UNIVERSITY OF LIMERICK

Financial Development, Crises, and Recovery in Small Open Economies

by

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in the Kemmy Business School
Department of Economics

November 21, 2016
Declaration of Authorship

I, Hamid Raza, declare that this thesis titled, ‘Financial Development, Crises, and Recovery in Small Open Economies’ and the work presented in it are my own. I confirm that:

- This work was done wholly while in candidature for a Ph.D degree at this University.
- Where any part of this thesis has previously been published or submitted to a journal, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself or jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

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Date: November 21, 2016
This study contributes to the existing literature on financial development, crises, and recovery in small open economies. In this dissertation, we use Iceland as an example of a small open economy with a sovereign currency and compare it with Ireland and other periphery countries from the EMU. We critically examine the developments that preceded the crises in Iceland and Ireland with an emphasis on the role of capital inflows. We then empirically investigate the recovery pattern in Iceland and other peripheral countries. Our findings can be summarised as follows. The process of financial development and its interaction with the real sector in Iceland and Ireland greatly differ primarily due to their exchange rate regimes amongst other things. Comparing the two countries, we find that the adjustment following a sudden stop to a capital inflow was faster in Iceland but the collapse more serious. In particular, the current account adjustment was the result of real exchange rate depreciations and domestic demand compression. For Ireland and other members of the euro zone, the adjustment process is much slower. The adjustment in the current account has been the result of domestic demand compression in these countries, which have resulted in long-lasting recessions, deflation and high unemployment in Ireland, as well as in Italy, Portugal and Spain. Moreover, our findings suggest that the role of capital controls combined with financial restructuring was crucial in the post-crisis period in Iceland. Finally, we present a macroeconomic framework in order to understand the process of crisis and recovery in small open economies. We demonstrate the generation of financial crisis and the subsequent adjustment process in a sovereign currency regime through the use of simulations.
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Abbreviations

ADF  Augmented Dicky– Fuller
AMECO  Annual Macro-economic
ARDL  Auto–Regressive Distributive Lag Model
CA  Current Account
CAB  Current Account Balance
CBI  Central Bank of Iceland
CBL  Central Banks of Luxembourg
CDS  Credit Default Swap
CUSUM  Cumulative Sum
DOLS  Dynamics Ordinary Least Square
DIGF  Deposit Insurance Guarantee Fund
DSGE  Dynamic Stochastic General Equilibrium
EEA  European Economic Area
EG  Engle–Granger
EMS  European Monetary System
EMTN  Euro Medium–Term Notes
EMU  European Monetary Union
ESCB  European System of Central Banks
EU  European Union
FDI  Foreign Direct Investment
FEVD  Forecast Error Variance Decomposition
FMOLS  Fully Modified Ordinary Least Square
FSA  Financial Supervisory Authority
FX  Foreign Exchange
GBP  Great British Pound
GDP  Gross Domestic Product
HAC  Heteroskedasticity and Autocorrelation Consistent
IO  Innovational Outlier
### Abbreviations

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<td>ISK</td>
<td>Icelandic Krona</td>
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<td>NFC</td>
<td>Non-Financial Corporation</td>
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<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<td>OI</td>
<td>Other Investment</td>
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<td>PFI</td>
<td>Portfolio Investment</td>
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<td>PP</td>
<td>Philips–Perron</td>
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<td>SFC</td>
<td>Stock–FlowConsistent</td>
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<td>SIC</td>
<td>Special Investigation Commission</td>
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<td>SVAR</td>
<td>Structural Vector Auto Regression</td>
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<td>USMTN</td>
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<td>VAR</td>
<td>Vector Auto Regression</td>
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Symbols

CHAPTER 3

Credit  Financialisation proxy: Private credit to GDP
FDEV  Financialisation proxy: M3 to GDP
FDL  Financialisation proxy: Deposit liabilities to GDP
HHD  Household debt to GDP
INV  Foreign investment returns to GDP
Trade  Trade openness (imports + exports) to GDP
T  Time trend
Wage  Wage share

CHAPTER 4

A  Total factor productivity
AT  Productivity of tradable sector
AN  Productivity of non–tradables
C  Total consumption
CT  Consumption of tradables
CN  Consumption of non–tradables
CAB  Current account balance
D  Domestic demand
e  Nominal exchange rate
F  Total capital inflows
FT  Share of inflows invested in tradables
FN  Share of inflows invested in non–tradables
I  Gross fixed capital formation
K  Total capital
KT  Capital allocated in the production of tradables
KN  Capital allocated in the production of non–tradables
M  Volume of imports
\[ P^* \] Price of imports
\[ P \] Price of exports
\[ r \] Interest rate
\[ r_{xx} \] Real exchange rate
\[ X \] Volume of exports
\[ Y^T \] Production of tradables
\[ Y^N \] Production of non–tradables
\[ Y \] Total production

**CHAPTER 5**

\[ I \] Gross fixed capital formation to GDP
\[ S \] National savings to GDP
\[ S^+ \] Positive changes in national savings to GDP
\[ S^- \] Negative changes in national savings to GDP

**CHAPTER 6**

\[ B_{h,ice,d} \] Demand for Icelandic bills by Icelandic households
\[ B_{h,eu,d} \] Demand for EU bills by Icelandic households
\[ B_{h,eu,d}^{eu} \] Demand for EU bills by EU households
\[ B_{ice,d}^{eu} \] Demand for Icelandic bills by EU households
\[ B_{ice,s} \] Bills supplied by Icelandic banks
\[ B_{eu}^{b,us} \] Icelandic bills held by foreign banks
\[ B_{ice}^s \] Total bills issued by Iceland
\[ CAB_{ice} \] Current account balance
\[ C_{ice} \] Nominal consumption
\[ CK_{ice} \] Real consumption
\[ D_{h,ice,d}^{d} \] Demand for deposits in Icelandic domestic banks by Icelandic households
\[ D_{h,eu,d}^{d} \] Demand for deposits in EU banks by EU households
\[ D_{ice,d}^{d} \] Demand for deposits in Icelandic banks by EU households
\[ D_{ice}^d \] Total demand for deposits in Icelandic banking system
\[ dxre^{eu} \] changes in exchange rate expectations
\[ F \] Gross capital inflows
\[ F_{ice}^{f} \] Profit of the firms
\[ F_{ice}^{b} \] Profit of the banks
\[ FAB_{ice} \] Financial account balance
\[ G_{ice} \] Government expenditure
\[ I_{ice} \] Nominal investment
\[ Ik_{ice} \] Real investment
\( L^d_{\text{f,ice}} \)  Total demand for loans by firms
\( L^{f,d}_{\text{f,ice}} \)  Demand for ISK denominated loans by firms
\( L^{f,eu,d}_{\text{f,ice}} \)  Demand for FX denominated loans by firms
\( L^{h,eu,d}_{\text{f,ice}} \)  Demand for FX denominated loans by households
\( L^d_{\text{f,ice}} \)  Total demand for loans in Iceland
\( L^s_{\text{f,ice}} \)  Total supply of loans
\( M_{\text{ice}} \)  Nominal imports
\( M^k_{\text{ice}} \)  Real imports
\( n_{\text{ice}} \)  Employment
\( PS_{\text{ice}} \)  Total sales price
\( PD^S_{\text{ice}} \)  Domestic sales price
\( PM_{\text{ice}} \)  Import prices
\( PX_{\text{ice}} \)  Export prices
\( PY_{\text{ice}} \)  GDP deflator
\( i^B_{\text{ice}} \)  Interest on Icelandic bills
\( i^B_{\text{eu}} \)  Interest on EU bills
\( i^L_{\text{ice}} \)  Interest on ISK denominated loans
\( i^{L,eu}_{\text{ice}} \)  Interest on FX denominated loans
\( i^{D,eu}_{\text{ice}} \)  Interest on deposits in foreign branches of Icelandic banks
\( i^D_{\text{ice}} \)  Interest on deposits in domestic branches of Icelandic banks
\( S \)  Share prices
\( x_{ru} \)  Nominal exchange rate (ISK per euro)
Chapter 1

Introduction

1.1 Financial flows and instabilities

Over the last three decades, many countries in pursuit of financial development abolished capital controls and discouraged interventions in the financial markets. Financial account openness in an environment of innovative financial markets during this period greatly facilitated access to international capital. Less emphasis was placed on the risks associated with foreign borrowing. This allowed a sizeable expansion of the financial sector relative to the real sector in small economies. The expansion of financial sector took place regardless of the prevailing currency regimes, e.g., European peripheral countries (currency union), the Baltics (fixed exchange rate), and Iceland (floating regime).

In 2007–08, the financial crisis erupted in the US sub–prime mortgage market with the bursting of housing bubble, resulting in large bankruptcies in the private sector. The wave of bankruptcies transmitted to the balance sheets of other firms and banks in other economies exposed to US markets. The effects eventually engulfed economies without a direct exposure to US markets, turning it into a full–blown global crisis. Small open economies, reliant on high leverage, experienced capital reversals, balance of payments crisis, and recessions, all resulting in high unemployment, large fiscal costs, and spending cuts on welfare.
The crisis in 2007–08 revealed two fundamental but interrelated weaknesses in small open economies. First, it revealed the lack of resilience in these economies to withstand the effects of global shocks. Second, it exposed the destabilising effects of financial flows in their systems which had largely been ignored before the crisis.

After the crisis, large financial flows relative to the size of the economy, and their effects on growth and stability have become a central debate in macroeconomics. This, however, is one of the most controversial and least understood issues as described by Eichengreen (2004). Small economies benefited from globalisation and the resultant international capital flows, but this also posed a serious challenge to the policy makers essentially due to loss of monetary control, loss of competitiveness, and vulnerability to external shocks. The challenges posed to policy makers by globalisation are well described in the political trilemma of world economy by Rodrik (2000).

The trilemma presented in figure shows that economic integration, nation state, and democratic politics are simultaneously incompatible, and thus only a combination of the two at a time can be chosen by a country.

If a country wants to pursue the goal of full economic integration, it has to choose between democratic politics or nation–state. Combining full economic integration

---

1See, for example, Obstfeld (2012); Krugman (2014a).
2Rodrik’s trilemma can be considered as an extension of the standard open economy trilemma also known as the “impossible trinity”.

---
with nation–state, to what Friedman (1999) calls putting on a ‘golden straitjacket’, is to sacrifice democratic politics in the interest of global markets. This will reduce the influence of national politics and considerably restrict economic policy choices at national levels. Combining true economic integration with democratic politics requires global federalism. This would involve relocating the politics to a larger scale, i.e., aligning global markets with the global politics. Finally, a country can maintain nation state and democratic politics by limiting economic integration as was the case during Bretton Woods–GATT regime.

The surge in cross–border financial flows linked to economic integration and the subsequent decline generating economic instabilities is not unique to the recent episode of 2007–08. The asset boom fuelled by capital inflows can be traced back to the Railway Mania in Britain in 1840s, ending with a banking crisis and severe economic recession in 1847 (Bordo and Landon-Lane, 2013). While the past experiences of booms and busts share many similarities, they also have vital differences. These differences provide important lessons for policy makers to design better policies and regulations.

In the past 140 years, the surges in global capital flows can broadly be divided into five major episodes.\(^3\)

- The first episode, 1870–1913, is characterised by a boom in bond financing from advanced economies to the regions of recent settlement with abundant resources and scarce labour. The investors preferred fixed income debt instruments while FDI share was small.

- The second episode, from the post–WWI to the Great depression, is marked by a large investment in government bonds. The governments heavily borrowed to finance public expenditures.\(^4\)

\(^3\)See Bordo and Landon-Lane (2013) for a discussion on historical perspective of asset prices, booms and busts. Also see Accominotti and Eichengreen (2015) on the history of capital inflows and reversals in Europe.

\(^4\)During these two episodes, credit was volatile but remained stable relative to the size of the economy in the long–run. The only exception is the Great Depression of 1930s during which credit relative to the size of economy collapsed (Schularick and Taylor, 2009).
• The third episode of surges in capital flows from 1973 to 1981 was driven by oil price shocks. The flows, however, were dominated by bank lending to finance the balance of payments in developing countries, while the share of debt instruments remained low.

• Fourth episode, 1993–1997, marks the surge in capital flows to the private borrowers in emerging markets. The composition of capital flows in this episode greatly changed with the rise in FDI share along with investments in bonds and equities, while the share of bank lending was low. On the borrowing end, the share of private sector debt dramatically increased.

• Fifth, the recent episode of 2000s with increased short–term inflows in several financial instruments as will be discussed.

The recent crisis in its build–up and aftermath shares several commonalities with the past episodes. In all major episodes of capital booms, real output growth was accompanied by asset price booms and strong growth in international investment and trade. All episodes were eventually followed by a burst, causing currency crisis, financial instabilities, and real output losses in the capital borrowing economies. In most country–specific cases, the underlying factor triggering the crisis has been an abrupt stop of inflows, beyond the control of the recipient economy.\(^5\)

There are, however, striking differences between the boom–bust in 2008 and other historical events. The international financial markets have become more strongly integrated than ever, due to growth in technology. Consequently, financial events have become more contagious, making it almost impossible for small open economies to prevent themselves from adverse global shocks. The heterogeneous composition of inflows has made the determinants of these inflows more complex. Investors’ preferences have greatly shifted towards short–term profits. The scale and scope of financial activities has significantly increased with securitisation, and the subsequent introduction of new financial instruments, e.g. Credit

\(^5\)The only exceptions highlighted in the literature are the Chile (1990–91) and Malaysia (1993–94) where sudden stops were preceded by voluntary implementation of restrictions on short–term inflows (Calvo and Reinhart, 1999).
Default Swaps (CDS). As a result, the link between financial sector and real economy has become stronger and more complex.\(^6\) In recent capital booms, many economies experienced high levels of financial sector growth relative to real economy, reaching levels never experienced before on the available statistics. This resulted in an extremely heavy reliance on finance-led growth.\(^7\) The impact of the crisis on real economy in 2008 was also the most severe since the Great Depression. The average output loss as a result of the recent crisis, reported by Laeven and Valencia (2010), is 25 percent as compared to a historical average of 20 percent estimated for past crises.

The recent experience of the crisis-hit countries clearly suggests that a very large financial sector amplified by large financial inflows is potentially destabilising as it is more vulnerable to external shocks. The close nexus between financial and real sector implies that problems in the balance sheet of financial sector (e.g., banking sector) can easily permeate into other sectors (e.g., firms and households) of the economy. The experience of Iceland with a floating currency and Ireland as a member of the currency union in this regard is largely similar to other crisis-hit economies, but nonetheless provides an excellent testing ground due to their exceptional financial and real sector growth, and their post-crisis dynamics. Both countries were widely believed to have successfully turned globalisation to their advantage, benefiting from large financial flows. Few countries witnessed as rapid a growth of the financial and real sector as Ireland and Iceland in such a short period, and few countries had to suffer the full consequences of a financial meltdown as directly.

Iceland and Ireland, as very small and very open economies, experienced large financial flows mainly due to low risk premia and high liquidity in international markets. The mechanism of international borrowing differed in the two countries.

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\(^6\) The macroeconomic costs and benefits associated with such financial instruments are not entirely clear. Kregel (2008) explains how securitisation in the financial markets contributed to the recent financial crisis.

\(^7\) The term finance-led (finance-dominated) or debt-led is used in this study to highlight that increases in financial activities (financialisation) are shaping the aggregate demand patterns and its volatility in open economies.
The policy of low interest rates in the Eurozone allowed Ireland to internationally borrow in its own currency at lower costs, while bearing zero exchange rate risk. Iceland after gaining access to international markets benefited from sovereign credit rating (AAA). Iceland in the early 2000s borrowed by issuing fixed income securities in the international market and later in 2006–07 by offering higher interest rates on its international deposits. The increasing size of banks’ balance sheets and high debt burden was unsustainable and eventually led to the crisis.

Large financial inflows had a strong impact on the real sectors of these economies. Both countries before the crisis experienced high economic growth combined with low levels of unemployment and inflation. Large inflows had a negative impact on the net exports, but this negative effect on economic growth was offset by domestic demand boom. Thus, the investment–led growth in Iceland and Ireland was accompanied by large current account deficits, which had largely been ignored before the crisis.

As financial development, induced by capital inflows, was an essential driver of economic growth in Iceland and Ireland, the eruption of the global crisis too had serious consequences for their economies. The crisis from the financial sector in Iceland and Ireland quickly spread to their real sectors, resulting in the balance of payments crisis, recessions, and soaring unemployment. Iceland in addition faced a currency crisis and a strong pass through to domestic prices resulting in high inflation.

The two countries responded differently to the crisis, mainly because of their institutional setups and different currency regimes as will be discussed in detail in Chapter 2. Iceland’s banks collapsed because of a lack of a lender of last resort while the Irish banks received sufficient liquidity support to survive. The prevailing situation at the time forced Iceland to follow a more heterodox approach along with conventional fiscal consolidation to counter the crisis. Capital controls were imposed to prevent further depreciation of the currency. Ireland’s membership of a currency union tightly bound it to follow a more conventional approach of banks
bailout, austerity measures and internal devaluation, resulting in a sovereign debt crisis.

### 1.2 Crisis recovery and rebalancing approach

The real and financial crisis in 2008 revealed several shortcomings and limitations of the conventional macroeconomic paradigms, focusing on supply side. The corresponding policy implications have set countries on different paths coming at different social and political costs. Many economies such as the countries of the European Periphery and the Baltic states, faced greater challenges in their recovery process.

Since the onset of the crisis, an interesting scenario developed with regards to the recovery of small open economies, mainly due to their exchange rate regimes and economic policies during the crisis and onwards. Iceland and Ireland operating under different currency regimes are two appropriate examples in this regard. The different institutional setup and post-crisis policies of the two countries led them to a different recovery pattern. The Irish and Icelandic recoveries from the crisis are generally portrayed as success stories. Both countries have experienced positive economic growth, current account adjustments, and reductions in unemployment. But their contrasting policy choices and respective recovery paths are still an open debate. At the same time, the policy consequences in some countries (e.g., Greece) have made the recovery debate more controversial. The post-crisis scenario puzzled many economists and also revealed a large divergence between policy makers and academics.

The conventional policy focused on the saving–investment gap as an explanation of the large financial flows, and the subsequent current account imbalances.\(^8\) Likewise, the rebalancing approach focused on reducing the saving–investment gap and

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\(^8\)This is represented by the following identity: \(NX = (S-I) + (T-G)\). NX stands for net exports, S represent national savings, I represents investment, G represents government expenditure, and T represents tax revenue.
adopting fiscal consolidation measures. Structural reforms, calling for internal devaluation in order to improve competitiveness, are implemented in the crisis–hit countries of the eurozone. The implementation of these reforms backfired not because of the current accounts imbalances but because of the large reduction in economic growth.

The rebalancing approach in the currency union places the entire adjustment burden on the deficit countries. The policy of increased competitiveness might be crucial in the long–run but its implementation as an immediate response to the crisis, in the absence of short–run adjusting mechanism, has resulted in the slowdown of overall economic activities, resulting in high unemployment.

The only exception where such reforms are believed to have been effective is Ireland. But these claims have been the subject of intense debate. Linking the Irish recovery to the implementation of structural reforms has been questioned on several grounds by many academics, as will also be discussed in this study. Contrary to the Irish recovery path is the case of a sovereign currency regime in Iceland, where the domestic demand restored relatively faster than in other crisis-hit countries. In general, the Icelandic economy had to face less severe impacts of the crisis, reflected in its sharp current account adjustment, low unemployment, and positive economic growth since 2010–11.

While the crisis build–up in Iceland and Ireland has received considerable attention in the literature, the discussion of their post–crisis situations is only confined to journalistic claims from a few leading economists. The general impression emerging from the existing literature so far is that the two small open economies followed a similar path to the crisis.9 Regarding the post–crisis period, there seems to be agreement on the recovery path of Iceland being successful than Ireland and other eurozone countries. This, however, is a matter of in–depth investigation of the two economies, which also forms the basis of our study.

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9Several studies draw a comparison between Iceland and Ireland by highlighting similarities in terms of their banks’ size, external debt, speculative inflows, and unsustainable demand patterns in the build–up phase of the crisis (see, e.g., Christensen (2011), (Howden, 2014, p.423), Zeissler et al. (2014)).
1.3 Philosophical approach

Macroeconomic studies aim to explain macroeconomic realities, and models attempt to demonstrate these realities in simplified frameworks in order to provide useful guidance to policy makers. Macroeconomics is not a simple aggregation of microeconomic fundamentals. The interplay between the two is a complex phenomenon. It is, however, vital for macroeconomic frameworks not to defy microeconomic intuition.

It is essential to discuss the philosophical approach and clarify the methodological foundations before presenting any framework. First, determining the ontology of any research methodology is important to know in which cases the methodology can be effectively applied. It is therefore equally important to understand the subject of analysis to which the research methodology will be applied. For instance, the methodologies used to study real business cycles might not be appropriate to study financial cycles. Second, understanding the ontological prior is vital for an appropriate interpretation and derivation of useful knowledge from any analysis (Lawson, 2007).

Given the aim of macroeconomic analysis is to provide policy recommendations, the relevant theory cannot be valid if it rests on unrealistic hypotheses regardless of whether the outcome is able to reflect stylised facts or not. Every economic model will to a certain degree be affected by loss of realism, if it’s a model. But it is important to base the model on assumptions that are not descriptively false. The concepts in the model should correspond with the data. This will allow to establish a connection between analytical frameworks and reality. According to (Lavoie, 2014, p.13),

“The structure of a model cannot be built on foundations describing an imaginary or idealized economy. What is needed is an abstraction, not a fiction.”
Macroeconomics studies are subject to two fundamental uncertainties namely, ontological and epistemological (or epistemic) uncertainty. Ontological uncertainty simply refers to the notion that future cannot be known and yet to be created. Epistemic uncertainty refers to our limited understanding due to lack of information and knowledge or the inability to exploit information when available.

There is an element of partial uncertainty in the future due to innovations in the economy, or due to decisions and responses of agents during certain events that can likely affect the future course of the economy. The behaviours of economic fundamentals are partially uncertain and they have a tendency to change over time, yet they still are affected by previous events up to a certain degree. Our view in this regard is that the decisions in economic world are partially non–ergodic. The outcomes of these decisions have an element of similarity to the past experience but at the same time retain some unique characteristics of their own. For example, speculation in the financial markets is partially ergodic. The process is repetitive but the introduction of new financial instruments for speculation makes it look different than the previous instances. While the instruments of speculation might differ, the consequences of speculation to a larger degree remain the same, i.e., it inflates asset prices. It is in this context that we see the use of empirical models essential for conceptualising demi–regularities in economic processes and detecting any emerging patterns.

However, macroeconomic data as well as estimation techniques are subject to uncertainty. Economists, for example, have traditionally used simple Ordinary Least Square (OLS) methods to study relationships, but advancements in econometrics have shown that without studying properties of the data, a researcher can easily conclude spurious relationships. Similarly, recent advancements in computer programs have enabled economists to design better analytical frameworks and incorporate complex economic phenomena in their analysis through algorithms.

The above discussion on uncertainties in macroeconomic studies implies that ontological uncertainty will perhaps partially remain there but epistemic uncertainty, with the introduction of new tools and designs, can be reduced if not eliminated.
This study adopts a mixed-method approach, in which elements of deductive and inductive methods are combined, known as the retroductive approach. In contrast to other research strategies such as deduction or induction, retroduction does not simply develop specific claims from general premises nor general claims from specific premises, but combines research methods on pragmatic grounds which better suits the nature of inquiry. The methodology, however, requires ‘triangulation’ of research methods, which can combine research contributions in an attempt to transcend the use of specific methods in a discipline (Downward and Mearman, 2007). Central to this approach is the interplay of theory and data (Ragin, 1994).

The focal point of this study is the macroeconomic system as a whole rather than the direct actions of individuals in an economy. The purpose of the empirical part of the thesis is to investigate the interaction between macroeconomic variables of interest as will be discussed in each chapter. The goal of theoretical framework is to integrate macroeconomic dimensions and analyse them in one framework.

In empirical models, reality is simplified and the analyses are confined to a few central macro variables that reflect the overview of the economy such as the national income, balance of payments, private debt, etc. We detect patterns in the data and attempt to establish tendencies using statistical exercises. The method is dynamic in which changing economic phenomena are analysed on the basis of these patterns in the data. We place more weight on explanation rather than in predictions. Our explanation in this case is not fundamentally causal but an attempt to provide a plausible interpretation and develop a profound understanding of past economic events. In statistical terms, we make a clear distinction between causation and correlation. In our explanations of economic phenomenon, we go beyond the supply and demand forces and attempt to discuss the mechanisms which are not directly observable, when testing our hypotheses.\(^\text{10}\) We draw our

\(^{10}\)A retroductive approach implies that researchers attempt to explain conditions which are not directly observable (Ryan et al., 2012). This feature makes our approach different than logical positivism or empiricism. See Downward and Mearman (2007) and chapter 2 of Jespersen (2011) for a detailed discussion on the difference between reproductive approach and other methodologies.
conclusions on the basis of these explanations and propose appropriate policy measures for future reference. Our analyses will always be conditional and open for improvement.

“Realisticness”, if not realism, in the assumptions is crucial to our theoretical approach. The theoretical framework is based on a comprehensive framework of the economy. Unlike the empirical models, the theoretical approach does not consider macroeconomic behaviours in isolation, i.e., we view the economy as a nexus of economic behaviours of different sectors which are strongly interlinked. The variables in our framework are clearly consistent with the standard definitions of the data and the economic behaviours are therefore empirically testable upon the availability of the data. The approach is dynamic where changing economic phenomena in the form of regime shifts are analysed by introducing shocks in certain periods. We then perform an econometric exercise on several key aspects of our model to test whether the established tendencies in our analytical framework are revealed in the actual data. The econometric exercise serves as a bridge between our theoretical framework and reality.

1.4 Conceptual framework

The link between real and financial sector in small open economies is central to this study in the wake of the recent financial and real crisis. In order to understand this relationship, it is essential to understand both the process of financial development itself and the destabilising features incorporated in this relationship. There are several challenges in this due to the complexities stemming from both the measures of financial development itself and the framework in which they are analysed as will be discussed.

The channels through which large financial flows promote financial and real sectors can broadly be divided into two frameworks as follows.
First, the well-established framework, linked to the ideas of neoclassicals, argues that financial account openness facilitates an efficient allocation of resources. Capital inflows in the standard neoclassical models can boost economic growth by enhancing total factor productivity and capital accumulation (Gourinchas and Jeanne, 2006). This framework, based on loanable funds theory, emphasises the role of increasing capital inflows to promote financial development and focus on the supply side of economic growth.\footnote{See, for example, (Acemoglu, 2008) for an explanation of neoclassical growth models.} For example, traditionally inflows in the form of FDI are considered an important determinant of long-term economic growth. FDI is associated with increasing productivity through new technology, which eventually will increase the production capacity. As a result economies, which initially borrowed, can repay their debt and also experience economic growth in the long-run. In this framework, inflows in the long-run enable the borrowers to ultimately experience export-led growth. The sudden stop, however, will lower the productivity of capital stock, resulting in real sector crisis. In this explanation, the transmission channel explaining the effect of capital inflows on real economy ignores the role of financial sector instabilities. Using this lens to analyse the link between financial and real sector ignores any instability in this nexus but rather highlights the positive relationship between the two. The empirical models based on this framework provided partial support to financial liberalisation and capital account openness before the crisis.

The second framework, linked to the post-Keynesians, is inspired by the ideas of John Maynard Keynes and Michal Kalecki. This framework, while linking financial and real sector, realises the instabilities incorporated in the pattern of capital inflows. It focuses on the demand side of economic growth in which the capital inflows into small open economies are seen as a drain on increasing the components of domestic demand.\footnote{See (Deprez and Harvey, 1999, p.45)} Hence, capital inflows increase economic growth through the channel of domestic demand. The resultant domestic demand boom is unsustainable without an external source of financing. Sudden stops will directly affect domestic demand, causing economic contractions.
In particular, small economies operating under sovereign currency regimes are more reactive and vulnerable to these inflows primarily due to currency risk premiums. The artificial rise in real wages due to overvaluation results in an increase in the consumption of tradable goods, creating large trade deficits. But the negative effect of trade balance on economic growth is generally offset by an increase in the domestic demand. Many small open economies from traditionally long-run export-led growth have shifted towards short-run finance-led growth.

The developments in theories and models focused on supply side interpretation could not keep pace with the innovations in the markets. The growth transition from traditionally export-led to finance-led in deficit countries did not receive considerable attention. This resulted in the deviations of macroeconomic paradigms from reality to a certain degree. The recent financial and real crisis, however, has revived interest in re-examining the link between finance and real economy.

Finance in the last two decades has proven to be a double-edged sword. Many small economies in the past have benefited from FDI inflows. But the share of FDI in total inflows has significantly fallen. The inflow stream has recently been dominated by short-term speculative inflows, which are destabilising due to their fleeting relationship with the recipient economy.

The increased level of short-term but persistent financing has increased the purchasing power of small open economies. Capital inflows in many small open economies, regardless of their currency regimes, created domestic demand booms due to an increase in debt-led consumption, wage spirals, and domestic investment booms. These inflows also speculated on the asset prices creating a stock market boom, which in turn had a strong wealth effect on economic growth. This scenario resulted in overheating of the economies.

However, excessive external borrowing eventually created unsustainable debt dynamics, resulting in sudden stops of one kind or another. The sudden stop of capital resulted in the balance of payments crisis, and recessions caused by domestic demand compressions. Many small developed economies recently suffered
from a lack of effective demand, and not from a lack of production capacity in the economy.

The conceptual framework of our analysis is presented in Figure 1.2. The framework is built around the link between real and financial sector in two small open economies with sovereign currency (left) and currency union (right). Our analysis highlights two regimes; the period preceding 2007–08 crisis, and and the post crisis period. These two regimes are linked through policy response during the crisis and onwards.

The conceptual map clearly highlights the link between real and financial sector under different currency regimes. Small open economies with different currency regimes and institutional setups share large similarities in the process of financial development ending with sudden stops. However, the differences in currency regimes can come into play during the crisis and onwards. The designed conceptual map mainly characterises the scenarios of recent financial crisis as is also the focus of this study, but these sequential events also largely hold for other historical financial crises as discussed above.

At the heart of our analysis, there are four sequential economic scenarios. The first scenario is the process of financial development induced by financial inflows. The resultant financial development is strongly linked to real economic development regardless of currency regime. The process of financial development through financial inflows in sovereign currency (floating) results in currency appreciation whereas the currency will remain stable in a monetary union. Large currency appreciation in sovereign regime will result in large trade deficits. The trade deficit in the case of currency union can only be due to income elasticity of imports, i.e., a rise in the income induces the demand for imports with no currency risk involved in trade.
The process of financial development is subsequently followed by a crisis due to sudden stops for one reason or another as discussed earlier. The crisis situation requires immediate response from the policy makers. The institutional setup of the currency union requires countries to implement conventional policies of bank bailouts and structural reforms. The policy makers emphasise fiscal consolidation and adjustments of external imbalances through internal devaluation as is currently the case in eurozone. In the post-crisis phase, currency union can experience current account adjustment due to internal devaluation at the cost of domestic demand compression which can result in high unemployment. Sovereign
currency regime has the option of autonomous financial restructuring, capital controls and external devaluation to rebalance its balance of payments and recover from the crisis. The financial sector restructuring\textsuperscript{13} can protect the compression of domestic demand, which can also restore employment.

In order to explore the link between real and financial sector in different currency regimes, this thesis develops both a theoretical and an empirical framework. In general, the approach, inspired by the post–Keynesian literature, focuses on the destabilising features of finance–led growth as will be discussed in great detail. This study mostly focuses on the demand aspects of economic growth, hence the finance–led growth in our analyses is demand oriented.

Appropriate understanding of the link between financial and real sector is essential for adopting correct marcorpudential regulations which will ensure a robust financial system. These measures will minimise risks in the economy and ensure stability of the financial system.

Given the history of recurrent financial crises, there are reasons that none of the measures will guarantee a prevention of the crisis in small open economies. There might be situations where the effects of crisis are inevitable and adverse global shocks will eventually propagate in the economy. In such circumstances, a good understanding of the interaction between real and financial sector is extremely crucial. This will enable policy makers to react to early signs and take preventive measures when the destabilising forces are gaining momentum, i.e., more proactive policy response to changing scenarios. Iceland, for example, experienced signs of the crisis in 2006 but did not make significant adjustments to reduce the fragility of its financial sector but instead came up with a different strategy to borrow internationally as will be discussed in Chapter 2. A timely response will reduce the effects of the crisis and reduce contagious effects. This will reduce, if not eliminate, output and welfare loss during the crisis.

