistically significant effect on turnover and employment growth in manufacturing and services firms in 2001-2007. This implies that firms produce more output and employ more workers during periods of low economic growth. This finding is contrary to expectations. It may be that GDP is not a good broadly-based measure of macroeconomic activity during the second growth phase 2001-2007. As detailed previously in Chapter 4, in this period, new homebuilding disguised problems in the export sector. As indicated previously, it could be argued that Ireland was in recession from 2001 if the construction industry was subtracted from national output, (Dineen and Lenihan, 2011).

In contrast to the positive effect found in the first growth period, a negative significant inflation effect was found for manufacturing turnover growth, implying that turnover growth declines with rising prices. On the other hand, unemployment showed a positive significant effect on turnover growth for manufacturing and services firms. As expected, the REER index had a negative significant effect on manufacturing turnover growth, contrary to the positive effect found for the wider period 1991-2007. The former finding implies that an appreciation of the REER leads to lower growth in turnover. Finally, the availability of credit promotes turnover growth in both manufacturing and services firms consistent with expectations.
Summary

To sum up, a comparison of employment and turnover growth in manufacturing firms during the two growth periods revealed performance differences, with firms in some industries such as chemicals and food and beverages showing higher turnover growth during the credit-led consumer demand-driven growth period (2001-2007). Furthermore, the scale of the positive effect of industry growth on manufacturing turnover growth was significantly lower in the second growth phase relative to the first, an indication of reduced opportunities in manufacturing industries during the period. Additionally, the impact of firm strategy on turnover and employment growth was conditional on the growth period. Thus, the magnitude of the positive effects of strategies such as trade, training and R&D was more pronounced in the second growth phase compared to the first. Given that this period was characterised by the loss of international competitiveness in the Irish economy, the results suggest that the aforementioned strategies are more relevant in helping manufacturing firms adjust to the adverse changes in the operating environment during this growth phase.

In relation to the macroeconomic environment, the effect of this group of determinants was also found to vary across both periods. Thus, GDP and inflation had growth-enhancing effects on manufacturing turnover growth in the first growth period 1991-2000, while these variables lowered turnover growth in the second growth period. With regard to services turnover and employment performance, findings were not very robust. However, results confirmed firm size, the initial level of productivity, two-way trade, training, GDP, inflation and the availability of credit as significant determinants of employment growth in services firms. In addition to the above variables, industry growth, importing, unemployment and the availability of credit...
were found to be important drivers of turnover growth for services firms in 2001-2007.

The results obtained from the analyses of employment and turnover growth undertaken so far, indicate that firm characteristics, firm strategy and macroeconomic conditions are important for improved employment and turnover performance in manufacturing and services firms. To provide additional insights on another aspect of firm performance (specifically, the efficiency with which firms produce output given their resource base), the determinants of productivity growth are investigated in the following section.

6.4.2 Determinants of Productivity Growth

The factors driving productivity growth are analysed and the results presented in this section. To test the sensitivity of results from the productivity growth analysis to the use of different size measures, log employment is used in the first specification and log turnover in a second specification. This approach is motivated by the fact that productivity (turnover per employee) consists of two components: turnover (output) and employment (input). Thus, alternate use of employment and turnover is important given that these not only capture different aspects of the firm, but also reflect different strategies adopted by the firm in achieving improved performance. The regressions estimated to test the sensitivity of estimation results to size measures are given as follows:
Where, \( \text{PRODGRWTH} \) is measured as the logarithmic difference of productivity in two consecutive periods.


Productivity growth in manufacturing firms over the period 1991-2007 is examined in this section. Hansen test results confirm the validity of the first three lags of R&D intensity as instruments in the reported results, while the test for second order serial correlation rejects the null hypothesis of no second order correlation. Estimation results are presented in Table 6.17. To begin with, a discussion on the effect of firm characteristics is presented in the section which follows.

(i) Firm-specific characteristics

The role of firm characteristics in determining firm productivity growth is examined in this section. More specifically, a discussion on the effect of firm size, initial productivity level, industry characteristics, nationality of ownership and location is detailed below.
## Table 6.17 Determinants of Productivity Growth in Manufacturing, 1991-2007

<table>
<thead>
<tr>
<th>Productivity Growth</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOG TURNOVER(_{t-1})</td>
<td>-0.102***</td>
<td>-0.237***</td>
<td>-0.096***</td>
<td>(0.011)</td>
<td>(0.008)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>(LOG TURNOVER(_{t-1}))^2</td>
<td>0.019***</td>
<td>0.047***</td>
<td>0.018***</td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>LOG EMPLOYMENT(_{t-1})</td>
<td>0.263***</td>
<td>0.369***</td>
<td>0.264***</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT(_{t-1}))^2</td>
<td>-0.031***</td>
<td>-0.062***</td>
<td>-0.031***</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY(_{t-1})</td>
<td>-0.163***</td>
<td>-0.517***</td>
<td>-0.157***</td>
<td>(0.013)</td>
<td>(0.008)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.158***</td>
<td>0.095***</td>
<td>0.181***</td>
<td>(0.027)</td>
<td>(0.021)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>0.000</td>
<td>-0.000***</td>
<td>0.000***</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>0.010</td>
<td>-0.010</td>
<td>0.058***</td>
<td>(0.007)</td>
<td>(0.012)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>EXPORT</td>
<td>0.059***</td>
<td>0.037***</td>
<td>0.052***</td>
<td>(0.012)</td>
<td>(0.011)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>IMPORT</td>
<td>0.019***</td>
<td>0.011</td>
<td>0.017**</td>
<td>(0.007)</td>
<td>(0.008)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>0.043***</td>
<td>0.031***</td>
<td>0.039***</td>
<td>(0.007)</td>
<td>(0.008)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>TRAINING</td>
<td>-0.007</td>
<td>-0.010**</td>
<td>-0.005</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>-0.023***</td>
<td>0.000</td>
<td>-0.020***</td>
<td>(0.007)</td>
<td>(0.006)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>0.013*</td>
<td>0.035**</td>
<td>0.012*</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>R &amp; D INTENSITY</td>
<td>-0.004***</td>
<td>-0.004***</td>
<td>-0.005***</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>GDP</td>
<td>0.004***</td>
<td>0.002**</td>
<td>0.004***</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>-0.001</td>
<td>-0.003**</td>
<td>-0.000</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>INFLATION</td>
<td>0.009***</td>
<td>0.006**</td>
<td>0.008***</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>0.003***</td>
<td>0.002**</td>
<td>0.002***</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>CREDIT</td>
<td>0.000</td>
<td>0.001***</td>
<td>0.000</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.279***</td>
<td>-0.218***</td>
<td>-0.286***</td>
<td>(0.060)</td>
<td>(0.057)</td>
<td>(0.062)</td>
</tr>
<tr>
<td>Observations</td>
<td>20,720</td>
<td>20,720</td>
<td>20,720</td>
<td>20,720</td>
<td>20,720</td>
<td>20,720</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.180</td>
<td>0.441</td>
<td>0.158</td>
<td>0.404</td>
<td>0.180</td>
<td>0.441</td>
</tr>
<tr>
<td>F-test</td>
<td>11.94(0.000)</td>
<td>636.9(0.000)</td>
<td>8.985(0.000)</td>
<td>25.79(0.000)</td>
<td>548.1(0.000)</td>
<td>16.18(0.000)</td>
</tr>
<tr>
<td>Breschi-Pagan test</td>
<td>19540</td>
<td>4071</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Number of Firms</td>
<td>1,295</td>
<td>1,295</td>
<td>1,295</td>
<td>1,295</td>
<td>1,295</td>
<td>1,295</td>
</tr>
<tr>
<td>Hansen test</td>
<td>3.709(0.295)</td>
<td>5.526(0.137)</td>
<td>3.709(0.295)</td>
<td>5.526(0.137)</td>
<td>3.709(0.295)</td>
<td>5.526(0.137)</td>
</tr>
<tr>
<td>m2</td>
<td>2.452</td>
<td>2.452</td>
<td>2.452</td>
<td>2.452</td>
<td>2.452</td>
<td>2.452</td>
</tr>
<tr>
<td>Instruments</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
</tr>
</tbody>
</table>

***significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parenthesis. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, as asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. Full results with industry and location dummies included are available on request from the author. All macroeconomic variables are estimated in levels.

### Firm Size

Firm size and its squared term were found to be statistically significant in both the turnover and employment size models. The two models, however, differed in terms of...
the nature of the relationship between firm size and productivity growth. This is discussed as follows:

(i) Turnover

In terms of turnover size, on average, a negative relationship between firm size and manufacturing productivity growth was observed. This implies that small manufacturing firms were more likely to increase productivity faster. The positive coefficient on the square term of turnover size indicates that the inverse size effect diminishes with productivity growth over time. This finding is consistent with decreasing returns to scale. Due to the presence of higher sunk costs and scale intensities in manufacturing, small manufacturing firms operating below the MES have to increase productivity rapidly to catch up with larger firms in attaining the MES in a given industry, otherwise they may decline or exit the industry.

(ii) Employment

In contrast to the finding for the turnover model, when size is measured in terms of employment, a positive size-productivity growth relationship is observed. This indicates that large manufacturing firms demonstrated higher probabilities of productivity growth, consistent with Jovanovic’s (1982) learning model, where firms gain knowledge of their productivity level over time. Large firms enjoy economies of scale with lower unit costs through learning by doing effects as workers gain experience over time. This brings about a rapid growth in output, up to the point when average costs begin to rise and diseconomies of scale set in (Halkos and Tzeremes, 2007). Furthermore, large firm size promotes productivity growth because it confers on firms the ability to exploit in increasing returns associated with R&D investments.
A positive link between firm size (employment) and productivity growth was found by Pagano and Schivardi (2003) in European countries over the period 1994-1998. Similar to the finding for turnover size, the employment size-productivity growth relationship is quadratic (negative coefficient on the squared employment term). This is an indication that productivity growth increases with size up to a given threshold, after which decreasing returns to scale begin to set in. In other words, productivity growth decreases with increased use of inputs (workers) consistent with decreasing returns to scale.

**Initial Level of Productivity**

Consistent with the evolutionary theory of the firm, the initial level of productivity had a negative statistically significant effect on productivity growth in both the employment and turnover size measures. This is similar to the finding for turnover growth in manufacturing firms in Section 6.4.1. Thus, firms with lower initial levels of productivity enjoy higher turnover and productivity growth in subsequent periods. Low productivity firms below the industry MES have to increase productivity so as to catch up with high productivity firms, in order to remain in operation, suggesting convergence effects are at play in the industry.

**Industry Characteristics**

Industry growth was statistically significant in both employment and turnover size models. Location in fast growing industries promotes productivity growth in both manufacturing and services firms over time due to a lower degree of competition and the availability of more opportunities for firms in such industries (Audretsch, 1995; Otto and Fornahl, 2009). Industry MES had a positive statistically significant effect
on manufacturing productivity growth in relation to the employment size measure. This finding is consistent with the literature. The larger the scale intensity in a given industry, the more productive the firm has to become to attain the industry MES to avoid exit (Audretsch et al., 2004; Delmar and Wennberg, 2010).

A strong industry effect on manufacturing productivity growth was found. In the turnover size model, 10 of the 17 manufacturing industries had a statistically significant effect on productivity growth. More specifically, firms in the high-tech industries (chemicals, machinery and electrical industry) showed higher productivity growth, with the chemicals industry as the best performer. In the employment size model, a weaker industry effect was found, with only 5 industry dummies being statistically significant for productivity growth. No significant effect was found for high-tech industries. The latter finding could be related to the fact that high-tech industries are more skill-intensive in nature and may thus employ fewer workers.

**Nationality of Ownership**

Foreign ownership is statistically significant in explaining productivity growth when size is measured by employment. Foreign ownership increased manufacturing productivity growth by 5.6 per cent. This is in line with evidence in the literature that foreign firms are more productive than domestic firms due to access to better technology, specialized knowledge and assets from their home countries (Doms and Jensen, 1998). This result should, however, be interpreted with caution within the Irish context. As indicated earlier in Chapter 4 (Section 4.2), the observed large productivity differentials between foreign and indigenous firms in Ireland has been frequently attributed to transfer pricing practices adopted by foreign firms in order to...
take a advantage of the low corporation tax rate prevalent in Ireland (Arora and Gambardella, 2005; Forfás, 2006).

**Location**

A statistically significant location effect was also found. In relation to the employment size model, location in the Border, Mid-east, Midland, Mid-west, South-east and West regions had a negative significant effect on manufacturing productivity growth. Similarly, a negative significant effect was found in the turnover size model for firms located in the Border, Midland, Mid-west, South-east and West regions. This finding implies that, on average, manufacturing firms in these regions had low productivity growth relative to firms in the Dublin region. The finding also suggests that higher costs (e.g. rental costs and wages) associated with location in Dublin may constrain manufacturing firms to increase productivity. A discussion on the effect of the strategy variables is presented in the next section.

**(ii) Firm Strategy**

This section presents a discussion on the impact of trade, R&D, training and use of grants/subsidies on productivity growth over the period 1991-2007. This provides insights as to how these strategy variables drive productivity growth in manufacturing firms.

**Trade**

All forms of trade are positively related to manufacturing productivity growth, with the most significant effect observed for firms which export only, based on the turnover size measure. Importing also matters for manufacturing productivity growth.
when size is assessed by turnover. Access to imported superior quality capital goods enables firms to improve the quality of final goods, thus increasing sales and market shares (Castellani et al, 2010). In relation to the employment size measure, manufacturing firms which export only or engage in two-way trade are more likely to increase productivity, with the greatest impact found for firms that only export. These findings suggest a learning effect might be at play here. By exporting, a firm must improve its processes to be more efficient so as to compete favourably in the global market, leading to a productivity increase. In addition, importing offers the firms access to higher quality intermediate inputs with which it can improve its processes, thus firms are able to increase output by offering better products (Castellani et al, 2010). A combination of these two factors would lead to higher productivity increase in the firm. The higher productivity growth premium shown by two-way traders is in line with empirical evidence (Vogel and Wagner, 2010; Haller, 2012).

**Training**

Training was found to have a positive statistically significant effect on labour productivity growth in the manufacturing employment size model. Training programmes provide workers with specialised knowledge and skills through which the firm acquires organisational capabilities. These capabilities, in turn, allow the firm to compete through the introduction of new products or processes. These can potentially increase the firm’s productivity over time.
Grants/Subsidies

Although statistically significant, the effect of subsidies on manufacturing productivity growth is sensitive to the size measure used. When size is measured as turnover, subsidies have a depressing effect on manufacturing productivity growth. On the other hand, subsidies have a positive effect on productivity increases when the employment size measure is used. This performance-enhancing effect associated with the use of grants may be related to the type of grant received or the amount received. Job creation is commonly a major objective for Irish policymakers and, thus a key indicator in assessing the performance of grant-assisted firms (Girma et al, 2008). It could then be that firms in Ireland employ more workers to meet public policy objectives without a corresponding increase in turnover. However, a lack of data on the grant type and amounts received precludes further analysis.

R&D

The firm’s decision to invest in R&D, the amount invested (R&D intensity) and the level of R&D intensity (R&D spend) are statistically significant in both size measures. Manufacturing firms which invest in R&D are more productive, on average, while productivity growth decreases with increased R&D investment and the level of R&D intensity (employment size model).

(iii) Macroeconomic Environment

All macroeconomic variables, with the exception of availability of credit, had a positive significant effect on manufacturing productivity growth in the employment size model. Additionally, GDP, inflation and the REER index showed a positive statistically significant effect in the turnover size model. Thus, productivity growth in
manufacturing firms rises with an increase in economic growth, unemployment, inflation and the REER index.

Summary

In summary, manufacturing productivity growth in Ireland over the period 1991-2007 was driven by firm-specific characteristics, firm strategy and the macroeconomic environment. However, the specific effect of these drivers is dependent on the size measure adopted. For instance, a negative significant effect of firm size was found in the turnover size model, suggesting convergence effects, whilst a positive effect was found in the employment size model, evidence of increasing returns. Similar to findings for manufacturing turnover growth in the same period, trade was an important determinant of manufacturing productivity growth, with a higher growth effect found for firms which export only. Contrary to the findings for manufacturing turnover and employment growth, foreign-owned firms showed higher productivity growth relative to indigenous firms. In relation to the macroeconomic environment, GDP, unemployment, inflation and the REER index had a growth-enhancing effect on manufacturing productivity growth.

(2) Productivity Growth across the Two Growth Phases

This section investigates the determinants of productivity growth in manufacturing firms across the two growth phases (1991-2000 and 2001-2007) to determine whether these vary across both periods. A comparison of manufacturing and services productivity growth in the second growth phase 2001-2007 is also undertaken to determine whether these are driven by different factors. First, estimation results for
manufacturing productivity growth in the first sub-period 1991-2000 are presented in the section which follows.

(i) Manufacturing productivity growth, 1991-2000

As with the analysis undertaken in the preceding section, alternate measures of size (employment and turnover) were employed to determine whether productivity growth in manufacturing firms in the first growth phase (1991-2000) is sensitive to the size measure used. The Hansen test confirmed the validity of the first three lags R&D intensity as instruments. However, the null hypothesis of no second order serial correlation was rejected in both models. Estimation results are presented in Table 6.18. The findings are similar to previous results obtained for productivity growth in the wider 1991-2007 model. Firm size and its squared term, the initial level of productivity and industry growth were statistically significant in both size models with the same variable signs as found for the wider period 1991-2007. Differences in the results obtained are discussed below.

(i) Firm-specific Characteristics

A statistically significant industry effect was found which was also sensitive to the size measure. In the turnover size model, productivity growth was higher in the chemicals industry similar to the finding for the full sample period. Higher growth in productivity was also observed in low-tech industries such as food and beverages, pulp and paper, non-metallic in the turnover size models, similar to the finding for the overall sample period 1991-2007.
### Table 6.18 Determinants of Productivity Growth in Manufacturing, 1991-2000

<table>
<thead>
<tr>
<th>Productivity Growth</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOG TURNOVER,1</td>
<td>-0.118***</td>
<td>-0.263***</td>
<td>-0.110***</td>
<td>(0.012)</td>
<td>(0.011)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>LOG TURNOVER,1jt</td>
<td>0.029***</td>
<td>0.062***</td>
<td>0.019***</td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>LOG EMPLOYMENT,1</td>
<td>0.264***</td>
<td>0.325***</td>
<td>0.260***</td>
<td>(0.012)</td>
<td>(0.013)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>LOG EMPLOYMENT,1jt</td>
<td>-0.032***</td>
<td>-0.032***</td>
<td>-0.032***</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY,1</td>
<td>-0.145***</td>
<td>-0.622***</td>
<td>-0.139***</td>
<td>-0.101***</td>
<td>-0.634***</td>
<td>-0.098***</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.277***</td>
<td>0.134***</td>
<td>0.287***</td>
<td>0.353***</td>
<td>0.284***</td>
<td>0.356***</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>(0.047)</td>
<td>(0.035)</td>
<td>(0.047)</td>
<td>(0.047)</td>
<td>(0.036)</td>
<td>(0.048)</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.007</td>
<td>-0.006</td>
<td>0.050***</td>
<td>0.049***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXPORT</td>
<td>0.041***</td>
<td>0.016</td>
<td>0.033**</td>
<td>0.021</td>
<td>0.042***</td>
<td>0.017</td>
</tr>
<tr>
<td>IMPORT</td>
<td>-0.001</td>
<td>0.008</td>
<td>-0.003</td>
<td>0.001</td>
<td>-0.006</td>
<td>-0.001</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>0.028***</td>
<td>0.034***</td>
<td>0.025***</td>
<td>0.013</td>
<td>0.053***</td>
<td>0.011</td>
</tr>
<tr>
<td>TRAINING</td>
<td>-0.028***</td>
<td>-0.019***</td>
<td>-0.028***</td>
<td>-0.006***</td>
<td>-0.005</td>
<td>0.034***</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>-0.025***</td>
<td>0.009</td>
<td>-0.022***</td>
<td>0.030***</td>
<td>0.005</td>
<td>0.030***</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>0.000</td>
<td>0.040**</td>
<td>0.004</td>
<td>0.046***</td>
<td>0.052***</td>
<td>0.047***</td>
</tr>
<tr>
<td>R &amp; D INTENSITY</td>
<td>-0.008**</td>
<td>-0.011***</td>
<td>-0.015***</td>
<td>-0.004</td>
<td>-0.010***</td>
<td>-0.010</td>
</tr>
<tr>
<td>R &amp; D SPEND</td>
<td>0.009</td>
<td>-0.017</td>
<td>0.028*</td>
<td>-0.059***</td>
<td>-0.034***</td>
<td>-0.038*</td>
</tr>
<tr>
<td>GDP</td>
<td>0.004***</td>
<td>0.002</td>
<td>0.005**</td>
<td>0.006***</td>
<td>0.005***</td>
<td>0.006***</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>-0.000</td>
<td>0.002</td>
<td>-0.002</td>
<td>0.004</td>
<td>0.003</td>
<td>0.002</td>
</tr>
<tr>
<td>INFLATION</td>
<td>0.015***</td>
<td>0.011***</td>
<td>0.014***</td>
<td>0.017***</td>
<td>0.010***</td>
<td>0.018***</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.001</td>
<td>-0.001</td>
<td>-0.002*</td>
<td>-0.001</td>
</tr>
<tr>
<td>CREDIT</td>
<td>-0.000</td>
<td>0.001</td>
<td>-0.000</td>
<td>0.000</td>
<td>0.002**</td>
<td>-0.001</td>
</tr>
<tr>
<td>Constant</td>
<td>0.051</td>
<td>-0.255**</td>
<td>0.121</td>
<td>-0.528***</td>
<td>-0.432***</td>
<td>-0.453***</td>
</tr>
<tr>
<td>Observations</td>
<td>11,655</td>
<td>11,655</td>
<td>11,655</td>
<td>11,655</td>
<td>11,655</td>
<td>11,655</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.180</td>
<td>0.496</td>
<td>0.135</td>
<td>0.461</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-test</td>
<td>4.629</td>
<td>14.92(0.000)</td>
<td>367.8(0.000)</td>
<td>14.92(0.000)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breusch-Pagan test</td>
<td>6092</td>
<td>872.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Firms</td>
<td>1,295</td>
<td>1,295</td>
<td>1,295</td>
<td>1,295</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hansen test</td>
<td>5.210(0.157)</td>
<td>4.596(0.204)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m1</td>
<td>-0.709</td>
<td>-9.166</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m2</td>
<td>4.629</td>
<td>4.060</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instruments</td>
<td>47</td>
<td>47</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as \( \chi^2 \) under the null of instrument validity with \( p \)-values reported in parentheses. \( m1 \) and \( m2 \) are the \( F \) tests for a first and second order serial correlation in the first-differenced residuals, asymptotically distributed as \( N(0,1) \) under the null of no serial correlation. \( \text{Values in parentheses represent the } p \text{ values for the } F \text{ test and Hansen test. Full results with industry and location dummy variables included are available on request from the author. All macroeconomic variables are estimated in levels.} \)

### Firm Strategy

The impact of a firm's strategy variables was also conditional on the size measure employed. Similar to the results found for the wider period 1991-2007, exporting and two-way trade had a positive statistically significant impact on productivity growth in
the turnover size model, indicating that firms which exported or engaged in two-way trade increased productivity faster. Training, use of grants/subsidies and R&D spend had statistically significant effects in both size models. Training and the use of grants/subsidies had a growth-enhancing effect on productivity growth in the employment size model. However, these two strategy variables lowered productivity performance in the turnover size model. As previously detailed, training increases the flexibility and adaptability of workers, which in turn potentially increases productivity, thus the positive training effect is likely to be less pronounced in the turnover size model. Similarly, given that grant assistance in Ireland is mostly linked to job creation, as noted previously, the positive grants/subsidies effect is also likely to be less pronounced in the turnover size model. R&D intensity and R&D spend reduced productivity growth in the turnover and employment size models respectively. With regard to macroeconomic variables, a positive statistically significant effect was found for GDP and unemployment in both size models.

**Summary**

In summary, based on the results from the analysis of the determinants of productivity growth in manufacturing firms in Ireland from 1991-2000, the specific impact of firm characteristics and strategy on productivity growth was shown to be sensitive to the definition of firm size adopted. This is consistent with the previous findings obtained for the wider period 1991-2007. Thus, firm characteristics (such as firm size, the initial level of labour productivity, industry growth and nationality of ownership), firm strategy (trade, training and R&D) and macroeconomic variables (GDP and unemployment) were significant drivers of manufacturing productivity growth in the export-led growth phase. Having examined manufacturing productivity growth...
performance in the first phase of the boom period in Ireland, performance in the second growth period is analysed in the section which follows. Given that Irish economic growth during the two growth periods was driven by different factors (as detailed in Chapter 4), analysis of firm performance over the period 2001-2007 serves to determine whether a difference in the sources of economic growth matters.

(ii) Manufacturing and Services Productivity Growth, 2001-2007

The analysis of productivity growth in manufacturing and services firms undertaken in this section is based on the estimation of the manufacturing model for 2001-2007; and two specifications of the services model for 2001-2007 and 2005-2007 respectively. Based on the Hansen test, the validity of the first three lags of R&D intensity as instruments is confirmed. Whilst, it is not possible to reject the hypothesis of the absence of second order serial correlation in the 2001-2007 services model, the null hypothesis of no serial correlation is rejected in the 2001-2007 manufacturing and 2005-2007 services models. The latter result has implications for the consistency of estimated results. The estimation results presented in Table 6.19 for manufacturing firms in 2001-2007 and Tables 6.20 and 6.21 for services firms in 2001-2007 and 2005-2007 respectively are broadly similar to earlier findings, notable exceptions are discussed in turn.