\textsuperscript{13}The process of financial restructuring requires significant debt restructuring and write–offs which also inflicts losses on the creditors. A small open economy with sovereign currency can implement such programs with complete monetary freedom as opposed to a country in a currency union, which is heavily reliant on external creditors for its monetary requirements such as Greece.
Finally, good knowledge of the nexus between real and financial sector will enable policy makers to find plausible explanations of the currently unresolved crisis, and consequently suggest appropriate solutions which can put countries on the track of stable growth. In this regard, understanding the policy tools available to different economies is extremely crucial such as the use of capital controls in a sovereign regime or the fiscal policy tools in a currency union. While the pros and cons of these police choices and the political circumstances influencing them are not straight forward, their analyses based on a natural experiment, as conducted in this study for Iceland and Ireland, can provide useful explanations.

1.5 Methodology

The empirical framework in this study investigates key relationships before advancing to a theoretical framework. Our empirical models are presented in a comparative style, highlighting the similarities and differences in the dynamics of small open economies. The empirical approach has its own fundamental importance, which derives its policy recommendations on the basis of real world scenarios. The analyses are based on actual magnitudes as a consequence of data dynamics.

The methodologies for investigating the relationships are based on dynamic modelling techniques. In general, a time series approach is important to understand patterns in the data, reflecting past behaviour. The approach allows for meaningful comparison between historical events within an economy as well as between several economies. Time series models with dynamic features are an essential tool to understand the short-run and long-run relationship between the variables. We pay considerable attention to structural breaks and regime shifts in all empirical frameworks using latest econometric techniques available.

The study relies on secondary data obtained from online official databases. The types of data used in this study are time series and panel data. The data are
treated with appropriate econometric methods by testing for seasonality, deterministic trends, breaks and stationarity. The measure of financial development is not confined to single definition but is described as a scenario reflected in many variables. Likewise, there is no single variable or definition used for measuring economic recovery. We focus on the income (wages and profits) and demand components of GDP, level of employment, and the adjustment in the balance of payments as the indicators that reflect economic health of the economies.

The theoretical framework adopted in this study links the real and financial sector through accounting principles. The approach is known as the Stock–Flow Consistent (SFC) model. The theoretical framework in this thesis allows us to understand the whole economy in one framework. Unlike empirical approach, this has the advantage of designing several experiments within one framework. In this framework, the small open economy and the rest of the world are treated as two regions. All the key transactions taking place within the economy as well as with the rest of the world are reported. This makes the model consistent. The framework also describes the interconnection between the balance sheets of different sectors as will be shown in Chapter 6.

The theoretical framework is simulated to obtain a baseline scenario. The technique of simulation is essential to characterise the dynamic properties of any given theoretical model. Several experiments are then performed in order to understand the process of financial development, crisis and recovery in small open economies. The purpose of these experiments is not to estimate the magnitudes but to explain trends in the economy. The theoretical framework is then followed by real data experiments in order to judge its potential of explaining the real world scenarios.

1.6 Research questions and hypotheses

The recent episode of financial development ending with real and financial crisis in small open economies, and the policy responses resulting in different speeds of recoveries lead us to ask three important and interconnected questions.
• What are the transmission channels of financial development in small economies? In particular, how does financial development interact with the real sector under different currency regimes? The transmission channel explaining the positive relationship between financial development and economic growth is obvious but what exactly are the driving forces behind this interaction that eventually makes it unsustainable. What measures can be taken in the future to achieve a stable growth. The first hypothesis that emerges from our discussion so far is as follows:

**Hypothesis 1:** Is the interaction between financial development and real economy similar in small open economies regardless of their currency regimes?

Understanding the process of financial development, the mechanisms behind financial development and its transmission channels should provide more insights as will be discussed in more detail in Chapter 3.

• Second, what role does the currency regime directly or indirectly play in resolving the crisis? In particular, is external devaluation against internal devaluation the only advantage a sovereign currency regime has over a currency union, during the crisis? This currently is the most controversial debate both in academia and policy circles. The second hypothesis that we can formulate in this regard is as follows:

**Hypothesis 2:** Does a sovereign regime lead to a rapid crisis–recovery?

Understanding the recovery mechanisms and policy tools in different currency regimes should facilitate testing our hypothesis and provide some answers to our research questions as will be discussed in Chapter 4.

• Third, is restricting capital mobility a viable option during credit events? In particular, how does implementation of capital controls affect the relationship between domestic savings and investment after a period of free capital mobility, and what implications does it have for the economic recovery? How does the effect of recent capital controls, imposed in response to a sudden
stop, differ than the effect of capital controls that historically prevailed before the international market integration. This leads us to formulate our third and final hypothesis as follows:

**Hypothesis 3:** Is the implementation of capital controls an effective strategy in response to the crisis?

Drawing a clear distinction between different capital controls regimes and understanding the domestic saving-investment nexus should provide some valuable explanations regarding the current account adjustment and economic growth as will be discussed in Chapter 5.

This study contributes to the existing literature on financial development, crises, and recovery in small open economies. In this dissertation, we use Iceland as an example of a small open economy with a sovereign currency and compare it with Ireland and other periphery countries from the EMU. We critically examine the developments that preceded the crises in Iceland and Ireland with an emphasis on the role of capital inflows. We then empirically investigate the recovery pattern in Iceland and other periphery countries. Finally, we present a macroeconomic framework in order to understand the process of crisis and recovery in small open economies.

### 1.7 Outline of the thesis

This dissertation consists of 7 chapters. The structure of the thesis is presented in Figure 1.3. Chapter 2 deals with the history of the Icelandic economy and briefly explains how the economy has evolved over time. The section mainly focuses on the events of the financial crisis, including its build-up and aftermath. A later part of the section compares the post-crisis scenario in Iceland and Ireland.

Chapter 3 addresses our first research question. In this chapter, we develop a dynamic model of financialisation for Iceland and Ireland. We use three separate aspects of financialisation namely; financial depth, credit growth and deposit
liabilities of the financial sector, and construct auto regressive distributive lag (ARDL) models for each country and explore the dynamic relationship between financialisation and the transmission channels of financialisation as discussed in the literature on financialisation.

Figure 1.3: Structure of the thesis
Chapter 4 addresses our second research question. In this chapter, we theoretically as well as empirically discuss the dynamics of recovery patterns in Iceland and Ireland. We discuss and distinguish the adjustment mechanism in a fully sovereign regime from that in a currency union. The analyses are also extended to other periphery countries including Spain, Italy and Portugal. The chapter contributes to the ongoing debate on recovery in small open economies operating under different exchange rate regimes.

Chapter 5 deals with our third research question. In this chapter, we particularly focus on Iceland’s special case after the implementation of capital controls during the crises. After relying on international credit for almost a decade, the country now operates under capital controls. In this regard, we investigate the saving-investment relationship with a focus on regime shifts. Moreover, we extend our analyses to a panel of 16 OECD countries.

In Chapter 6 we build a Stock-Flow Consistent (SFC) model for the Icelandic economy. We investigate the role of capital inflows and identify the most important channels of balance of payment imbalances and exchange rate misalignments. Chapter 7 concludes the thesis.
Chapter 2

A tale of two economies: boom and bust in Iceland and Ireland

2.1 Introduction

An extensive experiment in economic liberalisation has been under way in Europe for over two decades, starting with the Single Market initiative in the early 1990s to the full-scale economic and financial integration of the EU and EEA countries.\(^1\) Ireland and Iceland participated in this project and took on all the legal and institutional obligations required by Iceland’s membership of the EEA and Ireland’s membership of the EU and the eurozone.

Both countries started from different initial conditions but share similarities in experiencing unprecedented growth of the financial sectors relative to the size of their economies. The size of banking sector in Iceland reached 9 times the size of its pre-crisis GDP in 2008. The size of Irish-owned banks reached almost 3.75 times its GDP in 2007 while the total banking sector, including international financial

\(^1\)The countries belonging to the European Economic Area and not to the European Union are part of the Single Market (goods, labour and capital markets) and are obliged to adopt the European Union’s regulatory and legal framework that applies to the Single Market but are not members of the European Union - do not share a common agricultural policy and do neither have the right nor the obligation to aim at euro membership. The EEA countries are Iceland, Lichtenstein and Norway.
centres, almost equalling 7.1 times the GDP of 2007. The massive financial sector growth in both countries was made possible by easy access to international credit, resulting in the accumulation of a large volume of external debt as reflected in their net international investment position (NIIP) in Figure 2.2. Heavy reliance on capital inflows made their economies vulnerable to capital flight.

The rising financial sector in the two countries had significant impacts on their economic growth. It relaxed borrowing conditions in the economy and created a private credit boom, which in turn created an economic boom. The real economic boom in both countries was largely demand-driven, mainly led by private investment and consumption. Large private investments also had the effects of inflating asset prices in the two countries. Ireland and Iceland experienced higher economic growth than the average growth in Europe during the years preceding the crisis. During 2001–2007, Iceland and Ireland, respectively, experienced an average growth of 4.6% and 4.9% while the Euro–18 and Nordic states experienced an average growth of 1.9% and 2.5%, respectively.

Figure 2.1: GDP growth

Figure 2.2: NIIP to GNI

Source: Statistics Iceland, Central Bank of Iceland, CSO (Ireland)

In both countries stories were told that had the effect of justifying the elevation of asset prices, credit creation, and the accompanying economic boom. As in the bubble that engulfed England in the early 18th century when prices of shares in the

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2 The measure of size is based on the balance sheet of financial corporations.

3 All data used for ‘Nordic’ in this chapter excludes Iceland and only refers to Sweden, Denmark, Finland and Norway. Euro-18 includes the aggregate of 18 European Countries in OECD statistics.
newly founded South Sea Company traded at exorbitant prices based on the hope of future profits that never materialised, there was supposed to be something very special happening in Iceland and Ireland at the beginning of the 21st century. This time was really believed to be different, to use the title of the book by Reinhart and Rogoff (2009). The story in Iceland was based on a belief in the superior business model of the Icelandic banks based on informal communication channels and the combination of commercial and investment banking. The booming Irish economy was believed to be lacking an ever increasing housing stock, which, when combined with favourable demographics, justified the house price boom.

In both countries there was an excessive concentration of political and economic actors within a golden circle, which combined with what Regling and Watson (2010) describe as excessive groupthink ensured that naysayers, whistle blowers, and those external to the system who issued warnings were either derided or ignored. Byrne (2012) computed the relational distance between key political and economic actors in Ireland and showed that it was much closer pre–crisis than post–crisis. Clancy et al. (2010) mapped the network of bank and state boards, showing a very large overlap. Hreinsson et al. (2011) describe the close relationship between politicians and bankers in Iceland and the borrowing by individual politicians from the banks. The ‘insider/outsider’ dynamic acted to shield important economic actors from criticism during the ‘buildup’ phase of the crisis.

The real and financial sector growth induced by capital inflows in Iceland and Ireland did not last much longer. In the second half of 2007, liquidity crisis in the global markets gained momentum with the eruption of crisis in the US sub–prime mortgage market and the share prices fell internationally. Both Iceland and Ireland like many other countries, experienced difficulties in acquiring credit. As interbank–liquidity dried up, both countries eventually faced a severe financial crisis resulting in the collapse of their banking systems.

The crisis from the financial sector quickly spread to the real sector in both countries, which pushed their economies into a deep recession. In 2008, the real output
in Iceland and Ireland compressed by 6.6% and 6.4%, respectively.\textsuperscript{4} Recession, as measured by negative real output growth, in both the countries lasted for a longer time span than many other countries as shown in Figure 2.1.

The respective institutional setups, and the prevailing situation of the time forced Iceland and Ireland to adopt contrasting policies to tackle the crisis as will be discussed in detail. Both countries showed signs of a slight recovery and experienced positive growth after a recession of almost 2 years. In 2011, the real output in Iceland and Ireland increased by 2.7% and 2.2%, respectively.

While the two countries somewhat followed a similar trend during the crisis build–up phase, there are significant differences in the strategies and drivers of financial and real sector development which played a central role during the crisis. Exploring these strategies and drivers of real and financial sector growth is important for two reasons, a) It shows how two small open economies under different currency regimes can apparently follow a similar looking pattern towards the crisis, b) It helps understanding the interplay of real and financial sectors during the crisis.

This chapter\textsuperscript{5} aims to discuss the build–up and aftermath of the financial crisis in Iceland and Ireland. The chapter in particular devotes a large section to cover the story of Icelandic crisis which will be vital to develop a theoretical model for sovereign currency in Chapter 6. We, however, also draw a detailed comparison between the Icelandic and Irish experience of the crisis later on in the chapter. We discuss the impact of the crisis on the real sectors in both countries, and evaluate the policy response of the two countries.

This chapter has 6 main sections. Section 2.2 reviews the real and financial developments in Iceland. Section 2.3 discusses the collapse of the Icelandic banking system. Section 2.4 briefly reviews the real and financial developments in Iceland. Section 2.5 presents a comparative analyses of the Irish and Icelandic experience of the crisis including a discussion on the impact of the financial crisis on the real

\textsuperscript{4}For Iceland, this was the lowest growth recorded since 1945 based on the available statistics.
\textsuperscript{5}Some analyses in this chapter have previously appeared in a working paper of Financialisation, Economy, Society and Sustainable Development (FESSUD).
sector, and the policy stance of the two countries during the crisis and onwards. Section 2.6 concludes this chapter.

2.2 Real and financial growth in Iceland

Iceland is a small open economy with a population of approximately 329,100 (year: 2015) inhabitants which mostly experienced positive economic growth during the 20th century. Economic growth in Iceland is mainly led by advancement in fishing industry along with the utilisation of hydroelectric and geothermal energy. Post–World War II economic growth with an average of 4% during 1945 to 2007 is relatively higher than the average growth of other OECD countries as shown in Table 2.1. It is argued that the business cycle in Iceland during the 20th century was mainly affected by the exports and is to a great extent asymmetric to international business cycles (Danielsson and Zoega, 2009).

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<tbody>
<tr>
<td>Europe</td>
<td>-</td>
<td>3.4</td>
<td>4.9</td>
<td>3.7</td>
<td>2.4</td>
<td>2.3</td>
<td>2.4</td>
</tr>
<tr>
<td>OECD</td>
<td>-</td>
<td>3.6</td>
<td>5.1</td>
<td>4.3</td>
<td>2.9</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Iceland</td>
<td>3.8</td>
<td>4.1</td>
<td>4.3</td>
<td>6.5</td>
<td>3.2</td>
<td>2.2</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Source: Statistics Iceland, OECD

Historically, most of the Icelandic economy was heavily regulated. Unlike its neighbouring countries, the regulations implemented after the Great Depression and the World War II lasted much longer to protect local businesses. The financial sector in particular was the least developed along with capital controls in place for most part of the century. With the exception of a few small institutions, the banking sector was mostly owned by the government, and was highly politicised in its operations. Politicians were involved in the bank boards and influenced lending decisions (Matthiasson, 2008). Credit was rationed between a few industries, resulting in the lack of investment in the sectors, where credit was unavailable. The nominal interest rate was set by the central bank, which was controlled by the government (Danielsson and Zoega, 2009).
The monetary regime in the country was based on an adjustable peg against the currency of a trading partner (e.g., to the US dollar or British pound at times), or a basket of currencies but with differing degrees of adjustability. Thus, the line between adjustable peg and managed floating is not very clear as the exchange rate has gone through fundamental regime shifts during the 20th century.\footnote{For example, during 1983 the exchange rate regime could be specified as managed floating due to more flexible exchange rate but then in the mid-1980s the regime became more restrictive (Andersen and Gudmundsson, 1998).} In 1970s and 1980s the exchange rate was frequently adjusted with respect to the world export prices to counter external imbalances. The exchange rate, however, was frequently adjusted to negative external shocks and was rarely revalued to any positive external shocks. Thus, the exchange rate in 1970s and 1980s was accommodating with devaluation bias. The exchange rate policy in the 1990s until the adoption of floating regime was less accommodating as a result of wage settlements and public commitment to stabilise exchange rate (Gudmundsson et al., 2000).

Along with high exchange rates, Iceland was a country with high and persistent inflationary pressure as compared to other OECD countries as shown in Figure 2.2. This is not surprising for a small economy with export–led growth experiencing devaluations. Inflation was relatively higher than other countries especially in the 1970s and 1980s, reaching its highest peak of 84 percent in 1983 as shown in Figure 2.3. Monetary policy in response to the external shocks in the 1970s and 1980s, tight labour policy of full employment, and devaluation bias are considered the main drivers of high inflation during this period (Andersen and Gudmundsson, 1998). Inflation started declining in 1984 when it reached 30 percent, and further declined to single digit in the 1990s. The process of disinflation was mainly due to strict income policy, and commitment to stabilise the exchange rate along with compensatory social security in order to protect living standards (Andersen and Gudmundsson, 1998; Gudmundsson et al., 2000).

During periods of high inflation, the real interest rates were mainly negative. As a result the economy failed to attract considerable amount of domestic savings. This led to an accumulation of external debt and persistent current account deficits, where major projects were financed by foreign loans with government guarantees.
Financial Development, Crises, and Recovery in Small Open Economies

(Jonsson, 1999; Matthiasson, 2008). In 1979, indexation of loans was legalized and banks were authorized to index lending and deposits.\(^7\) Indexation of deposits prevented outflow from the banks. By 1986, interest rate was deregulated and the banks were free to set the interest rate. The real interest rate rose to positive for the first time in 1980s due to a significant decline in inflation.

Figure 2.4 shows that the real interest rates became positive in 1984 and then significantly increased after deregulation in 1986. The gap between nominal and real interest rate shows the amount of inflation prevailing in the economy. As inflation declined and real interest rate increased, the gap between nominal and real interest rates narrowed.

![Figure 2.3: Inflation](image1)

![Figure 2.4: Interest rates](image2)

Source: Statistics Iceland, OECD

Several studies have argued that financial indexation as a whole was beneficial for Iceland as it encouraged savings and pressurized the borrowers to pay back the real amount of loan. This also reduced the scope for credit rationing (Jonsson, 1999; Matthiasson, 2008).

2.2.1 Financial liberalisation in Iceland

The economy in Iceland experienced a wave of liberalization in the early 1990s when young libertarians, advocates of free markets, came in power and implemented their agenda. Iceland joined the EEA in 1994 and capital controls were

\(^7\)Although limited financial indexation existed before which can be traced back to 1955 and on government bonds to 1964 but it mainly became dominant and widely spread in 1979 (Andersen and Gudmundsson, 1998)
removed which allowed the banks to rapidly expand their operations by opening new branches abroad. The state owned banks were privatized. The foundation of the privatization was practically laid when the state owned bank (Utvegsbankinn) along with three minor banks formed the Islandsbanki in 1990. Investment bank (FBA) merged with Islandsbanki in 2003 and later on formed Glitnir. Other state owned banks (Landsbanki and Bunadarbanki) were also privatised during 1998-2003. Kaupthing, an investment bank, merged with Bunadarsbanki in 2003. Moreover, a stock market was established and the Central Bank of Iceland (CBI) shifted its monetary policy from a fixed exchange rate regime to a flexible and floating exchange rate policy with inflation targeting in 2001 (Danielsson and Zoega, 2009; Benediktsdottir et al., 2011; Bergh et al., 2011).

Figure 2.5: Formation of Icelandic Banks

The privatization of the banking sector in Iceland is shown in Figure 2.5, which
clearly explains that the three largest banks were formed out of small banks in the 1990s. And by 2003, Icelandic banking sector was considered one of the important pillars of the economy. The banking sector was mainly dominated by the three large banks (Landsbanki, Kaupthing & Glitnir).\(^8\)

### 2.2.2 Expansion of the banking sector

A considerable expansion in the banking sector started in 2003 when the process of privatisation was completed in 2003. The assets of the three largest banks from 1.4 trillion ISK in 2003 increased by 103 percent to 2.9 trillion in 2004 as reported in Table 2.2. These three banks comprised of 85 percent of the total banking sector in Iceland. The rapid increase in banks was mainly due to access to cheap credit in the international markets along with the good credit rating of the sovereign in Iceland as noted by Baldursson and Portes (2013).

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Assets</td>
<td>1.4</td>
<td>2.9</td>
<td>5.4</td>
<td>8.4</td>
<td>11.3</td>
<td>14.4</td>
</tr>
<tr>
<td>Change in Assets</td>
<td>1.4</td>
<td>2.4</td>
<td>3.0</td>
<td>2.8</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Asset Growth (%)</td>
<td>103.1</td>
<td>83.9</td>
<td>56.4</td>
<td>34</td>
<td>27.2</td>
<td></td>
</tr>
</tbody>
</table>

Source: Special Investigation Commission

The banks initially expanded by acquiring capital in the European debt security markets and later on in the American debt security markets. During 2004 to 2005 the three largest banks issued 19 billion euros in the European bond market in the form of Euro Medium–Term Notes (EMTN). As a consequence, the share of deposits in financing decreased substantially (Baldursson and Portes, 2013). Apart from the banks’ own strategy to expand, the increase in assets was due to less scrutiny and inadequate supervision both from the CBI and in the international markets.

SIC Chapter 2 (2008) report reveals a strong nexus between the banks and their largest owners. The largest shareholders of the banks were the largest borrowers

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\(^8\)Three banks from now on would refer to Landsbanki, Kaupthing and Glitnir.
as they had easy access to credit in the banks. The banks also acted in the interest of their owners while ignoring small investors. The report reveals that the banks heavily invested in the securities linked to the banks’ owners in the money market. Moreover, the banks also invested large funds in buying their own shares. These investment strategies of the banks in Iceland aggressively induced credit growth as well as share prices.

Table 2.3 shows return on the assets of the three biggest Icelandic banks in comparison with the mean value in the Nordic countries. From high return on assets of the Icelandic banks, it is obvious that the Icelandic banks had found effective ways to expand rapidly as compared to its competitors.

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glitnir</td>
<td>1.3</td>
<td>1.6</td>
<td>1.3</td>
<td>1.7</td>
<td>0.9</td>
<td>0.3</td>
</tr>
<tr>
<td>Kaupthing</td>
<td>1.4</td>
<td>1.1</td>
<td>2.0</td>
<td>2.1</td>
<td>1.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Lansbanki</td>
<td>0.6</td>
<td>1.7</td>
<td>1.7</td>
<td>1.8</td>
<td>1.3</td>
<td>0.7</td>
</tr>
<tr>
<td>Mean</td>
<td>1.1</td>
<td>1.5</td>
<td>1.7</td>
<td>1.8</td>
<td>1.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Mean (Nordic)</td>
<td>0.5</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Source: Special Investigation Commission

Table 2.4 reports the tier 1 capital ratio which is the ratio of banks’ capital to its risk weighted assets. In general banks’ regulatory capital is composed of two main components, a) banks’ equity capital, which is the value of assets exceeding its debts and b) subordinated debt. Subordinated loans (referred to as the hybrid debt) are designed to absorb losses for the issuer but these loans are vulnerable to the stock market as they are convertible into shares. Tier 1 capital in Iceland consisted a considerable amount of subordinated loans. The reliance on subordinated loans from 27 percent in 2003 increased to 49 percent in 2007 as discussed in Nielsson and Torfason (2012). The mean of Tier 1 capital ratio of Icelandic banks for each year during 2003-2008 is higher than the mean of the Nordic banks as reported in the Special Investigation Commission (SIC from now on) report (SIC Chapter 21, 2008).
Table 2.4: Tier 1 Capital Ratios

<table>
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<tr>
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<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glitnir</td>
<td>8.0</td>
<td>9.4</td>
<td>9.9</td>
<td>10.8</td>
<td>8.1</td>
<td>8.0</td>
</tr>
<tr>
<td>Kaupthing</td>
<td>12.1</td>
<td>11.5</td>
<td>9.4</td>
<td>10.5</td>
<td>9.6</td>
<td>9.3</td>
</tr>
<tr>
<td>Landsbanki</td>
<td>6.9</td>
<td>7.8</td>
<td>11.9</td>
<td>13.0</td>
<td>10.1</td>
<td>8.2</td>
</tr>
<tr>
<td>Mean</td>
<td>9.0</td>
<td>9.5</td>
<td>10.4</td>
<td>11.4</td>
<td>9.2</td>
<td>8.5</td>
</tr>
<tr>
<td>Mean (Nordic)</td>
<td>7.3</td>
<td>7.6</td>
<td>7.1</td>
<td>7.3</td>
<td>6.9</td>
<td>7.6</td>
</tr>
</tbody>
</table>

Source: Special Investigation Commission

On the available record, it clearly seems that the Icelandic banks were reporting good health with rapid expansion as compared to their Nordic competitors. But according to the report from SIC the tier 1 capital ratio of the Icelandic banks was weak and not an appropriate reflection of the financial health in reality. During 2004 – 2007(mid), the banks increased their lending for stock purchasing and in some cases directly accepted each other’s stocks as collateral. Figure 2.6 clearly traces the comovement between increased collatarisation of stocks and rising stock prices in the Icelandic stock exchange market during 2004–2007.

Figure 2.6: Collateralisation of Icelandic stock

Source: SIC Chapter 21 (2008)
This pattern in Wade and Sigurgeirsdottir (2012) is explained with an example as follows: Bank A lends to Bank B while taking the shares of Bank B as collateral. Bank B uses the borrowed money to buy its own shares, thereby inflating the B’s share prices. This practice of cross–financing – lending to borrowers to invest in each other’s shares – in the banks increased banks’ shares value without acquiring new credit. (SIC Chapter 21, 2008, p.16) argues that the Icelandic banks, due to collateral and future contracts on their own shares, were vulnerable to their own shares risk and that made the capital adequacy ratio an improper indicator of the banks’ financial health. The stock prices during 2004–2007 were largely driven by banks lending for stock purchasing and using each other’s shares as collateral.

2.2.3 Mini–crisis in 2006

During 2004 to 2005 the three largest banks collectively issued 19 billion euros in the European bond Market in the form of Euro Medium–Term Notes (EMTN). As a consequence the share of deposits in financing significantly fell from 45% in 1998 to 24% in 2005 (Baldursson and Portes, 2013, p.34). During 2005, the three banks acquired 14 billion euros in capital (higher than the GDP of that year) from foreign debt security markets. Most of the debt securities issued were for a period of 3 to 5 years with moderate interest rates; ranging from 15 to 25 points above the benchmark rate. In November, 2005 the banks’ credit default swap (CDS) and bonds’ spread started to rise relative to its European counterparts indicating negative signs for Icelandic banks (Baldursson and Portes, 2013, pp.34-35).

Icelandic banks faced a mini crisis in 2006 which according to Portes et al. (2007) was an informational crisis due to external criticism identifying issues such as the banks’ dependence on market funding with short maturities, cross holdings, the quality of loan portfolio, lack of transparency and the macroeconomic imbalances in the Icelandic economy. Many were also sceptical of CBI’s role as a lender of last resort due to enormous size of the banks relative to the Icelandic GDP. In early 2006, Fitch published a report pointing out the vulnerability of the Icelandic banks to the volatile stock markets. Fitch also changed the Issuer Default rating
of the Icelandic companies from stable to negative in February, 2006. The banks’ CDS and bonds’ spread that had started rising in November, 2005 as discussed earlier, further increased in March, 2006.\(^9\) The crisis also led to the depreciation of the Icelandic Krona by 25 percent, along with a 25 percent decrease in the share prices (from their peak in February) by mid-2006 (Portes et al., 2007; SIC Chapter 21, 2008; Baldursson and Portes, 2013). The mini-crisis, however, had no effects on the real sector of the economy as there were no credit shocks.

In response to the crisis, the banks made several adjustments; (a) In particular to decrease its reliance on the wholesale markets, the banks (Kaupthing & Landsbanki) turned to international retail deposits to acquire credit, and had great success in doing so, (b) They liquidated some of their shares and increased their transparency by deciding to fully identify the borrowers, (c) The banks were successful in extending their maturities, (d) Furthermore, the Icelandic banks were successful in selling securities (worth above 6 billion euros) in the US Medium Term Note (USMTN) market later in 2006. These adjustments helped in obtaining foreign currency denominated funding as well as diversifying the origin of funding (Portes et al., 2007).

Through high interest rate on the deposits, the banks attracted a large number of customers. Landsbanki, through its foreign branches\(^{10}\) in the UK and some other European countries, accumulated deposits under the name, ‘Icesave’ (see Figure 2.7). The Icesave deposits of the Landsbanki were insured by the Icelandic Deposit Insurance Guarantee Fund (DIGF), based in Iceland. Kaupthing raised its deposits through its subsidiaries in foreign countries, under the name, ‘Edge’. These deposits were guaranteed by insurance schemes in their respective home countries. It was later discovered in September, 2008 that the overseas deposit liabilities of the banks were extremely larger than the capability of DIGF to act as an insurer (Flannery, 2009; Baldursson and Portes, 2013).

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\(^9\)During the period of January, 2006 to February, 2006, all the 3 banks’ spread on average increased from 40 bps to 60 bps.

\(^{10}\)These were foreign branches (not subsidiaries) of the bank which means they had no separate legal entity and were solely controlled by Iceland.
Figure 2.7 shows the Icesave deposits of Landsbanki subsidiary in the UK; it is clear that there was a rapid expansion from zero in 2006 to 4.5 billion GBP within one year. These deposits in the UK were funding almost 20 percent of Landsbanki’s total assets as reported in (Flannery, 2009, p.100).

The adjustments by the banks in response to the criticism as discussed above were sufficient to overcome the crisis at the time. But despite these adjustments a point of concern in the banking sector, apart from their size, was lending to the households and domestic companies in the foreign currency. In the three banks, 60 to 75 percent of the lending was in foreign currency. Domestic companies borrowed in foreign currencies as part of their revenue was from exports in foreign currencies but the earnings of the household sector was mainly in the domestic currency. And lending to the household sector in foreign currency increased from 7 percent to 14 percent in 2007 while the banks underestimated the exchange rate risk or in fact, the risk was shifted to the household sector (Balduresson and Portes, 2013, pp.38-39).

Figure 2.8 shows the lending pattern of the banking sector based on different types of borrowers. It is clear that in the early phase of expansion the lending pattern was dominated by firms’ borrowing. However, with the rise in cross-border operations,
the lending pattern became more diversified where a large share of lending was to the foreign parties (non-residents; including individuals and companies).

Figure 2.8: Lending pattern

Source: SIC Chapter 21 (2008)

2.3 Road to the systematic crisis

The process of successful expansion after recovery from the mini crisis did not last much longer. In the second half of 2007, liquidity crisis in the global markets gained momentum and the share prices fell internationally.\textsuperscript{11} Iceland, like many other countries, experienced difficulties in acquiring credit in the markets. In response to credit shocks, the Icelandic banks increased collateralised loans which became an important source of funding. The banks used each other’s debt securities (referred to as ‘love letters’) as collateral for borrowing. In particular, the Landsbanki through its subsidiary in the Luxembourg, borrowed significant amount from the Central Banks of Luxembourg (CBL) under the European System of Central Banks

\textsuperscript{11}In contrast, the crisis in 2006 was of different nature as no credit shocks (e.g., loan defaults) were experienced.
(ESCB) while using debt contracts of the other banks as collateral (Flannery, 2009, p.101).

In the beginning of 2008, Icelandic banks were clearly facing liquidity problems. The banks’ CDS doubled from 200 points in January, 2008 to 400 points in February, 2008 as reported in (SIC Chapter 21, 2008, p.56). This followed a significant withdrawal from the Icesave accounts of Landsbanki in the UK. As a consequence, the Icelandic banks experienced a substantial decrease in the foreign currency. In May 2008, CBI made currency swap agreements with the Nordic Central Banks; these agreements were tied to the condition that the Icelandic Prime Minister, CBI and Financial Supervisory Authority (FSA) would pressurize the banks to reduce the size of their balance sheets but the Icelandic authorities failed to fulfil these promises. At the same time uncertainty increased in the financial markets in the US. The interest rate difference in the currency market almost disappeared and the banks were willing to pay the same interest on the Icelandic Krona and the euro; concurrently the Icelandic Krona fell substantially. Apart from the deposit outflows for the Landsbanki, the CDS spread on Kaupthing and Glitnir climbed above 1000 points by the end of March, 2008 and the liquidity crisis continued to grow in the Icelandic banks as discussed in (SIC Chapter 21, 2008, pp.56-57). Credit scenario in the international markets deteriorated and in September, 2008 the Lehman Brothers went bankrupt. Uncertainty increased and liquidity dried up in the global markets. Credit in the markets froze and asset prices fell. The fiscal and monetary authorities in the countries were active in refinancing the banks. However, the weakened Icelandic banks, whose assets at the time of liquidity crisis were almost 9 times 2007s GDP, failed to withstand the financial storm.