(i) Firm-specific Characteristics

In relation to both manufacturing and services size models, firm size and its square term, the initial level of labour productivity and industry growth were found to be statistically significant. The variable signs also remained unchanged from the results obtained for manufacturing firms for the wider period and the first growth phase.
Table 6.19 Determinants of Productivity Growth in Manufacturing, 2001-2007

<table>
<thead>
<tr>
<th>Productivity Growth</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOG TURNOVER,1</td>
<td>-0.099***</td>
<td>-0.135***</td>
<td>-0.079***</td>
<td>(0.020)</td>
<td>(0.016)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>LOG TURNOVER,1^2</td>
<td>0.018***</td>
<td>0.052***</td>
<td>0.016***</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>LOG EMPLOYMENT,1</td>
<td>0.290***</td>
<td>0.292***</td>
<td>0.290***</td>
<td>(0.017)</td>
<td>(0.017)</td>
<td>(0.021)</td>
</tr>
<tr>
<td>LOG EMPLOYMENT,1^2</td>
<td>-0.033***</td>
<td>-0.067***</td>
<td>-0.033***</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY,1</td>
<td>-0.191***</td>
<td>-0.778***</td>
<td>-0.173***</td>
<td>(0.027)</td>
<td>(0.016)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.104***</td>
<td>0.064*</td>
<td>0.126***</td>
<td>(0.039)</td>
<td>(0.033)</td>
<td>(0.035)</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.199</td>
<td>-0.022</td>
<td>0.005***</td>
<td>(0.012)</td>
<td>(0.014)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>EXPORT</td>
<td>0.061***</td>
<td>0.046**</td>
<td>0.043*</td>
<td>(0.021)</td>
<td>(0.022)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>IMPORT</td>
<td>0.051***</td>
<td>0.021</td>
<td>0.042***</td>
<td>(0.015)</td>
<td>(0.014)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>0.062***</td>
<td>0.016</td>
<td>0.050***</td>
<td>(0.016)</td>
<td>(0.014)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>TRAINING</td>
<td>-0.019</td>
<td>-0.003</td>
<td>0.018**</td>
<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>0.009</td>
<td>0.008</td>
<td>0.010</td>
<td>(0.012)</td>
<td>(0.014)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>0.032**</td>
<td>0.026**</td>
<td>0.025***</td>
<td>(0.010)</td>
<td>(0.011)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>R &amp; D INTENSITY</td>
<td>-0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>(0.000)</td>
<td>(0.001)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>R &amp; D SPEND</td>
<td>-0.041***</td>
<td>-0.024</td>
<td>-0.040**</td>
<td>(0.014)</td>
<td>(0.015)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>GDP</td>
<td>0.007</td>
<td>0.004</td>
<td>0.007</td>
<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>0.522***</td>
<td>0.321**</td>
<td>0.606***</td>
<td>(0.179)</td>
<td>(0.149)</td>
<td>(0.194)</td>
</tr>
<tr>
<td>INFLATION</td>
<td>-0.051***</td>
<td>-0.036**</td>
<td>-0.060***</td>
<td>(0.018)</td>
<td>(0.015)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>0.001*</td>
<td>0.002***</td>
<td>0.001**</td>
<td>(0.006)</td>
<td>(0.005)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.301***</td>
<td>-1.228***</td>
<td>-1.495***</td>
<td>(0.414)</td>
<td>(0.342)</td>
<td>(0.469)</td>
</tr>
<tr>
<td>Observations</td>
<td>7,770</td>
<td>7,770</td>
<td>7,770</td>
<td>(0.024)(0.000)</td>
<td>(0.024)(0.000)</td>
<td>(0.024)(0.000)</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.548</td>
<td>0.145</td>
<td>0.538</td>
<td>(47)</td>
<td>(47)</td>
<td>(47)</td>
</tr>
<tr>
<td>F-test</td>
<td>4.085(0.000)</td>
<td>326(0.000)</td>
<td>3.082(0.000)</td>
<td>(7,770)</td>
<td>(7,770)</td>
<td>(7,770)</td>
</tr>
<tr>
<td>Breusch-Pagan test</td>
<td>8836</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Firms</td>
<td>1,295</td>
<td>1,295</td>
<td>1,295</td>
<td>(2.886)(0.410)</td>
<td>(2.760)(0.430)</td>
<td>(2.760)(0.430)</td>
</tr>
<tr>
<td>Hansen test</td>
<td>-7.386</td>
<td>-7.386</td>
<td>-7.386</td>
<td>(m1)</td>
<td>(m1)</td>
<td>(m1)</td>
</tr>
<tr>
<td>Instruments</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as $N(0,1)$ under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. Full results with industry and location dummies included are available on request from the author. All macroeconomic variables are estimated in levels.
Table 6.20 Determinants of Productivity Growth in Services Firms, 2001-2007

<table>
<thead>
<tr>
<th>Turnover</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
</tr>
<tr>
<td>LOG TURNOVER_{t,1}</td>
<td>-0.149***</td>
</tr>
<tr>
<td>(LOG TURNOVER_{t,1})^2</td>
<td>0.019***</td>
</tr>
<tr>
<td>LOG EMPLOYMENT_{t,1}</td>
<td>0.358***</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT_{t,1})^2</td>
<td>-0.037***</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY_{t,1}</td>
<td>-0.111***</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.253***</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>0.289***</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>0.000</td>
</tr>
<tr>
<td>LOCATION</td>
<td>0.000</td>
</tr>
<tr>
<td>EXPORT</td>
<td>-0.018</td>
</tr>
<tr>
<td>IMPORT</td>
<td>-0.004</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>0.012</td>
</tr>
<tr>
<td>TRAINING</td>
<td>-0.004</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>0.447***</td>
</tr>
<tr>
<td>INFLATION</td>
<td>-0.052***</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>-0.000</td>
</tr>
<tr>
<td>CREDIT</td>
<td>0.000</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.739***</td>
</tr>
<tr>
<td>Observations</td>
<td>5.430</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.680</td>
</tr>
<tr>
<td>F-test</td>
<td>5.421(0.000)</td>
</tr>
<tr>
<td>Breusch-Pagan test</td>
<td>1816</td>
</tr>
<tr>
<td>Number of Firms</td>
<td>905</td>
</tr>
<tr>
<td>Hansen test</td>
<td>1.708(0.635)</td>
</tr>
<tr>
<td>m1</td>
<td>-5.564</td>
</tr>
<tr>
<td>m2</td>
<td>0.453</td>
</tr>
</tbody>
</table>

*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. Full results with industry dummies included are available on request from the author. All macroeconomic variables are estimated in levels. All macroeconomic variables are estimated in levels.
Table 6.21 Determinants of Productivity Growth in Services, 2005-2007

<table>
<thead>
<tr>
<th>Productivity Growth</th>
<th>Turnover</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>FE</td>
</tr>
<tr>
<td>LOG TURNOVER, t-1</td>
<td>-0.096**</td>
<td>0.069**</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.033)</td>
</tr>
<tr>
<td>(LOG TURNOVER, t-1)^2</td>
<td>0.013**</td>
<td>0.009**</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>LOG EMPLOYMENT, t-1</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(0.043)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT, t-1)^2</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY, t-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.027)</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.154*</td>
<td>-0.022</td>
</tr>
<tr>
<td></td>
<td>(0.093)</td>
<td>(0.076)</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>0.004</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.021)</td>
</tr>
<tr>
<td>LOCATION</td>
<td>0.006</td>
<td>0.035</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.082)</td>
</tr>
<tr>
<td>EXPORT</td>
<td>0.050</td>
<td>0.023</td>
</tr>
<tr>
<td></td>
<td>(0.037)</td>
<td>(0.040)</td>
</tr>
<tr>
<td>IMPORT</td>
<td>0.001</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>EXPORT- IMPORT</td>
<td>0.017</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.030)</td>
</tr>
<tr>
<td>TRAINING</td>
<td>-0.003</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>-0.046</td>
<td>-0.088**</td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td>(0.048)</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>0.001</td>
<td>-0.029</td>
</tr>
<tr>
<td></td>
<td>(0.032)</td>
<td>(0.056)</td>
</tr>
<tr>
<td>R&amp;D INTENSITY</td>
<td>0.001</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>R&amp;D SPEND</td>
<td>-0.004</td>
<td>0.030</td>
</tr>
<tr>
<td></td>
<td>(0.044)</td>
<td>(0.063)</td>
</tr>
<tr>
<td>GDP</td>
<td>0.038*</td>
<td>0.072*</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.182)</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>0.218</td>
<td>0.104</td>
</tr>
<tr>
<td></td>
<td>(0.149)</td>
<td></td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>-0.001**</td>
<td>-0.000**</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>CREDIT</td>
<td>0.002**</td>
<td>0.001</td>
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<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.314</td>
<td>-1.502**</td>
</tr>
<tr>
<td></td>
<td>(0.178)</td>
<td>(0.183)</td>
</tr>
<tr>
<td>Observations</td>
<td>2.715</td>
<td>2.715</td>
</tr>
<tr>
<td></td>
<td>2.715</td>
<td>2.715</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.530</td>
<td>0.237</td>
</tr>
<tr>
<td>F-test</td>
<td>4.127(0.000)</td>
<td>126.3(0.000)</td>
</tr>
<tr>
<td>Breusch-Pagan test</td>
<td>7.133</td>
<td>682.6</td>
</tr>
<tr>
<td>Number of Firms</td>
<td>905</td>
<td>905</td>
</tr>
<tr>
<td>Hansen test</td>
<td>1.270(0.530)</td>
<td>0.892(0.640)</td>
</tr>
<tr>
<td>m1</td>
<td>31</td>
<td>31</td>
</tr>
</tbody>
</table>

**significant at 1%, *significant at 5%, *significant at 10%**

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. The nationality of ownership was dropped from the FE models as this does not vary over time. Real effective exchange rate and credit variables were dropped from all SYS-GMM models, while unemployment was dropped from the OLS and FE models due to collinearity. All macroeconomic variables are estimated in levels. Full results with industry dummies included are available on request from the author.

The positive industry growth effect was smaller in the second growth period- possible evidence of the reduced productive opportunities in the manufacturing industry at the time. Nationality of ownership was statistically significant in the manufacturing sector.
employment size model in 2001-2007. Accordingly, foreign firms were found to increase productivity faster in 2001-2007, similar to findings for manufacturing firms in the sub-period 1991-2000 and wider period 1991-2007 (employment size models). Strong industry effects were also found, with manufacturing firms located in the food and beverages and electrical industries showing higher productivity growth.

(ii) Firm Strategy

All trade variables were found to be statistically significant in the manufacturing turnover size model during this growth phase. Manufacturing firms, which exported only, increased productivity growth by 4.3 per cent during the second growth phase compared to 3.3 per cent in the previous sub-period (Table 6.19). Two-way traders also showed higher productivity growth in the same period (5 per cent compared to 2.5 per cent in the first growth period), followed by firms which import only (4.2 per cent) relative to non-traders in 2001-2007. Pre-2001, the trade strategies with statistically significant effects on productivity growth are two-way trade and exporting only. These results further confirm the previous finding that the effect of trade on manufacturing turnover growth was higher during the domestic demand-driven growth phase in the Irish economy. No significant trade effect was found for services firms during the second growth phase.

Training, Use of Grants/Subsidies and Innovation

In relation to the turnover size model, training had a significant positive impact on manufacturing productivity growth in the second growth period, and a negative effect pre-2001. This indicates that training, which represents investments in human capital, was an essential strategy for manufacturing firms in Ireland to increase labour
productivity in workers during the second growth period. According to Mason and Bishop (2010), firms’ responses to reduced sales revenues and profits in a recessionary environment are varied. Firms may respond to a recession by cutting training-related costs, while firms seeking to reposition and strengthen themselves may view employee training as a major element of their strategy and increase training investments accordingly. In the employment size model, training had a negative statistically significant effect on productivity growth in services firms. Pre-2001, the use of subsidies had a strong significant inverse effect on productivity growth in services firms. Pre-2001, the use of subsidies had a strong significant inverse effect on manufacturing productivity growth, becoming statistically insignificant in the post-2000 period (turnover size model). A positive significant effect is, however, found for manufacturing productivity growth in the employment size model in both growth periods. The decision to invest in R&D increases manufacturing productivity growth across both size measures post-2000, while productivity growth slows down with higher levels of R&D intensity during this second growth phase.

Macroeconomic Factors

Lastly, with regard to macroeconomic factors, GDP had a weak negative effect on services productivity growth in 2001-2007. Thus, productivity growth in services firms was shown to be higher with lower economic growth in both size measures. This finding suggests that limited business opportunities during periods of recession constrain services firms to become more productive so as to remain in operation. Conversely, a positive statistically significant GDP effect was found for services firms in 2005-2007. This finding, which is in line with a priori expectations, indicates that services firms increase productivity faster during periods of high growth in the economy. In interpreting contrasting results found on the effect of GDP for
services firms a cross the tw o time periods, it is important to note that the services model specifications are not the same for the two time periods. For instance, the 2001-2007 specification does not include the R &D and subsidies variables, whilst the sample period in the 2005-2007 services model is relatively shorter. Contrary to findings for the first sub-period, unemployment and availability of credit had a positive statistically significant effect on manufacturing productivity growth, while inflation and the ERP index had a negative statistically significant effect on productivity growth in manufacturing and services firms. Additionally, unemployment had a positive significant effect on productivity growth in services firms in the second growth phase 2001-2007.

**Summary**

To sum up, estimation results from the econometric analysis of the determinants of productivity growth in manufacturing and services firms in Ireland demonstrated that the overall impact of the determinants of productivity growth is sensitive to the definition of size measure employed in the analysis. Overall, the results suggest that firm characteristics such as size, initial level of productivity and industry growth rate are important for productivity growth in both manufacturing and services firms. Furthermore, firms which engage in R&D, trade and training were also observed to be more likely to increase productivity. In a similar manner, the macroeconomic environment is important for productivity growth. Productivity growth was likely to increase during periods of high GDP growth, high inflation and high unemployment for manufacturing firms. In relation to productivity growth in the services, growth was higher during periods of high GDP growth (low GDP growth in 2005-2007), high unemployment, low inflation and low competitiveness.
Summary of Results from Growth Analyses

The empirical investigation undertaken so far has analysed the drivers of three measures of firm growth (employment, turnover and productivity) in manufacturing and services firms in Ireland over the period 1991-2007. The observed differences between the FE and SYS-GMM models in some of the growth estimation results (in terms of statistical significance and magnitude of estimated coefficients) may be due to the fact that industry dummies and the nationality of ownership variables were dropped from the FE models (since these do not vary over time), whereas, the aforementioned variables are included in the SY-S-GMM models. Nevertheless, as indicated previously, this analysis benefits from the inclusion of the FE model, which allows the researcher examine the robustness of results across different estimations methods. Additionally, the FE, by its nature, provides information in relation to unobserved differences (e.g. entrepreneurial characteristics, human capital of employees and other variables the researcher might like to include in the model for which data is not available). The observed differences between the two approaches are interesting from a methodological perspective and provide a fertile area for future investigation.

Tables 6.22(a), 6.22(b) and 6.23(c) summarise the findings for the turnover, employment and productivity growth measures respectively. This outlines the determinants found to have a statistically significant effect on firm growth. The ‘+’ sign denotes a positive effect, while ‘-’ indicates a negative effect of the determinant on firm growth. The results provide supporting evidence on the importance of firm characteristics (such as size, initial level of labour productivity, industry growth, and industry), firm strategy (e.g. trade, training, decision to invest in R&D), as well as the
The macroeconomic environment as drivers of firm growth. The macroeconomic effect was, however, more robust for manufacturing (employment and turnover growth) relative to the services industry.

Table 6.22(a) Summary of Findings from Growth Analyses

<table>
<thead>
<tr>
<th>Turnover Growth</th>
<th>Determinants of Firm Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manufacturing</strong></td>
<td></td>
</tr>
<tr>
<td>1991-2007</td>
<td>SIZE (-), SIZE² (+), LOG LABOUR PRODUCTIVITY₁,₁(-), FOOD&amp;BEVERAGES (+), WEARING APPAREL&amp;LEATHER (-), WOOD PRODUCTS (+), PULP&amp;PAPER (+), CHEMICALS (+), RUBBER (+), NON-METALLIC PRODUCTS (+), FABRICATED METALS (+), MACHINERY (+), ELECTRICAL (+), MEDICAL&amp;OPTICAL (+), INDUSTRY GROWTH (+), INDUSTRY MINIMUM EFFICIENT SCALE (-), NATIONALITY (-), SOUTH-EAST(-), EXPORT (+), EXPORT-IMPORT (+), SUBSIDIES (-), GDP (+), UNEMPLOYMENT RATE (+), INFLATION (+), REAL EFFECTIVE EXCHANGE RATE (+), CREDIT (+)</td>
</tr>
<tr>
<td>1991-2000</td>
<td>SIZE (-), SIZE² (+), LOG LABOUR PRODUCTIVITY₁,₁(-), FOOD&amp;BEVERAGES (+), WEARING APPAREL&amp;LEATHER (-), PULP&amp;PAPER (+), PUBLISHING&amp;PRINTING (-), CHEMICALS (+), RUBBER (+), NON-METALLIC PRODUCTS (+), ELECTRICAL (+), MEDICAL&amp;OPTICAL (+), INDUSTRY GROWTH (+), INDUSTRY MINIMUM EFFICIENT SCALE (-), SOUTH-EAST(-), EXPORT-IMPORT (+), TRAINING (-), SUBSIDIES (-), R&amp;D INTENSITY (-), R&amp;D SPEND (+), GDP (+), INFLATION (+)</td>
</tr>
<tr>
<td>2001-2007</td>
<td>SIZE (-), SIZE² (+), LOG LABOUR PRODUCTIVITY₁,₁(-), FOOD&amp;BEVERAGES (+), WOOD PRODUCTS (+), PULP&amp;PAPER (+), CHEMICALS (+), RUBBER (+), NON-METALLIC PRODUCTS (+), FABRICATED METALS (+), MACHINERY (+), ELECTRICAL (+), MEDICAL&amp;OPTICAL (+), INDUSTRY GROWTH (+), INDUSTRY MINIMUM EFFICIENT SCALE (-), IMPORT (+), EXPORT-IMPORT (+), TRAINING (+), GDP (-), UNEMPLOYMENT RATE (+), CREDIT (+), INFLATION (-), REAL EFFECTIVE EXCHANGE RATE (-), CREDIT (+)</td>
</tr>
<tr>
<td><strong>Services</strong></td>
<td></td>
</tr>
<tr>
<td>2001-2007</td>
<td>SIZE(-), SIZE²(+), LOG LABOUR PRODUCTIVITY₁,₁(-), MOTOR VEHICLES (+), WHOLESALE (+), RETAIL (+), HOTELS (+), TRANSPORT AND COMMUNICATIONS (+), REAL ESTATE (+), RENTING MACHINERY (+), COMPUTER (+), RESEARCH&amp;DEVELOPMENT (+), OTHER BUSINESS (+), RECREATION (+), INDUSTRY GROWTH (+), IMPORT (+), EXPORT-IMPORT (+), TRAINING (+), GDP (-), UNEMPLOYMENT RATE (+), CREDIT (+)</td>
</tr>
<tr>
<td>2005-2007</td>
<td>SIZE (-), SIZE² (+), LOG LABOUR PRODUCTIVITY₁,₁(-), MOTOR VEHICLES (+), HOTELS, RESEARCH&amp;DEVELOPMENT (+), OTHER BUSINESS (+), INDUSTRY GROWTH (+), TRAINING(+)</td>
</tr>
<tr>
<td>Table 6.22b: Summary of Findings from Growth Analyses</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Employment Growth</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Manufacturing</strong></td>
<td></td>
</tr>
<tr>
<td>1991-2007</td>
<td></td>
</tr>
<tr>
<td>SIZE (-), SIZE^2 (+), LOG LABOUR PRODUCTIVITY_{t-1} (+), FOOD&amp;BEVERAGES (+), TEXTILES (+), WOOD (+), PULP&amp;PAPER (+), CHEMICAL (+), RUBBER (+), NON-METALLIC (+), FABRICATED METALS (+), MACHINERY (+), ELECTRICAL (+), INDUSTRY GROWTH (+), INDUSTRY MINIMUM EFFICIENT SCALE (-), NATIONALITY (-), BORDER (+), MID-WEST(+), MIDLAND(+), WEST (+), EXPORT-IMPORT (+), TRAINING (-), SUBSIDIES (-), R&amp;D (-), R&amp;D INTENSITY (-), R&amp;D SPEND (+), GDP (+), UNEMPLOYMENT RATE (+), INFLATION(-)</td>
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</tr>
<tr>
<td>1991-2000</td>
<td></td>
</tr>
<tr>
<td>SIZE (-), SIZE^2 (+), LOG LABOUR PRODUCTIVITY_{t-1} (+), FOOD&amp;BEVERAGES (+), TEXTILES (+), WEARING APPAREL&amp;LEATHER (+), PULP&amp;PAPER (+), CHEMICAL (+), RUBBER (+), FABRICATED METAL (+), MACHINERY (+), ELECTRICAL (+), INDUSTRY GROWTH (+), INDUSTRY MINIMUM EFFICIENT SCALE (-), NATIONALITY (-), MID-EAST(+), MIDLAND(+), IMPORT(-), TRAINING (-), SUBSIDIES (-), R&amp;D (-), R&amp;D SPEND (+), INFLATION (+)</td>
<td></td>
</tr>
<tr>
<td>2001-2007</td>
<td></td>
</tr>
<tr>
<td>SIZE (-), SIZE^2 (+), LOG LABOUR PRODUCTIVITY_{t-1} (+), FOOD&amp;BEVERAGES (+), WOOD PRODUCTS (+), PULP&amp;PAPER (+), RUBBER (+) NON-METALLIC (+), FABRICATED METALS (+), NATIONALITY (-), BORDER (+), MID-WEST (+), WEST (+), EXPORT-IMPORT (+), TRAINING (+), R&amp;D (-) GDP (-)</td>
<td></td>
</tr>
<tr>
<td><strong>Services</strong></td>
<td></td>
</tr>
<tr>
<td>2001-2007</td>
<td></td>
</tr>
<tr>
<td>SIZE(-), SIZE^2(+), LOG LABOUR PRODUCTIVITY_{t-1} (+), MOTOR VEHICLES (-), HOTELS (+), LOCATION (+)</td>
<td></td>
</tr>
<tr>
<td>2005-2007</td>
<td></td>
</tr>
<tr>
<td>SIZE(-), SIZE^2(+), LOG LABOUR PRODUCTIVITY_{t-1} (+), MOTOR VEHICLES (+), WHOLESALE (+), RETAIL (+), HOTELS (+), INDUSTRY GROWTH (+), TRAINING (+)</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Employment Size Model</td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Manufacturing</strong></td>
<td></td>
</tr>
<tr>
<td>1991-2007</td>
<td><strong>EMPLOYMENT SIZE MODEL</strong>&lt;br&gt;SIZE (+), SIZE² (-), LOG LABOUR PRODUCTIVITYt-1 (-), FOOD&amp;BEVERAGES (+),&lt;br&gt;TEXTILES (-), WEARING APPAREL&amp;LEATHER (-), PUBLISHING&amp;PRINTING (-), NON-METALLIC PRODUCTS (+), INDUSTRY GROWTH (+), INDUSTRY MINIMUM EFFICIENT SCALE (+), NATIONALITY (+), BORDER (-), MID-EAST(-), MIDLAND(-), MID-WEST (-), SOUTH-EAST(-), WEST (-), EXPORT (+), EXPORT-IMPORT (+), TRAINING (+), SUBSIDIES (+), R&amp;D (+), R&amp;D INTENSITY(-), R&amp;D SPEND (-), GDP (+), UNEMPLOYMENT RATE +, INFLATION (+), REAL EFFECTIVE EXCHANGE RATE(+)</td>
</tr>
<tr>
<td>1991-2000</td>
<td><strong>EMPLOYMENT SIZE MODEL</strong>&lt;br&gt;SIZE (+), SIZE² (-), LOG LABOUR PRODUCTIVITYt-1 (-), TEXTILES (-), WEARING APPAREL&amp;LEATHER (-), PULP&amp;PAPER (-), PUBLISHING&amp;PRINTING (-), RUBBER(-), FABRICATED METALS (-), MACHINERY (-), ELECTRICAL (-), MOTOR VEHICLES (-), OTHER TRANSPORT (-), INDUSTRY GROWTH (+), NATIONALITY (+), MIDLAND(-), MID-WEST (-), SOUTH-EAST(-), WEST (-), TRAINING (+), SUBSIDIES (+), R&amp;D (+), R&amp;D SPEND (-), GDP (+),INFLATION (+)</td>
</tr>
<tr>
<td>2001-2007</td>
<td><strong>EMPLOYMENT SIZE MODEL</strong>&lt;br&gt;SIZE (+), SIZE² (-), LOG LABOUR PRODUCTIVITYt-1 (-), FOOD&amp;BEVERAGES (+),&lt;br&gt;RUBBER (+), FABRICATED METALS (+), ELECTRICAL (+), INDUSTRY GROWTH (+), NATIONALITY (+), BORDER (-), SOUTH-EAST(-), WEST (-), EXPORT (+), SUBSIDIES (+), R&amp;D, UNEMPLOYMENT RATE (+), INFLATION (-), REAL EFFECTIVE EXCHANGE RATE (-), CREDIT (+)</td>
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</table>
Table 6.22c: Summary of Findings from Growth Analyses

<table>
<thead>
<tr>
<th>Productivity Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TURNOVER SIZE MODEL</strong></td>
</tr>
<tr>
<td>SIZE (-), SIZE² (+), LOG LABOUR PRODUCTIVITY₁₁ (-), FOOD &amp; BEVERAGES (+), PULP &amp; PAPER (+), RUBBER (+), NON-METALLIC PRODUCTS (+), FABRICATED METALS (+), MACHINERY (+), ELECTRICAL (+), INDUSTRY GROWTH (+), BORDER (-), SOUTH-EAST (-), EXPORT (+), IMPORT (+), EXPORT-IMPORT (+), TRAINING (+), R&amp;D (+), R&amp;D SPEND (-), UNEMPLOYMENT RATE (+), INFLATION (-), REAL EFFECTIVE EXCHANGE RATE (-), CREDIT (+)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMPLOYMENT SIZE MODEL</strong></td>
</tr>
<tr>
<td>SIZE (+), SIZE² (-), LOG LABOUR PRODUCTIVITY₁₁ (-), HOTELS (-), RECREATION (-), INDUSTRY GROWTH, TRAINING (-), GDP (-), UNEMPLOYMENT RATE (+), INFLATION (-)</td>
</tr>
</tbody>
</table>

| **TURNOVER SIZE MODEL** |
| SIZE (-), SIZE² (+), LOG LABOUR PRODUCTIVITY₁₁ (-), MOTOR VEHICLES (+), INDUSTRY GROWTH, GDP (-), UNEMPLOYMENT RATE (+), INFLATION (-), REAL EFFECTIVE EXCHANGE RATE (-) |

<table>
<thead>
<tr>
<th>2005-2007</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMPLOYMENT SIZE MODEL</strong></td>
</tr>
<tr>
<td>SIZE (+), SIZE² (-), LOG LABOUR PRODUCTIVITY₁₁ (-), HOTELS (-), RENTING MACHINERY (-), OTHER BUSINESS (-), RECREATION (-), INDUSTRY GROWTH (+), GDP (+)</td>
</tr>
</tbody>
</table>

| **TURNOVER SIZE MODEL** |
| SIZE (-), SIZE² (+), LOG LABOUR PRODUCTIVITY₁₁ (-), MOTOR VEHICLES (+), R&D INTENSITY (+), GDP (+) |

Having analysed the drivers of productivity growth in Ireland’s manufacturing and services industries, the determinants of productivity levels are examined in the section which follows. It is essential to examine productivity levels, as these not only determine the rate at which firms are able to increase productivity, but also their ability to compete successfully with other firms. Since productivity is an important determinant of competitiveness, analysis of the drivers of productivity performance in firms in Ireland provides useful insights given the openness of the Irish economy.
6.4.3 Determinants of Level of Productivity

Similar to the approach adopted in the estimation of the productivity growth models, alternative measures of size (i.e. employment and turnover) are used to test the sensitivity of analysis to performance measures used. First, a productivity model is estimated with turnover as the size measure, followed by a model estimated with employment as the size measure. A squared size term is included in the model to determine the exact nature of the relationship between size and labour productivity level. Regression models were also estimated to determine manufacturing productivity performance differences across the two distinct growth phases in the Irish economy. The regression models estimated are given as:

\[
\ln \text{LABPROD} = \beta_0 + \beta_1 \ln \text{EMP}_{t-1} + \beta_2 \ln((\text{EMP}_{t-1})^2) + \beta_3 \ln(\text{LABPROD})_{t-1} + \beta_4 \text{INDUSTRY} \\
+ \beta_5 \text{IND \_GROWTH} + \beta_6 \text{IND \_MES} + \beta_7 \text{NATIONALITY} + \beta_8 \text{LOCATION} + \beta_9 \text{EXPRESS} \\
+ \beta_{10} \text{IMPORT} + \beta_{11} \text{EXPRESS \_IMPOR} + \beta_{12} \text{TRAINING} + \beta_{13} \text{SUBSIDIES} \\
+ \beta_{14} R \& D + \beta_{15} R \& D \_INTENSITY + \beta_{16} R \& D \_SPEND + \beta_{17} \text{GDP} \\
+ \beta_{18} \text{UNEMP \_RATE} + \beta_{19} \text{INFLATION} + \beta_{20} \text{REER} + + \beta_{21} \text{CREDIT} + \epsilon_{i,t}
\]

\[
\ln \text{LABPROD} = \beta_0 + \beta_1 \ln \text{TURNOVER}_{t-1} + \beta_2 \ln((\text{TURNOVER}_{t-1})^2) + \beta_3 \ln(\text{LABPROD})_{t-1} + \beta_4 \text{INDUSTRY} \\
+ \beta_5 \text{IND \_GROWTH} + \beta_6 \text{IND \_MES} + \beta_7 \text{NATIONALITY} + \beta_8 \text{LOCATION} + \beta_9 \text{EXPRESS} \\
+ \beta_{10} \text{IMPORT} + \beta_{11} \text{EXPRESS \_IMPOR} + \beta_{12} \text{TRAINING} + \beta_{13} \text{SUBSIDIES} \\
+ \beta_{14} R \& D + \beta_{15} R \& D \_INTENSITY + \beta_{16} R \& D \_SPEND + \beta_{17} \text{GDP} \\
+ \beta_{18} \text{UNEMP \_RATE} + \beta_{19} \text{INFLATION} + \beta_{20} \text{REER} + + \beta_{21} \text{CREDIT} + \epsilon_{i,t}
\]

Where, \( \text{LABPROD} \) is measured as the level of labour productivity (turnover per employee) in the current period.

(1) Level of Productivity in Manufacturing Firms, 1991-2007

The Hansen test confirms the validity of the first three lags of R&D intensity as instruments, while the null hypothesis of no serial correlation is rejected in the turnover and employment size models. In general, the results from the analysis of
productivity levels for manufacturing firms in 1991-2007 (Table 6.23) are largely similar to those found in the productivity growth models for both size measures used. A major exception is the initial level of productivity, which had a positive significant effect on the current level of productivity. A negative significant effect was found for productivity growth. The former finding indicates that highly productive firms in one period are likely to be more productive in a subsequent period. In other words, the past productivity level is a good predictor of future productivity. This is consistent with empirical findings as noted by Bartelsman and Doms (2000) in their survey of the productivity literature.
Similar to the previous findings for productivity growth, firm characteristics (firm size, initial level of productivity, industry growth, industry MES and location), firm strategy (trade, training, subsidies and R&D) and macroeconomic variables (GDP growth, unemployment, inflation and the R EER index) all significantly affect productivity levels in manufacturing firms in the wider period 1991-2007. It should,
however, be noted that the specific effect of these determining factors is conditional on the definition of size adopted. The positive relationship between the level of firm productivity and GDP growth can be interpreted in the context of X-inefficiency. It is possible that strong economic growth rates and the corresponding growth in aggregate demand experienced in Ireland during the period of analysis could have eased the pressures on firms to control costs. Consequently, firms may have continued employing workers beyond efficient levels. Having analysed the level of productivity over the entire sample period, productivity performance across the two growth periods 1991-2000 and 2001-2007 is investigated in the section which follows.

(2) Manufacturing Productivity Performance, 1991-2000

Table 6.24 presents estimation results for manufacturing productivity levels in 1991-2000. Again, the results, in terms of variable signs and statistical significance, are broadly similar to those obtained for productivity growth and the productivity level in the wider period. A statistically significant industry effect is found such that firms located in the chemical and food and beverages industries demonstrated higher productivity levels in the turnover growth model. In contrast, productivity levels were lower in the machinery and electrical industries (turnover size model), contrary to the positive significant effect found in the estimation for the wider period. During this export-led growth phase, exporting and two-way trade had a positive significant effect on manufacturing productivity levels in the turnover size model. Training, R &D spend and the use of grants/subsidies were statistically significant, with the effect dependent on the size measure adopted. Thus, similar to the finding for productivity growth in the first growth period, training and use of grants had a negative effect on
productivity levels in the turnover size model. Similarly, productivity levels were higher with increased R&D spending, while GDP and inflation were positively significant.

Table 6.24 Determinants of Level of Productivity in Manufacturing, 1991-2000

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOG TURNOVER, t-1</td>
<td>0.118*** (0.012)</td>
<td>-0.263*** (0.011)</td>
<td>-0.110*** (0.011)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(LOG TURNOVER, t-1)**</td>
<td>0.020*** (0.002)</td>
<td>0.062** (0.001)</td>
<td>0.019*** (0.002)</td>
<td></td>
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</tr>
<tr>
<td>LOG EMPLOYMENT, t-1</td>
<td>0.264*** (0.012)</td>
<td>0.325*** (0.013)</td>
<td>0.260*** (0.016)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(LOG EMPLOYMENT, t-1)**</td>
<td>-0.032*** (0.002)</td>
<td>-0.073*** (0.002)</td>
<td>-0.031*** (0.002)</td>
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<tr>
<td>LOG LABOUR PRODUCTIVITY, t-1</td>
<td>0.858*** (0.011)</td>
<td>0.379*** (0.013)</td>
<td>0.861*** (0.011)</td>
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</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.277*** (0.047)</td>
<td>0.134*** (0.047)</td>
<td>0.287*** (0.047)</td>
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<td></td>
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<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
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<td>-0.000 (0.000)</td>
<td>0.000 (0.000)</td>
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<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.007 (0.009)</td>
<td>-0.006 (0.012)</td>
<td>0.050*** (0.010)</td>
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<tr>
<td>EXPORT</td>
<td>0.044*** (0.014)</td>
<td>0.016 (0.014)</td>
<td>0.033** (0.014)</td>
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<tr>
<td>IMPORT</td>
<td>-0.001 (0.009)</td>
<td>0.006 (0.009)</td>
<td>-0.003 (0.009)</td>
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<tr>
<td>EXPORT-IMPORT</td>
<td>0.028*** (0.009)</td>
<td>0.034*** (0.009)</td>
<td>0.026*** (0.009)</td>
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<tr>
<td>TRAINING</td>
<td>-0.028*** (0.008)</td>
<td>-0.019*** (0.007)</td>
<td>-0.028*** (0.007)</td>
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<tr>
<td>SUBSIDIES</td>
<td>-0.025*** (0.007)</td>
<td>0.009 (0.008)</td>
<td>-0.022*** (0.007)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R &amp; D</td>
<td>0.000 (0.008)</td>
<td>0.040** (0.008)</td>
<td>0.004 (0.008)</td>
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<tr>
<td>R &amp; D INTENSITY</td>
<td>-0.008** (0.008)</td>
<td>-0.011*** (0.009)</td>
<td>-0.015*** (0.008)</td>
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<tr>
<td>R &amp; D SPEND</td>
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<td>-0.017 (0.013)</td>
<td>0.028** (0.015)</td>
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<tr>
<td>GDP</td>
<td>0.004** (0.002)</td>
<td>0.002 (0.002)</td>
<td>0.005*** (0.002)</td>
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<tr>
<td>UNEMPLOYMENT RATE</td>
<td>-0.000 (0.005)</td>
<td>0.002 (0.004)</td>
<td>-0.002 (0.005)</td>
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<tr>
<td>INFLATION</td>
<td>0.015*** (0.003)</td>
<td>0.011*** (0.004)</td>
<td>0.014*** (0.004)</td>
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<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
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<td>-0.000 (0.001)</td>
<td>-0.001 (0.001)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>CREDIT</td>
<td>-0.000 (0.001)</td>
<td>0.001 (0.001)</td>
<td>-0.000 (0.001)</td>
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<td>Constant</td>
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<td>0.255*** (0.111)</td>
<td>0.121 (0.109)</td>
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<td>11,655</td>
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<tr>
<td>R-squared</td>
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<td>0.333</td>
<td>0.885</td>
<td>0.286</td>
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<tr>
<td>F-test</td>
<td>2048(0.000)</td>
<td>215.2(0.000)</td>
<td>872.4(0.000)</td>
<td>1343(0.000)</td>
<td>172.6(0.000)</td>
<td>1025(0.000)</td>
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<td>Breusch-Pagan test</td>
<td>1237</td>
<td>2777</td>
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<td>1.295</td>
<td>1.295</td>
<td>1.295</td>
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<td>m1</td>
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<td>m2</td>
<td>4.629</td>
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<td>47</td>
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<td></td>
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</table>

** significant at 1%, *** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. Full results with industry and location dummies included are available on request from the author. All macroeconomic variables are estimated in levels.
Summary

In summary, based on results from the analysis of the determinants of productivity performance in manufacturing firms in Ireland from 1991-2000, the specific impact of firm characteristics and strategy on productivity level was shown to be sensitive to the definition of firm size adopted. These results are broadly consistent with the previous findings for productivity growth and levels in the wider period. Additionally, compared to the wider period, a weaker macroeconomic effect was found, with GDP and inflation showing a positive significant effect on manufacturing productivity level. Hence, firm size, initial level of labour productivity, industry growth, nationality of ownership, location, exporting, two-way trade, training, subsidies, the decision to invest in R&D spend, GDP and inflation are significant determinants of the level of productivity in manufacturing firms in 1991-2000. The determinants of productivity levels in manufacturing and services firms over the second growth period 2001-2007 are investigated in the section which follows.

(3) Manufacturing and Services Productivity Performance, 2001-2007

Estimation results from the analysis of productivity levels in the credit-led consumer demand-driven growth period are presented in Table 6.25 (manufacturing firms for 2001-2007), Table 6.26 (services firms 2001-2007) and Table 6.27 (services firms 2005-2007). The Hansen test confirms the validity of three lags of R&D intensity as instruments. The null hypothesis of no second order serial correlation was rejected in the manufacturing employment and turnover size models, whilst the absence of second order serial correlation was confirmed in the services size models.
### Table 6.25 Determinants of Level of Productivity in Manufacturing, 2001-2007

<table>
<thead>
<tr>
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<th>Labour Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
</tr>
<tr>
<td>LOG TURNOVER, t</td>
<td>-0.096***</td>
</tr>
<tr>
<td>(LOG TURNOVER, t)^2</td>
<td>0.018***</td>
</tr>
<tr>
<td>LOG EMPLOYMENT, t</td>
<td>0.290***</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT, t)^2</td>
<td>-0.033***</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY, t</td>
<td>0.809***</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.104***</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
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</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.019*</td>
</tr>
<tr>
<td>EXPORT</td>
<td>0.061***</td>
</tr>
<tr>
<td>IMPORT</td>
<td>0.051***</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>0.062***</td>
</tr>
<tr>
<td>TRAINING</td>
<td>0.019**</td>
</tr>
<tr>
<td>SUBSIDIES</td>
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</tr>
<tr>
<td>R &amp; D</td>
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</tr>
<tr>
<td>R &amp; D INTENSITY</td>
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</tr>
<tr>
<td>R &amp; D SPEND</td>
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<tr>
<td>GDP</td>
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</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>0.522***</td>
</tr>
<tr>
<td>INFLATION</td>
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</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
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<tr>
<td>CREDIT</td>
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<tr>
<td>R-squared</td>
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<tr>
<td>Breusch-Pagan test</td>
<td>4997</td>
</tr>
</tbody>
</table>

*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with $p$-values reported in parentheses. $m_1$ and $m_2$ are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as $N(0,1)$ under the null of no serial correlation. Values in parentheses represent the $p$ values for the $F$ test and Hansen test. Full results with industry and location dummies included are available on request from the author. All macroeconomic variables are estimated in levels.
Table 6.26 Determinants of Productivity Levels in Services Firms, 2001-2007

<table>
<thead>
<tr>
<th></th>
<th>Turnover</th>
<th>Labour Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>FE</td>
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<tr>
<td>LOG TURNOVER_{t-1}</td>
<td>-0.149***</td>
<td>-0.229***</td>
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<tr>
<td>(LOG TURNOVER_{t-1})^2</td>
<td>0.019***</td>
<td>0.061***</td>
</tr>
<tr>
<td>LOG EMPLOYMENT_{t-1}</td>
<td>0.358***</td>
<td>0.327***</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT_{t-1})^2</td>
<td>-0.037***</td>
<td>-0.074***</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY_{t-1}</td>
<td>0.899***</td>
<td>0.282***</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.253***</td>
<td>0.086*</td>
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<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
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<td>-0.000</td>
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<td>NATIONALITY OF OWNERSHIP</td>
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<td>-0.000</td>
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<tr>
<td>LOCATION</td>
<td>-0.004</td>
<td>-0.062</td>
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<td>EXPORT</td>
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<td>-0.004</td>
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<tr>
<td>IMPORT</td>
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<td>-0.024*</td>
</tr>
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<td>EXPORT- IMPORT</td>
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<td>-0.052***</td>
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<tr>
<td>TRAINING</td>
<td>-0.004</td>
<td>-0.011</td>
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<tr>
<td>GDP</td>
<td>-0.023***</td>
<td>-0.004*</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
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<td>0.266**</td>
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<td>INFLATION</td>
<td>-0.052***</td>
<td>-0.038**</td>
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<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
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<td>-0.000</td>
</tr>
<tr>
<td>CREDIT</td>
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<td>-0.000</td>
</tr>
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<td>R-squared</td>
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<td>0.236</td>
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<td>F-test</td>
<td>3474(0.000)</td>
<td>92.70(0.000)</td>
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<td>Breusch-Pagan test</td>
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<td>421.3</td>
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<td>Number of Firms</td>
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<td>905</td>
</tr>
<tr>
<td>Hansen test</td>
<td>1.708(0.635)</td>
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<tr>
<td>m1</td>
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<tr>
<td>m2</td>
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<td>-0.222</td>
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</table>

*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with $p$-values reported in parentheses. $m1$ and $m2$ are the tests for first and second order serial correlation in the first-differenced residual, asymptotically distributed as $N(0, 1)$ under the null of no serial correlation. Values in parentheses represent the $p$ values for the $F$ test and Hansen test. Full results with industry dummies included are available on request from the author. All macroeconomic variables are estimated in levels.
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<th>FE</th>
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<tr>
<td>LOG TURNOVERt-1</td>
<td>-0.097***</td>
<td>0.068</td>
<td>0.178***</td>
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<td></td>
<td>(0.023)</td>
<td>(0.061)</td>
<td>(0.061)</td>
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<tr>
<td>(LOG TURNOVERt-1)^2</td>
<td>0.013***</td>
<td>0.050***</td>
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<td>(0.002)</td>
<td>(0.009)</td>
<td>(0.005)</td>
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<td>LOG EMPLOYMENTt-1</td>
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<td>0.370***</td>
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<td>(0.063)</td>
<td>(0.06)</td>
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<tr>
<td>(LOG EMPLOYMENTt-1)^2</td>
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<td>-0.081***</td>
<td>-0.037***</td>
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<tr>
<td></td>
<td>(0.004)</td>
<td>(0.009)</td>
<td>(0.006)</td>
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<td>0.245***</td>
<td>1.155***</td>
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<td>-0.028</td>
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<td>(0.066)</td>
<td>(0.155)</td>
<td>(0.015)</td>
<td>(0.068)</td>
<td>(0.114)</td>
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<td>0.154*</td>
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<td>(0.073)</td>
<td>(0.096)</td>
<td>(0.093)</td>
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<td>(0.000)</td>
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<td>(0.02)</td>
<td>(0.064)</td>
<td>(0.021)</td>
<td>(0.050)</td>
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<tr>
<td>EXPORT</td>
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<td>0.019</td>
<td>0.049</td>
<td>0.022</td>
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<td>(0.027)</td>
<td>(0.046)</td>
<td>(0.037)</td>
<td>(0.040)</td>
<td>(0.079)</td>
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<td>-0.006</td>
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<td>(0.011)</td>
<td>(0.018)</td>
<td>(0.025)</td>
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<td>(0.015)</td>
<td>(0.024)</td>
<td>(0.036)</td>
<td>(0.014)</td>
<td>(0.023)</td>
<td>(0.037)</td>
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<td>TRAINING</td>
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<td>-0.029</td>
<td>-0.003</td>
<td>-0.001</td>
<td>-0.060**</td>
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<tr>
<td></td>
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<td>(0.016)</td>
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<td>SUBSIDIES</td>
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<td>(0.029)</td>
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<td>(0.031)</td>
<td>(0.061)</td>
<td>(0.108)</td>
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<tr>
<td>R &amp; D</td>
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<td>-0.024</td>
<td>0.001</td>
<td></td>
<td>-0.050</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.030)</td>
<td>(0.04)</td>
<td>(0.032)</td>
<td>(0.097)</td>
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<tr>
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<td>0.002</td>
<td>0.004</td>
<td>-0.005</td>
<td>0.001</td>
<td>-0.003</td>
<td>0.034***</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.005)</td>
<td>(0.008)</td>
<td>(0.005)</td>
<td>(0.007)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>R &amp; D SPEND</td>
<td>0.015</td>
<td>-0.048</td>
<td>0.025</td>
<td>-0.004</td>
<td>0.007</td>
<td>-0.009</td>
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<tr>
<td></td>
<td>(0.045)</td>
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<td>(0.046)</td>
<td>(0.044)</td>
<td>(0.058)</td>
<td>(0.101)</td>
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<tr>
<td>GDP</td>
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<td>0.056***</td>
<td>0.052</td>
<td>0.091**</td>
<td>0.055**</td>
<td>0.036</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.021)</td>
<td>(0.037)</td>
<td>(0.038)</td>
<td>(0.028)</td>
<td>(0.037)</td>
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<tr>
<td>INFLATION</td>
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<td>0.027</td>
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<tr>
<td></td>
<td>(0.154)</td>
<td>(0.024)</td>
<td>(0.023)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>0.016</td>
<td>-0.015</td>
<td>-0.168</td>
<td></td>
<td></td>
<td>0.468**</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.018)</td>
<td>(0.154)</td>
<td></td>
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<td>(0.200)</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.103***</td>
<td>-0.374</td>
<td>-1.536**</td>
<td>-0.458*</td>
<td>-1.713***</td>
<td>-3.551***</td>
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<tr>
<td></td>
<td>(0.236)</td>
<td>(0.345)</td>
<td>(0.694)</td>
<td>(0.242)</td>
<td>(0.232)</td>
<td>(0.966)</td>
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<td>R-squared</td>
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<td>0.416</td>
<td>0.947</td>
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<td>F-test</td>
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<td>14.94(0.000)</td>
<td>1790.38(0.000)</td>
<td>2171(0.000)</td>
<td>6.434(0.000)</td>
<td>361.8(0.000)</td>
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<td>Observations</td>
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<td>2715</td>
<td>2715</td>
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<tr>
<td>Number of Firms</td>
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<td>905</td>
<td>905</td>
<td>905</td>
<td>905</td>
<td>905</td>
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<tr>
<td>Breusch-Pagan test</td>
<td>2.776</td>
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<td></td>
<td></td>
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<tr>
<td>Hansen test</td>
<td>6.81(0.147)</td>
<td>8.224(0.144)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m1</td>
<td>-4.45(0.000)</td>
<td>-4.209(0.000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instruments</td>
<td>32</td>
<td>33</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parentheses. m1 is the test for first order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test, Hansen test, first order test of serial correlation. Full results with industry dummies included are available on request from the author. All macroeconomic variables are estimated in levels.
(i) Firm-specific Characteristics

The results obtained for manufacturing productivity performance in 2001-2007 are quite similar to findings for manufacturing productivity performance in the first growth period. In both size models, firm characteristics such as size and its square term, the initial level of productivity, industry growth were statistically significant for manufacturing firms during this second growth phase. The findings for services firms for 2001-2007 are similar to those for manufacturing across both growth periods. Additionally, the nationality of ownership variable was statistically significant in the manufacturing employment size model. All variable signs remained unchanged from the previous sub-period.

For both manufacturing and services firms, the size-productivity relation was also dependent on the definition of size measure used, similar to the results found for manufacturing in the first growth period. However, contrary to the negative significant size effect found for manufacturing and services in 2001-2007, a positive significant size effect was found for the services turnover size model in 2005-2007. The squared term of size was, however, not significant, implying that the size effect is non-linear in the turnover size model. Similar to the finding for productivity growth in 2001-2007, the positive significant effect of industry growth was smaller for manufacturing productivity performance in the second growth period, compared to the first sub-period 1991-2000. Additionally, the magnitude of the positive industry growth effect was higher in services firms relative to manufacturing for the second growth phase.
Industry

Strong industry effects are found with manufacturing firms located in food and beverages, electrical and machinery industries showing higher productivity levels in the turnover size model. Similarly, for services firms a positive industry-productivity effect is evident for all industries in 2001-2007 and a negative significant effect is found for hotels, other business, renting machinery and recreation in 2005-2007.

Trade

Exporting, importing and two-way trade were statistically significant for manufacturing firms in the turnover size model, while no trade effect was found for services firms during the second growth phase. Again, a higher positive significant effect for exporting and two-way trade was found during this period. This is consistent with findings for manufacturing turnover and productivity growth in 2001-2007. In contrast to the previous sub-period, importing was found to have a positive statistically significant effect on productivity levels in 2001-2007. This finding may be related to the increase in import volumes recorded during this period of credit-led consumer demand-driven growth, as detailed earlier in Chapter 4. This finding is also in line with the previous results found for employment, turnover and productivity growth in this study. Taken together, the above findings suggest that trade was more important for manufacturing firm performance in Ireland during the second growth phase.

Strategy and Macroeconomic Variables

With respect to training, this was statistically significant in the turnover size models for manufacturing and services firms (2001-2007 and 2005-2007), with opposing
effects found. Training was found to increase (decrease) productivity levels in manufacturing (services) firms. The positive effect found for manufacturing firms in the second growth phase is contrary to the negative effect found in the manufacturing turnover size model in the first growth period. Results suggest that subsidies were not important for manufacturing productivity performance during the second growth phase, in contrast to the significant effect found in the first growth period and in the wider period 1991-2007. In relation to manufacturing firms, the decision to invest in R&D was positively significant in both size measures in 2001-2007 and for the wider period 1991-2007 (employment size model), while the level of R&D intensity lowered productivity levels in the turnover size model in the second growth period. In contrast, a positive significant effect of R&D intensity is found for services firms in 2005-2007, implying that productivity levels increased with increased investments in R&D for services firms during this time.

With respect to the macroeconomic variables, unemployment, inflation, the availability of credit (manufacturing only) and the REER index showed a statistically significant effect on productivity performance in both size models for manufacturing and in the turnover size model for services firms in 2001-2007. The variable signs were similar to findings for manufacturing turnover and productivity growth in 2001-2007. Thus, firms increased productivity levels during periods of high unemployment, low inflation, increased competitiveness and availability of credit. Similar to findings for turnover growth, a weak negative significant effect of GDP growth was found for services firms in both size models in 2001-2007. However, contrary to the positive effect found in the previous sub-period, GDP had no statistically significant effect on productivity levels in manufacturing firms during the second growth phase.
Summary

Overall, the estimation results from the analysis of productivity levels provide supporting evidence on the importance of firm characteristics, firm strategy and the macroeconomic environment in manufacturing and services firms. However, similar to productivity growth, the specific effect of firm performance determinants is dependent on the size measure adopted. It is also important to note that, similar to the findings for productivity growth, the effect of firm size, the initial level of productivity and industry growth remained significant for both manufacturing and services firms, regardless of the period of analysis and size measure adopted. This suggests that the firm’s starting point, in terms of size and productivity, and the prevailing growth rate in the industry within which the firm operates are important determinants of its productivity level and growth.