Figure 2.9 shows the 5 year CDS for Iceland and Germany. The CDS for Iceland climbed to almost 10% (1000 basis points) during 2008, clearly reflecting Iceland’s struggle for credit.
Glitnir facing liquidity problems, approached the CBI for loan. The loan was not granted but the government, in an attempt to rescue the bank, injected 6 million euros in exchange for 75 percent of the shares. Thus, CBI bought 75 percent of Glitnir’s shares at a very low price, anticipating that partial nationalization would improve the credit rating but instead the opposite happened. The negative news from Glitnir impacted other banks as the Icesave deposits decreased by 5 percent within one week (Danielsson and Zoega, 2009). Meanwhile, British media printed articles on the risk of holding deposits in the Icelandic banks. On October 6, 2008, news of possible collapse of the Icelandic banks circulated in the media; this resulted in a full-scale run on the Landsbanki’s branch of London.\textsuperscript{12} Landsbanki announced to the FSA on October 7, 2008 that it could not meet its obligations, after its request for the loan of 200 mn GBP was denied by the CBI. FSA in response, seized the control of the Landsbanki using Emergency Legislation which was passed by the parliament on October 6, 2008. The authorities in UK on October 8, 2008 responded in an aggressive manner and used Anti-terrorism, Crime and Security Act 2001 to freeze the assets of Landsbanki as well as the Landsbanki subsidiary (Heritable Banks) in the UK (Baldursson and Portes, 2013, pp.18-19). However, Kaupthing with an anticipated survival was granted a loan of 500mn

\textsuperscript{12}See, for example, BBC web report by (Furlong, 2008, October 03). It is important to note the date of these reports as they were launched a few days before the banks’ collapse.
euros by the CBI on October 6, 2008 but this did not happen and eventually the UK authorities used Banking (Special Provisions) Act 2008 to take over the Kaupthing as discussed in (Baldursson and Portes, 2013, pp.21-22).

Unlike other countries, due to the overgrown size of the banks, the CBI and the state in Iceland were merely spectators. Iceland faced systematic crisis, known as the collapse of the payments system, which means no foreign bank was willing to transfer funds between Icelandic banks. As a consequence, the international payments system was completely shut down while domestic payments system faced difficulties. This eventually led to the collapse of the three biggest giants (Glitnir, Kaupthing & Landsbanki) of the Icelandic banking sector in the beginning of October, 2008.

Financial Regulation and stability in Iceland is a joint responsibility of the CBI and FSA and they failed to monitor the financial market. Instead, the CBI’s monetary policy contributed to the crisis in some ways. For example, the CBI’s inflation targeting is typically based on the model that links the interest rates to the inflation while the capital movements are not accounted for in such models. And in case of Iceland, for the most part of 2000s inflation was above the target of the CBI which increased the expectations of higher interest rate. This then increased borrowing in the foreign currency and also created an opportunity for speculative capital inflows (carry trade). When the channel of borrowing in foreign currency is open, as was the case in Iceland, the increase in interest rate is not very effective to control domestic demand. Hence, the CBI failed to control liquidity in the financial market. However, fiscal policy in Iceland during the period of 2003-2008 was expansionary with lower taxes in order to increase investments. Despite lowering taxes, the total tax revenue increased mainly due to expansion of the financial sector which increased real wages. Higher tax revenues in turn increased government spending by paying down the public debt (Benediktsdottir et al., 2011).
2.3.1 Collapse of the Icelandic banking sector

In response to the crisis, the government immediately prepared an Emergency Legislation as discussed above. Extensive powers were granted to the FSA, in order to protect the internal payment system. The FSA took over all the three old banks (Glitnir, Kaupthing & Landsbanki) and were split into domestic and foreign liabilities. It created ‘Arion Bank’ out of Kaupthing, Islandsbanki out of Glitnir and Landsbanki (new) out of the original (old) Landsbanki (see Figure 2.5). The newly formed banks consist of the domestic assets & liabilities that were transferred from the old banks. The foreign assets of the banks were left within the old banks while their subsidiaries in the foreign countries were either sold or liquidated during the crisis. Splitting the banks into domestic and foreign assets was done overnight without any disruption in the domestic operations of the banks. As the current banks now consist of the domestic assets of the original banks therefore the creditors of the old banks still hold considerable amount of shares in the newly formed current banks; 87 percent in the Arion Bank is owned by the Kaupthing, 98 percent of the current Landsbanki is owned by the state and 2 percent by the employees (Balduísson and Portes, 2013), 95 percent of the shares in the current Islandsbanki were owned by creditors of Glitnir (old) and 5% by the state after the crisis, however, recently Glitnir signed an agreement to deliver the remaining 95% stake in Islandsbanki to the Central Bank of Iceland and the Icelandic Government as part of stability contribution in January, 2016.

Iceland faced many challenges in obtaining external finances as it was isolated in the International community. The use of anti-terrorist law by the UK to freeze the assets of Icelandic banks resulted in tense relations between the two countries. All the EU member states along with the Nordics stood by the UK resulting in delay of external assistance (Thorhallsson and Kirby, 2011). Iceland was eventually granted $5.2 billion from the IMF and Nordic countries. IMF program emphasized three main objectives a) stabilizing the krona and preventing it from further depreciation while maintain capital controls, b) ensuring medium term fiscal sustainabiliity and c) developing a comprehensive strategy for restructuring the banks.
2.4 Real and financial growth in Ireland

Ireland’s small economy, with approximately 4.5 million inhabitants, is roughly 14 times the size of Icelandic economy both in terms of population and GDP.

Economic integration of the Irish economy increased in the 1960s with a policy shift from trade protectionism towards trade openness. Ireland joined General Agreement on Tariffs and trade (GATT) in 1967, and European Economic Community (EEC) in 1973. The policy shift towards openness increased productivity growth, and resulted in export–led growth (O’Donnell, 1998). In the 1970s and onwards, the speed of convergence, the ‘catching–up’ process with average EU economies, greatly increased due to a combination of policies, encouraging foreign direct investment, rise of non–agriculture sector, export–led growth, and a well–educated labour force (Honohan and Walsh, 2002).

The economy, however, was greatly affected by the slowdown in global economy due to oil crisis in the 1970s. Ireland responded to global shocks by running large fiscal deficits. Fiscal problems combined with rising prices, high taxes, and balance of payments deficits resulted in debt crisis and stagnation (McAleese, 1997). In the mid–1980s, Ireland’s debt to GDP reached 110 percent in which almost 10 percent of GDP per year was paid as interest (Whelan, 2011).

Financial liberalisation in Ireland started in the late 1980s when the exchange controls were eased in 1988–89, and most restrictions on portfolio flows were removed. In 1999, Ireland joined the European Monetary Union (Eurosystem) and adopted euro as an official currency. The economy experienced a phase of high growth in the 1990s, which came to known as the the ‘Celtic tiger’ era which ran from 1994 to 2002. This era is marked by macroeconomic stability, stable inflation, high growth
in exports and employment. Financial liberalisation and membership in the EU Single Market among other things (e.g., fiscal stabilisation, a well-educated and young labour force, multi-national friendly tax policies) are widely accepted as drivers of high non-inflationary growth during this era (Cain, 2008).

2.4.1 Rise in the banking sector

In the early 2000s, strong economic integration led to a substantial growth of the financial sector, which in turn created a boom in residential and commercial property markets. The financial sector growth was induced by two major factors as highlighted by Regling and Watson (2010). First, the adoption of euro facilitated an easier access to international credit without an exposure to currency risks. Second, the competition between the Irish and international banks played a central part in the aggressive growth of financial sector.

The size of the balance sheets of Irish-owned banks reached almost 3.75 times its GDP in 2007; however after including international financial centres the estimated ratio equals 7.1 times the GDP of 2007 as reported in (Darvas, 2011, p.7). The Irish financial sector was dominated by six major national banks and credit intuitions, namely Bank of Ireland (BOE), Allied Irish Banks (AIB), Anglo Irish Bank, Education Building Society, Irish Nationwide Building Society, and Irish Life and Permanent.

The size of banking sector in relation to its GDP was not very different from the scenario in Iceland, whose banks were 9 times the size of its GDP at the time of collapse as discussed earlier. The financing strategy of the Irish financial sector was largely similar to the Icelandic strategy while there was a sharp contrast in the lending pattern between the two small economies.

\footnote{Inflation remained stable and close to the average of euro area, except during 2000–2003, when prices were higher than the average euro area mainly due to sharp depreciation of euro and increased energy prices.}
The increased banking competition and international borrowing bearing zero currency risk, like in other euro zone countries, were widely considered beneficial for the Irish economy. The Irish banks prior to 2003 operated in a traditional way where deposits financed loans, but the competition between Irish and international banks under zero currency risk greatly affected the strategies of financing. Like the Icelandic banks, the business model of the banks from deposit financing largely shifted towards short-term borrowing in international wholesale markets (Centonze, 2014).

The collective wholesale funding of the six financial institutions in the euro area rapidly increased, reaching 39% of their combined loan books (Regling and Watson, 2010). International bond borrowing of the six financial institutions from a size of less than 15 billion in 2003 increased to almost 100 billion by 2007, which corresponds to more than half of 2007s GDP as reported by Whelan (2014). In particular, the short-term borrowing with maturity of one year or less was even more aggressive in the banking sector. The banks financed themselves by issuing short-term euro-denominated bonds in the interbank market. The two largest banks experienced a threefold increase in short-term debt which escalated from 11.1bn euros in late 2003 to 41bn euros in late 2006 (Regling and Watson, 2010).

### 2.4.2 Property bubble

The lending pattern was clearly dominated by property-related activities in the economy. Low interest rates combined with easy access to credit, increased the demand for property loans, which in turn inflated property prices and also increased banks’ equity. Intense competition in the commercial property lending between financial institutions inflated residential prices by 180 percent during 1995–2007 (Report of the Commission of Investigation into the Banking Sector in Ireland, 2011, p. 18).

During 2002–2008, domestic property lending increased by 200 billion euros. The share of property lending from under 45 percent of total credit in 2002 increased to
almost 60 percent of the total credit in 2008 as discussed in the report by the Report of the Commission of Investigation into the Banking Sector in Ireland (2011). In particular, Anglo Irish Bank and Irish Nationwide Building Society specialised in property development, and aggressively lent out property loans. The assets of Anglo Irish grew from 26 billion euros in 2003 to 97 billion euros in 2007 (Whelan, 2014).

Large property lending had significant effects on the labour market. The share of the labour force in construction rose from almost 7 per cent in the early and mid–1990s to above 13 per cent by 2007 (Honohan, 2009). The excessive credit growth, apart from increasing household debt, led to overheating of the economy. According to IMF, Irish economy was perhaps the most overheated of all advanced economies as cited in (Thorhallsson and Kirby, 2011, p.17).

### 2.4.3 Financial crisis and bank bailouts

The excessive property lending clearly created a property bubble in Ireland, which eventually reached its climax. The creation of the Irish property bubble, like any other bubble, was made possible by excessive amount of credit in this sector which encouraged speculation. Unlike goods market, there is a strong positive relationship between asset prices and demand. Thus, a fall in demand after reaching its climax results in the collapse of asset prices. Irish demand for housing, financed by borrowing, reached its peak in 2006. The demand for commercial property began to fall. The construction sector was heading towards a collapse as unsold units began to accumulate in 2007. The default rate on property loans started to increase. Falling property prices and increasing loan defaults resulted in higher loan losses and lower banks’ equity (Kelly et al., 2009; Centonze, 2014). The share prices of Irish financial institutions began to decline steadily in March 2007. The slowdown in property was a clear sign of trouble for the banking sector, property–related businesses, and workers in the construction industry.
The eruption of crisis in the US in September 2008 triggered the crisis in Ireland with a market run on Anglo Irish Bank. Several authors, such as Whelan (2014) and Centonze (2014), have argued that Ireland was heading towards a crisis even in the absence of International crisis. By late 2007, the Irish house prices started falling from their peak much prior to the turbulence in the international markets as discussed above.

International crisis exposed the weakness of the Irish banks. Acquiring credit in the global markets became difficult and Irish banks experienced problems in financing their existing foreign debt. As a result, Irish banks frequently turned to ECB for funding while deposits of the banks started to decline as customers transferred their savings to non–Irish banks (Centonze, 2014).

The senior management of the largest Irish banks sought government’s help, and the Irish government on 29th September, 2008 decided to guarantee the deposits and all the liabilities (worth 375 billion euros) of the domestic banking system. The government also guaranteed the liabilities of the two property lending institutions, Anglo Irish Bank and Irish Nationwide Building Society. According to Whelan (2014), the details of meetings between the politicians and staff from the Department of Finance and Central Bank, concluding a bailout decision, are unclear to date. It is widely argued that the government decision to guarantee the liabilities of these financial institution was based on the belief that the financial sector was facing a liquidity crisis, and not a solvency crisis (Centonze, 2014; Whelan, 2014).

The government assurances, however, did not prevent the fall in shares of the Irish banks. The government nationalised Anglo Irish in February, 2009, and created National Asset Management Agency (NAMA) to buy non–performing loans.

During 2009 and 2010 the Irish government injected capital in the banks and finally in November, 2010 EU, ECB and IMF forced a bailout package on the Irish government. The agreed rescue package was 85 billion euros for a time period of seven and a half years, in which Irish government agreed to pay 17.5 billion euros from Nation Pension Reserve Fund (Thorhallsson and Kirby, 2011).
2.5 The Irish Icelandic comparison

The post-crisis scenario in Iceland and Ireland evolved differently but the build-up of the crisis and its effects on the real economy was similar in some respects. The episode of large financial flows inducing credit growth in Iceland and Ireland was largely similar in its timing and scale. The composition of credit, however, was different: Iceland’s financial system was more innovative and complex with a major chunk of credit comprised of indexed and foreign currency loans, while Ireland’s credit system was more conventional consisting of interest based short term and long term loans.

Figures 2.10 – 2.12 trace out, in comparative terms, the stories of financial development in the two economies from the early 2000s to 2013. On the face of it, a clear case can be presented for the influence of financialisation on these economies.

Figure 2.10 shows the development of private credit to GDP in the two countries. Credit in both the countries increased with the same pace during 2004 to 2008. In Iceland, the credit from a level of 1.65 times GDP in 2004Q1 increased to a highest level of 3.82 times GDP in 2008Q3, before falling in 2008Q4. In Ireland, credit from 1.31 times GDP in 2004Q1 increased to a maximum level of 3.12 times GDP in 2009Q1.

Figure 2.11 shows the development of the broad money supply, M3, relative to GDP, reflecting financial depth in the two countries. The stories are rather different: Iceland experienced a large increase in M3 from 2002 to 2008-09 as compared to Ireland, but the actual ratio of M3 to GDP in Ireland was slightly higher than in
Iceland. In Ireland, the stock of M3 in 2004Q1 increased from 2.10 times the GDP to a maximum of 3.62 times the GDP in 2009Q4, while in Iceland it increased from 1.50 times the GDP in 2004Q1 to a maximum of 3.13 times the GDP in 2008Q4. This is a clear indication of how rapidly Icelandic financial activities expanded in this period. Consistent with other financial indicators, deposit liabilities of the financial sector in the two countries also shows an increasing trend until 2009 as Figure 2.12 documents.

Figure 2.13 – 2.15 begins to pull out the international dimension of the story. Both countries experienced large capital inflows in the years preceding the crisis, ending with sudden stops as shown in Figure 2.13. Large inflows had the effects of increasing trade openness in the two countries. The increased trade growth, however, was largely due to large volume of imports. Figure 2.15 shows the difference between investment income as a share of GDP in Iceland versus that of Ireland. Investment incomes are paid to non–residents in the form of interest and dividends on respective capital inflows. We refer to this as foreign rentiers’ income share in the balance of payments. Foreign rentiers’ income encouraged further investments in the financial markets, which in turn fuelled financial development as will be investigated in Chapter 3.

Source: Statistics Iceland, Central bank of Iceland, CSO Ireland

Figure 2.16 shows household debt as a share of GDP. The Irish story was clearly an old–fashioned asset bubble, where households over borrowed based on rising asset price values as discussed earlier. Icelandic households with an already high debt experienced a mild increase in their balance sheets as compared to Ireland, though it was surely the case that some Icelandic households over borrowed, the main
changes caused by financialisation seem to have taken place in the non–financial (NFC) sector. Despite dropping from its peak levels in 2008, the household debt in both the countries remains high. It is important to point out that Icelandic household borrowing was higher than the NFC’s in 2002–03 but in 2004, the NFC borrowing increased surpassing households. The total NFC debt is even higher when accounted for the NFC securities owned by the financial sector. Both countries increased the size of their respective balance sheets but in Ireland, the household sector became more fragile as a result of increases in debt while in Iceland the non–financial corporate sector experienced the increase.

Looking at Figure 2.18, we see a large and persistent increase in the ratio of adjusted wage to GDP from 2002 to 2008 in both the countries. Icelandic wage share significantly declined during the financial crisis but slightly improved as the economy recovered. Over the past decade, Iceland’s adjusted wage share has remained much higher than other countries in Europe and is currently the highest amongst all developed countries. The wage share in Ireland remained stable during the years of the crisis, but slightly dropped in 2011. Several authors have pointed out that Ireland’s debt–financed growth was wage–led, in the sense that a series of national pay agreements, plus a large increase per capita incomes, contributed to the expansion household balance sheets.

2.5.1 Impact of the crisis on real economy

The crisis from the financial sector in Iceland and Ireland quickly spread to their real sectors. Macroeconomic indicators such as changes in output, unemployment,
government debt and investment responded in a very typical manner following a stylized pattern.

All the components of domestic demand compressed, resulting into the contraction of real GDP. Figure 2.20 clearly shows that the share of total investment as a percentage of GDP in the pre-crisis period was high in both the countries. The sudden stop of capital resulted in the collapse of investment. Icelandic economy was more vulnerable to the share prices due to companies investing in each other as well as foreign businesses while Irish economy was exposed to its domestic asset prices (mainly housing prices as discussed). Unemployment as a typical lagging—indicator of the economic crisis started to rise in 2009 and reached its highest level in 2010 in both countries as shown in Figure 2.19.

Figure 2.19: Unemployment rate

Figure 2.20: Investment to gdp

Source: Statistics Iceland, CSO (Ireland)

Both countries experienced persistent current account deficits in the years preceding the crisis. In 2008, current account deficit in Iceland reached its highest level of 28.4 percent of GDP while it was moderate in Ireland around 5.6 percent of GDP. The current account deficits as mentioned earlier was due to large increase in imports and large payments to non–residents on their investments. Both countries, however, experienced a rapid adjustment in their current accounts after the crisis. The adjustment mechanisms of current account balance will be investigated in more detail in Chapter 4.
The crisis significantly affected the fiscal balance as the government sector in both countries incurred heavy costs. Ireland’s fiscal deficit to GDP is clearly much higher than in the case of Iceland as shown in Figure 2.21. The bailout package of Ireland converted the financial crisis into sovereign debt crisis as discussed below in Section 2.5.2. It is, however, important to highlight that Icelandic government also made desperate attempts to bailout the financial sector but the size of the banking sector and lack of financial resources at the time made it impossible to implement such a strategy as discussed earlier. Thus, Iceland’s decision to allow the collapse of its banking system was not deliberate but the only choice available to the government (Matthiasson and Davidsdottir, 2013).

Since the onset of the crisis, both countries experienced positive growth in their trade balances. Iceland experienced a trade surplus largely due to a fall in the volume of imports while exports have remained relatively stable. The fall in imports was due to currency depreciation and a fall in investment. The Icelandic krona depreciated by almost 27 percent against the US dollar within one quarter during 2008Q2–2008Q3, and then further depreciated by almost 18 percent in the next quarter in 2008Q4 (see Figure 2.24). The primary reason for the stability of export sector is that it is mostly based on natural resources. Icelandic exports have historically contributed to the economic growth during recessions in the past.
The capital controls in Iceland, still in place, restrict international capital flows and allows current account transactions. As a result of the capital controls, significant amount of the foreign capital, in the form of ISK-demoninated assets, remained in Iceland. One of the main concerns about removing the capital controls in Iceland is that there would be an immediate outflow as the foreign parties holding assets in Iceland would sell these assets for foreign exchange. Such a substantial outflow would likely bring a significant decrease in the exchange rates (Danielsson and Zoega, 2009). The effects of capital control regime on the economy will be investigated in Chapter 6.

Figure 2.23: Trade balance to gdp

![Figure 2.23](image)

Source: Statistics Iceland, Central bank of Iceland, CSO (Ireland)

The improved trade balance in the case of Ireland was led by sectors including biotech, pharmaceuticals, business and computer services. However, the mechanism behind Ireland’s export-led growth is an unsettled debate. Proponents of Ireland’s economic policy consider it the outcome of successful implementation of their structural adjustment program. The Irish recovery is held as an example for other countries in the eurozone. On the other hand, critics argue that the adjustment of Ireland had little to do with its structural adjustment program. The export growth took place in sectors with high wage and price in-elastic products, owned by large US multinational firms. In addition, they refer to the ineffectiveness of eurozone policies in the countries of the European periphery. This issue will be addressed in more detail in Chapter 4.
In a situation, where most macroeconomic indicators have fallen considerably, for exports to remain stable is vital for both these economies. This obviously played an important role in their recoveries.

### 2.5.2 Response to the crisis

“Iceland is a dramatic demonstration of the wrongness of conventional wisdom in these times. Ireland did everything it was supposed to; nobody would describe it as “healing”. Iceland broke all the rules, and things are not too bad” (Krugman, 2012).

If we compare Irish and Icelandic response to the crisis it is clear that the differences are partly related to exchange rate and partly to the policies adopted during the crisis. Protecting the banks in response to the crisis was not possible in case of Iceland. Apart from the size of the Icelandic banks as discussed earlier, almost two–third of the banks’ balance sheets comprised of the foreign denominated assets while the foreign currency available in the country’s reserve was only 35 percent of the GDP as reported by Thorgeirsson and Noord (2013) while the ratio of reserve to external debt was only 8 percent as reported by Benediktsdottir et al. (2011). This situation forced Icelandic authorities to go for a policy of denying the burden of foreign liabilities while protecting the domestic operations of the banks. Iceland faced several difficulties in finding external funders while Ireland benefited from EU membership as it received immediate rescue package from EU and IMF.

For Iceland, exchange rate flexibility has played a crucial role in adjustment to the crisis. It increased the export growth while at the same time shifted demand from imported goods to the domestic goods. Adjustment through the exchange rate was not possible for Ireland as a member of the EMU since 1999, but it is important to highlight that the Irish export sector has remained competitive as discussed above. Exchange rate flexibility in Iceland had significant inflationary pressure as inflation reached 12.7 percent while Ireland benefited from the currency union as inflation remained low.
The response of Iceland to the crisis by many economists is seen as a heterodox approach that has never been tried in the past.\textsuperscript{14} The outcome of these policies in Iceland is generally considered successful as compared to the outcome of the route chosen by Ireland. As stated by Joseph Stiglitz,

\begin{quote}
“Iceland did the right thing by making sure its payment systems continued to function while creditors, not the taxpayers, shouldered the losses of banks” (cited in Onaran (2011)).
\end{quote}

In response to the crisis, the heterodox policy helped Icelandic government to get better control over the budget as compared to Ireland. Irish policy response to the crisis resulted in the fiscal crisis as total cost of supporting the banks was 46.3 billion which increased public debt by 32 percent of GDP in 2010 as shown in Figure 2.21. This cost increased to 64 billion euros in 2012 which is almost 40 percent of GDP as reported by Irelands Department of Finance (2012). In Iceland, bank related losses increased public debt by almost 20 percent of GDP as reported in (Darvas, 2011, p.7).

Many economists believe that the terms of the bailout package on which Ireland has agreed are likely to hamper economic growth which might lead to a slow recovery as compared to Iceland which opted for a heterodox policy, e.g., Paul Krugman states,

\begin{quote}
“at this point Iceland seems, if anything, to be doing better than its near-namesake. Its economic slump was no deeper than Ireland’s, its job losses were less severe and it seems better positioned for recovery. In fact, investors now appear to consider Iceland’s debt safer than Ireland’s” (Krugman, 2010).
\end{quote}

Krugman (2010) identifies a number of policy tools available to Iceland that helped in better recovery. First, Iceland saved its tax payers from the debt burden of financial sector while let the foreign lenders pay the price of their bad decisions.

\textsuperscript{14}Icelandic response to the crisis is extensively discussed in Matthiasson (2013).
Second, Iceland imposed capital controls, an option not available in the currency union, and finally Iceland benefited from its own currency as well. While referring to these policy tools, Krugman further states,

“None of these heterodox options are available to Ireland, say the wise heads. Ireland, they say, must continue to inflict pain on its citizens - because to do anything else would fatally undermine confidence” (Krugman, 2010).

Both Ireland and Iceland have not fully recovered from the crisis and it is hard to judge the long run consequences of the two currency regimes. While Iceland experienced a faster recovery and adjustment than its trading partners, the role of currency regime nonetheless is a complex debate.\(^\text{15}\) The exchange rate flexibility, for example, played a mixed role in the build–up and aftermath of the crisis in Iceland. The appreciation of currency apart from large imports allowed businesses and households to speculate, and borrow FX denominated loans. The exchange rate, however, also facilitated crisis recovery but this had devastating impacts on debtors with FX denominated loans along with high inflation. Similarly, the role of capital controls was crucial in the recovery process but the consequences of its removal are not obvious yet. As a result of the capital controls, a significant amount of the foreign capital, in the form of ISK–denominated assets, remains in Iceland. One of the main concerns about removing the capital controls in Iceland is that there would be an immediate outflow which would destabilise the nominal exchange rate.

Finally, the Icelandic government took measures to offer debt relief to the indebted households. These measures involved debt write–offs, lowering principal for households with negative equity and lower earnings, subsidies on interest payments of loans. In particular, up to 20% of the households directly benefited from debt write–offs as highlighted by Olafsson (2012). The government covered 35% - 45%

\(^\text{15}\)Matthiasson and Davidsdottir (2013) argued that Iceland cannot be held up as a role model for other economies. The authors address some of the famous myths regarding Icelandic experience of crisis recovery.
of the interest payments on housing loans in Iceland (Olafsson, 2012). These measures taken by the government had several important implications. i) The cost of the crisis was mainly borne by the top income groups, e.g., if divided into ten income groups, the lowest income group in Iceland lost 9% of their disposable income as compared to 26% in Ireland for the lowest income group. The largest cost in Iceland was borne by the top income group with an income loss of 38%, whereas the biggest loss in the case of Ireland was experienced by the lowest income group.\footnote{See, Olafsson (2012) for a detailed discussion on debt relief program in Iceland.} ii) The debt write–offs prevented the rise of household debt after inflation increased as a result of the crisis.\footnote{Most of the household loans in Iceland are indexed to prices.} iii) The debt relief program reduced the effects of the crisis on private consumption.

## 2.6 Conclusion

At the turn of the 21st century, strong financial integration, high levels of innovation, and lower interest rates across global markets paved a path for extensive financial development in all open economies. The financial sector, already an important driver of growth in Ireland, also became an important pillar of the Icelandic economy. Both countries experienced unprecedented levels of growth in the financial sectors.

Iceland and Ireland, as very small and very open economies, experienced large financial flows mainly due to low risk premia and high liquidity in international markets. However, the mechanism of international borrowing differed between the two countries. The policy of low interest rates in the Eurozone allowed Ireland to internationally borrow in its own currency at lower costs, while bearing zero exchange rate risk. On the other hand, Iceland after gaining access to international markets benefited from sovereign credit rating (AAA). Iceland heavily borrowed by issuing Euro Medium-Term Notes (EMTN) and later by offering higher interest rates on deposits. The increasing size of banks’ balance sheets and high debt burden was unsustainable and eventually led to the crisis.
The increasing size of banks’ balance sheets and high debt burden had largely been ignored before the crisis. Most macroeconomic frameworks failed to anticipate the crisis. The dominant narrative in the mainstream paradigm was that the developments in the financial markets could not be seriously flawed. Intervention in the financial markets was considered to reduce innovation and efficiency instead of improving stability (See (Report of the Commission of Investigation into the Banking Sector in Ireland, 2011, p.94)).

Due to a strong link between financial sector and real sector of the economy, it is crucial to analyse them in one coherent framework. But the role of credit and wealth was ignored in the mainstream models, e.g., the most popular Dynamic Stochastic General Equilibrium (DSGE) model which is used in many Central Banks has a serious weakness, i.e., the absence of appropriately modelling the financial markets (Bezemer, 2010, p.685). According to Tovar (2009), the aggregate financial wealth in the DSGE framework does not matter for agents’ behaviour or for the dynamics of the economy. Model assumptions in the mainstream tradition normally eliminate systematic need for loans, money or credit therefore supply of money in these models is exogenous to the system (Jakab and Kumhof, 2015).

From the recent financial turmoil, it is now obvious that a modelling framework that realizes the role of credit in the system is far better than the one that treats it as ‘given’. Similarly, models that link real sector and financial sector in the economy are more realistic than the ones that models them apart. In this regard, we will use the Stock–Flow Consistent (SFC) Framework to develop a model for small open economy as will be discussed in Chapter 6.
Chapter 3

Experiencing financialisation in small open economies: An empirical investigation of Ireland and Iceland

“One thorn of experience is worth a whole wilderness of warning.”

James Russell Lowell

3.1 Introduction

This chapter examines the link between financialisation and the macroeconomy in Ireland and Iceland.\footnote{This chapter is published in International Review of Applied Economics. I authored approximately 75% of the chapter.} We focus on international capital flows and examine the effect of openness to trade and factor payments on the current accounts of each country.

Financialisation as a broad concept refers to an overall increase in financial activities of various kinds, the introduction and use of new financial instruments
contributing to an ever increasing emphasis of financial motives among economic agents (Hein, 2013). While there is little doubt that increased financial sophistication is closely linked with long term economic growth (Levine, 1997), the effects of excessive financialisation can be harmful and lead to negative short-term and long-term effects (Greenwood and Scharfstein, 2013).

Apart from increased financial fragility and financial crisis, financialisation has been held accountable for declining business sector investments (Stockhammer, 2004; Van Treeck, 2008; Orhangazi, 2008), increased household indebtedness (Palley, 1996; Dutt, 2006) and a more unequal distribution of income (Hein, 2013). The international dimension of financialisation is discussed by Hein (2012) and Stockhammer (2004) with an emphasis on the role of capital-account liberalisation and financial globalisation.

Stockhammer (2004) points out the liberalisation of capital flows has contributed to global instability, particularly because of the influence of the speculative cross-border carry trade (see also Lancastle (2011). The effects of financialisation also include the transmission channels of financialisation on the macroeconomy (Hein and Dodig, 2014). The view that a simultaneous opening of trade and financial liberalisation promote financial development is also referred to as the Rajan and Zingales (2003) hypothesis in the literature.

This chapter makes two contributions to the financialisation literature. First, we critically examine developments that preceded the crises in Iceland and Ireland, point out the importance of institutional differences and show clearly that they do not, as many authors claim, represent Frost’s road less travelled, except for Ireland’s membership of the euro zone. Rather, to borrow from another poet, James Russell, Ireland and Iceland represent two thorns of experience. Accordingly, we describe the forces that encouraged capital inflows into Ireland and Iceland, the effect on the real economy and the development of macroeconomic aggregates following the financial sector turmoil that hit Iceland in 2008 and Ireland in 2008-2010.
Second, using three separate aspects of financialisation: financial depth, credit growth and deposit liabilities of the financial sector, we construct auto regressive distributive lag (ARDL) models for each country and explore the dynamic relationship between financialisation and the transmission channels of financialisation as discussed in the literature on financialisation.

The chapter is organised as follows. Section 3.2 looks at the broad strokes of the story, examining in a comparative way the experiences of both countries with respect to their current accounts, private sector credit, financial depth, and the intersectoral effects of financialisation. Section 3.3 presents comparative empirical analyses of financialisation in the two countries, employing ARDL approach. Section 3.4 concludes with policy recommendations and a plan for further work.

### 3.2 Capital flows, credit and asset price bubbles

The European single market in capital had the effect of increasing capital mobility between countries. Mobility was further increased with the introduction of the euro in 1999 but has fallen in recent years due to the financial crisis.

Ireland became an international hub for large multinational companies and eventually an international centre of financial activity (Lane, 2014). This achievement was mainly due to tax policy initiatives aimed at attracting foreign investments (Ó’Riain, 2014). Ireland’s entry into the Eurozone increased its overall attractiveness to foreign investors further, as highlighted by Honohan (2010). Large capital flows and aggressive lending in rising residential and commercial property markets allowed the household and financial corporate sector to increase their debt from 2002 to 2007. The bubble that burst in 2007 was an old-fashioned house price bubble, and the consequences have largely been borne by households, the government, and the non-financial corporate sector (Kelly, 2007; Kinsella, 2012). In Iceland, the road to financialisation was somewhat different, as we will explain although political factors also played an important role.
The causes of the capital inflow into Iceland and Ireland can to some extent be traced to low risk premia in international capital markets but also to domestic factors. Iceland and Ireland, as very small and very open economies, benefited from the period of low risk premia and high liquidity in international capital markets from the beginning of the decade as well as historically loose monetary policies. Ireland’s membership of the euro zone increased the interconnection of capital markets. There was a sea change in the availability of cross-border bank funding that led both Irish and Icelandic banks to borrow from foreign banks.

In Ireland, without the complication of a foreign exchange exposure after 2001, and combined with a decade–long experience of very strong domestic growth from 1994 to 2004, the capital inflow exposed Ireland to large downside risks channelled through the domestic banking system. For a very small open economy with a highly developed export sector dependent on multinational companies, particularly in pharmaceuticals, countries outside the euro area with excessively expansionary fiscal policies helped push the level of Irish nominal GDP ever higher as debt-fuelled increases in their consumption and investment levels increased Irish GDP accordingly (Ó’Riain, 2014).

Iceland also effectively became exposed to a fully liberalised financial environment within Europe. The subsequent privatisation of the banking sector in 2002–2003 was seen as a move away from backward state-controlled banks into the modern era of financial liberalisation. Having gained access to global capital markets, Icelandic companies and newly privatised banks benefited from the AAA status of the sovereign and rushed into financial ventures overseas, eventually accumulating financial debt and assets of gargantuan proportions. The capital inflow transformed Iceland into a hedge-fund like structure.

Thus the international context certainly contributed to the credit boom, the strong increase in household debt in Ireland and financial sector - as well as the non-financial business sector - debt in Iceland, the generation of a property bubble in Ireland and a stock-market bubble in Iceland and the general overheating of the economies, including distorting the labour market towards expanding sectors.
Ireland experienced an old-fashioned asset bubble in the residential and commercial property markets caused by excessive credit lent to households from the financial corporate sector. The growth rate of the ratio of private sector credit to GDP increased by 380% from 2002 to 2007 before falling significantly in 2008 as the crisis took hold. The stock of outstanding debt to income for the household sector is still very high by international standards, standing at 196% at the end of 2014. The Icelandic economy was more vulnerable to a fall in the stock market due to a pattern of cross ownership and the use of leverage to fund investments in the stock market through limited liability companies, while the Irish economy was exposed to its domestic housing market.

To make matters worse, Irish fiscal policy was highly pro-cyclical\(^2\) (Fitzgerald, 2009; Weymes and Bermingham, 2012), and as the years of the boom went on, increasingly dependent on windfall taxes from property transaction taxes rather than on carbon, water, or site-value-type taxes. Coordinated wage-setting policies increased wages over the period, and income-tax policy accommodated these increases by reducing income tax rates. This substitution from income taxes to stamp-duty and capital gains taxes did not go unnoticed. Both the EU Commission and the OECD highlighted the weaknesses coming from a narrowing of the tax base, but as Ireland’s Stability and Growth Pact targets and commitments were never in breach, they had little official recourse and as detailed in Ó’Riain (2014), the Irish authorities were not interested in discussing any potential weaknesses. Once the crisis hit, only Ireland’s extremely low government debt to GDP ratio (24% net debt to GDP in 2006) helped in buffering the large fiscal shock as the authorities tightened fiscally as output fell and unemployment rose from 4% to 15.1% in 23 months. Fiscal policy in Iceland was also pro-cyclical (see Benediktsdottir et al. (2011). The government lowered corporate taxes from 30% to 18% at the end of 2001 and in February 2008 to 15%. The personal income tax rate was also lowered by 1% in each of the three years 2005, 2006 and 2007, property taxes abolished and the value-added tax lowered in 2007.

\(^2\)While the revenue increased due to increased property taxes, the spending growth of the government was also high during the years of boom. The policy stance was relatively relax, given positive output gaps and current account deficits.
The overheating of the economy and high economic growth in both the countries was accompanied by an investment boom. Another consequence of the expansion of credit was its effect on the labour market: the share of employment in construction in Ireland as percentage of total employment more than doubled from the 1990s to 2007. In Iceland, employment in the construction industry went from 6.88% of total employment in 2003 to 9.80% in 2008; employment in financial services and insurance went from 3.95% of total employment to 5.04% of total employment in 2008.

In both countries, the level of microprudential and macroprudential supervision by the regulatory authorities was lacking in the extreme. The level of risk management within individual banks, as well as core credit risk controls, was not sufficient. As a consequence of this lack of rigour in Ireland, the supply of credit to residential investments as a percentage of GDP reached nearly 13 per cent in 2006, double its long-run average. Regulatory supervisors were either blind to, or actively ignored, increasing risk concentration. In Ireland, this particularly applies to the aggressive expansion of Anglo Irish Bank, which expanded the size of its balance sheet by 200% in three years between 2004 and 2007. The expansion of credit fed into an unstable dynamic of increasing asset prices, increasing expectations amongst households of ever-increasing property values, which fed into wage increase demands and fed further demand for property. With effective regulatory supervision, credit supply could have been more effectively contained. The lack of supervision and regulation in Iceland has similarly dire consequences as described by Hreinsson et al. (2011). The banks did not set aside funds to cover expected losses on FX lending to unhedged borrowers - non-financial firms, households and municipalities - they inflated their capital by lending to buy own shares either directly through off-shore holding companies or indirectly through employees or their owner’s other companies; they lent a significant share of their capital to related parties; and last but not least inflated a stock market bubble that saw stock prices rise at an unsustainable rate. Domestic credit grew at very impressive rates between 20% and 31% in the years 2004–2007 (see Benediktsdottir et al. (2011)). As a result when the banks could no longer roll over their international debt the
stock prices were bound to fall and the domestic value of the FX borrowing of Icelandic firms to increase, leaving large parts of the economy, including the banks themselves, insolvent.

The mechanisms of the capital inflow differed somewhat between the two countries. Current account surpluses in other countries, low risk premia and low central bank interest rates in the Eurozone and in the U.S. created capital inflows that made the Icelandic krona appreciate which made the current account negative. The Icelandic central bank responded to the ensuing domestic investment boom generated by rapid credit creation by raising interest rates, which then created profit opportunities for the carry trade. The carry trade consisted of foreign currency speculators taking positions in the Icelandic krona, as well as local businesses and also households borrowing in foreign currency and hence taking an unhedged position in the currency market.

Firms that borrowed in foreign currencies showed higher profits as long as the Icelandic krona kept appreciating - which it did from 2003 to 2006 and then again until 2008 - but eventually turned technically bankrupt when the krona tanked in 2008. In this way the Icelandic economy took on enormous bets in the currency market, a development that was helped by the central bank’s high interest rate policy. In effect the central bank was forced to prevent the exchange rate from depreciating through ever higher policy rates because of the effect a depreciation would have on balance sheets in the business sector, hence the banks’ loan books and their solvency. From 2006 onwards, the economy was dependent on high interest rates and continued confidence in the currency. A sudden stop of capital inflows was bound to make the financial system collapse. The stock market bubble increased the volume of speculation even further. Investors could, through limited-liability holding companies, borrow in foreign currencies and invest in domestic stocks and record accounting profits from both the rise in stock prices and the appreciation of the currency. The expected depreciation of the currency was not recorded in annual statements in line with accounting rules and conventions.\(^3\) The

holding companies appeared to be perpetual money making machines without imposing any risk on the individuals involved. But a sudden stop of the capital flows was bound to make both stock prices and the currency fall, making the holding companies, and hence also the banks that had lent to them, bankrupt.

What made Iceland’s situation even more precarious was a decision made by the authorities at the beginning of the decade to create an international banking centre through low taxes, light regulation and minimal supervision, in effect to attempt to emulate the Irish banking sector. Banking was supposed to become new industry employing the educated young generations. As a result, supervision and regulation were almost deliberately neglected and the aggressive behaviour of bankers and government officials won them few friends abroad. Iceland found itself with a private sector locked into a huge currency bet having taken a long position in the krona an oversized banking sector lacking a lender of last resort and, finally, lacking the support of friendly and understanding allies. No other government or central bank had sufficient confidence in the authorities to be able to offer financial help without the IMF’s involvement. Already in early 2008, at the time when trouble was building up in the global financial market, Icelandic banks were among the first to confront financing difficulties (Baldursson and Portes, 2013). By the time that global market conditions had changed from gloomy to desperate, it became embarrassingly obvious that the Icelandic financial system was lacking a lender of last resort in foreign currency at a time when such services were desperately needed.

3.2.1 The collapse and its aftermath

There were early indicators of risk to Iceland’s financial system that preceded the world financial crisis. Already in late 2005, financial markets expressed scepticism towards the Icelandic financial model - the combination of high external debt, rapidly rising stock prices and increased private sector debt - and subsequently a mini crisis emerged in early 2006 when Icelandic banks experienced severe financing difficulties in international markets as discussed in Section 2.2.3. Sensing the
mounting macroeconomic imbalances, foreign investors started to sell kronur assets causing the currency to depreciate and stock prices to come down. The financial system was at risk because local banks were cut off from world financial markets and the fall in asset prices and the currency meant that the solvency of holding companies and non-financial businesses was under threat. However, falling foreign interest rates and a public relations exercise by the government managed to turn things around, the CDS on the banks’ debt fell and the currency recovered, the banks could continue with their borrowing.

Following a successful re-entry through bond issuance in the US market and the launch of the now infamous (but then wildly successful) on-line deposit schemes in 2006 (the Icesave accounts offered by the Landsbanki in the U.K. and the Netherlands), the Icelandic banks were able to resume their growth again. The final sign of approval came when Moody’s in early 2007 placed the Icelandic banks in the highest rating category, allowing them to continue their aggressive growth strategies even more forcefully than before.

Facing the abyss of financial collapse in late 2008, the Irish and Icelandic authorities responded somewhat differently. In Ireland, the authorities effectively guaranteed the obligations of the whole banking system while Icelandic authorities failed to set up lines of credit with foreign central banks and could therefore not offer any such guarantee. When the world capital market seized up in September and October 2008 the Irish banks were saved by the ECB through liquidity support while the Icelandic banks failed due to a lack of a lender of last resort and also their insolvency as the domestic stock market bubble burst and the exchange rate fell. The Icelandic authorities responded during the collapse by guaranteeing local deposits in local currency while leaving out deposits in foreign currencies\(^4\) and by splitting the operations of each of the three fallen commercial banks into domestic (new) and foreign (old) part and allowing the “old” banks to go into receivership. Furthermore, widespread capital controls were introduced. Starting with a new balance sheet, the “new” banks in Iceland were in fact given a significant room to

\(^4\)The separate treatment of domestic currency and foreign currency deposits was the source of conflict between the Icelandic authorities, on the one hand, and the British and Dutch authorities, on the other hand.
restructure domestic currency debt as financial assets were transferred following significant revaluation.

Thus Ireland was left with increased state debt due to the insolvency of the Irish banks while Iceland, freed from most of its foreign debt, had to rebuild a banking system from scratch and redefine property rights in its mostly technically insolvent private sector. Nevertheless the direct fiscal costs of the financial crisis were significant in Iceland and greater than in all other affected countries than Ireland.5

While Iceland suffered a currency and a banking crisis as a result of the sudden stop of capital inflows, Ireland had a banking crisis and a sovereign debt crisis. Its euro membership shielded it from a currency crisis but instead made the same economic forces active in the market for government bonds. Ireland’s euro membership also saved the Irish banks from collapsing in 2008 but did not provide funds for recapitalisation, which increased the government’s debt. Both countries had to bring in the IMF and adopt austerity programs aimed at restoring fiscal sustainability and rebuild the impaired financial system.

Andritzky (2014) compares public policy towards resolving the mortgage debt crisis in the two countries. In Iceland, the government announced a foreclosure moratorium and froze the level of debt payments. Subsequently, it implemented debt relief that took different forms over an extended period of time with the burden primarily carried by external creditors. In Ireland, a comprehensive reform of insolvency legislation was carried out. Forbearance in the form of interest only payments reduced the burden on household’s while mortgage workout was delayed. Resolution only began in earnest when the insolvency reforms were close to completion and the recovery became visible. The main difference between the two countries when it comes to mortgage debt relief stems from the ability of the Icelandic authorities to finance mortgage relief largely at the expense of the foreign creditors. In a surprise verdict, the Supreme Court decided that most the foreign currency loans had in fact been illegal, which forced the banks, two of which are

\footnote{The total gross fiscal outlays were 44.2% in Iceland and 40.7% in Ireland, while the net outlays, once account is taken of recoveries, were 20.5% in Iceland and 40.7% in Ireland. These two numbers dwarf those for the Netherlands (12.7% gross and 5.6% net) and the U.K. (8.8% gross and 2.1% net). See Laeven and Valencia (2012).}
owned by the foreign creditors, to convert them into domestic currency loans. The banks suffered further losses on their loan books as a result. This was not possible in Ireland where the sovereign had to recapitalise the banks without being able to impose losses on foreign creditors.

3.3 Empirical analyses

3.3.1 Data and methodology

Financialisation is a broad concept with so many dimensions as we explained in the Irish and Icelandic experience. The phenomenon in general refers to increasing financial activities, which is reflected in the increased balance sheets of the banking sector, speculative financial investments, large capital inflows, rising stock prices, and high credit growth. Hence, there is no single variable which can grasp all these aspects, making empirical studies more challenging. Another potential problem associated with empirical studies is that different aspects of financialisation can evolve in different time periods, e.g., after privatization of the Icelandic banking sector during 1998-2003, the banks initially expanded their balance sheets through wholesale funding while development in the banks’ deposit liabilities came much after the liberalisation of Iceland’s financial markets.\(^6\)

The measure of ‘financial development’ used in the literature is one aspect of financialisation often based on the size and depth of the financial sector. In our empirical section, we use three conventional measures\(^7\) of financial development as proxies of financialisation in order to cover the developments in financial sector that took place in different time intervals. Due to data limitations our proxies, also based on size and depth of financial sector, reflects only one dimension of financialisation. However, we show the dynamic interaction of these proxies with the transmission channels that affected the real sectors.

\(^6\)See Gudmundsson (2015) for an extended review on the process of financialisation in Iceland.

\(^7\)Due to data limitations, we were not able to compute any other proxies for financialisation in this paper.
Our first proxy is based on the stock of liquid liabilities, the ratio of M3 to GDP ($FDEV$) as a measure of financial development and financialisation. For this proxy, we use quarterly time series data from 1997Q4 to 2013Q4 for Iceland and from 2002Q1 to 2013Q4 for Ireland. The data are taken from the statistical databases of the respective central banks. The stock of liquid liabilities (M2 or M3) to GDP and the private credit are the most commonly used measures of financial development in the literature (see King and Levine (1993); Rousseau and Wachtel (2000); Bhattacharya and Sivasubramanian (2003)). The assumption here is that stock of liquid liabilities is positively linked with financial activities and a higher M3 to GDP implies a larger financial sector.

Second, we use private credit to GDP ($Credit$) and third, the ratio of deposit liabilities of the financial sector to GDP ($FDL$), to measure financial development and financialisation. We use quarterly data from 2003Q4 to 2013Q4 for Iceland and from 2002Q1 to 2013Q4 for Ireland. Using three proxies of financialisation covers different financial aspects in an economy and covers the developments in the financial sector that took place during different time intervals.

The Pearson product-moment correlation for our measures of financialisation is reported in the Table below. All measures of financialisation in both the countries are strongly correlated, except the financial depth and credit in Iceland; the correlation is highly significant but strength of relationship is modest.

<table>
<thead>
<tr>
<th></th>
<th>Ireland</th>
<th>Iceland</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FDEV</td>
<td>Credit</td>
</tr>
<tr>
<td>FDEV</td>
<td>1</td>
<td>0.82***</td>
</tr>
<tr>
<td>Credit</td>
<td>1</td>
<td>0.77***</td>
</tr>
<tr>
<td>FDL</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

To investigate the international dimension of financialisation, we use trade openness ($Trade$) and foreign rentiers’ income ($INV$) in our analysis. Trade openness, defined as the sum of imports and exports to GDP, is widely used as a measure of globalization in empirical studies. Foreign rentiers’ income share, which is paid
in the form of equity and dividends to non–residents, measures investment income to GDP. This also reflects financial liberalisation of a country as these investment returns are paid on their respective capital inflows. Hence, we test the hypothesis that a simultaneous opening of trade and financial liberalisation promote financial development.

Another important aspect of financialisation discussed by Hein (2013) is that a fall in wage share is compensated by a rise in household debt, which results in debt-led-consumption booms. To analyse this aspect of financialisation, we use household debt to GDP ((HHD) and wage share\(^8\) (Wage) in our empirical analysis. HHD is defined as households’ liabilities to financial corporations, taken from the financial accounts while wage share (Wage) is computed according to the definition in AMECO.

### 3.3.2 Model

We develop three ARDL models for each country. Using three models allows us to compare the dynamics of one model with another for each individual country as well as between the two countries. The three models are represented as follows:

Three ARDL models for each country are presented as follows.\(^9\)

Model 1

\[
\Delta \ln FDEV_t = \alpha_0 + \sum_{i=1}^{4} \alpha_1 \Delta \ln FDEV_{t-i} + \sum_{i=0}^{4} \alpha_2 \Delta \ln Wage_{t-i} + \sum_{i=0}^{4} \alpha_4 \Delta \ln Trade_{t-i} \\
+ \sum_{i=0}^{4} \alpha_3 \Delta \ln HHD_{t-i} + \sum_{i=0}^{4} \alpha_5 \Delta \ln INV_{t-i} + \psi D_i + \Phi T + \epsilon_t
\]

---

\(^8\)For Iceland, quarterly data for the compensation of employees is not available, therefore we use the quadratic–sum method to compute quarterly time series from the annual observations.

\(^9\)In the case of Iceland, we estimate Model 1 using unadjusted wage share due to data constraints, while in Model 2 and Model 3, we use the adjusted wage share. For Ireland, we use adjusted wage share in all the models.
**Model 2**

\[
\Delta \ln \text{Credit}_t = \alpha_0 + \sum_{i=1}^{4} \alpha_1 \Delta \ln \text{Credit}_{t-i} + \sum_{i=0}^{4} \alpha_2 \Delta \ln \text{Wage}_{t-i} + \sum_{i=0}^{4} \alpha_3 \Delta \ln \text{Trade}_{t-i} \\
+ \sum_{i=0}^{4} \alpha_5 \Delta \ln \text{INV}_{t-i} + \psi D_i + \Phi T + \epsilon_t
\]

**Model 3**

\[
\Delta \ln \text{FDL}_t = \alpha_0 + \sum_{i=1}^{4} \alpha_1 \Delta \ln \text{FDL}_{t-i} + \sum_{i=0}^{4} \alpha_2 \Delta \ln \text{Wage}_{t-i} + \sum_{i=0}^{4} \alpha_4 \Delta \ln \text{Trade}_{t-i} \\
+ \sum_{i=0}^{4} \alpha_5 \Delta \ln \text{INV}_{t-i} + \psi D_i + \Phi T + \epsilon_t
\]

In the model below, \( \sum_{i=1}^{4} \) represents the sum of lags, \( \Delta \ln \) represents first order difference of logged variables, \( \Psi D_i \) represents the crisis dummy, and \( \Phi T \) represents time trend. In Model 2 and 3 for both the countries, we refrain from using household debt in the model because household debt is a component of private credit to GDP whereas in Model 3, the data sample for Iceland is small which does not allow us to include many variables in the model. Hence, for a consistent comparison we do not include household debt for Ireland in model 3 as well.

We choose to use an ARDL modelling strategy because it allows for the mixing of variables with different order of integrations. It allows one to directly estimate long run and short run coefficients along with the speed of adjustment (error correction term) from short run to long run. Moreover, reparameterising the model to study cumulative dynamics is simple.

The statistical properties of all the variables, the estimation strategy, structural breaks, and robustness and diagnostics of our models are discussed in the appendix.

---

10 Dummy takes the value of 1 during the last 3 quarters of 2008 since we find a structural break in the proxies of financialisation, using Zivot and Andrews (1992) methodology. However in the case of Iceland, the structural break in FDL series occurred in 2011 therefore the dummy takes the value of 1 in 2011Q3.
3.3.3 Results and discussion

The results of the final restricted ARDL models are reported in Table 3.2 & 3.3 while the cumulative dynamics are reported in Table A4 & A4 in Appendix A. In case our results for individual lags are inconclusive, we will consider the cumulative dynamics of the models in deriving any inferences.

The results in Table 2 suggest that the foreign rentiers’ income share in the current account is positively linked to all the three proxies of financialisation in Iceland and Ireland. The strength of correlation in the case of Ireland is stronger as compared to Iceland. The significant correlation reflects financial liberalisation in both the countries, which has clearly increased in the past decade. There is a remarkable difference in the factors affecting financial liberalisation of both the countries, which needs to be highlighted. In the case of Ireland, payments in the form of dividends on equities held by international investors is more dominant than the interest payments, while for Iceland, interest on debt instruments totally dominates the payment stream to non-residents. In Iceland the significance of the interest on debt reflects the capital inflow in the form of bank borrowing abroad or the carry trade discussed in Section 2. Indeed, the significance of interest payments in the financialisation process in Iceland can be understood to capture the speculative or even Ponzi finance elements of the capital inflow when interest payments called for further borrowing.

Another important component of current account in our model is trade openness, reflecting globalisation, indicates different results in Ireland and Iceland. In the case of Iceland, we find a negative effect of trade openness on financialisation for all the three proxies employed in our analyses. On the other hand for Ireland, we find that trade openness has a positive relationship with two proxies of financialisation, namely credit to GDP and deposits liabilities to GDP, while the relationship is negative in the case of financial depth as a proxy for financialisation.\(^{11}\) Hence, we

\(^{11}\)Although the 4th lag of trade openness is negatively associated with the deposit liabilities to GDP, the cumulative dynamics indicate an overall strong positive effect (see Table A3 in the Appendix).
have partial evidence in support of a positive relationship between trade openness and financialisation in Ireland.

The negative effects of trade openness on financialisation in Iceland’s case are consistent with the capital inflows impeding exports through a higher real exchange rate. In addition to the capital inflows, Iceland also has a steady stream of foreign currency revenues from its fishing sector on top of having had a persistent current account deficit through most of its history. By causing the real exchange rate to be elevated for many decades, the fishing sector has made it difficult for any other export sector to grow, hence keeping trade openness down. Trade openness in Iceland fell due to a fall in export to GDP at the time when financialisation process reached its peak in 2007-08. In contrast, in the post crisis period trade openness has increased due to the effect of a lower real exchange rate on the export industry, tourism in particular, while all financialisation measures have shrunk. The contraction of GDP also had the effect of raising the ratio of exports to GDP and trade to GDP in the post-crisis years.
Table 3.2: Estimated Coefficients for Iceland

<table>
<thead>
<tr>
<th></th>
<th>(Model 1)</th>
<th>(Model 2)</th>
<th>(Model 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta \ln INV_t$</td>
<td>$-$</td>
<td>$-$</td>
<td>0.05***</td>
</tr>
<tr>
<td>$\Delta \ln INV_{t-1}$</td>
<td>$-$</td>
<td>$-$</td>
<td>0.09***</td>
</tr>
<tr>
<td>$\Delta \ln INV_{t-2}$</td>
<td>$0.03^{***}$</td>
<td>$-$</td>
<td>0.06***</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td></td>
<td>(0.03)</td>
</tr>
<tr>
<td>$\Delta \ln INV_{t-3}$</td>
<td>$-$</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.04)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>$\Delta \ln INV_{t-4}$</td>
<td>$-$</td>
<td>0.06***</td>
<td>0.07***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.01)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>$\Delta \ln Trade_t$</td>
<td>$-$</td>
<td>$-$</td>
<td>$-0.45^{***}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.15)</td>
</tr>
<tr>
<td>$\Delta \ln Trade_{t-1}$</td>
<td>$-0.20^{***}$</td>
<td>$-$</td>
<td>$-0.41^{**}$</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td></td>
<td>(0.14)</td>
</tr>
<tr>
<td>$\Delta \ln Trade_{t-2}$</td>
<td>$-0.13^{**}$</td>
<td>$-0.69^{***}$</td>
<td>$-0.56^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.18)</td>
<td>(0.15)</td>
</tr>
<tr>
<td>$\Delta \ln Trade_{t-3}$</td>
<td>$-0.28^{***}$</td>
<td>$-0.40^{**}$</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.13)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>$\Delta \ln Trade_{t-4}$</td>
<td>0.08</td>
<td>$-0.60^{***}$</td>
<td>$-$</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.13)</td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln Wage_t$</td>
<td>0.84***</td>
<td>2.08***</td>
<td>0.48***</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.21)</td>
<td>(0.20)</td>
</tr>
<tr>
<td>$\Delta \ln Wage_{t-1}$</td>
<td>$-0.91^{***}$</td>
<td>0.53***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.13)</td>
<td>(0.18)</td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln Wage_{t-3}$</td>
<td>0.32***</td>
<td>$-0.87^{***}$</td>
<td>0.44***</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.21)</td>
<td>(0.20)</td>
</tr>
<tr>
<td>Dummy</td>
<td>$-$</td>
<td>0.10</td>
<td>$-0.52^{***}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.09)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>$\Delta \ln HHD_{t-1}$</td>
<td>$-0.15^{**}$</td>
<td>$-$</td>
<td>$-$</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln HHD_{t-2}$</td>
<td>0.03</td>
<td>$-$</td>
<td>$-$</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln HHD_{t-3}$</td>
<td>0.07***</td>
<td>$-$</td>
<td>$-$</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>$-1.15^{***}$</td>
<td>0.004</td>
<td>0.03***</td>
</tr>
<tr>
<td></td>
<td>(0.48)</td>
<td>(0.01)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Observations</td>
<td>64</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.68</td>
<td>0.51</td>
<td>0.41</td>
</tr>
<tr>
<td>LB–test</td>
<td>10.70</td>
<td>6.25</td>
<td>13.58</td>
</tr>
<tr>
<td></td>
<td>(0.55)</td>
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Note: ***, ** and * indicate that the null hypothesis is rejected at the 1%, 5% and 10% levels, respectively.
Table 3.3: Estimated Coefficients for Ireland

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<th>(Model 3)</th>
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<tr>
<td>Δ(lnINV_t)</td>
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<td>–</td>
<td>–0.28**</td>
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<tr>
<td></td>
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<tr>
<td>Δ(lnINV_{t-1})</td>
<td>0.23**</td>
<td>–</td>
<td>0.17**</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td></td>
<td>(0.07)</td>
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<tr>
<td>Δ(lnINV_{t-2})</td>
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</tr>
<tr>
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<td>Δ(lnINV_{t-4})</td>
<td>–</td>
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<tr>
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<td>(0.08)</td>
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<td>(0.17)</td>
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<tr>
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<td>0.24***</td>
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<td>(0.13)</td>
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<td>(0.01)</td>
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<td>Δ(lnHHD_{t-1})</td>
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<td>Δ(lnHHD_{t-4})</td>
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<td>(0.01)</td>
<td>(0.01)</td>
</tr>
</tbody>
</table>

Observations 47 47 47

Adjusted R² 0.48 0.54 0.44

LB-test 18.08 9.20 12.79

Note: ***, ** and * indicate that the null hypothesis is rejected at the 1%, 5% and 10% levels, respectively.
The negative effects of trade openness on financialisation are similar to the findings of several empirical studies, e.g., Baltagi et al. (2009); Kim et al. (2010, 2012); Zhang et al. (2015).

Overall, the differences in the relationship between financialisation and trade openness in the two countries stem from Ireland having received foreign direct investment while in Iceland such investment was less important with the exception of a few large foreign direct investment projects in the aluminium sector.\(^\text{12}\) Thus, a speculative capital inflow, based on Iceland’s experience, can reduce trade openness through a higher real exchange rate while foreign direct investment, based on Ireland’s experience, can increase openness. However, as mentioned earlier, trade openness also had a significant negative impact on one of the financialisation proxies (i.e., financial depth) in Ireland. These differences make the effect of trade openness on financialisation unclear and at the same time give rise to an interesting debate on the dual role of financialisation in small open economies.

We find that our three proxies of financialisation indicate a strong positive relationship with wage share in both the countries. For Iceland, our results are consistent for both adjusted and unadjusted wage shares. Our findings for the wage share are in contrast to the existing literature on financialisation. Here it is important to highlight that previous studies have mainly used annual data with a longer time span covering different regimes, while we have used quarterly data for a shorter time span mainly covering periods of increased cross-border financial flows. There is also the possibility that labour demand has an investment dimension so that a capital inflow and domestic credit creation that generates an investment boom also has the effect of raising wages and employment and a sudden stop of capital inflows makes both employment and wages fall as described in Zoega (2010). In this case the wage growth is not a cause of the financialisation but rather a consequence of the capital inflows and credit creation. Moreover, the positive relationship between wage shares and financialisation in Iceland can also be explained by the higher wages paid to employees in the financial sector. In

\(^{12}\)In 2006, there were large investment projects in aluminium smelting but due to sudden stop in 2008, these projects did not reach their completion.
Ireland, wage growth may also have fed onto the house price bubble and increased household borrowing and hence played a more integral part in the financialisation process, a process that played a much less significant role in Iceland.

It is important to highlight that we estimated the short run dynamics of the model while the existing literature (e.g., Hein and van Treeck (2010) and Dallery and van Treeck (2011)) has argued that in the medium to long run, the wage share is likely to decrease due to an increasing shareholder power. It might well be the case that wage share and financialisation in Iceland and Ireland have a negative long run relationship but our findings are inconclusive, given the absence of cointegration in the current data.

Finally, household debt to GDP in both the countries indicates a positive relationship with financial depth to GDP in Model 1. The effect of household debt on financial depth in the case of Ireland is much stronger than in Iceland. This is consistent with our discussion in Section 2: household debt was important in Ireland but less so in Iceland where financial and non-financial debt drove the process of financialisation.

### 3.4 Conclusion

The goal of this paper is to understand the different effects of financialisation on two small, open economies. Financialisation matters precisely because excessive capital flows can damage the structures of small open economies as well as amplifying boom-bust cycles with large distortionary and distributional effects.

The experiences of Ireland and Iceland are similar in many ways, in that large gross flows from the rest of the world acted to destabilise their economies in the run up to the 2008 crisis. Our results provide strong empirical support in favour of the argument that financial liberalisation promoted financialisation in the small economies of Ireland and Iceland. We find that foreign rentiers’ income share, in the form of interest and dividends, is positively linked to financialisation. These
enormous profit outflows to non-residents asserts a negative pressure on the current account balance and further widens macro imbalances by attracting more inflows. Such scenarios for a small economy like Iceland and Ireland increases financial fragility as well as affecting the autonomy of their macroeconomic policies.

There is however a difference in the currency regime of the two countries which is reflected in the effect of trade growth on financialisation. We find partial evidence of trade growth promoting financialisation in Ireland, leading us to accept the Rajan and Zingales (2003) hypothesis. In particular, these results imply that openness of trade along with financial liberalisation promotes two financial proxies, namely credit to GDP and deposit liabilities to GDP, while for Iceland, trade growth is negatively associated with all measures of financialisation. This apparently puzzling result for Iceland can be attributed to the effect of the capital inflow on the exchange rate and exports in Iceland, an effect that was not present in Ireland due to its euro membership. In both the countries the share of imports rose rapidly as compared to exports, pushing their current accounts into deficits.

There are also sectoral differences both in the issuance and the holding of the debt by each country. In Ireland, the household sector holds almost all the debt, while in Iceland the non-financial corporate sector built up very large debt levels. This is also confirmed by our results where we find a weak relationship between household debt and financial depth in Iceland but a strong one in the case of Ireland.

Policy makers require new tools to track credit flows to sectors, while the international dimension of small open economies like Iceland and Ireland remains a concern going forward. In particular, there are several policy lessons to be drawn from the episode. First, even though the channels through which the capital inflow occurred differed between the two countries, it is clear that speculative capital inflows create financial instability. Thus the first lesson is to adopt macroprudential polices that limit the size of such inflows and thus prevent a sudden stop of the inflow from creating unmanageable financial and macroeconomic disturbances. The types of policies differ depending on the currency arrangement. Second, small economies should not have large banking sectors even if they have a lender of last
resort in the Eurozone because the sovereign has to be able to recapitalize the banks if they suffer losses. Without such a lender of last resort, which was the case of Iceland, a large banking system is inherently fragile since a suspicion about liquidity problems can easily cause a bank run. A large well-diversified economy is needed to support a large banking system.

Appendix A

Unit root, Structural breaks, and Estimation technique

We apply standard Augmented Dickey-Fuller test (ADF) (Dickey and Fuller, 1981) and Phillips-Perron (Phillips and Perron, 1988) unit root tests to the level data in order to check if the variables are stationary. We extend our analysis to the unit root structural break test of Zivot and Andrews (1992), which endogenously determines a break in the mean and the trend of the data. We conclude that all the variables are I(1). Consequently, we apply cointegration tests: First, we use residual based method suggested in Engle and Granger (1987) since all variables are I(1). Second, we use the bounds test of Pesaran et al. (2001) and compare our test statistics with the corresponding bounds. Third, we use Johansen approach of cointegration based on trace statistics and eigen values (Johansen, 1991). Overall, the evidence suggests that there is no cointegration between the variables used in our analysis.