6.4.4 Sensitivity Test of Joint Significance of Macroeconomic Variables

To test whether inclusion of the macroeconomic variables in all performance models is relevant, likelihood ratio tests are undertaken for all three growth models with respect to manufacturing and services firms. These test the null hypothesis that the macroeconomic variables are not jointly significant. Based on the results presented in Table 6.28, the null hypothesis is rejected for all manufacturing performance models at the 5 percent level. It is then concluded that the explanatory power of the firm performance models is significantly increased by the inclusion of the macroeconomic variables.
Table 6.28 Likelihood Ratio Tests for Significance of Macroeconomic Variables in Manufacturing Firms

<table>
<thead>
<tr>
<th></th>
<th>$\chi^2(3)$</th>
<th>Prob $&gt; \chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment Growth</td>
<td>117.32</td>
<td>0.000</td>
</tr>
<tr>
<td>Turnover Growth</td>
<td>42.27</td>
<td>0.000</td>
</tr>
<tr>
<td>Productivity Growth: Turnover as size measure</td>
<td>51.07</td>
<td>0.000</td>
</tr>
<tr>
<td>Productivity Growth: Employment as size measure</td>
<td>30.12</td>
<td>0.000</td>
</tr>
</tbody>
</table>

However, the results obtained for the services firms (Table 6.29) are slightly different from those for manufacturing. The null hypothesis is not confirmed in the employment growth model, implying that the inclusion of macroeconomic variables in the model does not provide additional information about employment growth. The null hypothesis is rejected at the 5 percent significance level in the turnover and productivity growth model. This finding suggests that inclusion of the macroeconomic variables increases the explanatory power of the turnover and productivity growth models.

Table 6.29 Likelihood Ratio Tests for Significance of Macroeconomic Variables in Services Firms

<table>
<thead>
<tr>
<th></th>
<th>$\chi^2(3)$</th>
<th>Prob $&gt; \chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment Growth</td>
<td>0.31</td>
<td>0.959</td>
</tr>
<tr>
<td>Turnover Growth</td>
<td>9.08</td>
<td>0.028</td>
</tr>
<tr>
<td>Productivity Growth: Employment as size measure</td>
<td>7.85</td>
<td>0.049</td>
</tr>
</tbody>
</table>

Based on these test results, the inclusion of macroeconomic variables set in the firm performance analyses carried out is beneficial as it increases understanding of the drivers of firm performance. However, this effect is more significant for the manufacturing sample than the services data set. The latter result is probably due to
the comparatively short length of the time period for which services data is available.

**Summary**

The econometric results of the analysis of the determinants of firm growth and productivity in manufacturing and services industries in Ireland from 1991-2007 were analysed and discussed in this section. The results show that GL is not valid in the manufacturing sample and this remained robust to all specifications of size, growth measures and time period. Thus, the overriding conclusion of the analyses is that firm size matters. Small firms were observed to grow more, providing possible support for public policy aimed at facilitating the development of SMEs. Firm strategy is also important for growth, as firms which engage in trade, training and R&D showed higher growth; this effect is however sensitive to the definition of growth measures.

Interestingly, foreign ownership had a negative effect on employment and turnover growth, whereas a positive effect on productivity growth and the productivity level (when size is measured by employment) was observed. This implies that although domestic firms increase output and employment at a faster rate than foreign-owned firms, they do not increase productivity; neither are they as productive as foreign firms. While, this result could be related to multinationals having access to better technology and more specialised knowledge, it may also be linked to transfer pricing practices adopted by foreign firms in Ireland, which overstate the output produced. This finding is similar to Roper et al (2008) who also found that foreign ownership had a negative effect on sales and employment growth and a positive impact on productivity in firms in Republic of Ireland and Northern Ireland.
Based on the two distinct phases identified during the Irish economic boom, the sample period was split into two sub-periods; 1991-2000 (export-led growth) and 2001-2007 (credit-led consumer demand-driven growth). Estimation results showed performance differences, with certain industries (chemicals, food & beverages) showing higher growth post-2000 (a period of lower economic growth masked by a bubble in the construction industry). The impact of strategy was also shown to differ across time periods. Strategies such as trade and training were more important for manufacturing performance in the latter phase of the so-called Celtic Tiger period. The above findings suggest that the macroeconomic environment determines the strategies adopted by the firm, which in turn define firm performance.

Although broadly similar to those found for manufacturing, estimates obtained for several determinants in services were not very robust or statistically significant, due to limitations in the ASI dataset (likely related to the shorter length of the sample period). Nevertheless, evidence of a negative size-growth relation was found (similar to manufacturing). This finding implies that GL is not valid for services firms in Ireland. Similar to manufacturing, the effect of the initial level of productivity was dependent on how firm performance is defined. For instance, a positive effect was found for employment growth and the level of productivity, while this had a negative effect on turnover and productivity growth. In a similar manner, the specific impact of the determinants of the productivity level and growth was also sensitive to the size measure adopted. For example, training was found to be a significant driver of productivity growth and levels in the turnover size model for manufacturing firms and the employment size model for services firms in 2001-2007. More generally, taking the above findings together, the analysis of the determinants of firm performance in
services firms in Ireland undertaken in this study potentially offers useful insights into the factors driving firm performance during the period for which data are available, 2001-2007.

In conclusion, firm growth is not a random process, with some firms more likely to grow than others. Manufacturing and services firm growth is dependent on factors, such as the firm’s investment in R&D, global engagement, formal training of workers, as well as the macroeconomic environment. The effect of these variables is dependent on the definition of firm growth and size adopted in the analysis. In the case of the services industry, firm size, the initial productivity level and industry growth are significant determinants of firm performance, regardless of the firm performance or size measure used. Potential policy implications arising from the results and analysis undertaken in this chapter will be discussed in Chapter 7. To further test the robustness of findings, disaggregation by ownership, size class and technology/knowledge intensity is carried out and the results are presented and analysed in the subsequent sections.

6.5 Tests of Robustness

Based on the empirical findings in this study, certain key determinants of firm performance have been identified which persist across time periods and industries. These include firm size, industry-specific characteristics and trade. The drivers of firm performance, in terms of turnover and employment, are therefore assessed to determine if these vary by ownership, size and technology intensity. To this end, employment and turnover growth models are estimated for high-tech and low-tech
manufacturing firms, knowledge-intensive and less knowledge-intensive services firms, as well as foreign and domestic manufacturing and services firms, in alternate specifications, to examine whether empirical findings obtained differ between both groups of firms over the period, 1991-2007. The effect of a firm’s technology/knowledge intensity on subsequent growth performance is examined in the next section.

6.5.1 Technology/Knowledge Intensity

High-technology firms are commonly considered to be larger and more productive than low-technology firms (Coad, 2009; Ortega-Argilés et al, 2013). For the purpose of the study, high-tech and knowledge intensity is defined in terms of technology intensity using Eurostat definition based on NACE rev. 1.1 2-digit code (Eurostat, 2013). Thus, high-technology (high-tech) is an aggregation of NACE codes 30, 32 and 33 (high-tech) and medium-high-technology (24, 29, 31, 34 and 35). Low-technology (low-tech) is an aggregation of Medium-low-technology 23 and 25 to 28 and Low-technology 15 to 22 and 36 to 37. Following a similar approach to manufacturing, the following NACE codes are defined by Eurostat as knowledge-intensive services (KIS): 61, 62, 64, 70-74 and 92. Due to CSO confidentiality policy, 51 services firms in NACE code industries 61-64 were dropped from the analysis. Thus, analysis of knowledge intensity in services firms is based on a sample of 854 firms. An analysis of employment growth in manufacturing and services firms which takes account of the knowledge/technology intensity of firms is undertaken in the section which follows.
(i) Employment Growth

Estimation results for employment growth in manufacturing and services firms are detailed in Table A1 (manufacturing firms in 1991-2007), Table A2 (services firms 2001-2007) and Table A3 (services firms 2005-2007) in Appendix A. Findings are largely similar to previously obtained results for the aggregated datasets.

(i) Firm Characteristics

Firm characteristics such as firm size and its square term, and the initial level of labour productivity were statistically significant for the two categories of manufacturing and services firms. The finding, in relation to firm size, indicates that small firms showed higher employment growth regardless of their technology and knowledge intensity. The prevailing growth rate in the industry within which the firm operates has a strong positive significant effect on employment growth in high-tech firms. This implies that a high industry growth rate encourages employment growth in firms located in industries with high technology intensity. The initial level of labour productivity had a weak significant effect on employment growth in knowledge-intensive services firms, while no significant effect was found for high-tech manufacturing firms.

As with previous results, foreign manufacturing firms in low-tech industries performed poorly in terms of employment growth, relative to domestic firms. This implies that multinationals located in low-tech industries employ fewer workers. Görg and Trobl (2003a) in their study of technology spillovers and plant survival in manufacturing firms in Ireland, found that the presence of multinationals in low-tech industries reduces the survival of other foreign firms in such industries. Based on the
finding from the current study, it is possible that prior to failure, foreign firms in low-tech industries would show negative employment growth rates due to competition effects.

(ii) Firm Strategy
Training, subsidies and R&D were statistically significant for high-tech, low-tech and less knowledge-intensive (LKIS) firms. Training, the decision to invest in R&D and the use of grants/subsidies had a depressing effect on employment growth in low-tech manufacturing firms. However, the R&D investment decision, and the intensity of R&D lowered employment growth in high-tech firms. On the other hand, LKIS firms, which engaged in training and increased R&D intensity (for the 2005-2007 period), showed higher employment growth. The receipt of grants/subsidies promoted employment growth in LKIS firms, while this lowered growth in low-tech firms. The level of R&D intensity increases employment growth in both high-tech and low-tech firms, with a larger effect found for high-tech firms. This finding signifies that low levels of R&D intensity reduce growth. However, firms able to increase their level of R&D investments enjoy higher employment growth.

Trade
Importing was statistically significant for low-tech and high-tech firms, while two-way trade had a significant effect on employment growth in high-tech firms. Contrary to the results previously obtained from the analysis of the aggregated manufacturing data set for 1991-2007, low-tech firms which engaged in importing employed fewer workers than non-trading firms. However, high-tech firms which imported showed higher employment growth. In a similar manner, high-tech firms which both import
and export had higher employment growth relative to non-traders. The above findings may be driven by the fact that high-tech industries in Ireland are dominated by foreign firms, with entry into European markets as a key factor in the decision to locate operations in Ireland as detailed previously in Chapter 4.

(iii) Macroeconomic Variables

Finally, with respect to macroeconomic conditions, GDP and inflation had statistically significant effects on employment growth in manufacturing firms. GDP encouraged employment growth in both high-tech and low-tech firms, whereas, inflation lowered employment growth in high-tech and low-tech firms. Unemployment had a significant positive effect on employment growth in low-tech firms. These results imply that high-tech firms increase employment during periods of high GDP growth and low inflation, whilst low-tech firms employ more workers during periods of high GDP growth, high unemployment and low inflation due to increased market demand and availability of a pool of labour willing to work at lower wages. In relation to services employment growth, a weak negative significant GDP effect was found for LKIS firms in 2005-2007. This finding, which is contrary to expectation, implies that firms in LKIS industries employ more workers during periods of low economic growth.

Summary

In summary, results from estimating employment regression models show that firm-specific characteristics (size, industry growth), firm strategy (importing, two-way trade, R&D, R&D intensity and R&D spend) and the macroeconomic environment have significant effects on employment growth. The direction of causality between GDP growth and employment growth was investigated using a Granger causality test. In this case, there was no evidence of employment growth Granger causing GDP growth.
(GDP and inflation) are important determinants of employment growth in high-tech manufacturing firms. In relation to low-tech manufacturing firms, employment growth was driven by firm characteristics (size, the initial productivity level, location, industry MES and nationality of ownership), firm strategy (training, subsidies, R&D and R &D spend) and the macroeconomic environment (GDP, unemployment, and inflation). Results found for knowledge-intensive services firms were less robust, with firm size and the initial level of productivity found to be significant determinants of employment growth. On the other hand, employment growth in LKIS firms is determined by firm-specific characteristics (size, initial productivity level and industry MES), firm strategy (training, use of grants/subsidies and R&D spend) and the macroeconomic environment (GDP growth). Analysis of the determinants of turnover growth in high-tech and low-tech industries is presented in the section which follows.

(ii) Turnover Growth

Estimation results from the analysis of turnover growth are detailed in Table A4 for manufacturing (1991-2007), Table A5 (services firms 2001-2007) and Appendix Table A6 (services firms in 2005-2007) in Appendix A.

(i) Firm-specific Characteristics

Similar to previous findings for manufacturing turnover growth in the aggregated data set, firm size, the initial level of productivity and industry growth were statistically significant for turnover growth in both high-tech and low-tech manufacturing firms. The variable signs remain unchanged. With respect to services firms, firm size, and industry growth were statistically significant for both KIS and LKIS firms in 2001-
2007. As with manufacturing employment growth, foreign ownership hampered turnover growth in low-tech firms, with foreign low-tech firms showing lower turnover growth relative to Irish-owned low-tech firms.

Comparable to the estimation of turnover growth for the broader manufacturing sample, location was not a very important factor for turnover growth. In the high-tech model, the Border and South-east regional dummies had a negative significant effect indicating that high-tech firms located in Dublin increased turnover faster than high-tech firms located in the Border and Southeast regions. No location effect was found for low-tech firms. This finding may be related to agglomeration economies resulting from the clustering of high-tech firms around the Dublin area, as noted previously in Chapter 4.

(ii) Firm Strategy

Trade was more important for high-tech firms relative to low-tech firms. In order of importance, both exporting and importing (11.2 per cent), exporting only (8.2 per cent) and importing only (6 per cent) encouraged higher turnover growth in high-tech firms compared to high-tech firms which did not trade (Table A4, Appendix A). Low-tech and LKIS firms, which both export and import, showed higher turnover growth relative to non-trading firms. Contrary to expectations, exporting had a weak negative significant effect on turnover growth in KIS firms in 2001-2007. In relation to training, a positive significant effect was found for turnover growth in KIS and LKIS firms, while the use of grants/subsidies lowered turnover growth in high-tech and low-tech firms. The decision to undertake R&D increased turnover growth in low-tech firms, while the amount of resources invested in R&D lowered turnover growth in low-tech firms. This result is possibly due to delays in translating R&D investments
into commercial success. In contrast, the decision to invest in R&D had a negative significant effect for KIS firms, whereas R&D spend in KIS firms increased their turnover growth. This finding suggests that for KIS firms, the decision to undertake R&D is not sufficient to increase turnover, rather the level of R&D investment matters.

(iii) Macroeconomic Variables

With respect to macroeconomic factors, high GDP, unemployment, inflation and the REER index encouraged turnover growth in low-tech firms. Similarly, GDP and the REER index had a positive significant impact on turnover growth in high-tech firms, indicating that firms increase turnover faster during periods of high GDP, high unemployment and high inflation. A weak positive significant unemployment effect was found for LKIS firms in 2005-2007.

Summary

Overall, the determinants of turnover growth are broadly similar across the high-tech and low-tech industries. The negative size-growth relation is confirmed for both high-tech and low-tech firms, as well as KIS and LKIS firms, further confirming that GL is not valid in the sample. All categories of trade are important for high-tech firm performance, while only two-way trading increases growth in low-tech and LKIS firms. Finally, the decision to invest in R&D increases turnover growth in low-tech firms, while macroeconomic stability is important to engender high performance in manufacturing firms. Results for services firms are less robust, possibly due to issues related to the comparatively shorter length of the sample period, as detailed previously. A comparison of performance drivers in foreign and domestic firms is...
undertaken in the next section to determine whether the factors influencing firm performance are moderated by nationality of ownership. This approach is appropriate given the relative performance differentials between foreign and domestic firms, as highlighted in the literature (Fotopolous and Louri, 2004; Ruane and Sutherland, 2004; Oliveira and Fortunato, 2006).

6.5.2 Nationality of Ownership

Employment and turnover growth models are estimated separately for foreign and domestic manufacturing and services firms to determine if the determinants of firm performance vary according to the nationality of ownership.

(i) Employment Growth

Estimation results from the analysis of employment growth are presented in Table A7 (manufacturing firms in 1991-2007), Table A8 (services firms in 2001-2007) and Table A9 (services firms 2005-2007) in Appendix A.

(i) Firm-specific Characteristics

Similar to previous findings in this analysis, the results indicate that firm size is an important determinant of employment growth regardless of the firm’s nationality of ownership and industry. Similarly, the initial level of productivity has a positive significant effect on employment growth in domestic manufacturing and services firms, consistent with previous findings for employment growth in this study and in the literature.
Industry and Location

A weak significant industry effect is found. For foreign manufacturing firms, being part of the traditional wearing apparel and leather industries lowered employment growth by about 15 per cent, while domestic firms located in textiles, wearing apparel and leather as rubber products industries increased employment faster. This finding may be due to foreign firms in traditional industries crowding out each other (Görg and Strobl, 2003). It may also be related to declining manufacturing employment performance in these industries during the period of analysis. Domestic firms in the hotels and recreation industries showed higher growth in employment. With reference to location, a significant location effect is found for domestic manufacturing firms, indicating that domestic firms located in the West region show higher employment growth than firms located in Dublin.

(ii) Firm Strategy

The trade effect differed between both foreign and domestic manufacturing firms. Exporting only and importing only had a negative significant impact on domestic firm employment growth, with the greatest effect shown by exporting. However, interestingly, no trade effect is found for employment growth in foreign firms. This result is interesting given the relative importance of trade to foreign firms, with many multinational firms locating in Ireland as a platform to launch into other European markets, as detailed earlier in Chapter 4. On the other hand, the negative trade effect found for domestic firms may be related to the sunk costs associated with international trade (Haller, 2012). As domestic firms are commonly smaller and more financially constrained than foreign firms, it is then likely that those firms which enter into global markets may downsize in order to minimize costs so as to compete.
favourably. Importing had a positive significant effect on employment growth in foreign services firms in 2005-2007. This may be related to the increasing internationalisation of services in Ireland during this period (Siedschlag et al, 2011), for instance through the payment of software license fees.

Strategies such as training, subsidies and R&D investment all reduced employment growth in domestic manufacturing firms, while foreign manufacturing and domestic services firms engaged in training showed higher growth in employment. Likewise, the use of grants/subsidies had a significant growth-enhancing effect on foreign employment growth in the services. In relation to the R&D variables, the level of R&D intensity had a positive significant effect on employment growth in domestic manufacturing firms, indicating that the decision to undertake R&D is not sufficient to improve employment performance. Rather, employment growth in domestic firms depends on the level of investment in R&D. It is possible that increased investments in R&D may lead to a higher demand for highly skilled workers, resulting in increased employment.

(iii) Macroeconomic Variables

Of the five macroeconomic variables examined, GDP and unemployment have a positive significant impact on foreign and domestic manufacturing firms, while inflation had a negative effect on domestic firm employment. This indicates that both foreign and domestic firms employ more workers during periods of high economic growth and unemployment. Domestic manufacturing firms employed more workers during periods of high inflation. The availability of credit increased employment growth in domestic services firms in 2001-2007.
Summary

In summary, analyses of employment performance in foreign and domestic manufacturing and services firms have shown differential effects. Initial firm size is a significant determinant of employment growth in both foreign and domestic manufacturing and services firms. Trade, the use of grants/subsidies and R&D were significant determinants of employment growth in domestic firms, with a growth-depressing effect found. However, training promoted employment growth in foreign manufacturing and domestic services firms. The macroeconomic environment is less significant for services firms, with only a positive significant credit effect found for domestic firms. High economic growth encouraged employment growth in foreign and domestic manufacturing firms. Similar treatment was applied to turnover growth in two specifications for domestic and foreign firms. The turnover growth estimation results are analysed next.

(ii) Turnover Growth

Results from the estimation of turnover growth in foreign and domestic manufacturing and services firms are reported in Table A10 (manufacturing 1991-2007), Table A11 (services 2001-2007) and Table A12 (services 2005-2007) in Appendix A.

(i) Firm-specific Characteristics

Again, firm size is statistically significant for both foreign and domestic firms. Thus, the results confirm a non-linear relationship between firm size and turnover growth in both foreign and domestic manufacturing and services firms. A positive significant industry growth effect was found for domestic manufacturing and services firms.
implying that domestic firms in high-growth industries increased turnover faster. A weak significant negative location effect was observed for both foreign and domestic manufacturing firms. Hence, foreign firms located in the South-west region and domestic firms located in the South-east region showed lower turnover growth relative to firms located in Dublin. Turnover growth was lower in domestic services firms located in Dublin.

**Industry Characteristics**

Significant industry effects are found for manufacturing firms. Foreign manufacturing firms located in the chemicals, non-metallic and wood products industries have higher turnover growth, while lower turnover growth is found for foreign firms located in the wearing apparel and leather industry. For domestic manufacturing firms, location in high-tech industries such as chemicals, electricals, machinery, medical and optical devices, increases turnover growth. A high turnover growth effect was also found for firms located in low-tech industries such as wood products, pulp and paper, and fabricated metals. All industry dummies were significant for turnover growth in domestic services firms, with a growth-enhancing effect found.

**(ii) Firm Strategy**

Trade had no significant effect on foreign manufacturing turnover growth, while both exporting and importing increased turnover in domestic manufacturing and services firms. This suggests that domestic firms which engage in both importing and exporting increase turnover growth faster than firms which do not trade. Similar to the finding for employment growth, training, the use of subsidies and R&D intensity all depressed turnover growth in domestic manufacturing firms. However, the positive
impact of R&D on turnover growth in domestic manufacturing firms is dependent on the level of R&D intensity. Training had a positive effect on turnover growth in foreign manufacturing firms. This implies that training is a channel through which foreign firms can transmit superior knowledge and skills to workers which confer on them certain competitive advantage. Similarly, a positive training effect was found in domestic services firms in 2005-2007. Furthermore, in the services sample, turnover growth was higher with increased R&D and lower at higher levels of R&D intensity during the same period.

(iii) Macroeconomic Variables

Macroeconomic conditions matter, with GDP, unemployment and the REER index, having significant positive impact on domestic and foreign manufacturing firm turnover performance. Similarly, GDP and the availability of credit had a significant growth-increasing effect in domestic services firms. Overall, size matters for both foreign and domestic firms, while the impact of strategies such as training and R&D spend on turnover performance differ across ownership types. Having investigated the robustness of findings from the growth analyses undertaken earlier in this chapter to the technology/knowledge intensity of the industry within which the firm operates, as well as the nationality of its ownership, the effect of firm size on the determinants of firm growth are analysed next.

6.5.3 Firm Size

This section aims to determine whether the drivers of firm growth vary across firm size classes. Adopting this approach provides potential policy insights, taking into consideration the strong supporting evidence provided thus far in the study on the
significant effect of firm size, particularly the superior growth performance shown by small firms. To this end, regression models are estimated for four size categories based on the European Commission (2003) definitions, as previously detailed in Chapter 5 (Section 5.2.1). The size categories are as follows: micro-sized firms (1-9 employees), small firms (10-49 employees), medium-sized firms (50-249 employees) and large firms (>250 employees). The determinants of employment and turnover growth in manufacturing and services firms are examined across these four size classes and analysed in turn.

(1) Employment Growth

The employment growth of manufacturing and services firms is investigated across firm size classes in this section. The estimation results, though largely similar to previous findings in the study for manufacturing and services firms, are not as robust or statistically significant. This is likely related to sampling issues arising from splitting the firms into size classes. The sample sizes ranged from 31 firms (micro-sized services firms) to 656 firms (small manufacturing firms). Table A13 presents results for micro and small manufacturing firms, while results for micro and small services firms are detailed in Table A14 (services firms 2001-2007) and Table A15 (services firms 2005-2007) in Appendix A.

(i) Employment Growth in Micro Firms versus Small Firms

As previously noted, the results are not very robust with many of the determinants not statistically significant. Again, the convex relationship between firm size and firm growth is confirmed for both size classes in manufacturing and services firms, as evidenced by the significant effect of firm size. Firm-specific characteristics (such as
firm size and its square term and the initial level of labour productivity) had a significant effect on employment growth for micro-sized and small services firms.

The effect of the initial level of labour productivity, however, varied across the two size classes. A positive significant effect was found for micro-sized firms, while the converse holds for small firms. This finding implies that micro-sized firms with lower levels of productivity increase employment faster, while small firms with high levels of productivity employ more workers. Location had a weak significant effect on the performance of micro-sized small firms. Thus, micro-sized firms located in the South-west region employed fewer workers relative to firms in Dublin, while small firms in the West region showed higher employment growth relative to firms located in Dublin. In terms of nationality of ownership, this had a negative significant effect on employment growth in small manufacturing firms, similar to findings for the complete manufacturing data set. Industry MES had a positive significant effect on employment growth in micro-sized services firms. This finding is consistent with theory and implies that firms grow faster in industries with high MES.

(i) Firm Strategy

All trade variables had a negative significant effect on the employment growth of micro-sized manufacturing firms. This result implies that trade reduces employment growth in this size class, contrary to the non-significant effect found for the full dataset in the wider period 1991-2007. Training was significant for manufacturing small firm employment performance with a growth-depressing effect. In contrast, the use of grants/subsidies promoted employment growth in micro-sized and small services firms in 2005-2007. With regard to R&D, a significant effect is found for
small and micro-sized manufacturing firms, with varying effects. The results indicate that the decision to invest in R&D reduces (increases) employment growth in small (micro-sized) manufacturing firms.

(ii) Macroeconomic Variables

The macroeconomic environment is a significant determinant of employment growth in small and micro-sized manufacturing and services firms. GDP promoted employment growth in both size classes of manufacturing firms. In contrast to the above finding, GDP had a weak negative significant effect on the employment performance of small services firms in the period 2005-2007. This implies that small services firms employed more workers during periods of low GDP growth during this period. Unemployment had a positive significant effect on employment growth in small manufacturing and micro-sized services firms, while a negative effect was found for small services firms. Contrary to expectation, a negative significant credit effect was observed for small manufacturing and services firms. This implies that small firms employed more workers with lower growth in domestic credit. Finally, a rise in the REER index decreases employment growth in micro-sized manufacturing firms. Appreciation of the REER indicates lower competitiveness which may result in rising unemployment.

Summary

The analysis of the determinants of employment performance in small and micro-sized firms suggests that the significant effect of these determinants, though similar to previous results found in the study, vary across the two size classes. For instance, trade is more important for employment growth in micro-sized manufacturing firms,
while the initial level of labour productivity is more significant for micro-sized and small services firms. Employment performance in medium and large firms is analysed in the next section.

(ii) Employment Growth in Medium-sized versus Large Firms

The determinants of employment growth in medium-sized and large firms are analysed in this section. Results for manufacturing and services firms are presented in Table A16 (manufacturing firms 1991-2007), Table A17 (services firms 2001-2007) and Table A18 (services firms 2005-2007) in Appendix A.