For estimating the models, we follow a general-to-specific modelling strategy. Due to the short data sample, we begin our estimation with a maximum of only four lags. We further reduce the models by dropping insignificant coefficients and confirm our reduction with an F-test. We also consider AIC and BIC methods for making a choice in reducing the model.
Diagnostic tests and robustness

We conduct several diagnostic tests to make sure the estimated coefficients are efficient and unbiased. We test the models for autocorrelation using Durbin-Watson and Ljung-Box tests and accept the null hypothesis of no autocorrelation in all the models. We examine multicollinearity in the models by analysing variance inflation factors (vif) and find evidence of low multicollinearity in the models, but not sufficient enough to affect the significance of our coefficients (see Fox and Monette (1992)). To account for heteroskedasticity in the model, we use Newey-West estimation method and report the heteroskedasticity and autocorrelation consistent (HAC) covariance matrix estimators.

Finally to ensure the stability of our models, we test the null hypothesis of coefficient and residual stability against the alternative that they are not stable, indicating a structural break in the model. Several structural break tests are applied: First, we extend the Chow test (Chow, 1960) in order to overcome the drawbacks of traditional Chow test, by computing F-statistics for all potential break points in the model finding that the models are stable. Second, we perform stability tests on the cumulative sum (CUSUM) on recursive residuals and CUSUM on the estimators, finding that the coefficients of the models are stable at 5% significance level.

Figure A1: Iceland (CUSUM test of recursive residuals)
We also test Model 1 for the period before the occurrence of a structural break and after the structural break for both the countries. We find that the interpretation of our results do not change, however, we refrain from drawing any further conclusions due to fewer degrees of freedom in the post crisis sample. Unfortunately, we could not split Models 2 and 3 for Iceland due to fewer observations. However, we strongly believe that in Iceland the sign of coefficients might not change after the crisis in 2008, but the strength of correlation between financialisation and our independent variables might have changed.
Most dynamic models are sensitive to lag lengths. For this reason we perform additional experiments on our models by varying lag length to ensure robustness. The estimated coefficients are found to be robust for all the models.

Finally, our modelling strategy in this paper is subject to several limitations primarily due to data constraints. First, we reduce the models to study the dynamic effects up to four lags to avoid overparameterisation, losing important information from the previous years. Second, we find structural breaks in the financial proxies for Iceland, which we control for using dummy variables, however, we could not re-estimate any model for the periods before and after the structural break in the series, except Model 1. Third, we use first order differences of logged series in our models to avoid the problems of spurious regression. This can possibly reduce the developments that take place in the original data, which can result in an underestimated impact of the variables on financialisation.

<table>
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<th>Table A1: Statistical Description for Ireland</th>
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<td>lnCredit</td>
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<td>lnFDL</td>
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<td>lnWage</td>
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<tr>
<td>lnHHD</td>
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<tr>
<td>lnTrade</td>
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<td>lnINV</td>
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The negative values in the table for the skewness means the data is left skewed while the positive numbers indicate that the skewness is rightward. The absolute values of skewness for all the variables are less than 1, which means that the skewness is moderate and asymmetry is not extreme. For Ireland, kurtosis for all the variables is lower and negative except for Trade, which is positive and greater than the kurtosis value of 3 for a normal distribution. For Iceland, all the variables have a negative kurtosis.
Table A2: Statistical Description for Iceland

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<th>SD</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
<th>Skew</th>
<th>Kurt</th>
<th>SE</th>
<th>JB-χ²</th>
<th>P.value</th>
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<td>0.37</td>
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<td>6.03</td>
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Table A3: Estimated Coefficients for Iceland

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<th>(Model 3)</th>
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<td>(0.67)</td>
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<td>(0.66)</td>
<td>(0.77)</td>
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<td>(0.54)</td>
<td>(0.62)</td>
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<tr>
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<td>-0.47***</td>
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<tr>
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<td>(0.09)</td>
<td>(0.15)</td>
</tr>
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<td>-0.53***</td>
<td>0.23</td>
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<td>(0.27)</td>
</tr>
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<td>-1.01***</td>
<td>-1.56***</td>
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<td>(0.15)</td>
<td>(0.26)</td>
<td>(0.40)</td>
</tr>
<tr>
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<td>-1.50***</td>
<td>-1.58***</td>
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<td>(0.22)</td>
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<td>(0.47)</td>
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<td>-2.10***</td>
<td>-1.72***</td>
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<td>(0.42)</td>
<td>(0.53)</td>
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<td>0.01</td>
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<tr>
<td>$\Delta \ln H_{t-3}$</td>
<td>-0.40**</td>
<td>-</td>
<td>-</td>
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<tr>
<td></td>
<td>(0.14)</td>
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<tr>
<td>$\Delta \ln H_{t-4}$</td>
<td>-0.63***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.19)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ***, ** and * indicate that the null hypothesis is rejected at the 1%, 5% and 10% levels, respectively.
Table A4: Estimated Coefficients for Ireland

<table>
<thead>
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<th></th>
<th>(Model 1)</th>
<th>(Model 2)</th>
<th>(Model 3)</th>
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<tr>
<td>$\Delta \ln W_{it}$</td>
<td>-0.06</td>
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<td>0.17</td>
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<td>$\Delta \ln W_{i,t-1}$</td>
<td>-0.21</td>
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<td>(0.18)</td>
<td>(0.34)</td>
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<td>-0.24</td>
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<td>0.55**</td>
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<td>(0.20)</td>
</tr>
<tr>
<td>$\Delta \ln W_{i,t-3}$</td>
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<td>0.98**</td>
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<td>(0.33)</td>
<td>(0.30)</td>
<td>(0.39)</td>
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<tr>
<td>$\Delta \ln W_{i,t-4}$</td>
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<td>1.00***</td>
<td>2.34***</td>
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<td></td>
<td>(0.41)</td>
<td>(0.36)</td>
<td>(0.44)</td>
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<td>$\Delta \ln T_{it}$</td>
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<td>0.89***</td>
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<tr>
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<td>(0.18)</td>
<td>(0.11)</td>
<td>(0.30)</td>
</tr>
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<td>-0.53**</td>
<td>0.65***</td>
<td>1.28***</td>
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<tr>
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<td>(0.20)</td>
<td>(0.18)</td>
<td>(0.40)</td>
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<td>-0.98***</td>
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<td>1.27***</td>
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<td>(0.26)</td>
<td>(0.29)</td>
</tr>
<tr>
<td>$\Delta \ln T_{i,t-3}$</td>
<td>-1.04***</td>
<td>0.56**</td>
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<td>0.65***</td>
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<td>(0.20)</td>
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</tr>
<tr>
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<td>(0.11)</td>
<td>(0.10)</td>
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<td>(0.17)</td>
<td>(0.15)</td>
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<td>$\Delta \ln I_{i,t-2}$</td>
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<td>(0.13)</td>
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<td>-0.04</td>
<td>0.34</td>
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<td>0.43**</td>
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<td>Dummy</td>
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<td>0.08</td>
<td>-0.25***</td>
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<tr>
<td></td>
<td>(0.27)</td>
<td>(0.23)</td>
<td>(0.01)</td>
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<tr>
<td>$\Delta \ln H_{it}$</td>
<td>0.58***</td>
<td>-</td>
<td>-</td>
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<td></td>
<td>(0.26)</td>
<td>(0.23)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>$\Delta \ln H_{i,t-1}$</td>
<td>0.34</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.16)</td>
<td>(0.23)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>$\Delta \ln H_{i,t-2}$</td>
<td>0.75***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
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<td>(0.15)</td>
<td>(0.23)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>$\Delta \ln H_{i,t-3}$</td>
<td>0.54**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.26)</td>
<td>(0.23)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>$\Delta \ln H_{i,t-4}$</td>
<td>0.71*</td>
<td>-</td>
<td>-</td>
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<tr>
<td></td>
<td>(0.21)</td>
<td>(0.23)</td>
<td>(0.01)</td>
</tr>
</tbody>
</table>

Note: ***, ** and * indicate that the null hypothesis is rejected at the 1%, 5% and 10% levels, respectively.
Chapter 4

Capital inflows, crisis and recovery in small open economies

4.1 Introduction

In Chapter 2, we argued that in the years preceding the crisis many small open economies in pursuit of financial development – regardless of their exchange rate regimes – developed large external imbalances. We also argued that the process of financial development in Iceland and Ireland was more aggressive than in other economies and that both the economies were the first victims of global financial crisis.

As previously discussed, the prevailing situation at the time forced Iceland to follow a more heterodox monetary approach along with conventional fiscal consolidation to counter the crisis. Capital controls were imposed to prevent further depreciation of the krona. On the other hand, Ireland’s membership in currency union tightly bound it to follow a conventional approach of banks’ bailout, austerity measures and internal devaluation, resulting in a sovereign debt crisis, wage repression, and mass emigration.

Since the onset of the crisis, a different recovery pattern has emerged across the world’s developed economies. The recovery pattern is still widely debated with no
consensus, while the situation in Greece has revealed a large divergence between policy makers and academics. Three main views have so far emerged as follows:

- One group of economists, ‘the austerians’, consider the “pre-crisis fiscal position” as an important determinant of the crisis and emphasise fiscal consolidation to resolve the crisis (see, for example, (Krugman, 2015)).

- Another group considers external imbalances as the main cause of the crisis and calls for an approach of rebalancing through internal devaluation in the deficit countries (see, for example, Dieppe et al. (2012)).

- Some call for a more radical change in the existing policy mix for which they propose a policy of increasing wages and inflation in the surplus countries via nominal GDP targeting.

The current policy measures in the eurozone largely consists of the first two combinations, however in a scenario of compressed domestic demand, these policies have further reduced confidence by imposing tough measures on the deficit countries, resulting in prolonged recessions.

The aim of this chapter is to understand the international dimension of the crisis in small open economies operating under different exchange rate regimes, using Ireland and Iceland as examples. The chapter seeks to establish some empirical ground on which to discuss the recovery pattern of small open economies in general, and Iceland and Ireland in particular.

Our contribution is related to the literature on external imbalances and exchange rates in small open economies. To our knowledge, this is the first study that empirically investigates Iceland’s crisis with a focus on the exchange rate. Iceland, being an extreme case, has previously been ignored in empirical studies. Our chapter has two main contributions. First, we empirically investigate the dynamics of recovery patterns in the two countries where we discuss and distinguish the adjustment mechanism in a fully sovereign regime from that in a currency union. Second, our chapter contributes to the ongoing debate on recovery in small open
economies operating under different exchange rate regimes, where we carefully
discuss the policy implications in the light of our empirical findings.

The remainder of the chapter is organised as follows. Section 4.2 explains the
theoretical and empirical literature on external imbalances under different currency
regimes, including a discussion of Iceland and Ireland. The section also discusses
the process of development and adjustment of external imbalances under different
currency regimes. Section 4.3 explains the financial inflows and sudden stops while
focusing on Iceland and Ireland. Section 4.4 empirically investigates the current
account adjustment. Section 4.5 concludes the chapter.

### 4.2 Literature review of exchange rate regimes

Exchange rate regime is one of the oldest and most controversial debates in macroeconomics. The exchange rates literature has evolved over the past 100 years (Bordo, 2003; Komulainen, 2000). A large section of the literature is based on
empirical studies, however, a considerable amount of theoretical studies also ex-
ists.

Traditionally, policy makers considered a fixed exchange rate regime as promoting
stable economic growth, but after the breakdown of Bretton Woods in 1971, this
policy changed as several intermediate regimes emerged (Combes et al., 2016).
Traditional literature on the international dimension of exchange rate is mostly
based on the argument that the balance of payments is driven by international
trade and the exchange rate operates through the trade channel, e.g., a country
with trade deficit balances its deficit through capital inflow or eventually through
official reserves (Bordo, 2003). This view changed after a series of dramatic crises
including, Britain in 1976, Europe (EMS) in 1992, Mexico (1994), Thailand, In-
donesia, and Korea (1997), Russia and Brazil (1998), Ecuador (1999), and Turkey
(2000). These crises inspired a new wave of research and the policy focus shifted
to the role of large capital flows alongside traditional real variables in the balance
of payments (Glick and Hutchison, 2005; Lane and Shambaugh, 2010).
Crisis periods led to the perception that even adjustable fixed regimes with a combination of liberalised capital flows are unsustainable and vulnerable to speculative attacks (see Ghosh et al. (2002); Husain et al. (2005)). Increasing capital flows posed new challenges for open economies, known as the trilemma or “impossible trinity”. This debate resulted in a strand of literature that formed the opinion, known as the bipolar view or the corner solution (See (Eichengreen et al., 1994; Bubula and Otker-Robe, 2003)). However, Fischer (2001) questioned the validity of the bipolar view and argued that the countries involved in the crisis had pegged or fixed exchange rate regimes. Many argued in favour of more flexible and floating exchange rates, while considering the combination of fixed exchange rate and liberalised capital flows as destabilising and unsustainable (Stiglitz, 2000). In general, there was a growing consensus in favour of a more flexible and floating regime.

“...times of economic disturbance and disorder, of crisis and chaos, are times when economic analysis is especially likely to be wrong. Yet such times are also when economics is most useful” (Krugman, 2012).

### 4.2.1 Theoretical literature

Economists developed several theoretical frameworks for open economies to understand the currency crisis. They are typically classified into three categories. First generation models in Krugman (1979); Flood and Garber (1984) were developed in response to currency crises in developing countries. The underlying feature of the first generation model is that a currency crisis can be generated by fiscal deficits, i.e., a government finances its fiscal deficits by using reserves. When reserves are exhausted the government finances its deficit by printing new money, which would put pressure on the currency. The fixed exchange rate eventually becomes unsustainable and the government decides to abandon the fixed exchange rate regime. The government decision to abandon the regime is exogenous in these models.
Second generation models in Obstfeld (1986, 1994) were developed to understand the EMS crisis in 1992. In second generation models a representative government with an objective function can decide in every period whether to abandon or maintain a fixed exchange rate. This decision of the government is based on the cost benefit analysis of maintaining a fixed exchange rate regime. The models have multiple equilibria, and the government can accommodate agents’ expectations. Economic fundamentals such as fiscal deficit or current account balance do not play a direct role in these models. The currency crisis in the model is generated by a speculative attack of the traders due to fear of devaluations for unexplained reasons.

Third generation models in Krugman (1999); Chang and Velasco (2000, 2001) were inspired by the Asian crisis of the late 90s. In general, third generation models incorporated the balance sheet effects of the private sector (banks and firms). Moreover, these models also included foreign currency debt and captured the effects of deleveraging on the real economy. It is hard to generalise the third generation models as pointed by Glick and Hutchison (2011), however, it is important to highlight that several others have significantly contributed to this framework (e.g., Dooley (2000); Aghion et al. (2001); Burnside et al. (2004); Calvo et al. (2008)).

After the introduction of the euro, the exchange rate debate calmed down in Europe after some degree of nominal stability was achieved. The policy of low interest rates in the eurozone meant that member states could internationally borrow in their own currency at lower costs, while bearing zero exchange rate risk (Lane, 2012). This scenario widened the gap between borrowers and creditors by pushing them into two extreme corners of deficit and surplus. Thus, the EMU set a platform for imbalances as highlighted by Hale (2013). The exact causes of these imbalances still remain an open question, but currently there are two plausible explanations for this in the EMU, a) a decline in the savings and a rise in the investments of the deficit countries Blanchard and Giavazzi (2002); Lane (2012), b) loss of competitiveness due to appreciation of the real exchange rate in the deficit countries Trichet (2011). These imbalances between the member states were considered irrelevant in a monetary union, or perhaps went unnoticed, until
the eruption of the crisis. However, it is worth mentioning that the politicians and policy makers have described the eurozone crisis as the sovereign debt crisis in 2009, as mentioned in Kaelberer (2014).

Many crises of the past as we highlighted in the previous section were essentially balance of payment crises.

“One might think at first that the international macro crisis literature is somewhat unrelated to the issues of the past four years, since it was overwhelmingly concerned with balance of payments and capital flow issues, not sovereign debt” (Krugman, 2014).

However, Krugman (2014) argues that this distinction is more apparent than real for two reasons, a) the eurozone crisis being arguably a balance of payment crisis than a sovereign debt crisis, b) speculative attacks due to loss of confidence increased the cost of public and private borrowing in the initial period of the crisis, however, intentions of an active role from ECB has decreased the cost of private borrowing by reducing the spread.

A balance of payments crisis is usually preceded by a combination of persistent CA deficits due to excessive financial borrowing and overvalued exchange rate. For CA deficits to prevail persistently, money has to constantly flow into the country. The constant inflow of money eventually creates a large pile of external debt in the recipient country. The external debt at some point reaches a level too large to sustain, which can either lead to a balance of payment crisis or a banking crisis, or both. This scenario coincides with or increases the likelihood of a sovereign debt crisis. This argument is also supported by several empirical studies (See Reinhart and Rogoff (2011)).

The eurozone crisis for some member states such as Ireland, is deeply rooted in the balance of payments problem due to large external imbalances, which later translated into sovereign debt crisis in attempts to guard the financial system. Ireland maintained a sound fiscal position in the period preceding the crisis but
after the decision of the bailout, the fiscal balance deteriorated which resulted in a sovereign debt crisis (See Krugman (2014b); Kaelberer (2014)). This debate still generates controversy in Ireland because the asset price boom generated a considerable amount of tax revenue for the government, reflecting a close nexus between the two.

Financial borrowing might have improved the Irish fiscal balance during the boom, but the boom in itself was a result of the external imbalances due to large inflows, with which fiscal policy had little to do. Weak fiscal position might be a contributing factor to the eurozone crisis but is not the underlying cause of the crisis, while the fundamental problem lies in the balance of payments in our opinion.

Similarly, other small economies outside the eurozone which retained their own sovereign currencies such as Iceland and the Baltic states, clearly faced balance of payments problems of their own (Grønn and Fredholm, 2013). Iceland with a policy of high interest rates to counter inflation, attracted large inflows, which exposed Iceland’s economy to a destabilising speculative attack. In the pre-crisis period Icelandic krona experienced an overvaluation due to inflows, which is a typical response for a floating currency. Like the Irish case, Iceland too had a sound fiscal position prior to the crisis. Iceland’s good sovereign credit rating encouraged large inflows but the crisis resulted into a deteriorated fiscal position.

Apart from generating imbalances, large financial inflows created large investment booms as well as increased debt-led consumptions which resulted in overheating of these small economies. The Icelandic central bank responded to the ensuing domestic investment boom by raising interest rates, which then created profit opportunities for the carry trade and attracted more inflows.

According to economic theory, the imbalances are unlikely to develop under a floating regime as timely adjustment takes place through depreciation Hale (2013). A sovereign currency in this case can avert the crisis, while in a currency union such as the EMU, no timely adjustment can take place and large imbalances can easily develop.
The adjustment even in the case of a sovereign floating currency is not always timely as explained in the theory and the imbalances can grow large. In this case a delayed adjustment is painful as observed in the Icelandic experience of large inflows and overvaluation of the krona. However, an important distinction here is that a tool of adjustment is available to Iceland which, if did not avert the crisis, can help in the adjustment process by absorbing the shock of the crisis through external devaluation.

In contrast for Ireland and other members of the eurozone, the absence of adjustment mechanism makes the adjustment process much more challenging. The adjustment in this case is slower and can only be achieved through real exchange rate devaluation in order to boost the exports. But the difficulty here is that the real exchange rate is not a policy variable and this can only be achieved through internal devaluation by reducing wages. This in turn pushes the economy into a long lasting recession along with high unemployment due to spending cuts.

The adjustment policy of the eurozone has placed the entire burden of adjustment on the debtors, while ignoring the flaws that exist within the framework of the monetary union. Policies of fiscal consolidation and internal devaluation have been enforced on the deficit countries such as Ireland, where the banking crisis played a more dominant role than the fiscal balance. These policies are aimed at restoring confidence in the markets but the opposite has happened so far. The balance of payment crisis is tightly bound with the sovereign debt crisis and it is now becoming clear that the fiscal policy alone has not achieved the adjustment in the short-run. In addition, implementation of these policies in itself is a big concern, as such policies are associated with large social and political costs.

We now proceed to discuss the empirical literature on the current account dynamics under different exchange rate regimes.
4.2.2 Empirical literature

While there is a large empirical literature on currency regimes and current account dynamics, we will largely focus on the studies of advanced economies which also include Eurozone countries. The current account adjustment of the Eurozone countries has become highly controversial due to the same currency as discussed above.

There are some empirical studies, which argue that exchange rate regime does not matter for the adjustment pattern. For example, Chinn and Wei (2008) compiles data for a panel of more than 170 countries over the 1971 – 2005 period to investigate the relationship between exchange rate regimes and current account adjustments. Chin and Wei find that real exchange rate affects the current account adjustment but nominal exchange rate does not matter. In explaining this result, they extend their analysis to the relationship between nominal and real exchange rate dynamics, finding that there is no strong monotonic relationship between nominal flexibility and the convergence speed of real exchange rate towards its long-run equilibrium. The authors conclude that the mean reversion (current account adjustment) takes place irrespective of the exchange rate regime. Hence, their analyses rule out the benefits of a floating currency in the process of correcting external imbalances. Algieri and Bracke (2011) analyse the current account dynamics in 23 industrial and 22 emerging market economies over the period 1973 - 2006. They identify 70 episodes of current account adjustments in 23 industrial and 22 emerging market economies. The authors divide these episodes in three main categories, differentiating the underlying factors behind current account adjustment. i) Internal adjustment, where the current account adjustment is the result of a slowdown in growth due to domestic demand compression without much movement in real exchange rate. This category of adjustment in their analyses constituted majority of the episodes. ii) External adjustment, where the current account adjustment was primarily due to real exchange rate depreciation. iii) Mixed category, where adjustment was the result of both real exchange rate
and slowdown in economic growth. The authors finally conclude that the adjustment pattern cannot be explained by exchange rate regime but is explained by economic conditions and business cycle positions.

In general a large number of studies find that real exchange rate (proxy for competitiveness) amongst other factors is an important variable for the current account dynamics. Ghosh et al. (2013) investigate the dependence of current account dynamics on exchange rate flexibility. The authors construct a bilateral trade-weighted real exchange rate volatility measures for 159 countries using data sample 1980 - 2010, finding significant impact of exchange rate on the current account dynamics. The authors conclude that flexible exchange rates result in a rapid adjustment of the current account in all economies (advanced, EM, and developing), and the persistence of current account imbalance is lower under flexible regimes.

Gnimassoun et al. (2013) investigate the link between exchange rate misalignments and current account imbalances for a panel of 22 industrialised countries over the period 1980 – 2011. The authors decompose the real exchange rate time series into episodes of overvaluations and undervaluations. They implement estimation of a panel smooth transition regression model using nonlinear specification, finding that current account imbalances are affected by exchange rate misalignments in general. Their results for the euro area in particular suggest that overvaluations are associated with increased persistent imbalances as compared to undervaluations.

Gossé and Serranito (2014) investigate the effect of real exchange rate on current account in a panel of 21 OECD countries over the period 1974 - 2009. Their findings regarding the Eurozone economies indicate that real effective exchange rate is one of the most important factors in explaining current account dynamics in the short–run. Belke and Dreger (2013) analyse the current account dynamics for a panel of 11 euro area members over the period 1982 - 2011. They find significant effects of real exchange rate on current account balance in the euro area. Furthermore, the authors propose adjustment in the deficit countries by increasing competitiveness while arguing against any adjustment in the surplus countries. The authors believe
that adjustment in surplus countries would result in loss of wealth at the entire euro level.

In the case of euro area, there are also studies which do not find any significant relationship between real exchange rate and current account balance. For example, Gabrisch and Staehr (2013) implement a VAR model to investigate the causality between relative unit labour costs and current account balance to GDP for a panel for 27 EU countries, using a sample for the period 1995 – 2011. They find that current account balance affects relative unit labour costs, but finds no evidence of relative unit labour costs affecting the current account. Atoyan et al. (2013) investigate the relationship between current account and real effective exchange rate for a panel of EM economies for the sample 2000 – 2012. The authors introduce an interacting dummy in the model for the crisis. Their results indicate that the real exchange exchange rate does not play any significant role in explaining the current account dynamics in the boom years for advanced Europe (including Peripheral countries). Furthermore, the authors find that the coefficient on interacting dummy is significant, concluding that the effects of real exchange rate in the post–crisis period are significant. Lane and Milesi-Ferretti (2012) investigate the current account adjustment in advanced and emerging economies following the recent financial crisis. They find that the post-crisis contractions in current account balances were sharp in those countries whose current account balances exceeded levels explained by fundamentals. Furthermore, their results suggest no evidence of real exchange rate affecting the post-crisis current account dynamics in the Eurozone, but find evidence of domestic demand compression playing a crucial role in the current account adjustment.

4.3 Sudden stop and crisis under different regimes

For a small economy with sovereign currency, episodes of large inflows pose serious threats to its financial system by generating misalignments and increasing volatility. Misalignment in the form of overvaluation weakens competitiveness by
pushing real exchange rate\(^1\) above its long-run equilibrium. The loss of competitiveness and the artificial rise in real wages due to overvaluation results in an increase in the consumption of tradable goods. Debt is used to finance consumption which overheats the economy. The excessive external borrowing eventually creates unsustainable debt dynamics (Gala, 2008). The reversal of the process due to sudden stop does not converge the economy to its equilibrium level smoothly but instead rapidly pushes all the above indicators in an opposite direction (e.g., demand compression, fall in wages, exchange rate devaluation). This has serious consequences for the financial system because large misalignments have important effects on the balance sheets of the domestic sectors, especially when the debt is denominated in a foreign currency.

For a comparison of sovereign floating regime against a currency union in small open economies, we estimate the real exchange rate misalignment in Iceland and Ireland by using a simple Hodrick-Prescott filter. Misalignment is the deviation of real exchange rate from its long run equilibrium. Note that the increase of real exchange rate in this chapter implies overvaluation or appreciation.

Figure 4.1: Real exchange rate misalignment

![Figure 4.1: Real exchange rate misalignment](image)

Figure 4.1 clearly shows that Iceland experienced a higher degree of real exchange rate misalignment as compared to Ireland. We highlight the episodes of large

\(^{1}\text{Real exchange rate in this chapter is defined as } REER = \frac{E_t P_t^*}{P_t}, \text{ where } E_t \text{ is the nominal exchange rate, } P_t \text{ is the price level in the home country, and } P_t^* \text{ is the relative price level in trading partners. An increase in the real exchange rate implies an appreciation.} \)
misalignments in Iceland during 2005 to 2011. During this period, Iceland experienced large deviations of real exchange rate from its long-run equilibrium, i.e., the real exchange rate is clearly overvalued between 2005 to 2008, except for a brief period of depreciation in 2006\(^2\) due to the mini crisis in Iceland. Since the onset of the crisis, the Icelandic real exchange rate is undervalued due to sudden stop. This has boosted export growth by increasing competitiveness.

In contrast, the real exchange rate for Ireland has been less volatile as compared to Iceland. This is one of the underlying features of the EMU that it has considerably reduced the real exchange rate variability of its member states as compared to the non-members. Eurozone as a single unit has maintained a balanced CA but the difference of real exchange rate between the member states is significantly large than one would expect in a currency union. Countries in the European periphery experienced a real exchange rate appreciation as compared to the countries in core. This is seen as one of the important determinants of widening imbalances between the member states as discussed earlier. Table 1, which represents a measure of cyclical volatility\(^3\), shows that the Icelandic exchange rate is much volatile as compared to Ireland.

Figure 4.2a shows a clear distinction in the dynamics of real exchange rates and trade flows in Iceland and Ireland. Iceland operating under a sovereign regime also experienced large real exchange rate appreciation. The artificial rise in real wages due to overvaluation resulted in an increase in the consumption of tradable goods, creating trade deficits (See Figure 4.2b). The subsequent capital outflow in 2008 made the real exchange rate fall. There is a clear co-movement in the import share and real exchange rate in Iceland while on the other hand in Ireland, the real exchange rate apparently does not seem to interact with the trade flows. An interesting feature of both the countries is that the export sectors have remained

\(^2\)Exchange rate received little to no attention in Iceland until 2006.

\(^3\)Volatility is calculated as follows:

\[
x = \left[ \frac{x_t - \text{trend}(x_t)}{\text{trend}(x_t)} \right] \ast 100 \]

; where \(x_t\) is the original series and \(\text{trend}\) is Hodrick-Prescott trend.
competitive in the pre and post crisis period. This has played a vital role in the recovery process of both the countries.

Figure 4.2: Real exchange rate and trade flows

![Real exchange rate and trade flows](image)

Note: Real exchange rate measured as relative prices, imports as a share of GDP, exports as a share of GDP).

Source: Statistics Iceland, OECD, CSO Ireland

The real exchange rate in Ireland also appreciated from 2000 to 2008 at the height of the financial bubble due to rising prices but the movements are more tempered. The real exchange rate has fallen since then because of deflationary pressures.

Exchange rate flexibility in Iceland also had a significant inflationary pressure as the annual inflation reached 12.7 percent in 2008. Iceland’s experience of exchange rate pass through to its consumer price index is not different than the experience of other sovereign regimes in similar situations, e.g., Malaysia’s experience of high inflation during the Asian financial crisis. In contrast for Ireland as a member of the EMU, a different scenario developed as it experienced a fall in the CPI, which is seen as a major obstacle to recovery. Deflation exacerbates the problem as real debt burden increases, leading to a further fall in the domestic demand.

4.3.1 Composition of financial flows

Not all flows are potentially harmful. The source and composition of inflows, and where these inflows end up in the recipient economy, are important questions to address for small open economies.
Theoretically, if the foreign investment is sustainable and is used in generating resources which can potentially pay back the cost of borrowing, then temporary deficits can contract without causing market volatility. Such properties are normally attributed to the FDI investments which temporarily increase the deficit, but which can also increase competitiveness by affecting productivity through capital accumulation. For example, FDI has played a crucial role in the development of the Irish economy during the Celtic tiger period.

However, FDI does not flow in isolation and is accompanied by other volatile investments, which are portfolio investments (PFI) and other investments (OI) as part of the current account. These volatile investments are easy to pull out due to their fleeting relationship with the recipient market, which makes them potentially destabilizing for the ‘host’ economies. A point of concern with regards to capital account openness is that the proportion of these volatile and other short-term flows has substantially increased over the last two decades. It has been argued that the innovation in the financial markets has increased short-termism in the corporate sector, which has resulted in increased financial investments as compared to real investments (see Orhangazi (2008); van Treeck (2009)).

Figure 4.3: Ireland: Inflows and share prices

Figure 4.3 shows the composition of the capital inflows into Ireland along with the variation in share prices. During 2004-08, the proportion of PFI and OI considerably increased while FDI fell. Share prices during this period were entirely

Source: OECD, CSO Ireland
driven by PFI and OI inflows. Inflows into Ireland consisted of large amounts of both equities and debt securities.

For Iceland, the openness of financial (capital) accounts occurred at a time when financialisation dominated the stock markets. This scenario is arguably one of the external reasons which led to a large proportion of international financial investments. A large proportion of inflows into Iceland were in the form of PFI and OI, while the proportion of FDI remained smaller in the initial years of liberalisation (See Figure 4.4).

The speculative financial inflows either dwarf the benefits of the real investments or make them ineffective due to the probability of a sudden stop. For example, there is an increase in FDI in Iceland during 2006-08, where a large proportion of investment was in export projects (e.g., aluminium smelting), but these projects became ineffective and did not reach their completion due to the crisis. Theoretically, investments in export projects would increase long run economic capacity and competitiveness and would contract external deficits in the future. In Iceland’s recent case, Baldursson and Portes (2013) have argued the completion of export projects would have likely reduced the deficit, as Iceland has done so in the past after the completion of large investment projects.

Figure 4.4: Iceland: Inflows and share prices

Investment inflows in Iceland mostly consisted of debt securities which sharply increased during 2003-06, as investors took advantage of interest rate differentials.

Source: Central bank of Iceland, OECD
High interest rates in Iceland also resulted in a large volume of short-term inflows (that is, the carry trade), which appreciated the krona. There is a close nexus between inflows, share prices and the exchange rate in Iceland. The banks heavily relied on shares as collateral and regularly purchased their own shares in the market, which drove share prices above their actual value.

Apart from the composition of inflows, another equally important question concerns the structure of international credit, i.e., the maturity of external debt, which defines future cash flows. Maturity mismatch in the borrowing-lending process can increase financial fragility as well as enhance one’s vulnerability to exchange rate risks. This undermines the credibility of financial corporations in acquiring future credit. Both Ireland and Iceland are good examples of this, where banks financed themselves by issuing short-term debt securities and quickly found that refinancing became a primary concern with regard to maintaining the banks’ operations when debt matured.

However, the pattern of lending differed in the two countries. Ireland had a large proportion of domestic private credit in which the proportion of households’ loans reached unprecedented levels. Most of the credit was used in property construction which generated an old fashioned asset bubble.

In contrast, the lending of Icelandic financial corporations was more diversified as well as risky, where a large proportion of the loans, apart from firms and households, went to holding companies and foreign parties. The investment in Iceland was mainly in aluminium smelting project and other residential constructions.

Despite contrastive borrowing conditions for the two small economies, both countries somewhat followed a similar path in developing large imbalances. These imbalances resulted into a twin crises for both, which eventually translated into a sovereign debt crisis for Ireland.

Iceland became the first victim of the financial crisis and attracted much attention worldwide in the initial phase of the crisis mainly due to its heterodox policies.

\(^4\)In general, the credit risk associated with holding companies is higher than the firms.
However, there was also some revival of interest in the issue of exchange rates in Iceland and the Baltic states for a brief period, when the role of exchange rate became crucial. Later on, sovereign debt crisis emerged in the eurozone, while the Baltics abandoned their currencies and joined the EMU; Icelandic krona has rarely received any attention since then.

4.4 Empirical analysis

4.4.1 Data and methodology

In this section, we investigate the current account adjustment in small open economies operating under different exchange rate regimes, using Irish and Icelandic data. While the main focus our empirical analyses remains on Ireland and Iceland, we will also include other periphery countries (Portugal, Spain and Italy) for the purpose of comparison in the end. However, due to time and space we will not present all statistical details for these countries but will only present our main results.

The variables used in the empirical analyses are the real domestic demand ($D$), interest rate ($r$), real exchange rate ($r_{xr}$), and the current account balance to GDP ($CAB$). Our data sample covers a time period of 1998Q2 – 2014Q3 for Iceland, and 1998Q2 – 2014Q1 for Ireland.

We then estimate the real exchange rate misalignment ($r_{xrM}$) in Iceland and Ireland. We define ‘misalignment’ as the deviation of the real exchange rate from its long-run path. Note that the increase of the real exchange rate in this chapter implies an overvaluation. We also estimate the deviation of the current account ($CAB_{M}$) balance from its long-run path. Time series plots of all the variables are reported in Figure B1 and B2 in the Appendix.

We begin our analysis by testing all the variables for a unit root. First we use Augmented Dicky–Fuller (ADF) test and Philips-Perron (PP) test. The results of
ADF and PP tests are sensitive to the presence of structural break therefore we extend our analysis to a unit root structural break test, using the ‘Innovational Outlier’ (here after IO) test by Perron (1997). The results of IO test are reported in Table B2 and B3 in the Appendix.

We conclude that in both the countries, domestic demand \((D)\) and real exchange rate \((rxr)\) are \(I(1)\), whereas current account balance \((CAB)\) is \(I(0)\). We perform the above testing procedure on the current account deviations \((CAB_M)\), real exchange rate misalignment \((rxr_M)\), and interest rate \((r)\), finding that these variables are stationary and do not exhibit a unit root.

**Model**

We set up 2 models based on a VAR approach. The unrestricted VAR model in levels is:

\[
x_t = \mu_0 + \Pi_1 x_{t-1} + \ldots + \Pi_p x_{t-k} + \phi Q + \varepsilon_t, \quad (t = 1, 2..T)
\]

where \(\mu_0\) is a \(p \times 1\) vector of constants, \(x_t\) is a \(p \times 1\) vector of variables in the model, \(\Pi_1\) is a \(p \times p\) matrix (with \(i = 1,..k\)) of parameters, \(\varepsilon_t\) is a \(p \times 1\) vector of error terms, and \(Q\) is a \(p \times 1\) vector for the crisis dummy.

\(Q\) for Ireland represents pulse intervention, which takes the value of 1 during the crisis period of [2008Q2 – 2009Q1], and zero for the rest of the sample. On the other hand, \(Q\) for Iceland marks the regime shift due to implementation of capital controls, which takes the value of 1 during the crisis and onwards, i.e., [2008Q2 – 2014Q3], and zero before the crisis period.

In our first model, we discuss the current account adjustment by setting up a trivariate VAR model. As we highlighted earlier, large financial inflows created, 1) domestic demand booms, and 2) real exchange rate misalignments. We empirically investigate these two factors in the adjustment of the current account balance by
initially setting up a recursive–VAR model of the following order:

\[
\text{Model A} : x_t = [\Delta rxr, \Delta D, CAB]
\]

\( \Delta rxr \) represents difference of logged real exchange rate, \( \Delta D \) represents the difference of logged domestic demand. Consistent with the standard practice in VAR, all the variables in our analyses are stationary, aiming to generate a stationary vector. In general, the variables are first logged and then included in levels if stationary, or differenced if found to have a unit root. This strategy is widely adopted in the empirical literature. For example, a very similar approach can be found in Lee and Chinn (2006) where a bivariate VAR model of real exchange rates and current account balance is estimated. In their analyses, real exchange rate is expressed as first difference of the logged series while current account to GDP is in levels as it is found to be stationary in its levels. Similarly, Kano (2008) while investigating current account dynamics implement a trivariate VAR model with world real interest rates, net output, and current account to net output. After performing unit root tests, the author generates a stationary vector by including net output as a first difference of the logged series while interest rate and current account to net output are included in their levels.

However, the ordering of variables is crucial in a recursive–VAR model. Our decision of real exchange rate preceding current account balance in the matrix is similar to several other studies (see, e.g., (Lee and Chinn, 2006; Narayan, 2013)), i.e., these studies argue that real exchange rate contemporaneously affects current account. There are also studies which place current account before the real exchange rate (see, e.g., Kim and Roubini (2008); Ilzetzki et al. (2013)). Hence, there is no general consensus on the ordering of current account and real exchange rate in a VAR model. In our initial set up, real exchange rate precedes domestic demand but the ordering of these two variables is unclear in the existing literature.

To overcome the ordering issue in Model A, we extend our analyses to modelling all possible combinations of the trivariate VAR model. We obtain orthogonal impulse responses by considering the following combinations:
We also compare our orthogonal impulse responses with the generalised impulse responses obtained from reduced-VAR. A reduced-VAR model excludes contemporaneous effects, implying that the generalised impulse responses are not sensitive to the ordering of variables in the system. The comparison of different VAR models is a useful exercise to study how the underlying assumptions are affecting the results.

In our second model, we analyse the impact of policy rate on current account deviations and real exchange rate misalignments in Iceland and Ireland. In the previous section, we argued that Icelandic central bank responded to domestic demand boom (mainly due to domestic investment boom) by increasing interest rates which created an opportunity for the carry trade and attracted more financial inflows. We investigate this underlying feature by setting up a 3 variable VAR model for both the countries. Moreover, this model provides further insights on the interaction between real exchange rate and current account in both the countries.

The recursive–VAR model is represented as follows:

$$x_t = [\Delta D, \Delta rxr, CAB]$$

$$x_t = [CAB, \Delta D, \Delta rxr]$$

$$x_t = [\Delta D, CAB, \Delta rxr]$$

$$x_t = [CAB, \Delta rxr, \Delta D]$$

$$x_t = [\Delta rxr, CAB, \Delta D]$$

where $r$ is the interest rate; $rxr_M$ is the real exchange rate misalignment; $(CAB_M)$ is the deviation of current account to GDP. The structure we impose on the model implies that real exchange rate misalignments and current account deviations contemporaneously respond to changes in policy rates. This ordering is similar to the
standard procedure of modelling monetary policy in a VAR model, where interest rate affects exchange rate contemporaneously (see, e.g., Kim and Roubini (2000); Artis and Ehrmann (2006)). Later on, we will change the ordering of the variables and impose a different structure on the model to test its robustness.

4.4.2 Results and discussion

Model A

While considering several lag length criteria, we estimate VAR(5) for Ireland and a VAR(8) for Iceland based on Hannan–Quinn criterion and final prediction error (FPE). Figures 4.5 shows the orthogonalised impulse responses of CA balance to a domestic demand shock in Iceland and Ireland. Following a demand shock of 5 percentage points, the CA experiences a deficit in both the countries. By the same token, compression in domestic demand in the two countries improves CA balance by the same magnitude. The response of CA balance to a demand shock in both the countries is highly significant and follows a similar pattern.

After sudden stop, domestic demand compression in the two countries has significantly contributed to the CA adjustment but this is an obstacle to recovery at the same time. While the imbalances have sharply contracted, large spending cuts have resulted in long lasting recessions. The same applies to Portugal, Spain and Italy as shown by the impulse responses in Figure 4.7. The evidence clearly suggests that compression in domestic demand significantly affects the current account balance in these countries.
Figure 4.5: Domestic demand shock

(a) Iceland

(b) Ireland

Note: x-axis represents quarters, y-axis represents CAB (as a percentage of GDP). Red-dotted line represents 90% confidence band, shock in (a) and (b) is 1% point change in the residual of domestic demand.

Figure 4.6: Real exchange rate shock

(a) Iceland

(b) Ireland

Note: x-axis represents quarters, y-axis represents CAB (as a percentage of GDP). Red-dotted line represents 90% confidence band, shock in (a) and (b) is 1% point change in the residual of real exchange rate.

Figure 4.6 shows the orthogonalised impulse responses of CA balance to a real appreciation (increase in the real exchange rate is an appreciation) in Iceland and Ireland. Following a 10 percent point increase in the real exchange rate, the CA experiences a deficit in Iceland while the effect is completely insignificant in Ireland. The response of CA balance to a real appreciation in Iceland reaches its maximum after 2 years. Once again, the finding in the case of Ireland is similar to other periphery countries where real exchange rate is ineffective in adjusting the current account balance (See Figure 4.8).
To further analyse the dynamics of adjustment mechanism in Iceland and Ireland, we extend our analysis to forecast error variance decomposition (FEVD) of the CA balance. Figure 4.9 shows that most of the variation in the Irish current account is mainly explained by the domestic demand shocks and the current account balance shocks to itself. In Ireland, the amount of current account adjustment attributed to real exchange rate is almost negligible as compared to the domestic demand shocks. Moreover, FEVD analyses of Italy, Spain and Portugal also revealed similar results.

In contrast for Iceland, the variation in CA balance in the initial quarters is mainly explained by real exchange rate shock as well as domestic demand shock. This strongly validates the argument that the adjustment mechanism in Iceland is strongly influenced by real exchange rate as well as domestic demand. Another interesting result to highlight is that the influence of domestic demand on CA balance in both the countries is almost similar in its timing as well as magnitude.
This clearly suggests that the fundamental difference in the adjustment process exists in their exchange rate regimes.

Figure 4.9: Forecast error variance decomposition (FEVD) of CAB in Ireland

Note: x-axis represents quarters, y-axis represents the percentage of variation in current account balance explained by variables in the model.

Figure 4.10: Forecast error variance decomposition (FEVD) of CAB in Iceland

Note: x-axis represents quarters, y-axis represents the percentage of variation in current account balance explained by variables in the model.
Model B

Based on the Hannan-Quinn criterion and final prediction error (FPE), we estimate VAR(3) for Iceland and a VAR(2) for Ireland. The impulse responses of our interest from the baseline SVAR model are reported in shown in Figure 4.11 and Figure 4.12.

The effect of unexpected interest rate shocks on the current account deviation is significant in both countries (See Figure 4.11a and 4.12a). The interest rate shock in the case of Ireland, although with a mild effect, is significant for a longer time span than in Iceland, i.e., the shock is significant for 2 years while in the case of Iceland, the effect of the shock becomes insignificant after one year.

An interest rate shock in Iceland also significantly misaligns the real exchange rate, where an increase in the policy rate overvalues real exchange rate from its long-run path. On the other hand, in the case of Ireland, policy rate has no effect on real exchange rate misalignment (See Figure 4.11b and 4.12b). This finding reflects a stylised fact that on the one hand, i.e., the policy rate has apparently little or no direct impact on the real exchange rate in small economies operating within a currency union. On the other hand, it also shows the effectiveness of monetary policy on real exchange rate in sovereign regimes.

In the case of Iceland, an unexpected shock to real misalignment generates a significant deviation of the current account balance from its long-run path (See Figure 4.11c). The current account deviation roughly follows the pattern of a J-curve, i.e., the current account initially improves in the first 3 quarters and then starts to decline, reaching a maximum deficit in the 5th quarter. In the case of Ireland, a shock to real misalignment has no effect on the current account deviation (See Figure 4.12c). This also provides additional evidence in the favour of our results in the case of Model A.
Figure 4.11: Impulse responses for Iceland (Model B)

(a): response of current account deviation after one percentage point (100bps) interest rate shock.
(b): response of real exchange rate misalignment after one percentage point (100bps) interest rate shock.
(c): response of current account deviation after real exchange rate misalignment shock.

The policy of improving the real exchange rate is mostly aimed at improving the current account through a trade balance effect. The relationship between the real exchange rate misalignment and the current account deviation in this regard has important implications. The existence of a significant relationship in the case of Iceland clearly indicates the adjustment in the current account was facilitated by a fall in the real exchange rate along with a compression in domestic demand. The fall in real exchange rate has considerably reduced the demand for imported goods, thus improving the current account balance through the trade balance effect (See Figure 4.2b). However in the case of Ireland, the real exchange rate has no effect on the current account adjustment. There are two plausible explanations for this, 1) Ireland’s current account deficit before the crisis was entirely due to a large deficit on net factor payments (large financial inflows) while the trade
balance was in surplus. The real exchange rate in this case has little or no effect on the current account adjustment as the underlying reason of deficit is entirely different than the trade balance effect, 2) Due to the same currency in euro area, the fall in Ireland’s real exchange rate had no impact on its import share. The real exchange rate fell in 2009 while the share of imports mildly decreased in 2010-11 after the bailout. This clearly explains the reason that the real exchange rate in Ireland has no effect on the current account adjustment. As mentioned earlier, the exports of both Iceland and Ireland have remained competitive regardless of their real exchange rate levels, which have helped the recovery pattern in both the countries.

4.4.3 Robustness

We pay considerable attention to the robustness of our results. All the variables in our models are stationary and the roots lie within the boundary of the unit circle, which means that the models are stable and converge to an equilibrium level.

To test the sensitivity of Model A, we compare the impulse responses of different VAR models, including a reduced-VAR as well as all possible combinations from our trivariate recursive–VAR.

Figure 4.13 and Figure 4.14 report the results of a domestic demand shock on the current account balance to GDP ratio for different models. For all combinations of recursive VAR we find that the effects of domestic demand shocks on current account balance are statistically significant and strong in magnitude for all countries. The effects of shocks in the case of reduced–VAR are smaller in magnitude in some cases as it excludes contemporaneous effects. However, the shapes of our impulse responses are not sensitive to the ordering of the model, which implies that adopting different VAR models or choosing different variable combinations does not alter our interpretations in any fundamental way.
Figure 4.13: Domestic demand shock

(a) Iceland  
(b) Ireland

Figure 4.14: Domestic demand shock

(a) Italy  
(b) Spain  
(c) Portugal

Figure 4.15 and Figure 4.16 report the effects of real exchange rate shocks on the current account balance to GDP ratio. Choosing different VAR models, we find that the real exchange rate has a very strong and significant impact on the current account balance of Iceland. On the other hand, the effects of real exchange rate shocks on the current account balances of Eurozone countries are weak and insignificant for all VAR models. Moreover, we test all these models for varying lag lengths, finding no major impact on their impulse responses.
Regarding model B, we assumed that real exchange rate misalignments and current account deviations respond contemporaneously to interest rate shocks in our baseline setting. We relaxed this assumption and changed the ordering of the model to $[rr_{x,M}, CAB_{M}, r]$, where we assume that the policy rate now responds to real exchange rate misalignments and current account deviations. Interestingly, the impulse responses of this model are not different than our baseline model indicating strong robustness (see Figure 4.17). We also find that this model is not sensitive to the definition of dummy. Furthermore, the model is not affected by changes in the lag length.
4.5 Conclusion

The period preceding the financial crisis was marked by large financial flows which created wide external imbalances between creditors and borrowers. The absence of a pricing of exchange rate risk in the Eurozone allowed countries like Ireland to borrow at lower costs, while Iceland attracted large inflows, initially benefiting from its good sovereign rating and later through higher interest rates. The sudden stop of inflows resulted in balance of payments problems, eventually turning into full-blown crisis in both countries.

Large inflows pose a serious threat to small open economies. Traditionally inflows in the form of FDI have been associated with long-term economic growth but in
the last decade, the share of FDI in total inflows has significantly fallen. The inflow stream, due to short-termism, has been dominated by short-term inflows, which are destabilising due to their fleeting relationship with the recipient economy. In particular, small economies operating under sovereign regimes are more reactive to these inflows and are easily destabilised primarily due to currency risk premiums. The artificial rise in real wages due to overvaluation results in an increase in the consumption of tradable goods, creating trade deficits as experienced in the case of Iceland. However, a feature shared by most small economies regardless of their exchange rate regime, is that large inflows generally create domestic demand booms due to rises in debt-led consumption, wage spirals, and domestic investment booms. This results in overheating of the economies. Excessive external borrowing eventually creates unsustainable debt dynamics, resulting in sudden stops of one kind or another.

Economies operating under fully sovereign currency regimes have the potential to adjust more rapidly after sudden stops due to domestic demand compression and improved trade balance, as indicated by our results. However, domestic demand recovery combined with a trade surplus in a sovereign currency will have a weaker effect on the current account but a stronger impact on economic growth. Along with adjustment through external devaluation, the option of capital controls and autonomous re-structuring of the financial sector is available.

For Ireland and other members of the eurozone, the adjustment process is slower and can theoretically be achieved through internal devaluation. Yet in practice, it is not entirely clear how real devaluation in the currency union, even if achieved, affects current account adjustments, especially in those countries where trade balance had little role to play in forming imbalances. This has resulted in long–lasting recessions, deflation and high unemployment. Our results clearly suggest that the current account adjustment in the periphery countries has been the result of domestic demand compression due to sudden stops, while there is no evidence of real exchange rate facilitating the current account adjustment. The policies of internal devaluation have so far resulted in a bitter experience of large spending cuts instead of restoring confidence, which resulted in prolonged recessions. The only
viable option is to restore domestic demand in the short–run, and form a strategy to adjust the balance of payments in the long–run. In contrast, current policies have forced the deficit countries to adjust the balance of payments in the short–run by targeting competitiveness at the cost of severe economic contractions, resulting in high unemployment.

Appendix B

Figure B1: Iceland

Figure B2: Ireland

Unit root Structural Break

The IO model with a dummy for the shift in mean and trend is represented as follows:

$$\Delta y_t = c + \alpha_1 y_{t-1} + \beta t + \theta_1 DU_t + \gamma_1 DT_t \sum_{j=1}^{k} d_j \Delta y_{t-1} + \varepsilon_t$$
The results of the ADF and PP test indicate that domestic demand ($D$) and the real exchange rate ($rxr$) exhibit a unit root while the current account balance to GDP ($CAB$) is stationary at levels in both the countries. We compare these findings with the results of IO test as shown in Table A1 below. While accounting for structural breaks, IO test also suggests that ($CAB$) is stationary while ($rxr$) and ($D$) have unit roots in Iceland and Ireland. We then first difference the log of domestic demand and the log of real exchange rate to re-test for the presence of unit root. We conclude that in both the countries, domestic demand ($D$) and real exchange rate ($rxr$) are $I(1)$, whereas current account balance ($CAB$) is $I(0)$.

We perform the above testing procedure on the current account deviations ($CAB_M$), real exchange rate misalignment ($rxr_M$), and interest rate ($r$). We find that the results of IO test are similar to the ADF and PP test except for the real exchange rate misalignment in Iceland; however when we further analyse this series using trend in the IO model, the finding indicates that the series has no unit root. We also test this series using Zivot and Andrews (1992) test which reveals similar results to the IO test with trend specification (see table A3 in the appendix). Based on these findings, we conclude that ($r$), ($CAB_M$) and ($rxr_M$) are stationary and do not exhibit unit roots.

Table B2: Unit root structural break test (IO test)

<table>
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<th>variables</th>
<th>Iceland</th>
<th>Ireland</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>$CAB$</td>
<td>$r$</td>
</tr>
<tr>
<td>TB(break point)</td>
<td>2008Q3</td>
<td>2005Q1</td>
</tr>
<tr>
<td>$\theta_1$</td>
<td>0.04</td>
<td>0.06</td>
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<tr>
<td>$\gamma_1$</td>
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<td>-0.004***</td>
</tr>
<tr>
<td>Test-statistics</td>
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<td>-4.77(8)</td>
</tr>
<tr>
<td>Critical values</td>
<td>-5.06</td>
<td>-5.71</td>
</tr>
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</table>

**Notes:**
- The critical values are based on a 1%, 5%, and 10% significance level.
- The $*$, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.
### Table B3: Unit root structural break test (IO test)

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<tr>
<td></td>
<td>$CAB_M$</td>
<td>$rxr_M$</td>
</tr>
<tr>
<td>TB(break point)</td>
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<td>2008Q4</td>
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<td></td>
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<td></td>
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### Table B4: IO and ZA test

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<td>IO test</td>
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<td></td>
<td>-0.01</td>
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<tr>
<td>Test-statistics</td>
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<tr>
<td>Critical Values</td>
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<tr>
<td></td>
<td>5%</td>
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<td>10%</td>
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Chapter 5

Capital controls and the saving–investment nexus

5.1 Introduction

As described in Chapter 2, Iceland experienced large capital inflows during a credit boom from 2004 to 2008 ending in a collapse of its financial system, when the inflows stopped suddenly in the fall of 2008. The sudden stop of capital resulted in the collapse of the banking system and a wave of bankruptcies in the non-financial corporate sector, shutting down large investment projects. The period of free capital flows ended when capital controls were imposed as part of an IMF programme in November 2008.

After relying on international capital for financing its investments in the years preceding the crisis, Iceland currently operates in a regime of restricted capital mobility at the time of this writing. The implementation of capital controls makes domestic saving an important source of financing. The analysis of savings and investment under capital controls has important implications for the balance of payments and economic growth. In this context, investigating the S–I correlation,
known as the **Feldstein and Horioka (1980)**, hypothesis\(^1\) is of special interest in Iceland after capital controls.

The Feldstein–Horioka puzzle (F–H), described as the “mother of all puzzles” in macroeconomics by (Obstfeld and Rogoff, 2000, p.175), has received a great deal of attention in the literature. Studies on the F–H puzzle considerably differ both in terms of methodologies and their interpretations. The large volume of empirical literature on these methodologies can be divided into three main categories as follows:

- Studies using cross-sectional data, e.g., Feldstein and Horioka (1980); Murphy (1984); Penati and Dooley (1984); Dooley et al. (1987); Coakley et al. (1996); Herwartz and Xu (2010).

- Studies using time-series data, e.g., Miller (1988); Argimon and Roldán (1994); Jansen (1996); Coakley and Kulasi (1997); Abbott and Vita (2003); Caporale et al. (2005); Narayan (2005).

- Studies using panel data, e.g., Corbin (2001); Ho (2002); Fouquau et al. (2008); Kollias et al. (2008); Georgopoulos and Hejazi (2009); Murthy (2009).

The vast empirical literature on this topic has assumed a linear relationship and draws no distinction between positive and negative effects of savings on investment. In particular, the long-run relationship between saving and investment is represented as a linear combination of nonstationary stochastic regressors. However, many macroeconomic relationships are found to have nonlinear combinations, especially the ones directly interacting with the business cycles. For example, Schorderet (2001, 2003) has proposed a bivariate, asymmetrically cointegrating relationship between unemployment and output where output is decomposed into partial sum processes of positive and negative changes. The author finds significant differences in the response of unemployment to positive and negative changes.

\(^1\)Feldstein and Horioka (1980) hypothesis implies that in the presence of free capital mobility the S–I correlation will be lower while in the presence of restricted capital mobility S–I correlation will be stronger.
in output. Similarly, negative and positive shocks can have different effects in the presence of an asymmetric relationship between saving and investment. The linear models in this case may lead to misleading inferences.

This chapter aims to explore the relationship between savings and investment, allowing for asymmetric effects. We investigate the F-H hypothesis for Iceland and 16 OECD countries. In terms of methodology, we employ both time-series and panel estimation techniques. Moreover, we take advantage of the imposition of capital controls in Iceland, in the financial crisis of 2008 to test for the role of regime shift in the F–H relationship. This should be the case if the F–H coefficient is a measure of capital mobility.

This chapter\(^2\) makes two main contributions while testing the F–H hypothesis in a panel regression of 17 OECD countries. First, we take advantage of economic turbulence in Iceland and discuss regime shifts while investigating the asymmetric S–I relationship. Only a few studies on the F–H hypothesis included Iceland in its list of countries but ignored regime shifts (e.g., Katsimi and Zoega (2016) and Oh et al. (1999)). The panel estimation is not able to address the issue of capital controls in Iceland satisfactorily, highlighting the importance of country specific analyses. We therefore employ a time series approach for Iceland and other panel members. Second, we test the S–I correlation allowing for asymmetric effects in the panel estimation, offering more empirical insights on this relationship. In particular, this study is an attempt to address the issue of asymmetric effects in panel estimation. Our work also contributes to the emerging literature on the effectiveness of capital controls, summarised in Fernández et al. (2015).

The remainder of the chapter is as follows. Section 5.2 reviews the literature on FH puzzle. 5.3 discusses the data and methodology used in analysing S–I correlation, 5.4 discusses the results of the model, and 5.5 concludes this chapter.

\(^2\)At the time of this writing, the chapter is under review in ‘Applied Economics’.
5.2 Literature review

There are a large number of studies investigating the relationship between saving and investment in the context of FH puzzle. We will review some of the main papers, starting from the original paper of Feldstein and Horioka (1980) to some of the recently published papers.

Feldstein and Horioka in their famous article argued that under free capital mobility the correlation between saving and investment should be close to zero, whereas in a closed economy the correlation should be close to unity. They investigated the S-I correlation using cross-sectional data on industrial countries for the period 1960–1974. FH found a correlation of 0.89 between gross savings to GDP and investment to GDP, and attributed the finding to barriers to capital mobility. The higher coefficient found by FH revealed a macroeconomic puzzle as it was widely argued that capital mobility since the 1970s was high. Since then the FH hypothesis has been an area of intensive research especially in the empirical studies.

Dooley et al. (1987) investigate the relationship between saving (including both private and public savings) and investment (private and public) for a sample of 14 industrial and 50 developing countries covering a period of 1960–1984. They use cross-sectional data, finding that the positive correlation between national savings and investment is robust for both advanced and developing economies. Moreover, they estimate the correlation for different sub-samples, finding that it has been higher in the later years of their sample. Coakley et al. (1996) examine the relationship between saving and investment using cross-section data for 23 OECD countries using a whole sample of 1960–1992 and a sub sample (1980–92). Their findings suggest a higher coefficient (0.75) for the whole sample as compared to the coefficient (0.63) for the sub-sample. The authors argue that FH correlation, based on cross-section data, captures long-run relationship, irrespective of the degree of capital mobility.

\[^3\]For a survey see Coakley et al. (1998), Apergis and Tsoumas (2009) and Kumar and Bhaskara (2011).
Miller (1988) adopts a time series approach to examine the cointegration between saving and investment for the US, using quarterly data from 1946 to 1987. He performs his analyses for the whole sample, and two sub-samples, i.e., 1946 to 1971 for fixed exchange rates and 1971 to 1987 for flexible exchange rates. His findings suggest evidence of cointegration in the fixed exchange rate regime but no cointegration in the flexible exchange rate regime. Miller concludes that the increased degree of capital mobility under floating exchange rate has resulted in breaking the cointegration between the two variables. Argimon and Roldán (1994) use time series data for the period 1960–88 for EC countries. They find cointegration between saving and investment for five countries in the sample. They also examine the causality for cointegrating relationships, finding that causality in all cointegrated relationships is in the direction from saving to investment, while there is no evidence of reverse causality. Jansen (1996) adopts an error correction method for a large number of OECD countries, using data for the period 1951–1991. They find that saving and investment are cointegrated with a short-run coefficient of 0.57. Their estimates provide evidence of high capital mobility in eight countries and limited capital mobility in six countries. Caporale et al. (2005) uses a longer annual time series approach to examine S-I correlation for 23 OECD countries. The data sample for most of the countries covers a period of 1948 to 1998. The authors find evidence of cointegration between the two variables. The coefficients found in their estimations ranged from -0.104 to 1.319, indicating a negative relationship in some cases. Moreover, five countries in their sample (Finland, Ireland, Italy, New Zealand and Switzerland) indicated a coefficient above unity. Abbott and Vita (2003) uses a longer time series data on quarterly basis covering a period of 1955 to 1994 for the UK. They also analyse two sub-samples, 1955–1978 and 1980–1994. They adopt ARDL bounds testing approach, finding evidence of cointegration in all samples. Their results indicate that the S-I correlation has become weaker after abolishing of capital controls in the UK in 1970. This finding is consistent with the FH hypothesis. Narayan (2005) adopts the same strategy like Abbot and Vita to analyse the S-I correlation for China over the period of 1952–1998. He implements ARDL bounds test, finding evidence of cointegration
for different regimes. His results are also consistent with the FH hypothesis, indicating that the correlation has become weaker during managed floating exchange regime.

Corbin (2001) uses panel data for ten OECD covering a long period from 1855 to 1992. He examines the S-I correlation for different samples on the basis of international monetary regimes. He employs several estimation procedures. His results indicate a stronger correlation with an average of 0.84 across different estimation methods for the later years of the sample (1973–1992), while the average correlation across different estimation methods for the earlier sample (1885–1913) was (0.47). Murthy (2009) investigates the FH hypothesis for a panel of 14 Latin and five Caribbean countries over the period 1960–2002. He finds cointegration in the panel as a whole, as well as for most of the countries. He finds low correlation (around 0.5 in most cases) between saving and investment. The author concludes that the weak correlation is consistent with the FH hypothesis, marked by financial integration, and deregulation of the financial sector in the countries analysed in the sample.

Fouquau et al. (2008) adopt a Panel Smooth Transition Regression Model for a panel of 24 OECD countries over the period 1960-2000, finding that the relationship between saving and investment is nonlinear. Moreover, they find that the coefficient has decreased over time in their sample. The authors highlight three main factors – openness, country size, and current account to GDP – affecting the degree of capital mobility. Kollias et al. (2008) employ both a time series and panel data to investigate the S-I correlation for the EU15 member countries, using data over the period 1962–2002. They find mixed evidence for cointegration using time series approach. The authors do not find any general pattern emerging from their investigation, i.e., the S-I correlation is in some cases high, moderate, and lower. Their results for panel data indicate a lower coefficient (0.15).

Choudhry, Jayasekera and Kling (2014) estimate the time–varying FH coefficient using rolling panel regressions for both EU and non-EU countries with five–year
windows and find that deepening economic integration in the European Union lowered the value of the coefficient, indicating greater capital mobility. Moreover, the advent of the recent financial crisis raised the value of the coefficient implying reduced capital mobility. Katsimi and Zoega (2016) estimate the Feldstein-Horioka equation using a panel of 30 countries for the period 1960–2012 and test for structural breaks in the FH coefficient. They find structural breaks that coincide with the introduction of the European single market in 1993, the introduction of the euro in 1999 and the financial crisis in 2008. They find that the former effect occurs most strongly in single-market countries that are outside the euro zone whereas the second break is greater in the euro zone countries. Increased capital mobility within the euro zone consisted of capital moving from nations with a higher output per capita and lower government budget deficits.

A variety of explanations have been proposed for the FH puzzle. Frankel (1992) shows how the puzzle may arise due to omitted variables, such as tax rates, which can affect both savings and investment. Coakley et al. (1996) argue that large and persistent current account deficits may reduce access to international capital markets. According to Tobin (1983), governments may try to avoid deficits for financial stability reasons and also surpluses because the existence of surpluses implies room for expansionary policies.

5.3 Data and methodology

To investigate the relationship between investment and saving, we adopt an asymmetric cointegration approach, i.e, we separate the effects of positive and negative shocks of saving on investment. Granger and Yoon (2002) introduced the term “hidden cointegration”, according to which cointegration may be defined in terms of positive and negative changes. They showed that linear cointegration is a special case of hidden cointegration. There is a growing interest in the use of partial-sum processes to study asymmetric relationships (in particular cointegration) between variables, using the approach of Shin et al. (2014). The method has recently been
used in several empirical studies, e.g., Athanasenas et al. (2014); Choudhry, Hassan and Papadimitriou (2014); Bahmani-Oskooee and Fariditavana (2015), and Pal and Mitra (2015).