(i) Firm-specific Characteristics

Again, the results are not very robust, with fewer variables showing statistical significance. Firm size and its square term are statistically significant for medium-sized and large manufacturing and services firms. Thus, the negative non-linear size-growth relation is confirmed in both size classes. Large manufacturing firms located in the Midland and South-west regions employed fewer workers than firms located in Dublin. Industry growth was statistically significant for services firms, with differing effects. A positive effect was found for medium-sized firms, while it lowered growth in large firms. In the same manner, location was significant for services firms, with a positive (negative) effect observed for medium-sized (large) firms. This finding implies that medium-sized firms located in the SE region employed more workers relative to firms in the BMW region. The converse holds for large firms.
(ii) Firm Strategy

Exporting and two-way trade had a significant growth-increasing effect on employment growth in medium-sized manufacturing firms, whereas two-way trade lowered employment growth in large manufacturing firms. No significant trade effect was found for the services. Training increased growth in both medium-sized and large manufacturing firms in 1991-2007, while the decision to invest in R&D increased employment growth in large services firms in 2005-2007. Similarly, the intensity of R&D investments enhanced growth in medium-sized manufacturing firms.

(iii) Macroeconomic Environment

With regard to the macroeconomic environment, GDP had a positive significant effect on medium-sized manufacturing and large services firms, whereas a negative significant effect was found for medium-sized services firms. The REER index and unemployment increased growth in medium-sized services and manufacturing firms respectively.

Summary

Overall, the analysis undertaken in this section provides supporting evidence that the significant effect of the determinants of employment growth vary across size classes. For instance, the effect of the macroeconomic environment is more important for employment growth in micro-sized, small and medium-sized manufacturing firms, while no significant macroeconomic effect is found for large manufacturing firms. This suggests that these groups of firms are more vulnerable to changes in the macroeconomic environment relative to large firms. Similarly, trade has a significant, albeit negative effect on the employment performance of micro-sized manufacturing
firms and a positive effect on the growth of medium-sized manufacturing firms. The results, however, confirm the importance of firm size for employment growth in all size classes. Turnover performance is analysed in the section which follows.

(2) Turnover Growth

Following a similar approach as to employment growth, the determinants of turnover growth are investigated across size classes. The discussion begins with the drivers of turnover growth in micro-sized and small manufacturing and services firms.

(i) Turnover Growth in Micro-sized versus Small Firms

Results for manufacturing and services firms are presented in Table A19 (manufacturing firms 1991-2007), Table A20 (services firms 2001-2007) and Table A21 (services firms 2005-2007) in Appendix A. Similar to previous findings from the analysis of employment growth undertaken in the preceding section, the estimation results are not very robust. Furthermore, the significant effect of the determinants varies between the two groups of firms.

(i) Firm-specific Characteristics

A significant convex size-growth relation is confirmed for both manufacturing and services firms in both size classes. However, the square term of size is not significant for micro-sized services firms in 2001-2007. This implies that the firm-size growth relation is linear in this size class. The initial level of productivity is significant for micro-sized manufacturing firms and small manufacturing and services firms, evidence of a convergence effect. The positive significant effect of industry growth is found only for micro-sized services and small manufacturing and services firms.
Foreign ownership is significant for both size classes in manufacturing firms. Hence, micro-sized and small foreign manufacturing firms showed lower growth in turnover. This result is consistent with the previous finding for the full manufacturing sample.

(ii) Firm Strategy

A significant trade effect is found for micro-sized and small manufacturing and services firms. Two-way trade increased turnover growth in small manufacturing firms, in line with previous results. In contrast, importing lowered growth in micro-sized manufacturing firms, while the converse holds for small services firms. A significant training effect is found for both micro-sized and small services firms, indicating that firms which invest in training produce more output. The use of grants/subsidies has a positive statistically significant effect on turnover performance in micro-sized services firms in 2005-2007, while the decision to invest in R&D enhanced turnover growth in micro-sized and small manufacturing firms.

(iii) Macroeconomic Variables

A weak macroeconomic effect was observed for micro-sized manufacturing and services firms. GDP as a factor increased turnover growth in micro-sized manufacturing firms, whereas the converse holds for micro-sized services firms. GDP, unemployment, and inflation had positive significant effects on turnover growth in small manufacturing firms. This suggests that firms in high GDP growth, high unemployment, and high inflation.

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(ii) Turnover Growth in Medium-sized versus Large Firms

Estimation results from the analysis of turnover growth are presented in Table A22 (manufacturing firms), Table A23 (services firms 2001-2007) and Table A24 (services firms 2005-2007) in Appendix A. The results indicate a fewer range of determinants with statistical significance for manufacturing firms. Firm size, industry growth, R&D and unemployment were significant determinants of turnover growth in medium-sized and large manufacturing and services firms. Trade was more important for medium-sized firms, with no trade effect found for large firms. Another interesting finding is the varying effect of the initial level of productivity on turnover growth in medium and large services firms. A negative effect was found for medium-sized firms, suggesting convergence to the industry average, whereas a positive effect was found for large firms, consistent with increasing returns ensuing from experience and learning by doing effects. Finally, a significant macroeconomic effect was found for both manufacturing and services firms. GDP promoted turnover growth in medium-sized manufacturing and services firms, while unemployment increased turnover growth for medium-sized manufacturing and services firms and for large manufacturing firms.

To conclude, the empirical investigation of employment and turnover growth has shown that the determinants of firm growth vary across size classes. With the exception of turnover growth in micro-sized services firms in 2001-2007, results confirm the negative firm-size growth relation in all estimated size models. The magnitude of the size effect is more pronounced in large firms. This further supports the finding that small firms grow faster than large firms, with the effect diminishing over time.
Summary

In summary, analyses of the determinants of firm performance in manufacturing and services firms in Ireland were undertaken to determine whether previous findings vary across time periods, industry or ownership. Results show that while the effect of firm characteristics, for instance, firm size, remain stable across all specifications, the impact of strategy and macroeconomic factors does vary across the business cycle, size class, industry and ownership type. The persistence of growth is analysed and discussed in the section which follows. This provides useful insights to policy makers and firms on whether future growth performance can be predicted from past growth.

6.6 Persistence of Growth

A basic assumption of GL is the absence of serial correlation in the error terms. Gibrat’s Law of no relationship between initial firm size and growth is, therefore, invalidated if a correlation of growth rates is found. The persistence of growth is an important concept introduced by Chesher (1979) based on GL which examines the relationship between past and current growth as outlined in Section 2.4. From a policy perspective, growth persistence is important as it enables successful targeting of ‘winners’ if past growth is a predictor of future growth (Hölzl, 2011). Persistence of growth is also of interest to firms, with often limited resources and opportunities, as the ability to successfully predict future performance allows for more effective selection of investment opportunities.

Positive persistence of growth implies that firms which grew in the past have higher chances of growing in the future. Such firms keep growing until the optimal size is
reached, while negative growth persistence indicates that higher growth in the current period leads to lower growth in the next period. This suggests that firms converge to the average size in the industry. This section, therefore, aims to analyse the persistence of growth in the manufacturing and services industries in Ireland. This provides insights as to whether current growth encourages (discourages) future growth in firms in Ireland.

To analyse the relationship between past and current firm growth rates in manufacturing and services firms, the following equation is estimated:

\[ Z_{t,i} = \gamma_1 Z_{t-1,i} + \gamma_2 Z_{t-2,i} + \mu_{t,i} \]  

(1)

Where \( Z_{t,i} \) is the deviation of the natural logarithm of the size of firm, \( i \) at time \( t \) from the mean of the natural logarithms of the sizes of firms at time \( t \), \( Z_{t-1,i} \) and \( Z_{t-2,i} \) are similarly defined, \( \mu_{t,i} \) is the error term measuring the impact of past firm growth on future growth. \( \gamma_1 \) and \( \gamma_2 \) are the parameters to be estimated, which measure the impact of growth in previous periods. Growth is measured in alternate specifications as change in employment and turnover respectively.

### 6.6.1 Persistence of Growth in Manufacturing Firms

The estimation results from the analysis of growth persistence in manufacturing firms are presented in this section. First, the relationship between current and past turnover growth is examined followed by employment growth in manufacturing. In selecting valid instruments for the turnover growth model, turnover growth is assumed to be endogenous and lags two to four years are used as instruments. The instruments are collapsed to limit the number of instruments generated. The Hansen test confirms the
validity of instruments, while the test of second-order correlation fails to reject the null hypothesis of no serial correlation in the second order- implying the estimates are consistent. Results are presented in Table 6.30. With regard to past turnover growth rates, results show a negative correlation between past and current turnover growth. This implies that firms which experience high growth in the previous period will experience lower growth in the current period. The magnitude of this effect is, however, reduced when growth in the previous two periods is analysed. Next, the relationship between current and past employment growth rates in manufacturing firms is examined.

Table 6.30 Persistence of Turnover Growth for Manufacturing Firms

\[
\text{TURNGROWTH} = \beta_0 + \gamma_1 \text{TURNGROWTH}_{t-1} + \gamma_2 \text{TURNGROWTH}_{t-2} + \epsilon_{it}
\]

<table>
<thead>
<tr>
<th>Turnover Growth</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>TURNOVER GROWTH _t _1</td>
<td>-0.271***</td>
<td>-0.336***</td>
<td>-0.238***</td>
</tr>
<tr>
<td></td>
<td>(0.050)</td>
<td>(0.035)</td>
<td>(0.033)</td>
</tr>
<tr>
<td>TURNOVER GROWTH _t _2</td>
<td>-0.087***</td>
<td>-0.147***</td>
<td>-0.052***</td>
</tr>
<tr>
<td></td>
<td>(0.029)</td>
<td>(0.019)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.067***</td>
<td>0.073***</td>
<td>0.064***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Observations</td>
<td>18130</td>
<td>18130</td>
<td>18130</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.070</td>
<td>0.107</td>
<td></td>
</tr>
<tr>
<td>F-test</td>
<td>14.87</td>
<td>63.42(0.000)</td>
<td>34.53(0.000)</td>
</tr>
<tr>
<td>Breusch-Pagan test</td>
<td>35829.38(0.000)</td>
<td>1295</td>
<td>1295</td>
</tr>
<tr>
<td>No. of Firms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instruments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hansen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m_2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with p-values reported in parentheses. m\_2 is the test for second order serial correlation in the first-differenced residuals, asymptotically distributed as $N(0, 1)$ under the null of no serial correlation. Values in parentheses represent the p-values for the F test, Breusch-Pagan test, Hansen test and second order test of serial correlation.

In the manufacturing employment model, all available lags from the second lag are used as instruments. The instrument matrix is collapsed. Instruments are confirmed valid based on Hansen test results, while the absence of second order serial correlation
is confirmed with the test of second-order correlation. The estimation results are presented in Table 6.31.

Table 6.31 Persistence of Employment Growth for Manufacturing Firms

<table>
<thead>
<tr>
<th>Employment Growth</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMPLOYMENT GROWTH</td>
<td>-0.171***</td>
<td>-0.243***</td>
<td>-0.162***</td>
</tr>
<tr>
<td>Constant</td>
<td>0.022***</td>
<td>0.021***</td>
<td>0.022***</td>
</tr>
<tr>
<td>Observations</td>
<td>18130</td>
<td>18130</td>
<td>18130</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.028</td>
<td>0.058</td>
<td></td>
</tr>
<tr>
<td>F-test</td>
<td>70.43</td>
<td>153.33</td>
<td>56.58</td>
</tr>
<tr>
<td>Breusch-Pagan test</td>
<td>597.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Firms</td>
<td>1295</td>
<td>1295</td>
<td></td>
</tr>
<tr>
<td>Hansen</td>
<td>0.002</td>
<td>0.000</td>
<td>0.002</td>
</tr>
<tr>
<td>Instruments</td>
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<td>16</td>
<td></td>
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<tr>
<td>Hansen</td>
<td>10.59(0.645)</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td>m2</td>
<td>-0.16(0.875)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with p-values reported in parentheses. $m^2$ is the test for second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test, Breusch-Pagan test, Hansen test and second order test of serial correlation.

Again, a negative correlation is found between current and past employment growth rate. This signifies that firms which employ more workers in the previous period tend to employ fewer workers in the current period. The investigation of past and current employment and turnover growth rates in manufacturing firms in Ireland has revealed a negative relationship- indicating that previous growth discourages current growth in manufacturing firms in Ireland. Given the differences inherent in manufacturing and services firms, the nature of growth persistence in services firms in Ireland is examined in the section which follows.

6.6.2 Persistence of Growth in Services Firms

As with manufacturing firms, alternate growth measures (employment and turnover) are used in alternate specifications. First, persistence in turnover growth is examined.
In selecting valid instruments for the turnover growth model, turnover growth is assumed to be endogenous and various lags from the second lag are experimented with. Based on the Hansen test result, all available lags of turnover growth from the second lag are used as instruments and collapsed in the reported model. However, the null hypothesis of no second-order serial correlation is rejected. Estimation results are presented in Table 6.32. Persistence of turnover growth could not be confirmed in the sample as the coefficients on turnover growth in the previous period and two previous periods are not statistically significant in the SYS-GMM model. Results from the FE model are, however, statistically significant. This indicates that current growth is discouraged by growth in the previous period and encouraged by growth in the previous two periods. Next, the correlation between employment growth rates is examined.

Table 6.32 Persistence of Turnover Growth for Services Firms

\[ \text{TURNGROWTH} = \beta_0 + \gamma_1 \text{TURNGROWTH}_{t-1} + \gamma_2 \text{TURNGROWTH}_{t-2} + \varepsilon_{t,1} \]

<table>
<thead>
<tr>
<th>Turnover Growth</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{TURNGROWTH}_{t-1}</td>
<td>-0.008</td>
<td>-0.301***</td>
<td>-0.044</td>
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<tr>
<td></td>
<td>(0.039)</td>
<td>(0.040)</td>
<td>(0.041)</td>
</tr>
<tr>
<td>\text{TURNGROWTH}_{t-2}</td>
<td>-0.010</td>
<td>0.204***</td>
<td>-0.030</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.036)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.026***</td>
<td>0.034***</td>
<td>0.031</td>
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<tr>
<td></td>
<td>(0.004)</td>
<td>(0.000)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Observations</td>
<td>3620</td>
<td>3620</td>
<td>3620</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.000</td>
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</tr>
<tr>
<td>F-test</td>
<td>0.10(0.905)</td>
<td>31.24(0.000)</td>
<td>1.02(0.362)</td>
</tr>
<tr>
<td>No. of Firms</td>
<td>905</td>
<td></td>
<td>905</td>
</tr>
<tr>
<td>Instruments</td>
<td></td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Hansen</td>
<td></td>
<td>15.44(0.163)</td>
<td>-2.14(0.000)</td>
</tr>
</tbody>
</table>

*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as \( \chi^2 \) under the null of instrument validity with p-values reported in parentheses. m2 is the test for second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test, Hansen test and second order test of serial correlation.

In the employment growth model, employment growth is assumed to be endogenous and all available lags from the second lag are used as instruments. The instrument matrix is also collapsed to reduce the number of instruments. Estimates are consistent.
based on the Hansen test and second-order serial correlation test, which confirm the validity of instruments and the absence of second-order correlation respectively. Results are presented in Table 6.33. The negative coefficient on the lag of employment growth indicates a negative persistence of employment growth. In other words, higher growth in the previous period is not followed by higher growth in the next period. This effect, however, disappears in the second period as the coefficient on the second lag of employment growth is not statistically significant.

Table 6.33 Persistence of Employment Growth for Services Firms

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMPLOYMENT GROWTH(_t)</td>
<td>-0.148***</td>
<td>-0.428***</td>
<td>-0.122***</td>
</tr>
<tr>
<td></td>
<td>(0.039)</td>
<td>(0.042)</td>
<td>(0.034)</td>
</tr>
<tr>
<td>EMPLOYMENT GROWTH(_{t-1})</td>
<td>-0.042</td>
<td>-0.250***</td>
<td>-0.020</td>
</tr>
<tr>
<td></td>
<td>(0.046)</td>
<td>(0.051)</td>
<td>(0.064)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.023***</td>
<td>0.032</td>
<td>0.021***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.001)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Observations</td>
<td>3620</td>
<td>3620</td>
<td>3620</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.019</td>
<td>0.155</td>
<td></td>
</tr>
<tr>
<td>F-test</td>
<td>7.42(0.001)</td>
<td>83.35(0.000)</td>
<td>6.55(0.001)</td>
</tr>
<tr>
<td>No. of Firms</td>
<td>905</td>
<td>905</td>
<td></td>
</tr>
<tr>
<td>Instruments</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hansen</td>
<td>2.96(0.398)</td>
<td></td>
<td>0.45(0.652)</td>
</tr>
</tbody>
</table>

*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as \(\chi^2\) under the null of instrument validity with p-values reported in parentheses. m2 is the test for second order serial correlation in the first-differenced residuals, asymptotically distributed as N( 0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test, Hansen test and second order test of serial correlation.

Summary

In general, the analysis of the relationship between current and past growth rates in manufacturing and services in Ireland has revealed a strong dependence between growth rates which provides further evidence that GL is not valid in the sample of firms. A negative persistence of employment and turnover growth was found for manufacturing firms in Ireland, indicating that high growth in employment (turnover) in a previous period is most likely followed by lower growth in the next period.
Results for the services, were however, not conclusive as persistence of growth could not be confirmed in the turnover growth SYS-GMM model, while negative persistence is found for employment growth. These results are consistent with Oliveira and Fortunato (2006) who found negative growth persistence in Portuguese manufacturing firms over the period 1991-2000. Similarly, Hölzl (2011) observed a negative persistence of growth in Austrian ‘high growth’60 firms over the period 1972-2007.

Results from the analysis of the relationship between current growth and growth over the previous two periods offer potential implications for policy. Given that Irish policy makers are interested not only in the number of jobs created in the economy, but also in the numbers retained, this finding has implications for job retention, such that jobs created by manufacturing and services firms in Ireland in one period may not likely remain in the next period. Thus, policy targeted at supporting ‘high growth’ firms may be problematic, as past performance is not necessarily a predictor of future performance. Further investigation into the factors governing performance in firms is, therefore, required to provide clearer insights which would better inform policy targeted at selecting ‘high growth’ firms to ensure success.

6.7 Conclusion

The main objective of this chapter was to undertake econometric analysis to determine whether (and how) firm characteristics, firm strategy and the macroeconomic environment influence firm performance. The SYS-GMM estimation

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60 High growth firms are defined as firms that achieve an annual growth rate of at least 20 per cent over a three-year period and have a size of at least more than 10 employees.
method was used to estimate the firm performance models to control for potential endogeneity that may arise between firm performance and its determinants (such as R&D intensity and foreign ownership), as well as unobserved firm-specific effects that may arise from missing data on key variables such as managerial quality.

Alternate performance measures (growth and productivity) were employed to capture the multidimensional nature of firm performance, as well as to test the sensitivity of analyses to the use of performance indicators. Similarly, alternate size measures (employment and turnover) were used to determine if the productivity performance analysis was influenced by size definition. A distinction was also made between manufacturing and services to take account of the inherent differences between the two industries as detailed in Chapter 5.

The first set of estimations highlighted firm size, the initial level of productivity, industry growth, location, ownership, trade, training, innovation and the macroeconomic environment as important determinants of firm performance in manufacturing and services firms in Ireland. The specific effects of these variables were, however, dependent on the performance measures and industry. For instance, trade exerted no significant effect on employment growth in the services. Similarly, exporting only had no significant effect on employment growth in manufacturing firms. Trade was, however, found to have a growth-enhancing effect on turnover growth in manufacturing and services firms. This suggests that trade is more important for manufacturing turnover growth relative to employment growth.

The impact of the business cycle on manufacturing firm performance was also examined by disaggregating the sample period into two sub-periods (1991-2000 and 2001-2007) based on the two distinct growth phases identified in Chapter 4. This showed
performance differences across the two periods, with firms showing higher turnover growth in the credit-led consumer demand-driven growth phase. Moreover, the significant effects of strategy variables such as trade and training were more pronounced during the second growth period. Taken together, the implication of these findings is that the macroeconomic environment determines the strategies adopted by firms which, in turn, define subsequent firm performance.

Further robustness tests, across size classes, ownership type and technology intensity, given the relative importance of these to the Irish economy, indicated that the specific impact of firm strategy and macroeconomic factors on firm performance was dependent on the performance measure, ownership type and industry. Additionally, results showed that the effect of competitiveness varied with time period. Thus, a rise in the RER index led to a corresponding increase in manufacturing turnover and productivity growth over the period 1991-2007, and a decrease in manufacturing turnover and productivity growth in 2001-2007. Access to credit was observed to have a significant growth-increasing effect on turnover performance of manufacturing and services firms during the second growth period. Overall, the determinants of firm performance which remained robust to time period, industry, ownership type and performance measures were firm size, initial level of productivity, industry growth, trade and R&D.

The above results highlight the importance of adopting a multidimensional approach in the investigation of firm performance. For instance, when the wider sample period was considered, manufacturing firms which engaged in export activity outperformed non-traders in terms of turnover growth, while no significant effect was found for
manufacturing employment growth in all periods. When the first growth period, 1991-2000 is considered, exporting had a growth-increasing effect on turnover growth. In the second growth period (2001-2007), there was no significant difference between exporting manufacturing firms and non-traders. This suggests that the impact of exporting has differing impact on different dimensions of firm performance (employment and turnover), while the magnitude of effect is dependent on the macroeconomic environment. Thus, without taking into account the definition of performance or the prevailing macroeconomic conditions, estimation results may be somewhat misleading. The implications of the above findings are discussed in Chapter 7.

To conclude, this research has made a contribution to the firm performance literature by developing a holistic multivariate model relating the performance of firms to firm characteristics, strategy and the macroeconomic environment which the author anticipates will stimulate further research and enquiry in this area. Further discussion of results, highlighting the contributions, implications and limitations of this research are outlined in Chapter 7. Suggestions for further research are also highlighted in the chapter which follows.
Chapter 7: Conclusions and Recommendations

7.1 Introduction

This chapter summarises the findings from the theoretical and empirical investigation undertaken in this thesis, highlighting contributions of each chapter. The discussion draws out the conclusions, policy implications and suggestions for future research. The main objective of this study was to investigate the determinants of firm performance in Ireland during the period 1991-2007. To address this research objective (drawing on the evolutionary theory and firm growth literature), this thesis has developed a holistic multivariate model, which relates firm performance to firm-specific characteristics, strategy and the macroeconomic environment for manufacturing and services industries in Ireland over the period 1991-2007.

Developing a firm performance model makes an important contribution in addressing the dearth of research pertaining to the impact of the macroeconomic environment on firm performance highlighted in the firm performance literature. Firm performance is somewhat driven by macroeconomic conditions, which influence overall economic performance. Thus, a study of the 'how' of the interaction between macroeconomic effects and firm performance adds to our knowledge of firm performance drivers. Furthermore, this thesis provides potential insights on firm performance valuable to policy makers in designing more targeted policies to improve firm performance.

Firm performance was defined in terms of growth and productivity, given their relative importance to other performance indicators. Moreover, the use of these two firm performance measures takes account of differing objectives of various
stakeholders (such as for example, firms, consumers, employees and policy makers). The analysis of firm growth undertaken in this study was predicated on Gibrat’s *Law of Proportionate Effect* (GL) which states that a firm’s growth is independent of its initial size. Thus, all firms have an equal chance to grow regardless of initial size. However, evidence concerning this is mixed as detailed in Chapter 2, thus, necessitating the need for studies on the drivers of firm growth. Following on from a review of the substantial literature on firm performance (incorporating growth and productivity for the purpose of this thesis), which identified a lacuna in the literature relating to the link between macroeconomic conditions and firm performance, the research questions addressed in the thesis are as follows:

(i) What is the impact of macroeconomic conditions on firm performance in Ireland in the period 1991-2007?

(ii) What is the impact of type of firm strategy adopted on firm performance in Ireland in the period 1991-2007?

(iii) What is the impact of firm-specific characteristics on firm performance in Ireland in the period 1991-2007?

Based on the empirical and theoretical evidence gleaned from the literature, three main research hypotheses were formulated as follows:

- H1: Firm characteristics determine firm performance.
- H3: Macroeconomic conditions affect firm performance.
Lastly, to test the above hypotheses, descriptive and econometric analyses of secondary datasets (consisting of 2,200 manufacturing and services firms) obtained from the Irish Central Statistics Office (CSO) were undertaken. The remainder of the chapter is organised as follows. Section 7.2 summarises the main results from the study, whilst Section 7.3 outlines main contributions of the research. Section 7.4 provides the limitations of the research, while Section 7.5 offers suggestions for future research. Section 7.6 concludes.

7.2 Summary and Discussion of Results

This section presents a summary of the analyses and discussions detailed in the preceding chapters of this thesis. This provides an overview of the key findings from the chapters. The main highlights of the analyses carried out were:

(i) Testing the validity of GL;
(ii) Analysing the persistence of firm growth;
(iii) Testing the sensitivity of the firm performance analyses to the use of multiple firm performance measures (i.e. growth in employment, turnover and productivity, as well as productivity levels).

On the whole, the results obtained from the study serve to address its main research objective, which is to investigate the determinants of firm performance in manufacturing and services firms in Ireland. The key insights gained from the analysis and discussion presented in the thesis chapters are outlined in the material which follows.
The theoretical basis (underpinnings) for the firm performance analyses carried out in the empirical chapters was detailed in Chapter 2. To explain the observed firm performance differences in a given industry, a discussion on the theories of the firm was provided, with emphasis on the neoclassical, resource-based view and evolutionary theories. These offered theoretical explanations as to why some firms are more successful than others. To gain a better understanding of this performance heterogeneity, the theoretical foundation of the firm growth literature originating from Gibrat’s (1931) seminal article on firm growth was outlined. This examined the evolution of the firm growth debate, highlighting major theoretical and empirical contributions, as well as key approaches to this debate. This review highlighted the seeming lack of evidence on GL and the need to study other driving factors of firm growth. A review of international firm performance studies, with a focus on key determinants of firm performance (rooted in Storey’s (1994) and Hyne’s (2006) suggested firm growth model), was carried out. This highlighted a lacuna of research on the link between macroeconomic conditions and firm performance. Bearing in mind that Ireland serves as the laboratory for this study, a survey of the firm performance literature in Ireland was also undertaken. The review of Irish studies identified the apparent need for a study of firm performance in Ireland, which includes both manufacturing and services industries, and employs rigorous econometric techniques to explore the interactions between firm-specific characteristics, firm strategy, macroeconomic factors and firm performance.