We use annual time series data for 17 OECD countries covering a time span from 1960 to 2014. In the panel estimation, we create a balanced panel of the 17 OECD countries. The data are taken from Statistics Iceland and annual macro–economic AMECO.

The empirical analysis for Iceland is performed under different regimes, following a similar strategy used in Abbott and Vita (2003) and Narayan (2005). We investigate the S–I correlation under three regimes. First, we analyse the saving–investment (S–I) correlation for the period of restricted capital mobility between 1960 and 1994. Then we add a period of free capital mobility between 1994 and 2008 and estimate the correlation for the period 1960–2008. Finally, we extend our analysis to the 2008 to 2014 period, when capital controls were imposed in response to the financial crisis.

The F-H model is represented as following:

\[
I_t = \alpha_0 + \beta_1 S_t + \varepsilon_t \tag{5.1}
\]

where \(I_t\) represents the investment to GDP ratio (gross fixed capital formation), \(S_t\) represents the savings–to–GDP ratio (gross national savings), \(\alpha_0\) is the intercept, and \(\varepsilon_t\) is the error term in the model. With perfect capital mobility across countries we would find the coefficient \(\beta_1\) to be close to zero indicating that changes in savings in one country do not affect interest rates or investment in that country.

5.3.1 Model

Following the recent approach of Shin et al. (2014), we introduce asymmetry in the F-H model. The nonlinear asymmetric cointegrating regression is represented as follows:
\[ I_t = \alpha_0 + \beta_1^+ S_t^+ + \beta_1^- S_t^- + \varepsilon_t \]  \hspace{1cm} (5.2)

\[ S_t = S_0 + S_t^- + S_t^+ \]  \hspace{1cm} (5.3)

where \( S_t^- \) and \( S_t^+ \) are partial-sum processes of negative and positive changes in \( S_t \), defined as:

\[ S_t^+ = \sum_{j=1}^{t} \Delta S_j^+ = \sum_{j=1}^{t} \max(\Delta S_j, 0) \]  \hspace{1cm} (5.4)

\[ S_t^- = \sum_{j=1}^{t} \Delta S_j^- = \sum_{j=1}^{t} \min(\Delta S_j, 0) \]  \hspace{1cm} (5.5)

If there exists a vector \( \beta' = (\beta_1^+, \beta_1^-) \) with \( \beta_1^- \neq \beta_1^+ \) such that \( \varepsilon_t \) is a stationary process in equation 2 then there exists an asymmetric cointegration.

### 5.3.2 Unit root tests

Prior to the model estimation, we test the variables for stationarity to determine their order of integrations using several unit root tests. We start with the application of traditional Augmented Dicky Fuller (ADF) and Phillip–Perron (PP) tests on the univariate time series for each country. We then extend our analysis to the inclusion of the unit root structural break test by implementing the Zivot and Andrews (1992) (ZA) test, which endogenously determines the structural break in the model.

The ZA model with a dummy for the shift in mean and trend (originally referred to as Model C by ZA) is represented as follows:

\[ \Delta y_t = c + \alpha_1 y_{t-1} + \beta t + \theta_1 D U_t + \gamma_1 D T_t + \sum_{j=1}^{k} d_j \Delta y_{t-1} + \varepsilon_t \]  \hspace{1cm} (5.6)

where \( \Delta \) is the lag operator, \( \varepsilon \) is white noise term, \( t \) is the time index (\( t = 1, \ldots, T \)), \( D U_t \) in the model is a dummy for a shift in mean at a potential break point (\( TB \)),
and $DT_t$ is a dummy for the shift in trend, where $DU_t = 1$ and $DT_t = t - TB$ if $t > TB$ and zero otherwise.

In the case of panel estimation, we first test the cross-sectional dependence using Pesaran (2004). For unit root analyses, we apply the cross-sectionally augmented IPS (CIPS) test proposed by Pesaran (2007), which accounts for the cross-sectional dependence. For completeness we also apply Levin, Li and Chu (2002) and Im et al. (2003).

### 5.3.3 Cointegration tests

Having tested the data for unit root, the next step is to test for possible cointegration. We test for the presence of an asymmetric cointegration for individual countries in the panel using a method recently developed by Shin et al. (2014) in the ARDL framework of Pesaran et al. (2001). Asymmetric cointegration is determined in the framework of Shin et al. (2014) as follows.

\[
\Delta I_t = \alpha_0 + \rho I_{t-1} + \theta_1^- S_{t-1}^- + \theta_1^+ S_{t-1}^+ + \sum_{i=1}^{p} \phi_i \Delta I_{t-i} + \sum_{i=0}^{q} \pi_i^+ \Delta S_{t-i}^+ + \sum_{i=0}^{q} \pi_i^- \Delta S_{t-i}^- + \epsilon_t \tag{5.7}
\]

The selection of a final ARDL model in equation (7) is based on the general-to-specific methodology. Using an F-test, the joint null hypothesis of long-run symmetry, $\rho = \theta_1^+ = \theta_1^- = 0$, is tested against the alternative of an asymmetric cointegration between the variables.

This approach is valid irrespective of whether the regressors are $I(0)$, $I(1)$ or mutually cointegrated. However, studying integration properties of the variables is still essential to ensure that the series are not $I(2)$, in which case the test is invalid.

In the presence of significant asymmetric relationship, we extend the analyses to the cointegration test proposed in Engle and Granger (1987) (EG). The residuals of the asymmetric model (See equation 5.2) are tested for stationarity, provided
that the respective variables are found to be non-stationary with the same order of integration. Stationarity of the residuals implies that an asymmetric relationship between the variables in levels is stationary and they share a long–run path. Conversely, non–stationarity of the residuals implies that the variables do not share a common long–run path.

For panel data, we perform several cointegration tests on our model presented in equation (2). However prior to the implementation of cointegration tests, the results of a panel unit root and the possible presence of asymmetry in the relationship are taken into account. Currently, there is no methodology to test for asymmetric effects within the panel, thus we only consider an asymmetric model for our panel once we have found convincing evidence of an asymmetric relationship in individual countries. To determine panel cointegration, we use several methods starting with the second generation model of Westerlund (2007), which accounts for cross-section dependence. For a comparison, we also implement the tests of Kao (1999) and Pedroni (2004).

If the variables are found to have an asymmetric cointegration, long–run coefficients are estimated using DOLS and FMOLS for the panel and each country separately. These methods have been shown to provide robust results in small samples. Our estimation method for the panel allows us to estimate heterogeneous cointegrated vectors for the panel members. For sensitivity analysis, the results of the panel are compared with the fixed effect model and the random effect model.

### 5.4 Empirical results

The results of unit root tests for each country are reported in Table 5.1. Most of the data for investment and saving failed to reject the null hypothesis of a unit root in levels. The series in their first differences are stationary, indicating order of integration $I(1)$. Although the results of the ZA test differ from the ADF and PP tests in some cases, it is a well-established empirical fact that investment
and saving exhibit unit roots and are $I(1)$. Thus in a few cases, we have partial evidence of the variables being $I(1)$. The results of unit-root tests for partial sum processes are reported in Table C1 in the appendix. These results indicate that both variables are non-stationary with $I(1)$ order of integration.
<table>
<thead>
<tr>
<th>Country</th>
<th>Investment</th>
<th>ADF</th>
<th>PP</th>
<th>ZA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iceland70−74</td>
<td>-3.45*</td>
<td>-6.26***</td>
<td>-2.87</td>
<td>-6.49***</td>
</tr>
<tr>
<td>Iceland70−78</td>
<td>-2.70</td>
<td>-5.79***</td>
<td>-2.34</td>
<td>-6.40***</td>
</tr>
<tr>
<td>Iceland70−90</td>
<td>-2.18</td>
<td>-6.38***</td>
<td>-2.30</td>
<td>-8.98***</td>
</tr>
<tr>
<td>Finland</td>
<td>-2.90</td>
<td>-7.09***</td>
<td>-3.06</td>
<td>-10.42***</td>
</tr>
<tr>
<td>Italy</td>
<td>-2.07</td>
<td>-8.78***</td>
<td>-1.82</td>
<td>-9.43***</td>
</tr>
<tr>
<td>Ireland</td>
<td>-2.89</td>
<td>-5.74***</td>
<td>-2.55</td>
<td>-5.68***</td>
</tr>
<tr>
<td>Netherlands</td>
<td>-2.48</td>
<td>-4.82***</td>
<td>-2.62</td>
<td>-7.60***</td>
</tr>
<tr>
<td>Portugal</td>
<td>-1.97</td>
<td>-5.36***</td>
<td>-2.14</td>
<td>-7.09***</td>
</tr>
<tr>
<td>Spain</td>
<td>-2.99</td>
<td>-4.75***</td>
<td>-2.73</td>
<td>-4.65***</td>
</tr>
<tr>
<td>UK</td>
<td>-3.18</td>
<td>-6.74***</td>
<td>-2.61</td>
<td>-7.11***</td>
</tr>
</tbody>
</table>

Null hypothesis: Series has a unit root. Note: ***, ** and * indicate that the null hypothesis of a unit root is rejected at the 1%, 5% and 10% levels, respectively. AIC is used for lag selection.
Table 5.2 reports the cross-section dependence and panel unit root tests. The results of the Pesaran (2004) test indicate that the panel has cross-sectional dependence. In this case, the unit root test of Pesaran (CIPS) is used because it accounts for cross-sectional dependence in the panel. However, all three tests considered in this chapter generate similar results, indicating that the data are non-stationary in levels and the order of integration is $I(1)$.

Table 5.2: Cross-section dependence and unit roots

<table>
<thead>
<tr>
<th>Cross section dependence test</th>
<th>S</th>
<th>I</th>
<th>$S^+$</th>
<th>$S^-$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pesaran (CD)</td>
<td>18.872***</td>
<td>38.556***</td>
<td>79.636***</td>
<td>80.139***</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel unit root test</th>
<th>I</th>
<th>$\Delta I$</th>
<th>S</th>
<th>$\Delta S$</th>
<th>$S^+$</th>
<th>$\Delta S^+$</th>
<th>$S^-$</th>
<th>$\Delta S^-$</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLC</td>
<td>-1.33*</td>
<td>-11.38***</td>
<td>1.94</td>
<td>-2.00**</td>
<td>-0.78</td>
<td>-13.53***</td>
<td>2.33</td>
<td>-2.05**</td>
</tr>
<tr>
<td>IPS W–stat</td>
<td>-0.88</td>
<td>-8.65***</td>
<td>-1.04</td>
<td>-9.17***</td>
<td>-0.36</td>
<td>-5.95***</td>
<td>-0.27</td>
<td>-6.79***</td>
</tr>
<tr>
<td>Pesaran CIPS</td>
<td>-2.28</td>
<td>-3.28***</td>
<td>-2.09</td>
<td>-3.12***</td>
<td>-2.02</td>
<td>-2.93**</td>
<td>-1.956</td>
<td>-3.20***</td>
</tr>
</tbody>
</table>

Null hypothesis for cross-section dependence is that the panel has cross-sectional independence. Null hypothesis for the unit root test is that the series has a unit root. Note: ***, ** and * indicate that the null hypothesis is rejected at the 1%, 5% and 10% levels, respectively.

Table 5.3 reports the results of tests of asymmetric cointegration between investment and a partial sum process of negative and positive changes in savings. We find strong evidence of cointegration in all countries except the UK and France. While the residuals based EG test indicates that our proposed asymmetric model has cointegration in all the countries.

We check the robustness of these results by including a dummy for the potential break points detected by ZA test as shown in Table 5.1. We find that the inclusion of dummies for structural breaks has no impact on the outcome of these results.
### Table 5.3: Cointegration tests

<table>
<thead>
<tr>
<th>Country</th>
<th>Asymmetric cointegration test</th>
<th>Residual based (EG)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F-statistics</td>
<td>Outcome</td>
</tr>
<tr>
<td>Iceland</td>
<td>7.74***</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Iceland</td>
<td>4.13**</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Iceland</td>
<td>7.74***</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Austria</td>
<td>6.53***</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Australia</td>
<td>7.88***</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Belgium</td>
<td>4.61***</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Canada</td>
<td>2.20*</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Denmark</td>
<td>5.24***</td>
<td>cointegrated</td>
</tr>
<tr>
<td>France</td>
<td>1.97</td>
<td>not cointegrated</td>
</tr>
<tr>
<td>Finland</td>
<td>4.67***</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Italy</td>
<td>7.30***</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Ireland</td>
<td>6.81***</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Netherlands</td>
<td>3.61**</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Norway</td>
<td>4.54***</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Portugal</td>
<td>5.85***</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Spain</td>
<td>6.22***</td>
<td>cointegrated</td>
</tr>
<tr>
<td>Sweden</td>
<td>3.72**</td>
<td>cointegrated</td>
</tr>
<tr>
<td>UK</td>
<td>1.56</td>
<td>not cointegrated</td>
</tr>
<tr>
<td>US</td>
<td>3.42**</td>
<td>cointegrated</td>
</tr>
</tbody>
</table>

Null hypothesis of asymmetric cointegration test: There is no asymmetric cointegration. Null hypothesis of EG test: The residuals of asymmetric model are non-stationary. Note: ***, ** and * indicate that the null hypothesis is rejected at the 1%, 5% and 10% levels, respectively.

The results of panel cointegration tests are reported in Table 5.4. In the case of the Westerlund test, panel fixed–effects (Pa), panel time trend (Pt) and group (Ga) statistics indicate cointegration while the (Gt) statistics fail to reject the null hypothesis of no cointegration. Moreover, the results of Kao test and Pedroni test reject the null hypothesis of no cointegration. We therefore have sufficient evidence in supporting the existence of cointegration in the panel. We test for the robustness of these results by accounting for structural breaks, finding that the outcomes of our cointegration tests do not change. Based on our conclusions in this section, we proceed to estimate the long-run relationships in the next section.
5.4.1 Long–run estimates

Table 5.5 presents the S–I long run relationship for the time series of individual countries. We find significant differences in the response of investment to increases and decreases in savings. Focusing on Iceland, the asymmetric effects, although highly significant, are not as large as in other countries. The results indicate that the S–I correlation is stronger during the period of restricted capital mobility (1960–1994) than the period of free capital mobility (1960–2008), which confirms the F–H hypothesis for Iceland. The results for these two regimes, i.e., (1960–1994) and (1960–2008) are consistent for both methods employed in this chapter.

For the whole sample (1960–2015), the results are different for DOLS and FMOLS. The former suggests that the S–I correlation has strengthened after the implementation of capital controls in Iceland while the latter indicates insignificant effects of rising savings on investment, and a slight decrease in the correlation between falling savings and investment. However, based on our visual inspection of the residuals for the whole sample (1960-2015), we find that DOLS has performed better than FMOLS in explaining the S–I correlation. In this particular case, we find that the results of FMOLS for the whole sample (1960-2015) changes, i.e., the coefficient increases, when we introduce a dummy for the capital controls. On the other hand, we find that the dummy has no effect on the estimates of DOLS.
Hence, relying on the estimates of DOLS in this case, we can conclude that the coefficient has increased after the implementation of capital controls. Overall, the results support the argument that the S–I correlation reflects capital mobility.

Table 5.5: Long–run coefficients

<table>
<thead>
<tr>
<th></th>
<th>DOLS</th>
<th>FMOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$S^+$</td>
<td>$S^-$</td>
</tr>
<tr>
<td>Iceland$_{60-14}$</td>
<td>0.92**</td>
<td>0.86***</td>
</tr>
<tr>
<td>Iceland$_{60-08}$</td>
<td>0.81*</td>
<td>0.76***</td>
</tr>
<tr>
<td>Iceland$_{60-94}$</td>
<td>1.39***</td>
<td>1.43***</td>
</tr>
<tr>
<td>Austria</td>
<td>0.22</td>
<td>0.56***</td>
</tr>
<tr>
<td>Australia</td>
<td>0.59***</td>
<td>0.58***</td>
</tr>
<tr>
<td>Belgium</td>
<td>0.27**</td>
<td>0.56***</td>
</tr>
<tr>
<td>Canada</td>
<td>0.51***</td>
<td>0.58***</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.46***</td>
<td>0.81***</td>
</tr>
<tr>
<td>France</td>
<td>0.67***</td>
<td>0.75***</td>
</tr>
<tr>
<td>Finland</td>
<td>0.17</td>
<td>0.40***</td>
</tr>
<tr>
<td>Italy</td>
<td>0.77***</td>
<td>0.92***</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.58***</td>
<td>0.71***</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.26*</td>
<td>0.68***</td>
</tr>
<tr>
<td>Norway</td>
<td>0.75***</td>
<td>1.27***</td>
</tr>
<tr>
<td>Portugal</td>
<td>1.00***</td>
<td>1.08***</td>
</tr>
<tr>
<td>Spain</td>
<td>1.41***</td>
<td>1.49***</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.46***</td>
<td>0.80***</td>
</tr>
<tr>
<td>UK</td>
<td>-0.10</td>
<td>0.13</td>
</tr>
<tr>
<td>US</td>
<td>0.38**</td>
<td>0.43***</td>
</tr>
</tbody>
</table>

Note: ***, ** and * indicate that the null hypothesis is rejected at the 1%, 5% and 10% levels, respectively.

The shift from historical capital controls (1960–1994) to free capital mobility (1995–2008) has a dramatic effect on the S–I relationship, but the return to a capital control regime (2008–2014), despite increasing S–I correlation, has a relatively mild effect. The influence of regime shifts are consistent for both the negative and positive effects of savings on investment as can be seen in Table 5.5.

A clear distinction has to be drawn between the effects of capital controls on the investment–saving correlation in the “normal” 1960–1994 and the crisis period 2008–2014. The main difference between these two periods is a forced current account surplus in the latter period when foreign creditors needed to be repaid, which was created by lower investment and higher private savings, hence making
the two series diverge. In addition, the mild increase in the S–I correlation under recent capital controls, apart from less number of observations in the post–crisis period, can be explained by poor mobilisation of savings largely due to loss of confidence during the crisis.

Iceland’s current account adjustment was partially the result of capital controls under high interest rates. The country risk premium increased in 2008 making it necessary to both impose capital controls as well as raise domestic interest rates. The higher interest rates increased savings and reduced investment. In Iceland, the saving to GDP from 3.11% in 2008 increased to 20.34% in 2014 while investment to GDP from 25% in 2008 decreased to 16%. The IMF recommended that the capital controls be supported by high central bank interest rates, which were raised to 18% in 2009M1. On the contrary, the Icelandic central bank in 2011 started lowering interest rates from a very high level step by step, which did not affect the currency but facilitated the recovery of domestic demand.

It can thus be argued that capital controls in the short–run are important when a small open economy experiences sudden stops. An increased saving–investment correlation under capital control regime implies that savings become more important for economic growth after the source of external financing vanishes. Capital controls and higher interest rates after the crisis can help stabilising the economy in the short run, however, maintaining high interest rates for a longer period of time can also prolong recessions due to ‘paradox of thrift’ effect. Thus, channeling increased savings into investments is vital for the economy. In this regard, a close monitoring of the growth rates of saving and investment under capital control regimes is required as interest rate decisions become highly effective for the output.

Table 5.6 reports the long–run estimates for the panel before the introduction of European single market in 1994 for the whole sample. Once again, there is a significant difference in the response of investment to positive and negative changes in savings. This implies that the investment–saving relationship is asymmetric in all the regimes. Second, the correlation between saving and investment is stronger
in the period of restricted capital mobility while it has clearly weakened after the introduction of the European single market, suggesting that the F–H coefficient is a measure of capital mobility.

The effects of negative changes in savings on investment are stronger than the effects of positive changes in savings during the period of restricted capital mobility. A decrease in saving decreases investment by 0.65 - 0.70 percentage of GDP while an increase in savings increases investment by 0.48 - 0.50 percentage of GDP. However, both these effects have considerably weakened after the formation of the European single market, i.e., for the whole sample (1960–2015), a decrease in saving decreases investment by 0.45 - 0.48 percentage of GDP while an increase in saving increases investment by 0.26 – 0.27 percentage of GDP. The results are consistent for all the methods used in this chapter.

Table 5.6: Long–run coefficients for panel

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$S^+$</td>
<td>$S^-$</td>
</tr>
<tr>
<td>DOLS</td>
<td>0.50***</td>
<td>0.70***</td>
</tr>
<tr>
<td>FMOLS</td>
<td>0.53***</td>
<td>0.67***</td>
</tr>
<tr>
<td>Fixed effect</td>
<td>0.50***</td>
<td>0.66***</td>
</tr>
<tr>
<td>Random effect</td>
<td>0.48***</td>
<td>0.64***</td>
</tr>
</tbody>
</table>

Note: *** and * indicate that the null hypothesis is rejected at the 1%, 5% and 10% levels, respectively.

Moreover, we estimate the panel by excluding UK and France since our asymmetric cointegration test indicated the absence of cointegration in both of these countries. We find that the exclusion of these two countries does not affect the panel estimation (see Table C2 in the Appendix).

We test the robustness of our results for each country by introducing a dummy based on the break points indicated by structural break tests as well as the visual inspection of the data series and residuals. Except for Iceland as discussed above, other results are not affected by the presence of structural breaks.
5.5 Conclusion

We have investigated the saving-investment relationship with a focus on regime shifts in Iceland, which currently operates under restricted capital mobility. In particular, we have tested the Feldstein–Horioka hypothesis for a panel of 17 OECD countries, allowing for asymmetry in the saving-investment correlation for the period 1960-2015.

Our results show that the F-H coefficient depends on the level of capital mobility. Thus the lifting of capital controls in Iceland in 1994–2008 reduced the value of the coefficient and the imposition of capital controls in Iceland in 2008 raised it. Moreover, we find evidence for asymmetric cointegration between saving and investment. These results indicate significant differences in the response of investment to positive and negative changes in savings. The magnitude of the effect of changes in savings on investment is larger for a fall in savings than a rise in savings.

The implications of the results we obtain for policy makers are clear: real interest rates matter for small open economies, and closely monitoring the rate of growth of both saving and investment is vital. Institutional and structural changes can have far-reaching effects on the development of all economies, but for small open economies, capital controls in particular can alter their potential growth rates, both positively and negatively, in both the medium and long run.

There remains the task of explaining the asymmetric effect of changes in savings on investment. The strong negative effect of a fall in savings on investment could be caused by precautionary savings in periods of increased economic uncertainty, which affects investment adversely. Another plausible explanation for the presence of asymmetry could be rooted in the asymmetric effects and responses of the monetary policy shown in several empirical studies, e.g., Florio (2004); Schaling (2004); Cukierman and Muscatelli (2008). Further research is required to explore the question of asymmetry in the saving investment relationship.
## Appendix C

### Table C1: Unit root test for partial sum processes

<table>
<thead>
<tr>
<th>Country</th>
<th>ADF</th>
<th>PP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$S^-$</td>
<td>$\Delta S^-$</td>
</tr>
<tr>
<td>Iceland 60–08</td>
<td>-0.99</td>
<td>-0.48</td>
</tr>
<tr>
<td>Iceland 60–94</td>
<td>-1.47</td>
<td>-5.35***</td>
</tr>
<tr>
<td>Austria</td>
<td>-1.84</td>
<td>-6.95***</td>
</tr>
<tr>
<td>Australia</td>
<td>-0.78</td>
<td>-5.82***</td>
</tr>
<tr>
<td>Belgium</td>
<td>-1.95</td>
<td>-3.66**</td>
</tr>
<tr>
<td>Canada</td>
<td>-3.06</td>
<td>-6.98***</td>
</tr>
<tr>
<td>Denmark</td>
<td>-1.58</td>
<td>-6.36***</td>
</tr>
<tr>
<td>France</td>
<td>-2.75</td>
<td>-6.47***</td>
</tr>
<tr>
<td>Finland</td>
<td>-3.07</td>
<td>-5.48***</td>
</tr>
<tr>
<td>Italy</td>
<td>-3.43*</td>
<td>-6.50***</td>
</tr>
<tr>
<td>Ireland</td>
<td>-3.03</td>
<td>-4.75***</td>
</tr>
<tr>
<td>Netherlands</td>
<td>-2.59</td>
<td>-7.07***</td>
</tr>
<tr>
<td>Norway</td>
<td>-3.36*</td>
<td>-5.95***</td>
</tr>
<tr>
<td>Portugal</td>
<td>-1.38</td>
<td>-6.26***</td>
</tr>
<tr>
<td>Spain</td>
<td>-1.78</td>
<td>-6.82***</td>
</tr>
<tr>
<td>UK</td>
<td>-2.57</td>
<td>-6.75***</td>
</tr>
<tr>
<td>US</td>
<td>-3.06</td>
<td>-5.50***</td>
</tr>
</tbody>
</table>

Null hypothesis: Series has a unit root. Note: ***, ** and * indicate that the null hypothesis of a unit root is rejected at the 1%, 5% and 10% levels, respectively. AIC is used for lag selection.

### Table C2: Long-run estimates (excluding France and UK)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$S^+$</td>
<td>$S^-$</td>
</tr>
<tr>
<td>DOLS</td>
<td>0.49***</td>
<td>0.68***</td>
</tr>
<tr>
<td>FMOLS</td>
<td>0.61***</td>
<td>0.73***</td>
</tr>
<tr>
<td>Fixed effect</td>
<td>0.46***</td>
<td>0.62***</td>
</tr>
<tr>
<td>Random effect</td>
<td>0.45***</td>
<td>0.61***</td>
</tr>
</tbody>
</table>

Note: ***, ** and * indicate that the null hypothesis is rejected at the 1%, 5% and 10% levels, respectively.
Chapter 6

Balance of payments in a sovereign regime: A Stock-Flow Consistent and SVAR approach

6.1 Introduction

Lifting restrictions on capital movements has proven to be a double edged sword for many countries as expectations of greater prosperity have given way to financial turmoil and crisis. Iceland is a prime example where short period of open capital markets gave rise to intensive domestic growth fuelled by exuberant capital inflows. This eventually turned into a nightmare scenario when access to capital markets dried up dragging the economy into a recession as discussed in Chapter 2 & 3.

While the Icelandic story is relatively well–known in general,\textsuperscript{1} few attempts have been made to explicitly model the origins and channels of capital inflows to Iceland, which led to the build–up of external imbalances. As we discussed in Chapter 2, a sizeable part of the capital inflows can be traced to bond issuance of the Icelandic banking sector held by international portfolio investors. This made fixed income

\textsuperscript{1}For example, Matthiasson (2008); Danielsson and Zoega (2009); Benediktsdottir et al. (2011); Baldursson and Portes (2013).
securities as one of the main sources of credit inflow in the beginning years of financial expansion as previously discussed in detail. Another main source of the inflows into Iceland was the retail deposit accounts offered by the Icelandic banks during the last couple of years prior to the financial crisis. By offering significantly higher deposit rates, Icelandic banks were able to collect huge amounts of deposits, allowing them to lower their capital market exposure while maintaining high growth momentum.

In the previous chapters, we argued that capital inflows can induce financial sector growth, which in turn can have strong impacts on the real sector of the economy. Thus, explicitly modelling capital inflows alongside a financial and real sector enables us to understand the instability associated with capital inflows. The role of capital inflows in particular is crucial to understand the balance of payments and exchange rate dynamics in a sovereign currency regime.

Traditional models of exchange rate determination tend to play down the role of capital flows, treating them as an independent source of exchange rate movements. The main focus of these models has been centred on the trade flows usually within an inter–temporal optimizing setup.\(^2\) In such settings, movements on the capital account play a passive role relative to current account while resting on the usual assumptions of purchasing power parity and uncovered interest parity. The Icelandic experience is somewhat at odds with the above view. Iceland was able to maintain a current account deficit for a long time, suggesting that access to foreign financing was easily forthcoming despite obvious macroeconomic imbalances.

With the rise in cross–border flows, many models acknowledged the role of capital markets in explaining the balance of payments and exchange rate dynamics. Most of these models, however, considered the balance of payments in isolation\(^3\) or ignored the special role played by the banks in attracting financial flows\(^4\) (Benes et al., 2014). Thus, the effect of capital inflows and the subsequent sudden stops

\(^2\)See Dornbusch (1975) for explanation.
\(^3\)For example, Magud et al. (2011).
\(^4\)For example, Engel and Matsumoto (2006). While some progress has been made after the crisis, Benes et al. (2014) argues substantial work is still required in order to examine the role of financial sector from a balance sheet perspective in particular.
on real economy largely remains unclear. Consequently, the role of capital controls in macroeconomics has remained highly controversial (Magud et al., 2011).

The aim of this chapter is to develop a theoretical framework to explain the role of capital inflows in creating economic booms in a small open economy with sovereign currency. We demonstrate the destabilising effects of capital inflows on the economy by allowing for a sudden stop, and also discuss the role of capital controls in response to a sudden stop. In order to overcome the drawbacks of most macroeconomic models as highlighted above, we follow the Godley and Lavoie (2007) tradition which models the real and financial sector in one framework as will be discussed. We then empirically investigate the role of capital inflows by employing a structural VAR approach, using Icelandic data.

The chapter is organized as follows. Section 6.2 discusses the theoretical framework around SFC models in general, emphasizing the importance of balance sheets and the accounting framework in order to maintain consistency among stocks and flows. Section 6.3 presents the structure of our model for small open economy. Section 6.4 presents simulation of our model. Section 6.6 investigates some aspects of the SFC model, implementing structural VAR on Icelandic data. Section 6.7 concludes the chapter.

6.2 Review of the literature on SFC models

Stock Flow Consistent (SFC) Models, are a group of macro models built mainly in the post-Keynesian tradition. Many of the ideas which underpin SFC models can be traced back to the work of Copeland (1949), May (1970), Meyer (1975), and Turnovsky (1977).

The pioneering contribution in the field came from James Tobin in the 1980s. According to Dos Santos (2006), the Tobin’s alternative approach to the Hicks’s IS LM models is the “Stock Flow Consistent Approach (SFCA)”, while the very name

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5A comprehensive literature survey on SFC approach can be found in Caverzasi and Godin (2015).
of the SFC model comes from the work of post–Keynesians. Dos Santos (2006) argues that Tobin’s alternative approach to IS-LM, referred to as the ‘SFCA’, was not convincing to most in the profession and almost disappeared form the literature in the late 1980s. After the failure of mainstream models to anticipate the economic crisis in 2008, the alternative economic paradigm, generally known as heterodox economics has received a great deal of attention. Similarly, many heterodox economists have developed a keen interest in SFC models in the last few years.

Post–Keynesian literature on SFC is mainly dominated by the work of James Tobin and Wynne Godley. Tobin’s work significantly contributed to the post-Keynesian literature and part of his work is consistent with the idea of SFC as discussed in Dos Santos (2006). But it was mainly Godley’s efforts to build a comprehensive framework that integrated all stocks and flows, thus making it possible to understand the real and financial sector interaction in the economy. An important part of Godley’s work related to SFC approach can be traced back to some of his earlier contributions, e.g., Godley (1996, 1997, 1999). However, the most comprehensive and systematic representation on SFC can be found in the book Godley and Lavoie (2007). Apart from authors’ own significant contribution, the book compiles the dispersed literature and systematically presents it in a coherent framework. Their framework is currently used as a benchmark in most of the SFC models.

6.2.1 The SFC models

In general, SFC models can be defined as the specific type of models that integrates the stocks and flows in the economy. The stock–flow interaction in SFC models is based on standard accounting principles, and a set of behavioural equations as will be discussed. The approach can be best explained when contrasted with the conventional macroeconomic models. According to (Davis, 1987, pp.111-112), most neo–classical models are mainly flow–based, focusing on the flows and prices rather than the stocks. These models neglect the impact of flows on stocks and
the consequential impact of stocks on flows (Godley and Lavoie, 2007, p.71). In
flow-based models, the values of the rate of change of stocks are treated as given to
solve for the equilibrium. These stocks may be both financial (e.g., money, bonds,
equity, loans) and real (e.g., the stock of capital). Changes in these stocks through
time can change short run equilibrium as well as flows and prices in the economy.
Hence excluding these stocks from the models could falsify the consequences of
exogenous shocks to the models or in simple words can lead to a false prediction
regarding policy changes.

In contrast, the SFCA was developed to prevent the above mentioned problems.
SFC models are defined as the ones in which the balance sheet dynamics of all
the institutions (given by sectoral balances, portfolio shifts, and capital gains) in a
model are explicitly and logically modelled (Dos Santos, 2006, p.542). This implies
that SFC models include both flows and stocks, and are typically based on social
accounting that consistently or coherently combine National income accounts with
the flow of funds and the balance sheets.