Chapter 3 detailed the research approach adopted in the empirical investigation of the determinants of firm performance. A review of the methodologies and techniques in use in firm performance studies highlighted the multiplicity of methods and firm performance.
performance measures, as well as the need for the choice of research methods and firm performance measures to be guided by the focus of the research and stakeholders. The chapter also introduced the two discrete panel datasets of 2,200 firms analysed in the research (Census of Industrial Production and Annual Services Inquiry for manufacturing and services respectively). Furthermore, based on the discussion of ordinary least squares (OLS), fixed effects (FE) and the system generalised methods of moments (SYS-GMM) estimation techniques, the SYS-GMM estimator was identified as the method of choice in testing the research hypotheses developed in the chapter. Moreover, this estimation method was deemed as the most appropriate in dealing with econometric issues, such as endogeneity (arising from possible correlation between firm performance and its determinants) and unobserved heterogeneity (due to missing data on key variables such as managerial quality), which may ensue from the use of panel data.

Chapter 4 examined the context of the research laboratory (locale) to provide an overview of the Irish economy, with the aim of identifying key features and macroeconomic trends during the period of analysis (1991-2007). The discussion in this chapter highlighted the significant contributions of foreign-owned firms, small firms, the services industry and high-tech industries to Irish economic performance. The chapter also identified two distinct phases of the rapid economic growth experienced during this period. The first growth phase (1991-2000) was one of export-led growth, whilst growth in the second phase (2001-2007) was driven by growth in domestic demand, which in turn was fuelled by a steady rise in credit, culminating in a unsustainable bubble in the construction industry (Drudy and Collins, 2011). Analysis of firm performance across the two growth periods revealed
lower manufacturing performance (in terms of turnover and employment growth) in the second growth phase. The poor performance demonstrated during this period was a consequence of the loss of competitiveness, the ensuing slow-down of export growth, plant closures, downsizing and a shift to services.

To address the research questions, descriptive and non-parametric analyses of firm performance in Ireland over the period 1991-2007, based on secondary data obtained from the CSO were undertaken in Chapter 5. Transition matrices, graphs and statistical tests of normality were employed to gain insights on the relationship between firm performance and the macroeconomic environment, on the one hand, and between firm-specific characteristics and firm performance, on the other hand. Results indicated firm performance in Ireland varied across the two growth phases, with manufacturing firms demonstrating lower performance in the domestic demand-driven growth phase relative to the export-led growth period. Results also provided preliminary evidence on the interaction between firm-specific characteristics (more specifically, firm size) and firm performance (growth and productivity). Firm growth was found to decline with an increase in firm size, while productivity growth and levels increased with firm size.

Lastly, results from the econometric analyses undertaken to address the research questions and test the hypotheses were detailed in Chapter 6. Following on from the descriptive and non-parametric tests carried out in Chapter 5, econometric tests were required so as to establish a usual relationship between firm performance and its drivers. Consequently, OLS, FE and SYS-GMM estimation methods were employed to test the holistic multivariate model developed in this study. The results provide
evidence of the significance of firm-specific characteristics (e.g. firm size and initial level of productivity), firm strategy (such as trade and R&D) and macroeconomic variables (GDP growth and unemployment) as drivers of firm performance.

Having briefly outlined the analyses and discussions presented in the thesis chapters and highlighting the key insights gained from these, a summary of the key findings from the descriptive and econometric analyses, as well as the policy implications are outlined in the section that follows.

### 7.2.1 Summary of Findings and Potential Policy Implications

A synopsis of results from the descriptive and econometric analyses carried out in the empirical chapters (Chapter 5 and 6) is detailed in this section. The descriptive analyses indicated that:

i. Firm size matters for firm growth. However, only a few firms were observed to grow, as evidenced by limited mobility across size classes. Nevertheless, firm size was shown to be inversely related to growth, indicating that small firms showed higher growth rates relative to larger firms. The negative effect, however, appeared to diminish with size.

ii. The assumption of lognormality of the firm size distribution failed to hold in the sample of manufacturing and services firms. Instead, the firm size distribution was positively skewed, indicating the presence of many small firms and a few large firms coexisting together in the industry. Taken together, these two findings above suggest GIL is not valid in the sample of manufacturing and services firms in Ireland.
iii. Firm size is positively correlated with productivity growth and level, suggesting that large firms were not only more productive, but also increased productivity faster than their smaller firm counterparts. This implies that large firms enjoy economies of scale and are better positioned to exploit the increasing returns associated with increased size.

iv. There is heterogeneity in firm performance outcomes. Based on the findings, large size differentials across ownership type, industry, location and trade status were found. This implies that foreign firms, firms located in the South-west region (Southern and Eastern region for services firms) and firms which both export and import had larger average sizes (in terms of turnover and employment) during the sample period. These results were robust across both manufacturing and services industries.

v. Firm performance differs across the manufacturing and services industry. During the period of analysis, employment performance was higher in the services industry, while manufacturing firms showed higher turnover and productivity performance. This finding not only reflects differences in scale intensities between the two sectors, but also the fact that most of the employment growth in Ireland during this period was in the services. The manufacturing industry, on the other hand, accounted for most of the output growth (O’Hearn, 2003). Furthermore, the firm size distribution in services was found to be relatively more right skewed than manufacturing. An indication of the presence of a greater proportion of small and medium-sized firms in the services industry. Related to the above is the additional finding that manufacturing firms were more likely to decline, whereas probability of growth was higher in the services industry. Lower scale economies and sunk
costs in the services industry imply lower entry and exit barriers. Thus, services firms are able to increase growth more quickly, while higher scale intensities and sunk costs in manufacturing do hamper firm growth.

vi. Firm performance varies with macroeconomic conditions. Disaggregating the sample period into sub-periods revealed performance differences, with manufacturing firms showing lower employment and turnover growth in the credit-led domestic demand-driven growth period, while productivity performance was higher during this time. The probability of growth was also observed to decline during the second growth phase, which was a period of lower growth in the Irish economy.

Based on the preliminary results obtained in Chapter 5, a holistic multivariate model was developed and tested in Chapter 6, with the use of OLS, FE and SYS-GMM estimation techniques on panel data obtained from the CSO for manufacturing and services from 1991-2007. Overall, the specific impact of determinants on firm performance was largely dependent on the definition of firm performance adopted. Nevertheless, the most significant results emerging from the econometric analyses are as follows:

i. The negative size-growth relation outlined previously in Chapter 5 was confirmed in terms of employment and turnover growth. The implication of this result, which was robust to industry, ownership type and time period, is that GL is not valid in this sample of manufacturing and services firms in Ireland. Rather, small firms show higher growth rates than large firms, signifying that small firms created more jobs and produced more output during
the sample period. This finding suggests the potential role for policy to support the development of small firms.

ii. With regard to productivity level and growth, the specific effect of firm size was conditional on the industry and the definition of size adopted. A positive size effect was found with the use of employment as a size measure. This is consistent with evidence in Chapter 5 and the literature (Jovanovic, 1982) that productivity increased with size. This finding suggests that large firms are more productive than smaller firms. Due to economies of scale, large firms are able to enjoy lower per unit costs, indicating higher efficiency in resource use. On the other hand, small firms were shown to have higher productivity levels and increase productivity faster than their larger firm counterparts when firm size is measured by turnover (output). The latter provides an indication that small firms enjoy increasing returns to scale as they converge to the average productivity level in the industry. Productivity growth, however, slows down over time due to decreasing returns to scale. This result suggests the need for researchers to consider alternative measures of size in assessing productivity performance in firms so as to avoid over-stating or understating performance.

iii. Similarly, the effect of firm strategy was conditional on the performance measures adopted. Exporting encouraged growth in turnover and productivity in manufacturing firms, whereas, it had no significant effect on employment growth. These results suggest that careful thought should be given to the choice of measure employed in any firm performance analysis. This approach is necessary to take account of the multidimensional nature of firm
performance because determinants may have varying impacts on different aspects of performance.

iv. Macroeconomic conditions matter. However, the macroeconomic effect was found to be dependent on the performance measure. For instance, GDP growth has a positive effect on manufacturing turnover and employment growth in 1991-2007, as well as turnover growth in the first growth period. A negative GDP growth effect on turnover and employment growth was found for manufacturing and services firms in the second growth phase. This implies that manufacturing and services firms in Ireland were constrained by sunk costs and capital intensities to increase turnover rapidly during the consumer demand-driven growth phase in order to remain in operation. Similarly, the effect of strategy on firm performance is dependent on macroeconomic conditions, firm performance measures, as well as firm-specific characteristics. During the second growth period, strategies such as trade, training, and R&D had more significant positive effects on firm performance relative to the first growth phase. These findings signify that the strategies adopted by firms are determined by macroeconomic conditions. For instance, firms may remain in operation during periods of lower growth by simultaneously downsizing (defensive strategy) and employing offensive strategies such as trade, training and R&D to increase turnover/productivity (Gulati, 2010). The above result suggests a possible role for policy to support firms in the area of trade, employee training and R&D, particularly during economic downturns.
In line with findings in the literature, a trade premium was found, with two-way traders (i.e. firms that both export and import) showing the highest performance in many specifications. This effect was, however, conditional on technology intensity, performance measure and macroeconomic conditions. Thus, two-way trading engendered higher performance in high-tech manufacturing, less knowledge-intensive services firms, as well as all firms during the second growth period. The above result suggests the potential role for policy to stimulate importing in firms in Ireland, in addition to existing export-promoting policies. Importing provides firms in Ireland with access to better quality intermediate goods, while exports offer access to larger global markets. Overall, the results on the effect of macroeconomic conditions indicate that it is important to consider this group of factors in the analysis of firm performance, since these determine the strategies adopted by firms. To this end, the firm’s ability to achieve and maintain successful performance is determined by the extent to which it is able to adjust its strategies in response to changes in the environment. The above suggests a potential role for policy aimed at ensuring macroeconomic stability.

v. In terms of location effect, location outside of Dublin had a positive effect on employment performance, while firms located in Dublin, on average, showed higher performance in terms of turnover and productivity. This highlights the importance of access to larger markets, as well as cost considerations in terms of wages, rental costs and general price levels in firms’ location decisions. The implication of this finding is a possible role for policy in terms of reducing
regional disparities, regarding prices and costs, so as to make location in all Irish regions attractive to firms.

vi. Another notable finding was the poorer performance demonstrated by foreign firms in terms of employment and turnover contrary to general empirical evidence. However, it should be noted that foreign firms outperformed domestic firms in terms of productivity growth and levels. This finding closely links to one of the recommendations in the Telesis (1982) and Culliton (1992) reports on Irish industrial policy advocating for a policy focus on the development of indigenous firms, as well as to Ireland’s recent policy shift to the promotion of indigenous enterprise (Lawless et al, 2012; Action Plans for Jobs, 2013, 2014). Although it is commonly argued in the literature that the large productivity differential between foreign and indigenous firms in Ireland is largely overstated due to transfer pricing practices adopted by foreign firms, the lower productivity performance in small firms in Ireland relative to similar-sized firms in other countries has also been noted (Small Business Forum Report, 2006; Department of Jobs, Enterprise and Innovation, 2003). Consequently, the above results which show that small Irish-owned firms employed more workers and produced more output, particularly during the lower growth period in the economy, suggest a potentially greater (increased) role for policy to support Irish indigenous firms, as well as to increase productivity in these firms.

vii. With respect to the use of subsidies, subsidies were shown to hamper employment and turnover growth robust to size measure, while a positive
effect on productivity levels and growth was found when size is measured by employment. Given the importance of grant assistance in the Irish economy (Ruane and Görg, 1997; Girma et al, 2007; Girma et al, 2008), this finding is important as it suggests the need for evaluation of grant assistance which takes into account multiple dimensions of firm performance, as well as the impact of specific types of grants on firm performance along the lines argued by authors such as Lenihan (1999, 2004) and Lenihan (2011) in the Irish context.

viii. Finally, persistence of growth and productivity was found. Firms with high productivity in previous periods were more likely to show higher productivity in the current period, while firms with high growth in the previous period had lower growth in the current period. This result implies that past growth is not necessarily a good predictor of future performance, such that policy targeted at high growth firms may not necessarily be successful.

In general, findings from the descriptive, non-parametric and econometric analyses suggest firm size, foreign ownership, R & D, training, trade (particularly, two-way trade) and the macroeconomic environment as important drivers of firm performance in Ireland, with possible implications for policy. Furthermore, these results provide support for recent Irish policy initiatives outlined in the Irish government’s 2014 Action Plan for Jobs aimed at facilitating the development and growth of indigenous firms, improving access to finance for SMEs, supporting competitive regions and driving exports. The finding that the determinants of firm performance have varying effects (depending on the definition of firm performance employed) has possible
implications for policy. It follows that multiple measures of firm performance should be adopted when assessing which firms should be targeted by policy interventions.

7.3. Contribution of Research

This research contributes to firm performance research both from academic and policy perspectives. These contributions are discussed in turn. Firstly, this research makes a methodological contribution by developing a holistic multivariate model, which integrates both internal and external factors that influence firm performance. The model relates firm performance to firm-specific characteristics, firm strategy, and the macroeconomic environment. The impact of macroeconomic conditions on firm performance has not been explicitly considered in many studies. Therefore, building on the firm growth models suggested by Storey (1994) and Hyne (2006), a SYS-GMM model which included a group of macroeconomic variables, was developed to estimate the impact of the macroeconomic environment on firm performance. The use of this estimation method which allowed for the control of econometric issues such as endogeneity and unobserved heterogeneity in the data, ensured findings from the analyses carried out in this thesis are robust and consistent. To the best of the author’s knowledge, this is a novel attempt to model the interaction between firm-specific characteristics, firm strategy and macroeconomic factors.

Secondly, the research addresses the gap in the firm performance literature by providing empirical evidence on the impact of the macroeconomic environment, as well as the channels through which this influences firm performance. To the author’s knowledge, this is the first attempt to model the channels through which firm
performance is influenced by the macroeconomic environment. Results suggest that macroeconomic conditions determine firm strategy, which in turn determines firm performance. In addition, the study has identified the need to consider the multidimensional nature of firm performance given that macroeconomic factors have varying effects on different performance indicators. The research in this thesis is unique in that it provides a study of firm performance in an economy at full employment during a boom and a bubble, thus providing insights on firm behaviour across both periods.

Thirdly, this study makes a methodological contribution to the firm performance literature in Ireland through its use of the SYS-GMM estimation method, as well as large datasets on the manufacturing and services industries to test the validity of GL, to analyse the persistence of firm growth and investigate the determinants of firm performance within the Irish context. Adopting this methodological approach addresses issues related to the dearth of studies on the services industry, the neglect of micro-sized firms and the lack of rigorous econometric analysis (particularly, in the Irish context), as highlighted in the literature review.

This research on the drivers of growth and productivity in firms in Ireland also provides suggested policy outcomes that can be used by Irish policy makers to design more effective policies aimed at stimulating firm performance. As referred to above, results suggest a possible need for policy to take account of the multi-dimensional nature of firm performance through the use of multiple firm performance measures, rather than adopting a one-size fits all approach in assessing successful performance outcomes in firms. The findings from this research have also highlighted the potential
role for policy in the areas of small indigenous firm development, regional development, as well as in the promotion of two-way trade, training and R&D in firms. The policy avenues and implications that emanate from the current research certainly merit further research.

The final contribution of this research is from the firm perspective. The empirical results from this study showing the specific impacts of firm strategy on different indicators of performance will be of utmost interest to firms seeking ways to improve firm performance, particularly during downturns in the economy. The prime contribution of the research, however, is in providing a holistic multivariate model of firm performance which considers the link between firm characteristics, firm strategy and the macroeconomic environment, thus increasing our knowledge of the determinants of firm performance.

7.4. Limitations

Findings from this research need to be considered within the context of the limitations of the study as outlined. This research is based on the framework suggested by Storey (1994) which groups the determinants of firm growth into three categories related to the firm, entrepreneur and strategy. However, entrepreneurial characteristics were not considered in this analysis due to the significant body of research related to this subject, as well as the non-availability of data. In other words, given the already significant amount of work encountered by the author in terms of gaining access to the large secondary datasets from the Irish CSO, coupled with the detailed cleaning and so on that was necessary before the rigorous econometric analysis could be
undertaken, it was impossible for the author to also undertake a survey (best done face-to-face). The latter survey approach would be necessary to obtain data on entrepreneurial characteristics. Assuming availability of funding, such an approach certainly merits future research investigation.

Firm age is a key variable of interest in many firm performance studies, as this measures the life-cycle effect, as well as learning effect in firm performance. However, lack of data on this variable means the study was unable to distinguish between firms in varied stages of the life cycle. A lack of data on profits and capital preclude the use of alternative firm performance measures such as profitability and Total Factor Productivity (TFP) in this analysis. Additionally, the non-availability of regional wage data in Ireland makes it impossible to control for regional variations in firm performance which may possibly arise from regional differences in living costs.

Results for the services industry may have been affected by the relatively short time period for which data on strategy variables were available. This limited analysis to three years (for all variables under analysis) which may not have been suitably long enough to measure the actual effect of macroeconomic factors. Due to the CSO confidentiality policy, data on certain industries can only be reported at an aggregated level. It then follows that the specific performance impact of those industries cannot be explicitly evaluated. However, in spite of the limitations of the study, the research undertaken in this thesis makes a significant contribution to the literature on the determinants of firm performance not only within the Irish context but moreover, to the international literature in this field of study.
7.5 Suggestions for Future Research

The research offers many opportunities for future research. By focusing on the period 2001-2007, it was not possible to compare firm performance across business cycles for the services industry. Consequently, to confirm whether findings for the services were due to the bubble or lower growth in the economy over the period 2001-2007, the use of an extended dataset which covers the period of a boom, as well as a recession offers a line for future research. Moreover, extending the study to cover the current economic crisis also allows the impact of the macroeconomic environment on firm performance to be better studied for both manufacturing and services firms.

Should the data become available, future work on this interesting research area would benefit from the use of alternative measures of firm performance such as Total Factor Productivity (TFP) and profitability, as well as the inclusion of relevant data on wages at the regional level. As already indicated, inclusion of variables on the entrepreneur and firm age in the firm performance analysis also provide another area of future research which allows the adoption of a truly holistic approach to firm performance. Finally, further exploration of the policy implications stemming from the empirical analysis may also merit additional research.

7.6 Conclusion

In conclusion, based on the identified gap in the literature relating to the impact of the macroeconomic environment on firm performance, this study aimed to develop a holistic multivariate model, which framed the analysis of the determinants of firm performance into three categories consisting of firm-specific characteristics, firm
strategy and the macroeconomic environment. Following from this, descriptive, non-parametric and econometric (FE and SYS-GMM) analyses were employed to analyse two panel datasets of 2,200 manufacturing and services firms in Ireland from 1991-2007. The sample period coincides with a period of rapid economic growth in the Irish economy; a boom (1991-2000) and a bubble (2001-2007). This allowed an investigation of firm behaviour across a sustainable and unsustainable growth phase.

Overall, findings suggest that macroeconomic conditions are important for firms in achieving success, with performance differences observed across two growth phases in the sample period. The results also indicate that strategies adopted by firms are influenced by the macroeconomic environment, as firms adjust strategies in response to changes in the environment which in turn determines subsequent performance.

The observed estimation results further imply the need to adopt a holistic approach in the study of firm performance which considers its multidimensional nature, rather than adopting a one-size-fits-all approach. Another key finding is related to the definition of performance employed by a researcher, with the specific effect of the macroeconomic environment and other determinants (firm characteristics and strategy) largely being determined by the firm performance measure employed. Thus, a study of firm performance without adopting a holistic multivariate approach which takes cognisance of both internal and external factors influencing firm performance runs the risk of overestimating or underestimating the specific impacts of determinants.
This study not only makes an important contribution to firm performance literature, the results also have possible policy implications. This analysis of firm performance is, therefore, a first step in an interesting research area worthy of further exploration. In developing a holistic multivariate model which links firm performance to firm-specific characteristics, firm strategy and macroeconomic factors, the thesis has contributed to the scant literature on the impact of the macroeconomic environment on firm performance by providing empirical evidence that the macroeconomic environment does influence firm performance and the channels through which this occurs (through strategies adopted by firms), thus addressing both the ‘what’ and the ‘how’ of this interaction.
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Appendices

Appendix A: Test of Robustness Estimation Results

<table>
<thead>
<tr>
<th>Table A 1 Determinants of Manufacturing Employment Growth by Technology Intensity, 1991-2007</th>
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<td><strong>LOW-TECH</strong></td>
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<td>LOG EMPLOYMENT,t-1</td>
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<td>F-test</td>
</tr>
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</tr>
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<td>m1</td>
</tr>
<tr>
<td>m2</td>
</tr>
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<td>Instruments</td>
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</table>

*** significant at 1%  ** significant at 5%  * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. Full results with location dummies included are available on request from the author. All macroeconomic variables are tested in levels.
Table A2 Determinants of Services Employment Growth by Knowledge Intensity, 2001-2007

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<tr>
<th>Employment Growth</th>
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</tr>
</thead>
<tbody>
<tr>
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<td>FE</td>
</tr>
<tr>
<td>LOG EMPLOYMENT_{t-1}</td>
<td>-0.697***</td>
<td>-0.950***</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT_{t-1})²</td>
<td>0.078***</td>
<td>0.114***</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY_{t-1}</td>
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<td>0.036***</td>
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<tr>
<td>INDUSTRY GROWTH</td>
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<td>0.001</td>
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<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>0.036*</td>
<td>0.040</td>
</tr>
<tr>
<td>LOCATION</td>
<td>-0.043**</td>
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<td>0.007</td>
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<td>EXPORT-IMPORT</td>
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<td>-0.009</td>
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<td>TRAINING</td>
<td>0.033**</td>
<td>-0.007</td>
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<td>GDP</td>
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<td>UNEMPLOYMENT</td>
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</tr>
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<td>CREDIT</td>
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<tr>
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<td>R-squared</td>
<td>0.859</td>
<td>0.953</td>
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<td>F-test</td>
<td>21.87(0.000)</td>
<td>1529(0.000)</td>
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<td>Breusch-Pagan test</td>
<td>502.4</td>
<td>229</td>
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<td>Number of Firms</td>
<td>2,920(0.404)</td>
<td>1,681(0.641)</td>
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<td>-3.796</td>
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<td>m2</td>
<td>1.569</td>
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<td>Instruments</td>
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### Notes:
- ***** significant at 1%, ** significant at 5%, * significant at 10%
- Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as χ² under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. All macroeconomic variables are tested in levels.
### Table A3 Determinants of Services Employment Growth by Knowledge Intensity 2005-2007

#### Employment Growth

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<th>Knowledge-intensive</th>
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<tr>
<td>LOG EMPLOYMENT, t1</td>
<td>-0.692*** (0.062)</td>
<td>-0.964*** (0.018)</td>
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<td>(LOG EMPLOYMENT, t1)²</td>
<td>0.075*** (0.007)</td>
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<td>INDUSTRY GROWTH</td>
<td>0.075 (0.072)</td>
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<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
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<td>0.003 (0.002)</td>
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<td>NATIONALITY OF OWNERSHIP</td>
<td>0.032 (0.029)</td>
<td>0.023 (0.043)</td>
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<td>LOCATION</td>
<td>-0.024 (0.029)</td>
<td>-0.021 (0.074)</td>
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<td>-0.073 (0.050)</td>
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<td>0.030 (0.020)</td>
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<td>SUBSIDIES</td>
<td>0.012 (0.032)</td>
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<td>R&amp;D</td>
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*** significant at 1%  ** significant at 5%  * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parentheses. m1 is the test for first order serial correlation in the first-differenced residuals, asymptotically distributed as N( 0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. All macroeconomic variables are tested in levels.
### Table A4 Determinants of Manufacturing Turnover Growth by Technology Intensity, 1991-2007

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<th>SYSTEM-GMM</th>
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Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity. $p$-values reported in parentheses. $m1$ and $m2$ are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as $N(0,1)$ under the null of no serial correlation. Values in parentheses represent the $p$ values for the F test and Hansen test. Full results with location dummies included are available on request from the author. All macroeconomic variables are estimated in levels.
### Table A5 Determinants of Services Turnover Growth by Knowledge Intensity, 2001-2007

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<tr>
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<td>FE</td>
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<td>LOG TURNOVER,1</td>
<td>-0.283***</td>
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<td></td>
<td>(0.034)</td>
<td>(0.014)</td>
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<td>(LOG TURNOVER,1)**</td>
<td>0.039***</td>
<td>0.122***</td>
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<tr>
<td></td>
<td>(0.004)</td>
<td>(0.002)</td>
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<td>LOG LABOUR PRODUCTIVITY,1</td>
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<td>-0.045***</td>
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<tr>
<td></td>
<td>(0.010)</td>
<td>(0.010)</td>
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<tr>
<td>INDUSTRY GROWTH</td>
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<td>-0.024</td>
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<td>(0.020)</td>
<td>(0.016)</td>
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<tr>
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<td>0.016</td>
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<td>(0.016)</td>
<td>(0.012)</td>
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<tr>
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<td>-0.010</td>
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<tr>
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<td>(0.021)</td>
<td>(0.016)</td>
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<tr>
<td>TRAINING</td>
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<tr>
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<td>(0.009)</td>
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<tr>
<td>GDP</td>
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<td>0.003</td>
</tr>
<tr>
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<td>(0.010)</td>
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<tr>
<td>UNEMPLOYMENT</td>
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<td>(0.155)</td>
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<td>0.012</td>
</tr>
<tr>
<td></td>
<td>(0.043)</td>
<td>(0.022)</td>
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<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
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</tr>
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<td>Breusch-Pagan test</td>
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<td>5992</td>
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<td>229</td>
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<tr>
<td>Hansen test</td>
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<td>m1</td>
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<td>-1.896</td>
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<tr>
<td>m2</td>
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<td>-1.226</td>
</tr>
<tr>
<td>Instruments</td>
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Notes: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. All macroeconomic variables are estimated in levels.
Table A.6 Determinants of Services Turnover Growth by Knowledge Intensity 2005-2007

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<td>FE</td>
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<td>LOG TURNOVER&lt;sub&gt;1,t&lt;/sub&gt;</td>
<td>-0.229***</td>
<td>-0.924***</td>
</tr>
<tr>
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<td>(0.033)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>(LOG TURNOVER&lt;sub&gt;1,t&lt;/sub&gt;)&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.032***</td>
<td>0.127***</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY&lt;sub&gt;1,t&lt;/sub&gt;</td>
<td>-0.017</td>
<td>-0.045**</td>
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<tr>
<td></td>
<td>(0.012)</td>
<td>(0.020)</td>
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<tr>
<td>INDUSTRY GROWTH</td>
<td>0.154</td>
<td>-0.162*</td>
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<tr>
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<td>(0.178)</td>
<td>(0.096)</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>0.001***</td>
<td>0.005*</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.014</td>
<td>-0.016</td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td>(0.035)</td>
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<tr>
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<tr>
<td></td>
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<td>(0.097)</td>
</tr>
<tr>
<td>EXPORT</td>
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<td>0.068**</td>
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<td>(0.031)</td>
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<tr>
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<td>-0.021</td>
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<tr>
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<td>(0.019)</td>
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<tr>
<td>EXPORT-IMPORT</td>
<td>-0.027</td>
<td>-0.009</td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>TRAINING</td>
<td>0.024</td>
<td>-0.014</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>SUBSIDIES</td>
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<td>-0.025</td>
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<tr>
<td></td>
<td>(0.038)</td>
<td>(0.043)</td>
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<tr>
<td>R&amp;D</td>
<td>-0.283***</td>
<td>-0.209***</td>
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<td>(0.038)</td>
<td>(0.057)</td>
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<td>-0.016***</td>
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<td>(0.006)</td>
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<tr>
<td>R&amp;D SPEND</td>
<td>0.232***</td>
<td>0.179*</td>
</tr>
<tr>
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<td>(0.050)</td>
<td>(0.059)</td>
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<tr>
<td>GDP</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.032)</td>
<td>(0.032)</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
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<td>(0.147)</td>
<td>(0.147)</td>
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<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
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<td>-0.003</td>
</tr>
<tr>
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<td>(0.008)</td>
<td>(0.004)</td>
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<td>(0.001)</td>
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<td>Constant</td>
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<td>(0.294)</td>
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<tr>
<td>R-squared</td>
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<td>0.554</td>
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<td>F-test</td>
<td>6.546(0.000)</td>
<td>209.9(0.000)</td>
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<td>Breusch-Pagan test</td>
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<tr>
<td>Number of Firms</td>
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<td>229</td>
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<tr>
<td>Hansen test</td>
<td>2.086(0.556)</td>
<td>2.086(0.556)</td>
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<td>Instruments</td>
<td>21</td>
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*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as \( \chi^2 \) under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p-values for the F-test and Hansen test. All macroeconomic variables are estimated in levels.
Table A7 Determinants of Employment Growth in Manufacturing by Ownership Type, 1991-2007

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<th>Domestic</th>
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<td>OLS</td>
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<td>-0.850***</td>
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<tr>
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<td>(0.051)</td>
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<td>(LOG EMPLOYMENT,t)^2</td>
<td>0.046***</td>
<td>0.090***</td>
</tr>
<tr>
<td>(0.003)</td>
<td>(0.001)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY,t</td>
<td>-0.001</td>
<td>0.009**</td>
</tr>
<tr>
<td>(0.003)</td>
<td>(0.004)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.037</td>
<td>0.019</td>
</tr>
<tr>
<td>(0.027)</td>
<td>(0.013)</td>
<td>(0.026)</td>
</tr>
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<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>-0.000</td>
<td>-0.000***</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>EXPORT</td>
<td>0.079</td>
<td>0.098***</td>
</tr>
<tr>
<td>(0.056)</td>
<td>(0.027)</td>
<td>(0.083)</td>
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<td>0.067***</td>
</tr>
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<td>(0.057)</td>
<td>(0.027)</td>
<td>(0.084)</td>
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<td>0.120**</td>
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<td>(0.026)</td>
<td>(0.081)</td>
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<td>0.014**</td>
<td>0.003</td>
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<td>(0.006)</td>
<td>(0.004)</td>
<td>(0.008)</td>
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<td>SUBSIDIES</td>
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<td>-0.008</td>
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<tr>
<td>(0.010)</td>
<td>(0.005)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>-0.011</td>
<td>-0.013***</td>
</tr>
<tr>
<td>(0.007)</td>
<td>(0.005)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>R &amp; D INTENSITY</td>
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<td>-0.000</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>R &amp; D SPEND</td>
<td>0.010</td>
<td>0.018***</td>
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<td>(0.009)</td>
<td>(0.006)</td>
<td>(0.014)</td>
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<tr>
<td>GDP</td>
<td>0.002</td>
<td>0.002**</td>
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<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
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<tr>
<td>UNEMPLOYMENT</td>
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<tr>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.001)</td>
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<tr>
<td>INFLATION</td>
<td>0.001</td>
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<tr>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.003)</td>
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<td>-0.000</td>
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<tr>
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<td>(0.000)</td>
<td>(0.001)</td>
</tr>
<tr>
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<td>3,424</td>
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<td>4824</td>
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<td>Number of Firms</td>
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<td>21.27(0.168)</td>
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<td>m2</td>
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</tr>
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<td>Instruments</td>
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*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as χ^2 under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. Full results with industry and location dummies included are available on request from the author. All macroeconomic variables are tested in levels.
### Table A8 Determinants of Employment Growth in Services by Ownership Type, 2001-2007

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<td>(0.014)</td>
</tr>
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<td>(0.001)</td>
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<td>-0.004</td>
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<tr>
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<td>(0.006)</td>
<td>(0.010)</td>
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<tr>
<td>INDUSTRY GROWTH</td>
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<td>(0.029)</td>
<td>(0.020)</td>
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<td>IMPORT</td>
<td>0.068***</td>
<td>0.001</td>
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<td>(0.023)</td>
<td>(0.011)</td>
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<tr>
<td>EXPORT-IMPORT</td>
<td>0.038*</td>
<td>0.012</td>
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<tr>
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<td>(0.021)</td>
<td>(0.012)</td>
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<tr>
<td>TRAINING</td>
<td>-0.007</td>
<td>-0.011</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.010)</td>
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<tr>
<td>GDP</td>
<td>0.004</td>
<td>0.002</td>
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<tr>
<td></td>
<td>(0.017)</td>
<td>(0.007)</td>
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<td>UNEMPLOYMENT</td>
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<td>(0.106)</td>
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<td>0.013</td>
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<tr>
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<td>(0.013)</td>
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<td>0.000</td>
</tr>
<tr>
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<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>CREDIT</td>
<td>-0.000</td>
<td>-0.001***</td>
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<tr>
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<td>(0.000)</td>
</tr>
<tr>
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<td>3.206***</td>
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<td>(0.461)</td>
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<td>612</td>
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<td>0.953</td>
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<td>F-test</td>
<td>6,817(0.000)</td>
<td>674(0.000)</td>
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</table>

*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with $p$-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the $p$-values for the F test, and Hansen test. Full results with industry dummies included are available on request from the author. All macroeconomic variables are estimated in levels.
Table A 9 Determinants of Services Employment Growth by Ownership Type 2005-2007

<table>
<thead>
<tr>
<th>Employment Growth</th>
<th>FOREIGN</th>
<th>DOMESTIC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>FE</td>
</tr>
<tr>
<td>LOG EMPLOYMENT, t1</td>
<td>-0.726***</td>
<td>-1.006***</td>
</tr>
<tr>
<td></td>
<td>(0.107)</td>
<td>(0.029)</td>
</tr>
<tr>
<td>LOG EMPLOYMENT, t1</td>
<td>0.067***</td>
<td>0.105***</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY, t1</td>
<td>-0.001</td>
<td>-0.033*</td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.137</td>
<td>0.046</td>
</tr>
<tr>
<td></td>
<td>(0.169)</td>
<td>(0.085)</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>0.001</td>
<td>-0.001*</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>LOCATION</td>
<td>0.047</td>
<td>-0.018</td>
</tr>
<tr>
<td></td>
<td>(0.029)</td>
<td>(0.077)</td>
</tr>
<tr>
<td>EXPORT</td>
<td>0.053</td>
<td>0.017</td>
</tr>
<tr>
<td></td>
<td>(0.040)</td>
<td>(0.035)</td>
</tr>
<tr>
<td>IMPORT</td>
<td>0.097***</td>
<td>-0.024</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>0.041</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(0.030)</td>
<td>(0.020)</td>
</tr>
<tr>
<td>TRAINING</td>
<td>-0.005</td>
<td>-0.039***</td>
</tr>
<tr>
<td></td>
<td>(0.029)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>0.084*</td>
<td>-0.009</td>
</tr>
<tr>
<td></td>
<td>(0.045)</td>
<td>(0.038)</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>0.031</td>
<td>-0.009</td>
</tr>
<tr>
<td></td>
<td>(0.047)</td>
<td>(0.031)</td>
</tr>
<tr>
<td>R&amp;D INTENSITY</td>
<td>-0.003</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>R&amp;D SPEND</td>
<td>-0.064</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>(0.067)</td>
<td>(0.048)</td>
</tr>
<tr>
<td>GDP</td>
<td>0.008</td>
<td>0.008</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>0.796</td>
<td>0.089</td>
</tr>
<tr>
<td></td>
<td>(1.732)</td>
<td>(0.102)</td>
</tr>
</tbody>
</table>

*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parentheses. m1 is the test for first-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. Values in parentheses represent the p-values for the F test and Hansen test. Full results with industry and location dummies included are available on request. A full macroeconomic variables are estimated in levels.
Table A10 Determinants of Turnover Growth in Manufacturing by Ownership Type (1991-2007)

<table>
<thead>
<tr>
<th>Turnover Growth</th>
<th>Foreign</th>
<th>Domestic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>FE</td>
</tr>
<tr>
<td>LOG TURNOVER,1</td>
<td>-0.375***</td>
<td>-0.705***</td>
</tr>
<tr>
<td>(0.044)</td>
<td>(0.011)</td>
<td>(0.039)</td>
</tr>
<tr>
<td>LOG TURNOVER,2</td>
<td>0.034***</td>
<td>0.060***</td>
</tr>
<tr>
<td>(0.004)</td>
<td>(0.001)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY,1</td>
<td>-0.092***</td>
<td>-0.141***</td>
</tr>
<tr>
<td>(0.020)</td>
<td>(0.012)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.205***</td>
<td>0.094***</td>
</tr>
<tr>
<td>(0.044)</td>
<td>(0.024)</td>
<td>(0.043)</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>-0.000*</td>
<td>-0.000***</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>EXPORT</td>
<td>0.076</td>
<td>0.119**</td>
</tr>
<tr>
<td>(0.086)</td>
<td>(0.052)</td>
<td>(0.132)</td>
</tr>
<tr>
<td>IMPORT</td>
<td>0.230***</td>
<td>0.131***</td>
</tr>
<tr>
<td>(0.083)</td>
<td>(0.051)</td>
<td>(0.136)</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>0.130*</td>
<td>0.159***</td>
</tr>
<tr>
<td>(0.081)</td>
<td>(0.050)</td>
<td>(0.126)</td>
</tr>
<tr>
<td>TRAINING</td>
<td>0.053***</td>
<td>0.027***</td>
</tr>
<tr>
<td>(0.010)</td>
<td>(0.008)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>-0.007</td>
<td>0.015</td>
</tr>
<tr>
<td>(0.014)</td>
<td>(0.011)</td>
<td>(0.021)</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>0.027**</td>
<td>0.013</td>
</tr>
<tr>
<td>(0.013)</td>
<td>(0.009)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>R &amp; D INTENSITY</td>
<td>-0.003***</td>
<td>-0.003***</td>
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<tr>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>R &amp; D SPEND</td>
<td>-0.021</td>
<td>0.019</td>
</tr>
<tr>
<td>(0.017)</td>
<td>(0.012)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>GDP</td>
<td>0.003*</td>
<td>0.003**</td>
</tr>
<tr>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>0.004*</td>
<td>-0.000</td>
</tr>
<tr>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>INFLATION</td>
<td>0.007</td>
<td>0.001</td>
</tr>
<tr>
<td>(0.005)</td>
<td>(0.003)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>0.022</td>
<td>0.001</td>
</tr>
<tr>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>CREDIT</td>
<td>0.000</td>
<td>0.000**</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.531***</td>
<td>1.667***</td>
</tr>
<tr>
<td>(0.154)</td>
<td>(0.096)</td>
<td>(0.187)</td>
</tr>
<tr>
<td>Observations</td>
<td>3,424</td>
<td>3,424</td>
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<tr>
<td>R-squared</td>
<td>0.513</td>
<td>0.774</td>
</tr>
<tr>
<td>F-test</td>
<td>17.37(0.000)</td>
<td>454.4(0.000)</td>
</tr>
<tr>
<td>Breusch-Pagan test</td>
<td>6341</td>
<td>41030</td>
</tr>
</tbody>
</table>

** significant at 1%, *** significant at 5%, * significant at 10%
Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with p-values reported in parentheses. $m_1$ and $m_2$ are the F tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as $N(0, 1)$ under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. Full results with industry and location dummies included are available on request from the author. All macroeconomic variables are tested in levels.
Table A11 Determinants of Turnover Growth in Services by Ownership Type, 2001-2007

<table>
<thead>
<tr>
<th></th>
<th>FOREIGN</th>
<th>DOMESTIC</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>OLS</td>
<td>FE</td>
</tr>
<tr>
<td>Turnover Growth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOG TURNOVER_{t-1}</td>
<td>-0.539***</td>
<td>-0.874***</td>
</tr>
<tr>
<td>(0.053)</td>
<td>(0.020)</td>
<td>(0.115)</td>
</tr>
<tr>
<td>LOG TURNOVER_{t-1}^2</td>
<td>0.047***</td>
<td>0.077***</td>
</tr>
<tr>
<td>(0.005)</td>
<td>(0.001)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY_{t-1}</td>
<td>-0.033***</td>
<td>-0.014</td>
</tr>
<tr>
<td>(0.012)</td>
<td>(0.017)</td>
<td>(0.040)</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.131</td>
<td>0.078</td>
</tr>
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<td>(0.124)</td>
<td>(0.056)</td>
<td>(0.820)</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>0.000</td>
<td>-0.000***</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>LOCATION</td>
<td>0.053</td>
<td>-0.051*</td>
</tr>
<tr>
<td>(0.036)</td>
<td>(0.029)</td>
<td>(0.207)</td>
</tr>
<tr>
<td>EXPORT</td>
<td>0.037</td>
<td>-0.002</td>
</tr>
<tr>
<td>(0.024)</td>
<td>(0.016)</td>
<td>(0.210)</td>
</tr>
<tr>
<td>IMPORT</td>
<td>0.032</td>
<td>0.002</td>
</tr>
<tr>
<td>(0.025)</td>
<td>(0.017)</td>
<td>(0.382)</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>-0.015</td>
<td>-0.007</td>
</tr>
<tr>
<td>(0.026)</td>
<td>(0.014)</td>
<td>(0.304)</td>
</tr>
<tr>
<td>TRAINING</td>
<td>-0.000</td>
<td>-0.002</td>
</tr>
<tr>
<td>(0.018)</td>
<td>(0.009)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>GDP</td>
<td>0.103</td>
<td>0.120</td>
</tr>
<tr>
<td>(0.355)</td>
<td>(0.150)</td>
<td>(1.072)</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>-0.028</td>
<td>-0.018</td>
</tr>
<tr>
<td>(0.041)</td>
<td>(0.019)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>INFLATION</td>
<td>0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>CREDIT</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>(0.001)</td>
<td>(0.000)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.074</td>
<td>1.828***</td>
</tr>
<tr>
<td>(1.553)</td>
<td>(0.657)</td>
<td>(2.423)</td>
</tr>
<tr>
<td>Observations</td>
<td>612</td>
<td>612</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.573</td>
<td>0.894</td>
</tr>
<tr>
<td>F-test</td>
<td>9.750</td>
<td>277.6</td>
</tr>
<tr>
<td>Breusch-Pagan test</td>
<td>221.6</td>
<td>4459</td>
</tr>
<tr>
<td>Number of Firms</td>
<td>102</td>
<td>102</td>
</tr>
<tr>
<td>Hansen test</td>
<td>0.292</td>
<td>0.962</td>
</tr>
<tr>
<td>m1</td>
<td>-2.168</td>
<td>-2.512</td>
</tr>
<tr>
<td>m2</td>
<td>-0.762</td>
<td>-0.587</td>
</tr>
<tr>
<td>Instruments</td>
<td>28</td>
<td>29</td>
</tr>
</tbody>
</table>

*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. Full results with industry dummies included are available on request from the author. All macroeconomic variables are tested in levels.
<table>
<thead>
<tr>
<th>Instruments</th>
<th>Hansen test</th>
<th>Number of Firms</th>
<th>Breusch-Pagan test</th>
<th>Number of Observations</th>
<th>R-squared</th>
<th>F-test</th>
<th>Breusch-Pagan test</th>
<th>Number of Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>m1</td>
<td>(0.008)</td>
<td>(0.029)</td>
<td>(0.010)</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>4.320</td>
<td>5.052(0.000)</td>
<td>29</td>
</tr>
<tr>
<td>m2</td>
<td>(0.017)</td>
<td>(0.028)</td>
<td>(0.030)</td>
<td>(0.010)</td>
<td>(0.012)</td>
<td>0.334</td>
<td>0.028(0.034)</td>
<td>29</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>(0.020)</td>
<td>(0.091)</td>
<td>(0.012)</td>
<td>(0.015)</td>
<td>(0.026)</td>
<td>0.003</td>
<td>0.000(0.000)</td>
<td>29</td>
</tr>
<tr>
<td>LOCATION</td>
<td>(0.038)</td>
<td>(0.020)</td>
<td>(0.091)</td>
<td>(0.012)</td>
<td>(0.015)</td>
<td>0.004</td>
<td>0.009(0.000)</td>
<td>29</td>
</tr>
<tr>
<td>EXPERT</td>
<td>(0.034)</td>
<td>(0.019)</td>
<td>(0.084)</td>
<td>(0.009)</td>
<td>(0.010)</td>
<td>0.002</td>
<td>0.007(0.004)</td>
<td>29</td>
</tr>
<tr>
<td>IMPORT</td>
<td>(0.076)</td>
<td>(0.012)</td>
<td>0.125</td>
<td>(0.002)</td>
<td>(0.006)</td>
<td>0.002</td>
<td>0.043(0.003)</td>
<td>29</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>0.043</td>
<td>0.099</td>
<td>0.003</td>
<td>0.007</td>
<td>0.004</td>
<td>0.008</td>
<td>0.000(0.000)</td>
<td>29</td>
</tr>
<tr>
<td>TRAINING</td>
<td>-0.001</td>
<td>0.062</td>
<td>0.033</td>
<td>-0.003</td>
<td>0.028</td>
<td>-0.007</td>
<td>-0.008(0.014)</td>
<td>29</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>0.102</td>
<td>-0.008</td>
<td>0.089</td>
<td>-0.008</td>
<td>0.003</td>
<td>0.002</td>
<td>0.043(0.003)</td>
<td>29</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>0.066</td>
<td>-0.036</td>
<td>0.057</td>
<td>-0.010</td>
<td>-0.011</td>
<td>0.001</td>
<td>0.007(0.001)</td>
<td>29</td>
</tr>
<tr>
<td>R&amp;D INTENSITY</td>
<td>0.005</td>
<td>0.004</td>
<td>0.012</td>
<td>-0.015</td>
<td>-0.014</td>
<td>0.001</td>
<td>0.006(0.003)</td>
<td>29</td>
</tr>
<tr>
<td>R&amp;D SPEND</td>
<td>-0.204</td>
<td>-0.011</td>
<td>-0.263</td>
<td>0.006</td>
<td>0.011</td>
<td>-0.007</td>
<td>-0.006(0.001)</td>
<td>29</td>
</tr>
<tr>
<td>GDP</td>
<td>-0.026</td>
<td>0.014</td>
<td>(0.044)</td>
<td>(0.014)</td>
<td>0.002</td>
<td>0.003</td>
<td>0.043(0.003)</td>
<td>29</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>CREDIT</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Constant</td>
<td>1.594</td>
<td>2.454</td>
<td>3.197</td>
<td>1.873</td>
<td>-0.275</td>
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<td>2.409</td>
<td>2.409</td>
<td>2.409</td>
</tr>
<tr>
<td>R-squared</td>
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<td>0.962</td>
<td>0.197</td>
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<td>0.799</td>
<td>0.799</td>
<td>0.799</td>
<td>0.799</td>
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<td>5.837</td>
<td>5.052</td>
<td>394.8</td>
<td>4.320</td>
<td>4.320</td>
<td>4.320</td>
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<tr>
<td>Breusch-Pagan test</td>
<td>226.8</td>
<td>27.66</td>
<td>27.66</td>
<td>27.66</td>
<td>27.66</td>
<td>27.66</td>
<td>27.66</td>
<td>27.66</td>
</tr>
<tr>
<td>Number of Firms</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
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<tr>
<td>Hansen test</td>
<td>0(1)</td>
<td>3.258</td>
<td>0.196</td>
<td>3.258</td>
<td>3.258</td>
<td>3.258</td>
<td>3.258</td>
<td>3.258</td>
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</tbody>
</table>

**Note:** Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with $p$-values reported in parentheses. $m1$ is the test for first order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the $p$ values for the $F$ test and Hansen test. Full results with industry dummies included are available on request from the author. All macroeconomic variables are tested in levels.
Table A 13 Determinants of Employment Growth in Micro-sized and Small Manufacturing Firms

<table>
<thead>
<tr>
<th>Employment Growth</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
<th>SMALL</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOG EMPLOYMENT, t</td>
<td>-0.837***</td>
<td>-0.975***</td>
<td>-0.845***</td>
<td>-0.831***</td>
<td>-0.973***</td>
<td>-0.835***</td>
<td></td>
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<tr>
<td>(LOG EMPLOYMENT, t)^2</td>
<td>0.176***</td>
<td>0.956***</td>
<td>0.177***</td>
<td>0.124***</td>
<td>0.140***</td>
<td>0.125***</td>
<td></td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.016***</td>
<td>0.002</td>
<td>-0.015</td>
<td>0.009***</td>
<td>-0.002</td>
<td>0.006</td>
<td></td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFICIENT SCALE</td>
<td>0.000</td>
<td>0.000***</td>
<td>0.000</td>
<td>-0.000***</td>
<td>-0.000***</td>
<td>0.000</td>
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</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.103***</td>
<td>0.471</td>
<td>-0.024***</td>
<td>0.024**</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>EXPORT</td>
<td>-0.017**</td>
<td>-0.009</td>
<td>-0.019*</td>
<td>-0.011**</td>
<td>0.004</td>
<td>-0.011</td>
<td></td>
</tr>
<tr>
<td>IMPORT</td>
<td>-0.020***</td>
<td>-0.018**</td>
<td>-0.023**</td>
<td>-0.005*</td>
<td>0.002</td>
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<tr>
<td>EXPORT-IMPORT</td>
<td>-0.023***</td>
<td>-0.019***</td>
<td>-0.039***</td>
<td>-0.002</td>
<td>-0.001</td>
<td>-0.002</td>
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<td>TRAINING</td>
<td>0.001</td>
<td>0.000</td>
<td>-0.013</td>
<td>-0.012***</td>
<td>-0.008***</td>
<td>-0.012***</td>
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<td>SUBSIDIES</td>
<td>-0.009**</td>
<td>-0.002</td>
<td>-0.001</td>
<td>-0.006*</td>
<td>0.004</td>
<td>-0.007</td>
<td></td>
</tr>
<tr>
<td>R &amp; D</td>
<td>0.011**</td>
<td>0.008**</td>
<td>0.020**</td>
<td>-0.023***</td>
<td>-0.008***</td>
<td>-0.021***</td>
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<tr>
<td>R &amp; D INTENSITY</td>
<td>0.000</td>
<td>0.000</td>
<td>-0.002</td>
<td>0.000***</td>
<td>0.000</td>
<td>0.000</td>
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<tr>
<td>R &amp; D SPEND</td>
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<td>0.002</td>
<td>0.014***</td>
<td>0.002</td>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td>0.002**</td>
<td>0.002***</td>
<td>0.000**</td>
<td>0.001***</td>
<td>0.000</td>
<td>0.001***</td>
<td></td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>-0.001</td>
<td>-0.002***</td>
<td>0.001</td>
<td>0.001***</td>
<td>-0.001</td>
<td>0.001***</td>
<td></td>
</tr>
<tr>
<td>INFLATION</td>
<td>-0.002</td>
<td>-0.002</td>
<td>0.001</td>
<td>0.002</td>
<td>0.001</td>
<td>0.001</td>
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<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>-0.001</td>
<td>-0.001</td>
<td>-0.001*</td>
<td>-0.000</td>
<td>0.000</td>
<td>-0.000</td>
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</tr>
<tr>
<td>CREDIT</td>
<td>-0.000**</td>
<td>-0.000***</td>
<td>-0.000</td>
<td>-0.000**</td>
<td>-0.000***</td>
<td>-0.000***</td>
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</tr>
<tr>
<td>Constant</td>
<td>1.029***</td>
<td>1.227***</td>
<td>1.027***</td>
<td>1.361***</td>
<td>1.649***</td>
<td>1.384***</td>
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<tr>
<td>Observations</td>
<td>5,472</td>
<td>5,472</td>
<td>5,472</td>
<td>10,496</td>
<td>10,496</td>
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<tr>
<td>R-squared</td>
<td>0.790</td>
<td>0.852</td>
<td>0.798</td>
<td>0.904</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-test</td>
<td>178.2(0.000)</td>
<td>1657(0.000)</td>
<td>103.2(0.000)</td>
<td>318.4(0.000)</td>
<td>3832(0.000)</td>
<td>209.4(0.000)</td>
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<tr>
<td>Breusch-Pagan test</td>
<td>5095</td>
<td>826.9</td>
<td>656</td>
<td>656</td>
<td></td>
<td></td>
<td></td>
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<td>Number of Firms</td>
<td>342</td>
<td>342</td>
<td>656</td>
<td>2,789(0.425)</td>
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<tr>
<td>m1</td>
<td>-6.855</td>
<td>-7.777</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>m2</td>
<td>2.228</td>
<td>-0.400</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Note:** Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as \( \chi^2 \) under the null of instrument validity, with \( p \)-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as \( N(0,1) \) under the null of no serial correlation. Values in parentheses represent the \( p \)-values for the F test and Hansen test. Full results with location dummies included are available on request from the author. All macroeconomic variables are tested in levels.

*** significant at 1%, ** significant at 5%, * significant at 10%
Table A 14 Determinants of Employment Growth in Micro and Small Services Firms, 2001-2007

<table>
<thead>
<tr>
<th>Determinants</th>
<th>Employment Growth</th>
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<tr>
<td></td>
<td>MICRO</td>
</tr>
<tr>
<td></td>
<td>OLS</td>
</tr>
<tr>
<td>LOG EMPLOYMENT,$_{i,t}$</td>
<td>-0.943***</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT,$_{i,t}$)$^2$</td>
<td>0.228***</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY,$_{i,t}$</td>
<td>-0.008***</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>-0.054</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>0.000***</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-1.231***</td>
</tr>
<tr>
<td>LOCATION</td>
<td>0.067***</td>
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<tr>
<td>EXPORT</td>
<td>0.015</td>
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<tr>
<td>IMPORT</td>
<td>0.023</td>
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<tr>
<td>EXPORT-IMPORT</td>
<td>0.032</td>
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<tr>
<td>TRAINING</td>
<td>0.055</td>
</tr>
<tr>
<td>GDP</td>
<td>(0.037)</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>0.147</td>
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<tr>
<td>INFLATION</td>
<td>-0.002</td>
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<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>0.000</td>
</tr>
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<td>CREDIT</td>
<td>-0.001</td>
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<td>Constant</td>
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<td>Observations</td>
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<tr>
<td>R-squared</td>
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</tr>
<tr>
<td>F-test</td>
<td>39.72(0.000)</td>
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<tr>
<td>Breusch-Pagan test</td>
<td>14.58</td>
</tr>
<tr>
<td>Hansen test</td>
<td>(0.1)</td>
</tr>
<tr>
<td>m1</td>
<td>-1.336</td>
</tr>
<tr>
<td>m2</td>
<td>-1.366</td>
</tr>
<tr>
<td>Instruments</td>
<td>19</td>
</tr>
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</table>

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with $p$-values reported in parentheses. $m1$ and $m2$ are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as $N(0, 1)$ under the null of no serial correlation. Values in parentheses represent the $p$ values for the $F$ test and Hansen test. All macroeconomic variables are tested in levels.

*** significant at 1%, ** significant at 5%, * significant at 10%
Table A15 Determinants of Employment Growth in Micro and Small Services Firms, 2005-2007

<table>
<thead>
<tr>
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<th>Employment Growth</th>
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<tr>
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<td>OLS</td>
</tr>
<tr>
<td>LOG EMPLOYMENT, t</td>
<td>-0.684***</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT, t)^2</td>
<td>0.161***</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY, t</td>
<td>-0.104***</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>-0.095</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>-0.000**</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.827***</td>
</tr>
<tr>
<td>LOCATION</td>
<td>0.034</td>
</tr>
<tr>
<td>EXPORT</td>
<td>-0.103</td>
</tr>
<tr>
<td>IMPORT</td>
<td>-0.017</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>-0.006</td>
</tr>
<tr>
<td>TRAINING</td>
<td>0.061</td>
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<tr>
<td>SUBSIDISED</td>
<td>0.152</td>
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<tr>
<td>R&amp;D</td>
<td>0.002</td>
</tr>
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<td>R&amp;D INTENSITY</td>
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</tr>
<tr>
<td>GDP</td>
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<td>REAL EFFECTIVE EXCHANGE RATE</td>
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</tr>
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<td>CREDIT</td>
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<tr>
<td>Constant</td>
<td>0.452</td>
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<tr>
<td>Observations</td>
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</tr>
<tr>
<td>R-squared</td>
<td>0.710</td>
</tr>
<tr>
<td>F-test</td>
<td>11.62(0.000)</td>
</tr>
<tr>
<td>Breusch-Pagan test</td>
<td>2.801</td>
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<td>Number of Firms</td>
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<tr>
<td>Hansen test</td>
<td>3.728(0.052)</td>
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<td>m1</td>
<td>-1.198</td>
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<td>Instruments</td>
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Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as $N(0,1)$ under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test and tests of serial order correlation. All macroeconomic variables are tested in levels.

***significant at 1%, ** significant at 5%, * significant at 10%
Table A 16 Determinants of Employment Growth in Medium and Large Manufacturing Firms, 1991-2007

<table>
<thead>
<tr>
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<th>Employment Growth</th>
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<td></td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>OLS</td>
</tr>
<tr>
<td>LOG EMPLOYMENT(_i)</td>
<td>-0.836***</td>
</tr>
<tr>
<td>(0.023)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT(_i))^2</td>
<td>0.084***</td>
</tr>
<tr>
<td>(0.003)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>LOG LABOUR</td>
<td>0.002</td>
</tr>
<tr>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>PRODUCTIVITY(_i)</td>
<td>0.030</td>
</tr>
<tr>
<td>(0.019)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.000**</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM</td>
<td>0.000**</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
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<tr>
<td>EFFICIENT SCALE</td>
<td>0.000</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
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<tr>
<td>NATIONALITY OF</td>
<td>0.000</td>
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<tr>
<td>(0.003)</td>
<td>(0.003)</td>
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<tr>
<td>OWNERSHIP</td>
<td>0.012</td>
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<td>(0.007)</td>
<td>(0.006)</td>
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<tr>
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<td>0.011**</td>
</tr>
<tr>
<td>(0.003)</td>
<td>(0.002)</td>
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<tr>
<td>EXPORT-IMPORT</td>
<td>-0.011**</td>
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<tr>
<td>(0.005)</td>
<td>(0.003)</td>
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<tr>
<td>R &amp; D</td>
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</tr>
<tr>
<td>(0.004)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>R &amp; D INTENSITY</td>
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</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>R &amp; D SPEND</td>
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<tr>
<td>(0.004)</td>
<td>(0.004)</td>
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<tr>
<td>GDP</td>
<td>0.001**</td>
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<tr>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>0.000</td>
</tr>
<tr>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>INFLATION</td>
<td>0.000</td>
</tr>
<tr>
<td>(0.002)</td>
<td>(0.001)</td>
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<td>REAL EFFECTIVE EXCHANGE RATE</td>
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<td>(0.000)</td>
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<tr>
<td>CREDIT</td>
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<td>(0.000)</td>
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<tr>
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<td>84.42(0.000)</td>
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<td>(0.000)</td>
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<td>Breusch-Pagan test</td>
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<td>231</td>
</tr>
<tr>
<td>Hansen test</td>
<td>1.661(0.798)</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>m1</td>
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<td>(0.000)</td>
<td>(0.000)</td>
</tr>
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<td>m2</td>
<td>0.950</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Instruments</td>
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</table>

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as \( \chi^2 \) under the null of instrument validity with \( p \)-values reported in parentheses. \( m \) and \( m2 \) are the t tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as \( N(0, 1) \) under the null of no serial correlation. Values in parentheses represent the \( p \) values for the F test and Hansen test. Full results with industry and location dummies included are available on request from the author. All macroeconomic variables are tested in levels.
### Table A 17 Determinants of Employment Growth in Medium-sized and Large Services Firms, 2001-2007

**Employment Growth**

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<th></th>
<th>MEDIUM</th>
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<td></td>
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<td>FE</td>
</tr>
<tr>
<td>LOG EMPLOYMENT</td>
<td>-0.993***</td>
<td>-1.033***</td>
</tr>
<tr>
<td>(t)</td>
<td>(0.014)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT)</td>
<td>0.109***</td>
<td>0.111***</td>
</tr>
<tr>
<td>(t)</td>
<td>(0.002)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>LOG LABOUR</td>
<td>0.002</td>
<td>0.009**</td>
</tr>
<tr>
<td>PRODUCTIVITY</td>
<td>(0.001)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>-0.035**</td>
<td>0.007</td>
</tr>
<tr>
<td>(t)</td>
<td>(0.014)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM</td>
<td>-0.000***</td>
<td>-0.000</td>
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<td>(0.007)</td>
<td>(0.012)</td>
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<tr>
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<td>(0.012)</td>
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<td>(0.004)</td>
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<tr>
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<td>(0.005)</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
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<tr>
<td>(t)</td>
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<td>(0.003)</td>
</tr>
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<td>TRAINING</td>
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<td>-0.000</td>
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<tr>
<td>(t)</td>
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<td>(0.002)</td>
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<td>GDP</td>
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<td>0.003</td>
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<tr>
<td>(t)</td>
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<td>(0.004)</td>
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<td>-0.000</td>
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<td>(0.000)</td>
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<td>CREDIT</td>
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<td>-0.000**</td>
</tr>
<tr>
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<tr>
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<tr>
<td>m1</td>
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</tr>
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</tr>
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<td>Instruments</td>
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</table>

**significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with $p$-values reported in parentheses. $m1$ and $m2$ are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as $N( 0, 1)$ under the null of no serial correlation. Values in parentheses represent the $p$ values for the F test and, Hansen test. All macroeconomic variables are tested in levels.
### Table A 18: Determinants of Employment Growth in Medium-sized and Large Services Firms, 2005-2007

#### Employment Growth

<table>
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<tr>
<th></th>
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</tr>
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<tr>
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<td>FE</td>
</tr>
<tr>
<td>LOG EMPLOYMENT&lt;sub&gt;1&lt;/sub&gt;</td>
<td>-0.991***</td>
<td>-1.003***</td>
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<tr>
<td></td>
<td>(0.021)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>(LOG EMPLOYMENT&lt;sub&gt;1&lt;/sub&gt;)²</td>
<td>0.109**</td>
<td>0.117***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY&lt;sub&gt;1&lt;/sub&gt;</td>
<td>0.002</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>-0.044*</td>
<td>0.026</td>
</tr>
<tr>
<td></td>
<td>(0.025)</td>
<td>(0.021)</td>
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<tr>
<td>INDUSTRY MINIMUM</td>
<td>-0.000*</td>
<td>-0.000**</td>
</tr>
<tr>
<td>EFICIENT SCALE</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.006</td>
<td>-0.009</td>
</tr>
<tr>
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<td>(0.007)</td>
<td>(0.010)</td>
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<td>-0.013</td>
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<tr>
<td></td>
<td>(0.004)</td>
<td>(0.023)</td>
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<tr>
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<td>-0.001</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.012)</td>
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<td>IMPORT</td>
<td>0.005</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.006)</td>
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<tr>
<td>EXPORT-IMPORT</td>
<td>0.002</td>
<td>0.010</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>TRAINING</td>
<td>0.012***</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>0.009</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>-0.026</td>
<td>-0.015</td>
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<tr>
<td></td>
<td>(0.030)</td>
<td>(0.013)</td>
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<tr>
<td>R &amp; D INTENSITY</td>
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<td>-0.000</td>
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<tr>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>R &amp; D SPEND</td>
<td>0.011</td>
<td>0.016</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td>(0.016)</td>
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<tr>
<td>GDP</td>
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<td>-0.003</td>
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<tr>
<td>UNEMPLOYMENT</td>
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<td>REAL EFFECTIVE EXCHANGE RATE</td>
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<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>CREDIT</td>
<td>0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
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<td>Constant</td>
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<td>2.182***</td>
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<td>R-squared</td>
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<td>F-test</td>
<td>234.1(0.000)</td>
<td>3422(0.000)</td>
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<tr>
<td>Breusch-Pagan test</td>
<td>164.2</td>
<td>189.0</td>
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<td>Number of Firms</td>
<td>320</td>
<td>320</td>
</tr>
<tr>
<td>Hansen test</td>
<td>2.197(0.532)</td>
<td>2.324(0.508)</td>
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<td>m1</td>
<td>-1.414</td>
<td>-1.319</td>
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<td>21</td>
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</table>

*Significant at 1%, **significant at 5%, *significant at 10%

Note: Robust standard errors are in parentheses. Hansen’s test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p-values for the F-test and Hansen test.
<table>
<thead>
<tr>
<th>Instruments</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
<th>OLS</th>
<th>FE</th>
<th>SYS-GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>m2</td>
<td>-0.357***</td>
<td>-0.739***</td>
<td>-0.368***</td>
<td>-0.457***</td>
<td>-0.771***</td>
<td>-0.456***</td>
</tr>
<tr>
<td>m1</td>
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<td></td>
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<td></td>
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<td>Hansen test</td>
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<td>6.965(0.138)</td>
<td>2.530(0.470)</td>
<td>6.965(0.138)</td>
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</table>

** Table A 19 Determinants of Turnover Growth in Micro-sized and Small Manufacturing Firms, 1991-2007 **

**Note:** Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as \( \chi^2 \) under the null of instrument validity with \( p \)-values reported in parentheses. \( m1 \) and \( m2 \) are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as \( \mathcal{N}(0,1) \) under the null of no serial correlation. Values in parentheses represent the \( p \) values for the \( F \) test and Hansen test. Full results with location dummies included are available on request from the author. All macroeconomic variables are tested in levels.

\* \* \* significant at 1%, \* \* significant at 5%, \* significant at 10%
### Table A20: Determinants of Turnover Growth in Micro-sized and Small Services Firms, 2001-2007

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<td>FE</td>
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<td>LOG TURNOVER&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.352***</td>
<td>-0.888***</td>
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<td></td>
<td>(0.065)</td>
<td>(0.046)</td>
</tr>
<tr>
<td>LOG TURNOVER&lt;sub&gt;t-1&lt;/sub&gt;&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.101***</td>
<td>0.235***</td>
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<tr>
<td></td>
<td>(0.016)</td>
<td>(0.013)</td>
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<td>LOG LABOUR PRODUCTIVITY&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.008</td>
<td>-0.016</td>
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<tr>
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<td>(0.020)</td>
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<td>INDUSTRY GROWTH</td>
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<td>0.086</td>
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<td>(0.060)</td>
<td>(0.040)</td>
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<td>REAL EFFECTIVE EXCHANGE RATE</td>
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<td>(0.001)</td>
<td>(0.000)</td>
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<td>F-test</td>
<td>3.467(0.00)</td>
<td>42.62(0.00)</td>
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<td>Breusch-Pagan test</td>
<td>12.63</td>
<td>4026</td>
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<td>Number of Firms</td>
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<td>31</td>
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<tr>
<td>Hansen test</td>
<td>0(1)</td>
<td>2.722(0.437)</td>
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<td>m1</td>
<td>1.849</td>
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<td>m2</td>
<td>0.701</td>
<td>-1.091</td>
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<td>20</td>
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</table>

**significant at 1%, *** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as \( \chi^2 \) under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as \( N(0, 1) \) under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. All macroeconomic variables are tested in levels.
### Table A21 Determinants of Turnover Growth in Micro-sized and Small Services Firms, 2005-2007

<table>
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<th>Turnover Growth</th>
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</thead>
<tbody>
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<td>OLS</td>
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<tr>
<td>LOG TURNOVER_{t+1}</td>
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<td>-1.034***</td>
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<tr>
<td>(LOG TURNOVER_{t+1})</td>
<td>(0.065)</td>
<td>(0.096)</td>
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<tr>
<td>LOG LABOUR PRODUCTIVITY_{t+1}</td>
<td>-0.005***</td>
<td>-0.043</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>1.077***</td>
<td>0.336</td>
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<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>-0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.405**</td>
<td>0.000</td>
</tr>
<tr>
<td>LOCATION</td>
<td>0.024</td>
<td>-0.038</td>
</tr>
<tr>
<td>IMPORT</td>
<td>(0.047)</td>
<td>(0.046)</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>-0.326*</td>
<td>-0.032</td>
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<td>TRAINING</td>
<td>0.110</td>
<td>0.404</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>0.169</td>
<td>0.088</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>-0.048</td>
<td>0.006</td>
</tr>
<tr>
<td>R &amp; D INTENSITY</td>
<td>0.139</td>
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</tr>
<tr>
<td>R &amp; D SPEND</td>
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<td>-0.009</td>
</tr>
<tr>
<td>GDP</td>
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<td>-0.045</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>0.143</td>
<td>0.078</td>
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<td>0.000</td>
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<td>93</td>
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<td>R-squared</td>
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<tr>
<td>F-test</td>
<td>4.790(0.00)</td>
<td>2.618</td>
</tr>
</tbody>
</table>
| **Note:** Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as $\chi^2$ under the null of instrument validity with p-values reported in parentheses. m1 is the test for first order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p-values for the F-test and Hansen test. All macroeconomic variables are tested in levels.
### Table A 22: Determinants of Turnover Growth in Medium-sized and Large Manufacturing Firms, 1991-2007

<table>
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<th>Turnover Growth</th>
<th>MEDIUM</th>
<th>LARGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>FE</td>
</tr>
<tr>
<td>LOG TURNOVER(\text{t-1})</td>
<td>-0.454***</td>
<td>-0.819***</td>
</tr>
<tr>
<td>(LOG TURNOVER(\text{t-1}))^2</td>
<td>(0.026)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY(\text{t-1})</td>
<td>-0.041***</td>
<td>0.069***</td>
</tr>
<tr>
<td>(LOG LABOUR PRODUCTIVITY(\text{t-1}))^2</td>
<td>(0.003)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.188***</td>
<td>0.090***</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>(0.032)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>CREDIT RATE</td>
<td>-0.004***</td>
<td>-0.004***</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>-0.001</td>
<td>-0.001</td>
</tr>
<tr>
<td>GDP</td>
<td>0.023***</td>
<td>0.008</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>R &amp; D INTENSITY</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>R &amp; D SPEND</td>
<td>-0.005**</td>
<td>-0.004</td>
</tr>
<tr>
<td>GDP</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>0.003</td>
<td>0.002</td>
</tr>
<tr>
<td>INFLATION</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>0.003</td>
<td>0.001</td>
</tr>
<tr>
<td>RATE</td>
<td>(0.000)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>CREDIT</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>GDP</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Constant</td>
<td>1.131***</td>
<td>2.306***</td>
</tr>
<tr>
<td>(0.105)</td>
<td>(0.058)</td>
<td>(0.202)</td>
</tr>
<tr>
<td>Observations</td>
<td>3,966</td>
<td>3,966</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.484</td>
<td>0.773</td>
</tr>
<tr>
<td>F-test</td>
<td>27.66(0.000)</td>
<td>510.3(0.000)</td>
</tr>
<tr>
<td>Breusch-Pagan test</td>
<td>2404</td>
<td></td>
</tr>
<tr>
<td>Number of Firms</td>
<td>231</td>
<td>231</td>
</tr>
<tr>
<td>Hansen test</td>
<td>8.404(0.079)</td>
<td></td>
</tr>
<tr>
<td>m1</td>
<td>-5.998</td>
<td></td>
</tr>
<tr>
<td>m2</td>
<td>-0.00764</td>
<td></td>
</tr>
<tr>
<td>Instruments</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed to \(\chi^2\) under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residual, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. Full results with location dummies included are available on request from the author. All macroeconomic variables are tested in levels.

*** significant at 1%, ** significant at 5%, * significant at 10%
Table A 23 Determinants of Turnover Growth in Medium-sized and Large Services Firms, 2001-2007

<table>
<thead>
<tr>
<th>Variable</th>
<th>MEDIUM</th>
<th>LARGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>FE</td>
</tr>
<tr>
<td><strong>LOG TURNOVER</strong> ( t-1 )</td>
<td>-0.360***</td>
<td>-0.921***</td>
</tr>
<tr>
<td>(LOG TURNOVER) ( t-1 )²</td>
<td>0.042***</td>
<td>0.088***</td>
</tr>
<tr>
<td><strong>LOG LABOUR PRODUCTIVITY</strong> ( t-1 )</td>
<td>-0.060***</td>
<td>-0.037***</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.255***</td>
<td>0.004</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>0.000</td>
<td>-0.000***</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.029***</td>
<td>-0.028</td>
</tr>
<tr>
<td>LOCATION</td>
<td>-0.007</td>
<td>-0.005</td>
</tr>
<tr>
<td>EXPORT</td>
<td>0.037</td>
<td>0.007</td>
</tr>
<tr>
<td>IMPORT</td>
<td>0.046***</td>
<td>0.006</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>0.056***</td>
<td>0.025**</td>
</tr>
<tr>
<td>TRAINING</td>
<td>0.031**</td>
<td>0.006</td>
</tr>
<tr>
<td>GDP</td>
<td>0.001</td>
<td>-0.000</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>0.326**</td>
<td>0.125</td>
</tr>
<tr>
<td>INFLATION</td>
<td>0.060**</td>
<td>0.068</td>
</tr>
<tr>
<td>REAL EFFECTIVE EXCHANGE RATE</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>CREDIT</td>
<td>0.000</td>
<td>0.000***</td>
</tr>
<tr>
<td>Constant</td>
<td>0.769</td>
<td>1.615**</td>
</tr>
<tr>
<td>Observations</td>
<td>1.920</td>
<td>1.920</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.405</td>
<td>0.897</td>
</tr>
<tr>
<td>F-test</td>
<td>11.10(0.000)</td>
<td>918.8(0.000)</td>
</tr>
</tbody>
</table>

Note: Robust standard errors are in parentheses. Hansen is a test of over-identifying restrictions asymptotically distributed as \( \chi^2 \) under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as \( N(0,1) \) under the null of no serial correlation. Values in parentheses represent the p values for the F test and Hansen test. All macroeconomic variables are tested in levels.
### Table A 24 Determinants of Turnover Growth in Medium-sized and Large Services Firms, 2005-2007

#### Turnover Growth

<table>
<thead>
<tr>
<th></th>
<th>MEDIUM</th>
<th>LARGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>FE</td>
</tr>
<tr>
<td>LOG TURNOVER(_{t-1})</td>
<td>-0.369**</td>
<td>-1.001***</td>
</tr>
<tr>
<td></td>
<td>(0.054)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>(LOG TURNOVER(_{t-1}))^2</td>
<td>0.043***</td>
<td>0.098***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>LOG LABOUR PRODUCTIVITY(_{t-1})</td>
<td>-0.053***</td>
<td>-0.033**</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>INDUSTRY GROWTH</td>
<td>0.337***</td>
<td>-0.037</td>
</tr>
<tr>
<td></td>
<td>(0.095)</td>
<td>(0.038)</td>
</tr>
<tr>
<td>INDUSTRY MINIMUM EFFICIENT SCALE</td>
<td>0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>NATIONALITY OF OWNERSHIP</td>
<td>-0.040**</td>
<td>-0.039*</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>LOCATION</td>
<td>-0.018</td>
<td>0.021</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.042)</td>
</tr>
<tr>
<td>EXPORT</td>
<td>0.061**</td>
<td>0.018</td>
</tr>
<tr>
<td></td>
<td>(0.028)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>IMPORT</td>
<td>0.033**</td>
<td>0.008</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>EXPORT-IMPORT</td>
<td>0.050**</td>
<td>-0.022</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>TRAINING</td>
<td>0.023</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>SUBSIDIES</td>
<td>0.064*</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>0.047*</td>
<td>-0.029</td>
</tr>
<tr>
<td></td>
<td>(0.027)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>R &amp; D INTENSITY</td>
<td>-0.001</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>R &amp; D SPEND</td>
<td>-0.052</td>
<td>0.014</td>
</tr>
<tr>
<td></td>
<td>(0.041)</td>
<td>(0.029)</td>
</tr>
<tr>
<td>GDP</td>
<td>0.038</td>
<td>0.010</td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>UNEMPLOYMENT</td>
<td>0.155</td>
<td>0.306</td>
</tr>
<tr>
<td></td>
<td>(0.121)</td>
<td>(0.522)</td>
</tr>
</tbody>
</table>

**Real effective exchange rate**

-0.001** | -0.000 | 0.000 | -0.000

- (0.000) | (0.000) | (0.001) | (0.000)

**Credit**

-0.002** | 0.000 | -0.001 | 0.000

- (0.001) | (0.000) | (0.002) | (0.001)

**Constant**

0.425** | 2.237*** | -0.213 | 2.681*** | 3.114*** | 1.575

- (0.189) | (0.099) | (0.573) | (0.549) | (0.108) | (1.892)

**Observations**

960 | 960 | 960 | 171 | 171 | 171

**R-squared**

0.397 | 0.924 | 0.701 | 0.990

**F-test**

6.176(0.000) | 473.3(0.000) | 4.135(0.000) | 3.649(0.000) | 712.5(0.000) | 6.246(0.000)

**Breusch-Pagan test**

187.9 | 5.065

**Number of Firms**

320 | 320 | 57 | 57

**Hansen test**

2.500(0.475) | 1.957(0.581)

**m1**

-2.342 | -1.049

**Instruments**

21 | 21

*** significant at 1%, ** significant at 5%, * significant at 10%

Note: Robust standard errors are in parentheses. Hansen's a test of over-identifying restrictions asymptotically distributed as χ² under the null of instrument validity with p-values reported in parentheses. m1 and m2 are the tests for first and second order serial correlation in the first-differenced residuals, asymptotically distributed as N(0, 1) under the null of no serial correlation. Values in parentheses represent the p-values for the F test and Hansen test. All macroeconomic variables are tested in levels.
Appendix B: Sample Stata Syntax

(1) Turnover Growth Estimation model

xtabond2 T URNGRWTH L.LGTURNOVER T URNOVER21 .LGLABPROD _IINDUSTRY* IND_GROWTH1ND_MES FOREIGN _ILOCATION* _ITRADE* TRAIN S UBSIDISED _INOVA _ION R ANDDSPEND GDP1 UNE MP_RATE1 INFLATION1 R EER C REDIT, gmm(RANDD_INTENSITY, c1 lag(1 3)) iL.LGTURNOVER EM2 L.LGLABPROD _IINDUSTRY* IND_GROWTH IND_MES FOREIGN _ILOCATION* _ITRADE* TRAIN S UBSIDISED INNOVATION RANDDSPEND GDP 1 UNE MP_RATE1 INFLATION1 R EER C REDIT, eq(level)) twostep robust small artest(2)

(2) Persistence of Growth Estimations:

(1) xtabond2 EMPGRWTH L.EMPGRWTHL2.EMPGRWTH, gmm(L.LGEMP, c lag(2 .)) twostep robust small nodiffs argan artest(2)

(2) xtabond2 T URNGRWTH L.TURNGRWTHL2 TURNGRWTH, gmm(L.LGTURNOVER, c lag (2 4)) twostep robust small nodiffs argan artest(2)