SFC models are largely based on post-Keynesian and Kaleckian approach in a
sense that the level of economic activity is largely demand-driven. Supply side is
flexible and accommodates the level of demand, thus establishing an equilibrium
in every period. This approach allows for a natural integration of short periods to
reach a long-run while short periods are interlinked through stocks. Flows in the
short run will keep changing the stocks and in turn these stocks will change the
flows until a steady state is reached which, as describer earlier, is a situation in
which all stocks and flows grow at the same rate. This situation in (Dos Santos,
2006, p.556) is referred to as the ‘long period equilibrium’ while long-run (not equi-
librium) is defined as “more realist notion of a path-dependent sequence of ‘short
periods’ in which parameters are subject to sudden and unpredictable changes,
and growth is far from Balanced”. Thus long-run dynamics in SFC are composed
of adjacent short periods. This concept of long run according to Dos Santos and
Zezza (2008) is close to the idea of many post-Keynesians such as Michael Kalecki,
who argues that long run is not a separate entity and is the result of chain of short
periods. Similarly, Joan Robinsson and Athanasios Asimakopulos also agree with the same concept of long-run.

The concept of long run equilibrium however in the conventional macroeconomic theory is a different concept than in SFC models. Equilibrium in mainstream models is a conceptual time frame and its debate is centred on neutrality of money along with the behaviour of prices and wages. Mainstream equilibrium is more focused on the adjustment process, and its short–run equilibrium as discussed earlier, is mainly based on the equilibrium of the flows. In contrast, short periods in SFC are based on the evolution of balance sheets where values of all the stocks (i.e., capital losses or gains) at the end of any given period are fully considered in the beginning of next period, thus long–run is reached by integrating and rigorously linking adjacent short–run periods (Dos Santos and Zezza, 2008, p.444).

6.2.2 Components of SFC models

In general, theoretical SFC models consist of three main components. (1) The accounting framework, (2) The Behavioural equations, and (3) Solution to the system.

The accounting framework in SFC approach as discussed in Godley and Lavoie (2007) consists of three matrices: (i) Balance Sheet Matrix reporting stocks (assets and liabilities of different sectors), (ii) Transaction Flow Matrix reporting all the transactions (flows) taking place in the economy, and (iii) Stocks Revaluation Matrix which shows how flows affect the stocks at the end of each period. All these three matrices consist of different sectors, assumed in the model (e.g., Household, Financial corporations, Non-financial corporations, Government and Rest of the world). The stock and flow of money must satisfy accounting identities both within the individual sectors and in the economy as a whole. Someone’s inflow is someone’s outflow, similarly someone’s asset is someone’s liability and vice versa. In other words, the accounting framework of the matrices is designed in such a

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6Neutrality of money, which is related to the classical dichotomy of nominal and real variables is thoroughly discussed in Godley and Shaikh (2002).
way that there are no leakages in the stocks and flows between the sectors in the economy (Godley and Lavoie, 2007, p.14).

The accounting framework in any SFC model clearly specifies the constraints of each sector, i.e., “sectoral inflow” (sources of funds for the sector) and “sectoral outflow” (use of funds by the sector), e.g., the government expenditure is the sectoral outflow of fund as it involves usage of funds whereas the tax is the sectoral inflow as it is a source of fund for the government. In order to make sure there are no leakages in the accounting framework the consistency is normally checked by accounting identities, e.g., the total taxes received by the government sector in the system must equate the sum of taxes paid by each sector, similarly the total bonds issued by the government must equate the sum of bonds held by other sectors. Another underlying feature of the accounting framework is that it is based on quadruple entry system. The social accounting approach to money-flow is based on quadruple entry system as money-flow transactions involve two transactors at a time (Godley and Lavoie, 2007, p.42). For example the interaction between banks and the households is given by:

<table>
<thead>
<tr>
<th></th>
<th>Household</th>
<th>Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deposits</td>
<td>+D</td>
<td>-D</td>
</tr>
<tr>
<td>Loans</td>
<td>-L</td>
<td>+L</td>
</tr>
</tbody>
</table>

Table 6.1: A simple balance sheet

The household sector holds deposits (D) in the banks while the banks lend out loans (L) to the households. Each of the rows and columns in the table must sum to zero. This implies if there is any change in any of the entries, rest of the entries have to adjust to balance out and fulfil the accounting framework.

The accounting framework is followed by a set of behavioural equations in SFC model. Behavioural equations are defined for different sectors based on economic theory, explaining the relationship between different variables; such relationships
are not directly determined by the accounting framework. For example, households’ consumption function in its simplest form relates household’s current consumption to its current disposable income and previous wealth. Once the relationship between the variables is established, it becomes easier to explain how variables affect each other in the system. The result of any SFC model depends on its behavioural equations as they explain the causal chain in the system (Godley and Lavoie, 2007, p.15). Given that sectors are interdependent and interlinked, adding new sectors and assets to the accounting framework will increase the number of behavioural equations, making the overall structure of the model more complex.

The third component of SFC models is solving the system. Finding a solution to the system in SFC models is a pre-requisite for completion as the model structure rests on a system of behavioural equations. Solving the system is really important as it allows for generating different scenarios in the system. In practice, after fulfilling the accounting framework and defining the behavioural equations for a more realistic economy, one generally ends up with a complicated system of equations, requiring a lot of background knowledge as well as time to understand. Thus solving the system becomes crucial in explaining the intuition in a more simplistic manner (see (Godley and Lavoie, 2007, p.71)).

The type of solution and the approach of solving any SFC model mainly depends on the purpose of research. As discussed in Caverzasi and Godin (2015), there are two ways of solving the models: (1) Analytical solution, and (2) Numerical solution.

Analytical solution is theoretically solving the model for a growing economy with fixed ratio between the variables in the model (referred to as the steady-state). Once the steady state is specified, the model can be solved for short-run and long-run equilibrium (Dos Santos and Zezza, 2008; Dos Santos and Silva, 2009). The solution, however, requires a lot of algebra and can get quite complex due to large number of equations. The use of analytical methods to solve SFC models is rare, and will not be discussed in great detail. We will largely focus on the use of numerical solution in this thesis as we will use this approach to solve our model.
Numerical solution is basically performing comparative dynamic exercises performed through a computer simulation using algorithm. The idea is explained in much detail in the book (Godley and Lavoie, 2007), which systematically explains several steps to achieve the solution. The steps involved in solving a model can be summarised as follows: First, the stocks and exogenous variables are assigned initial values. Then the parameters are calibrated or estimated. Then the model is simulated to achieve a baseline scenario or a steady state, which by (Godley and Lavoie, 2007, p.71) is defined as a state where all the variables (stocks and flows) are in a constant relationship in a growing economy. Then different shocks are created in the system which allows one to analyse how the economy reacts to the changes in assigned parameters and exogenous variables in the model. The effects of the shocks are then compared with the baseline scenario of the model.

For example, (Godley and Lavoie, 2007, p.473) in a two–country SFC model for the UK and US in chapter 12 shows the effects of an increase in UK propensity to import on its balance of payments. The simulation of this shock is shown in Figure 6.1. A permanent shock occurs in 1960 which pushes the current account into a deficit and financial (capital) account into a surplus. Similarly, one can see the effects of this shock on any variable of interest in the model.

![Figure 6.1: UK’s balance of payments](image_url)
6.2.3 Parameter determination

As discussed above, a solution of the model involves determining parameters of the model. There is, however, no consensus on the method of determining parameters of the model, and this largely depends on the purpose of the study. In this regard, it is important to differentiate between theoretical SFC models and empirical models. Theoretical SFC models usually assign values to parameters based on economic intuition or existing empirical evidence, and simulate the model. The focus of these models is to study trends rather than magnitudes (e.g., Lavoie (2008); van Treeck (2009); Kinsella and Khalil (2012)). Empirical SFC models, on the other hand, are based on calibration or estimation of the parameters. Estimation of the parameters usually involve econometric exercises using time series data. Some authors (e.g., Godley and Zezza (1989)) have used an OLS method to estimate the parameters. This procedure involves running single-equation econometric model for each behavioural equation over a time series data. Calibration in empirical studies such as Kinsella and Khalil (2012) involve calculating parameter values that can replicate the data in each period. The method combines estimation, and generates consistent ratios between flows and stocks usually referred to as the ‘stock–flow norms’.

The difference between these two procedures can be illustrated with the help of a simple equation. The consumption function in its simplest form can be written as follows:

\[ C = \alpha_1(YD) + \alpha_2(V_{t-1}) \]

where \( C \) is private consumption, \( YD \) is disposable income, and \( V_{t-1} \) represents wealth. Estimation of \( \alpha_1 \) and \( \alpha_2 \) requires running an OLS of the above equation. Calibration of the parameters requires estimating \( \alpha_1 \) and generating a consistent ratio of \( C \) (flow) and \( V_{t-1} \) (stock) by calculating \( \alpha_2 \). For example, if the data reports that \( C = 100, YD = 100, \) and \( V_{t-1} = 100 \). Lets assume, we estimate \( \alpha_1 \) using OLS, and obtain a coefficient of \( \alpha_1 = 0.8 \). Then, \( \alpha_2 \) can be endogenously
determined by the system such that \( \alpha_2 = \frac{C - 0.8Y_D}{V_{t-1}} \). If we plug in the values in the above equation, we will get the following:

\[
C = 0.80(100) + 0.20(100)
\]

The parameter values are either adjusted for every period for a given time series or the model is simulated for a specific year, depending on the purpose of the study. In the above example, since \( \alpha_1 \) is determined by an OLS estimation, and its value is therefore fixed for a given time series, \( \alpha_2 \) representing stock flow norm will adjust in every period so that the above equation will always replicate the consumption data in every period.

Another method of determining the parameters is proposed in Ciuffo and Rosenbaum (2015), where Monte Carlo approach is adopted to examine different parameter combinations and initial values, using a sequence of random numbers. The authors first randomly assign the initial values and lower and upper bounds of the model parameters. A parameter combination which produces economically meaningless outcomes is ruled out while a combination which produces meaningful outcomes is selected.

### 6.2.4 Advanced applications

After the financial crises and increasing global imbalances, the advanced application of SFC models has focused on extending the framework to include two main features a) Financialisation, and b) Open economies.

Financialisation is the shift from regulated financial markets to liberalized and innovative ones where sales growth is driven by higher dividends, along with easy access to credit in the financial markets (Lavoie, 2008). Thus, including an explicit financial sector in SFC framework makes it possible to model the amount of credit, sources of finances, portfolio decisions and investment decisions within the same framework. This also helps in determining capital gains and debt in the economy.
Lavoie (2008) extended the second chapter of Godley and Lavoie (2007) to introduce different financial aspects in a SFC framework. He performed a set of experiments to analyse the possible effects of increasing financialization by changing households’ and firms’ behavioural parameters, e.g., increasing the proportion of profits distributed as dividends, or increasing households’ desire to hold equity in the stock market (Lavoie, 2008, p.345). Similarly, van Treeck (2009) used SFC framework to study the effect of financialisation in a closed economy. He analysed the impact of financialisation by focusing on two experiments related to shareholder value orientation; a) by increasing the dividend payout ratio of non-financial firms, and b) reducing the contribution of new equity issues to the financing of physical investment (van Treeck, 2009, pp.478-479).

Several authors have focused on extending SFC analysis from close to open economies. Modelling an open economy in SFC is a tough challenge as maintaining the core idea of consistency becomes complicated when the framework is extended to the rest of the world. The primary reason for this is that tracking and linking a country’s stocks and flows with the rest of the world is complicated, especially in the presence of an explicit financial sector in the model.

A very basic framework of an open economy with several oversimplified features (e.g., fixed exchange rates, no transactions in foreign assets, gold as the only foreign reserves etc.) is discussed in chapter 6 of Godley and Lavoie (2007). The analysis is then extended to a more advanced model in chapter 12 by introducing a number of realistic features such as flexible exchange rates, trading foreign assets, settling official imbalances through foreign currency denominated assets etc. Lavoie and Daigle (2011) further extended chapter 12 of Godley and Lavoie (2007) while mainly focusing on the issue of exchange rate expectations. Duwicquet and Mazier (2010) used SFC model for two countries with asymmetric size in a monetary union. They introduced three different shocks (loss of competitiveness, fall in consumption, and a reduction in capital accumulation) to analyse macroeconomic adjustment and stabilization in a monetary union. Kinsella and Khalil (2012) used a two-country SFC model to study a small economy experiencing debt deflation. They performed a series of simulations under varying assumptions as follows, a)
they analysed the impact of investment shock on debt deflation in a small economy under floating exchange rate, and b) they analysed the impact of investment shock on debt deflation in a small economy under currency union. The authors concluded that investment shock under the currency union extends the debt deflation of the small economy in the union.

6.3 SFC model of a small open economy

The two main features - financialisation and open economy – incorporated in the SFC framework, as discussed above, make it a good candidate to study the crisis in a heavily financialised small open economy like Iceland. The accounting consistency of the SFC models conveniently allows one to include a financial sector in the model, and this feature has been very well–incorporated in the SFC framework. In contrast, the DSGE modellers have largely ignored this feature. This tradition of modelling choices in DSGE is inspired by the neo–classical and New Keynesian traditions of treatment of money, which has dominated the macroeconomic literature.

While there is a large literature on DSGE models, and the approach includes a broad class of models (including neoclassical and New Keynesian) however, we will only highlight a few models which are used for policy analysis in different institutions. The objective of this brief presentation is to highlight the tradition of neglecting or oversimplification of the financial sector without going into technical details of their structures, as is not the focus of this study. One of the most popular DSGE models earlier used at the ECB was developed by Smets and Wouters (2003) for the euro area. The model incorporates the New Keynesian features of sticky wages and prices, but does not include a financial sector. For empirical application, the model is linearised and the Bayesian techniques are used for estimation. Christiano et al. (2005) developed a DSGE model for monetary policy analysis and incorporated a number of nominal and real rigidities in the model. They estimate the effects of monetary policy shocks in an identified VAR model, and
then select six parameters to minimise the difference between impulse responses of identified VAR and their proposed model. They include money in their model but it does not play an important role; the households allocate money in the form of cash balances or deposits in the banking sector, which is implicit in the model. Such treatment of money in their model leads to findings which are in conformity with Friedman’s argument, i.e., exogenous money supply shocks reduces interest rate - the effect lasting for 1–2 years, and increases output and employment - the effect lasting for two to five years. Smets and Wouters (2003) and Christiano et al. (2005) have been widely used as benchmark models in several studies. Smets and Wouters (2007) developed another DSGE model to analyse the US business cycle. They extend the previous versions of Smets and Wouters (2003) and Christiano et al. (2005) in several directions, but still neglect the banking sector. They use Bayesian estimation techniques, finding that a large proportion of fluctuation in output is explained by demand shocks. Christoffel et al. (2008) developed a newer version of the DSGE model for the euro area, came to known as the New Area-Wide Model (NAWM) a micro-founded open-economy model. Consistent with the traditional mainstream assumptions, the model is based on Ricardian equivalence and no banking sector. Money in the model is only included as a means of transactions. Kumhof et al. (2010) developed a DSGE model widely used at the IMF and a few central banks. The model deviates from the Ricardian equivalence assumption and includes a banking sector with financial frictions following Bernanke et al. (1999) procedure, in which financial frictions can affect output. However, like in the Bernanke et al. (1999)’s model, the only way of financing taking place in the banking sector is by holding deposits and lending to the firms. Hence, banking sector only plays the role of intermediation, and not as a source of instability. A very similar role to the banking sector is also assigned in Christiano et al. (2007).

Due to oversimplification of credit/money, an important characteristic of these models is that the policy rate responds to changes in inflation and output but does not take into account the cross-border inflows. The portfolio choice of traders determining the dynamics of capital inflows is missing in most DSGE models, as
also highlighted by Tovar (2009). Consequently, these models are silent about the changes in output due to cross-border financial flows, inducing aggregate consumption and generating investment booms. While this is true that the focus of these models is on aspects other than the financial sector, we see this as a flawed approach adopted by monetary institutions to modelling economies in a highly financialised environment. In addition, the use of these models at important institutions has also influenced many academics to follow the same tradition.

Clearly, the recent experience of Iceland and other crisis-hit countries is in sharp contrast to these assumptions. The banks were the key players involved in international borrowing, and international portfolio choices had an important impact on small open economies and their currencies. We believe, the lack of these important features in the DSGE modelling tradition is the result of not paying serious attention to the balance sheet of the banking sector as also acknowledged by the practitioners of this methodology. For example, (Benes et al., 2014, p.5) while referring to the interaction between financial markets and real economy states,

"Bank balance sheets play a critical role in such interactions. Conventional linearized DSGE models are not very useful for evaluating macroprudential policy tradeoffs under such conditions, first because by construction they do not capture the effects of nonlinearities, and second because they ignore the special role played by banks in contributing to vulnerabilities and nonlinearities."

In contrast, SFC models are based on the balance sheet approach and the construction of the model usually begins by analysing the balance sheet dynamics of different sectors. The balance sheet approach conveniently allows one to incorporate the dynamics of international capital flows by explicitly modelling the portfolio choices of domestic and international traders. In the context of recent financial crisis in Iceland, these features are central to our study, and we believe SFC approach provides a solid platform to study the Icelandic crisis. It is, however,

\footnote{Devereux and Sutherland (2007) developed a DSGE model of portfolio choices but have left out many important features such as a banking sector and a government sector.}
important to highlight that DSGE models are currently going through a phase of acknowledging and incorporating the role of an explicit financial sector in its models, and several advancements have been made recently. Apart from advancements in DSGE models, several other micro-foundation models have emerged such as SFC-ABM.

Another comparative advantage of SFC approach is the empirical application, when confronted with data. Data can be directly fed into the structure of the model for empirical analyses as the modelling tradition (based on balance sheets and flows) generally do not favour unobservable concepts. The empirical application of the framework does not usually require any fundamental changes in the structure of the original model. On the other hand, most DSGE models go through a phase of transformation in way or other. As highlighted by Iskrev (2010), most studies, involving simulation or estimation in the DSGE models use linear approximations of the original models.\(^8\) The model is first expressed in terms of stationary variables, and then linearized around the steady-state values. In addition, the presence of unobservable concepts (e.g., technology shock), can sometimes raise identification issues when confronted with data, e.g., Smets and Wouters (2003) model has 10 structural shocks but seven observables variables.

We now proceed to explain the structure of our SFC model developed for a small open economy with sovereign currency like Iceland. The model structure draws on the Godley and Lavoie (2007) modelling technique, combining the open economy aspects allowing for international trade and capital flows guided by portfolio choice equations of the advanced open economy model.

Open economy models in the SFC tradition of Godley and Lavoie (2007) emphasise the importance of completeness and reciprocity in order to catch the dynamics of economic interconnections of countries trading with each other. Built around the same general idea, our model slightly relaxes these conditions by adopting the “small country assumption” for Iceland, assuming negligible impact of the

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\(^8\)There are also methods of approximating nonlinear systems recently developed.
Icelandic economy on the rest of the world. As a consequence, only model equations for the domestic economy need to be considered.

6.3.1 Transaction flow and balance sheet matrices

Table 6.2 below presents an aggregated transaction flow matrix of a small open economy (Iceland) and the rest of the world (EU). The matrix tracks all the flows between different sectors within the economy as well as the cross border flows. The plus (+) sign in the matrix indicates that the flow has been received or it can simply be considered as an income, while the minus (−) sign represents an outflow or simply an expenditure.

The transaction flow matrix consists of flows which can be divided into three main categories. The upper part of the matrix represents real macroeconomic flows. The mid part of the matrix represents financial flows. The lower part of the matrix represents the changes in balance sheet items or simply the flows occurring due to changes in the stocks.

The production in the economy takes place as described in the standard GDP identity. Trade and production of goods take place in the firm sector. Firms pay wage bills to its workers (household), taxes to the government, and finance their investment through borrowing loans. They pay interest on their loans to the financial sector.

Households finance their consumption by receiving income in the form of wages and interest payments on deposits and bills. They pay income taxes to the government sector.

The government sector receives income in the form of taxes from the firms and the households. It adjusts its expenditures according to its revenue, hence, running a balanced budget.

The banking sector has two branches, a) domestic branch, which holds domestic assets on its balance sheets, b) foreign branch, which attracts foreign deposit
Table 6.2: Transaction Flow Matrix (TFM)

<table>
<thead>
<tr>
<th>Flows</th>
<th>Small Economy</th>
<th></th>
<th>ROW</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Households</td>
<td>Firms</td>
<td>Govt</td>
<td>Banks</td>
</tr>
<tr>
<td>Consumption</td>
<td>–C&lt;sub&gt;cie&lt;/sub&gt;</td>
<td>+C&lt;sub&gt;cie&lt;/sub&gt;</td>
<td>–I&lt;sub&gt;cie&lt;/sub&gt;</td>
<td></td>
</tr>
<tr>
<td>Investment</td>
<td>+I&lt;sub&gt;cie&lt;/sub&gt;</td>
<td></td>
<td>–G&lt;sub&gt;cie&lt;/sub&gt;</td>
<td></td>
</tr>
<tr>
<td>Gov. exp</td>
<td>+G&lt;sub&gt;cie&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exports</td>
<td>+X&lt;sub&gt;cie&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imports</td>
<td>–M&lt;sub&gt;cie&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(GDP)</td>
<td>[Y&lt;sub&gt;cie&lt;/sub&gt;]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wages</td>
<td>+WB&lt;sub&gt;cie&lt;/sub&gt;</td>
<td>–WB&lt;sub&gt;cie&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax</td>
<td>–T&lt;sub&gt;h&lt;/sub&gt;&lt;sup&gt;cie&lt;/sup&gt;</td>
<td>–T&lt;sub&gt;f&lt;/sub&gt;&lt;sup&gt;cie&lt;/sup&gt;</td>
<td>+T&lt;sub&gt;cie&lt;/sub&gt;</td>
<td></td>
</tr>
<tr>
<td>Interest on deposits in Iceland’s domestic banks</td>
<td>+r&lt;sub&gt;D&lt;/sub&gt;&lt;sup&gt;h,cie,d&lt;/sup&gt; (D&lt;sub&gt;h,cie&lt;/sub&gt;)</td>
<td></td>
<td></td>
<td>–r&lt;sub&gt;D&lt;/sub&gt;&lt;sup&gt;h,cie,d&lt;/sup&gt; (D&lt;sub&gt;h,cie&lt;/sub&gt;)</td>
</tr>
<tr>
<td>Interest on deposits in Iceland’s foreign banks</td>
<td>–r&lt;sub&gt;D&lt;/sub&gt;&lt;sup&gt;h,cie,eu&lt;/sup&gt; (D&lt;sub&gt;h,cie&lt;/sub&gt;)</td>
<td>+r&lt;sub&gt;D&lt;/sub&gt;&lt;sup&gt;h,cie,eu&lt;/sup&gt; (D&lt;sub&gt;h,cie&lt;/sub&gt;)</td>
<td>–r&lt;sub&gt;D&lt;/sub&gt;&lt;sup&gt;h,eu,d&lt;/sup&gt; (D&lt;sub&gt;h,eu&lt;/sub&gt;)</td>
<td></td>
</tr>
<tr>
<td>Interest on euro denominated loans in Iceland</td>
<td>–r&lt;sub&gt;L&lt;/sub&gt;&lt;sup&gt;h,cie,d&lt;/sup&gt; (L&lt;sub&gt;h,cie&lt;/sub&gt;)</td>
<td>–r&lt;sub&gt;L&lt;/sub&gt;&lt;sup&gt;h,cie,d&lt;/sup&gt; (L&lt;sub&gt;h,cie&lt;/sub&gt;)</td>
<td></td>
<td>+r&lt;sub&gt;L&lt;/sub&gt;&lt;sup&gt;h,cie,d&lt;/sup&gt; (L&lt;sub&gt;h,cie&lt;/sub&gt;)</td>
</tr>
<tr>
<td>Interest on ISK denominated loans in Iceland</td>
<td>–r&lt;sub&gt;L&lt;/sub&gt;&lt;sup&gt;h,cie,ice&lt;/sup&gt; (L&lt;sub&gt;h,cie&lt;/sub&gt;)</td>
<td>–r&lt;sub&gt;L&lt;/sub&gt;&lt;sup&gt;h,cie,ice&lt;/sup&gt; (L&lt;sub&gt;h,cie&lt;/sub&gt;)</td>
<td></td>
<td>+r&lt;sub&gt;L&lt;/sub&gt;&lt;sup&gt;h,cie,ice&lt;/sup&gt; (L&lt;sub&gt;h,cie&lt;/sub&gt;)</td>
</tr>
<tr>
<td>Interest on Icelandic banks bills</td>
<td>+r&lt;sub&gt;B&lt;/sub&gt;&lt;sup&gt;h,cie&lt;/sup&gt; (B&lt;sub&gt;h,cie&lt;/sub&gt;)</td>
<td></td>
<td>–r&lt;sub&gt;B&lt;/sub&gt;&lt;sup&gt;h,cie&lt;/sup&gt; (B&lt;sub&gt;h,cie&lt;/sub&gt;)</td>
<td></td>
</tr>
<tr>
<td>Interest on EU bills</td>
<td>+F&lt;sub&gt;cie&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profits (Firms)</td>
<td>–F&lt;sub&gt;cie&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in Icelandic banks’ bills</td>
<td>–ΔB&lt;sub&gt;h,cie,d&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>+ΔB&lt;sub&gt;h,cie&lt;/sub&gt;</td>
</tr>
<tr>
<td>Change in EU’s bills</td>
<td>–ΔB&lt;sub&gt;h,cie,eu&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>+ΔB&lt;sub&gt;h,cie,eu&lt;/sub&gt;</td>
</tr>
<tr>
<td>Change in Iceland’s euro denominated loans</td>
<td>+ΔL&lt;sub&gt;h,cie,d&lt;/sub&gt;</td>
<td></td>
<td>–ΔL&lt;sub&gt;h,cie&lt;/sub&gt;</td>
<td></td>
</tr>
<tr>
<td>Change in Iceland’s ISK denominated loans</td>
<td>+ΔL&lt;sub&gt;h,cie,ice&lt;/sub&gt;</td>
<td></td>
<td>–ΔL&lt;sub&gt;h,cie,ice&lt;/sub&gt;</td>
<td></td>
</tr>
<tr>
<td>Change in deposits in Icelandic domestic banks</td>
<td>–ΔD&lt;sub&gt;h,cie,d&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>+ΔD&lt;sub&gt;h,cie,d&lt;/sub&gt;</td>
</tr>
<tr>
<td>Change in deposits in Icelandic foreign banks</td>
<td>+ΔD&lt;sub&gt;h,cie,ice&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>–ΔD&lt;sub&gt;h,cie,ice&lt;/sub&gt;</td>
</tr>
<tr>
<td>Change in deposits in European banks</td>
<td>+ΔD&lt;sub&gt;h,eu,d&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>+ΔD&lt;sub&gt;h,eu,d&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

Financial Development, Crises, and Recovery in Small Open Economies
holders. The banking sector as a whole offers both the ISK denominated loans and the foreign denominated loans. The banking sector receives income in the form of interest on its lending. Banks also issue bills internationally to meet the demand for credit in the economy. The banks pay interest on their liabilities, which are deposits and bills.

In the rest of the world, there is a household, firm, and a banking sector. The foreign households’ receive income from Iceland in the form of interest on their deposits in the Icelandic banks abroad as well as their bills holdings. The foreign firms are engaged in trade with the Icelandic firms.

The foreign banking sector (European banks) receives interest from Iceland on its bills holding. The residuals of the Icelandic bills in the economy are sold in the international market, which we assume are held by the banking sector operating abroad. Finally, the foreign household, firm, and banking sectors also interact with each other, however, we will not discuss that and will mainly focus on the interaction of the rest of the world with Iceland.

A formal representation of assets and liabilities can be seen in the Balance Sheet Matrix in Table 6.3. The items reported with plus (+) signs represent assets while minus (−) signs represent liabilities.

<table>
<thead>
<tr>
<th>Small Economy</th>
<th>ROW</th>
<th>Net</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household</td>
<td>Firms</td>
<td>Banks</td>
</tr>
<tr>
<td>Deposits</td>
<td>+D_{ice}</td>
<td>−D_{b}</td>
</tr>
<tr>
<td>Loans</td>
<td>−L_f</td>
<td>+L_b</td>
</tr>
<tr>
<td>Banks Bills</td>
<td>+B_{ice}</td>
<td>−B_</td>
</tr>
</tbody>
</table>

As can be seen from the balance sheet matrix, credit in our model takes the form of deposits, bills and loans. The flow of credit in our model is graphically explained with the help of a simple figure below.
6.3.2 Structure of the model

The structure of our model makes clear reference to the exceptional growth of Icelandic financial sector. The institutional elements of the model relates to the specific social and economic conditions that evolved during the early 2000s when Icelandic banks could attract huge amounts of portfolio capital without seemingly raising concerns about systemic sustainability. By implementing policies such as financial sector privatization and deregulation of market activity, Iceland was seen as following a benign recipe for institutional improvement. Obviously some concerns were raised and during the Mini-crisis in early 2006, access to financial markets was temporarily restricted as we discussed in Chapter 2. However, confidence was restored as markets became convinced once again of the sustainability of the Icelandic financial model following protective measures by the Icelandic banks.
and assurances by the authorities that public support would be forthcoming if needed.

With the global financial crisis, it became gradually more and more evident that the likelihood of systemic failure could not be excluded and investors’ confidence disappeared, resulting in a sudden stop. This fits well into the Harvey (2009) framework, explaining the role of psychological or behavioural factors, with regard to exchange rate dynamics. The role of market psychology was perhaps even more important during the earlier stages when financial expansion took place in the early 2000s. As discussed in Chapter 2, the newly privatized Icelandic banks rushed into expansion mode attacking large amounts of capital supporting further expansion. Bandwagon effects or chartist investment strategies clearly seemed to be driving factors while economic fundamentals such as current account imbalances were given less attention until the eruption of the crisis.

In order to capture the above aspects, the structure of the model is specified as follows:

**Firms**

Firms produce goods by employing workers while paying them wages. They maintain a fix level of investment in the economy in every period. The level of investment in the model is exogenous. The profits are reinvested in order to finance investment in every period (equations 6.1 – 6.14). If the targeted investment is higher than the profits, investment is financed by directly borrowing from the banks.

Firms borrow both the ISK and foreign denominated loans (equations 6.16 – 6.18). In Chapter 2, we highlighted two main motives for borrowing foreign denominated loans: a) a proportion of firms’ revenue, coming from exports, was in the foreign currency, and b) interest rate charged on ISK denominated loans was higher than on the foreign currency denominated loans. Based on this argument, the demand for loans in our model has an inverse relationship with the associated interest rate,
i.e., if interest rate on domestic currency borrowing increases, the proportion of
domestic currency borrowing will fall while the proportion for FX denominated
loans will increase by the same amount.

Households

Households’ consumption is a function of disposable income and their past wealth
(equation 6.21 – 6.27). The households allocate their wealth in financial assets
and receive returns in the form of interests. The idea behind portfolio allocation
dates back to the work of James Tobin and his co-workers in the late 1960s in an
effort to model basic relationships in a financial economy with several assets and
their allocation among sectors (Brainard and Tobin, 1968).

However, our setting slightly differs from the standard practice of modelling finan-
cial assets. Following a more practical approach in Iceland’s case, the household
sector in Iceland is faced with a decision of allocating their wealth in three financial
assets, namely Icelandic bills, foreign bills and deposits in Icelandic banks operat-
ing domestically (equation 6.28 – 6.30). On the other hand, households in the EU
can allocate their wealth in four assets, i.e., Icelandic bills, EU bills, deposits in
the EU banks, and deposits in the foreign branches of Icelandic banks (equation
6.31– 6.34).

The portfolio allocation in our model is based on the fact that Icelandic house-
holds were not allowed to hold deposits in the foreign branches of Icelandic banks.
Clearly this might seem to be at odds with the principle of free importance of
completeness and reciprocity in order to catch the dynamics of capital movements,
but in practice this is precisely what happened when Icelandic banks were offering
foreign depositors considerably higher rates than to depositors in Iceland.

The exchange rate risk in our model does not affect the demand for deposits in
the banks because these deposits are held in the foreign branches of the Icelandic
banks. For example, a UK resident holding a deposit in an Icelandic bank that
operates in the UK will not consider exchange rate risks on his deposits as the
bank account is in GBP.

Banks

The banking sector provides credit in the economy. The banking sector fulfils the demand for loans in the economy and will only issue bills if the demand for loans is greater than the available credit in the system (equation 6.38). As can be seen, the first source of credit in the economy is provided by the available deposits in the banking sector. This, however, does not put a restriction on the demand for loans, i.e., if the demand for loans exceeds the available credit in the banking sector, the banks will issue bills to finance their operations and fulfil the demand for loans in the economy. These bills are held by the foreign banks, providing credit and willing to take a counter party risk on Icelandic banks. Moreover, we do not put a restriction on the flow of credit between the domestic and foreign branches of the Icelandic banks. This implies the deposits accumulated in the foreign branches can be used by the banks domestically without any direct risks involved. The deposits in the foreign branches of Icelandic banks are also considered as an inflow in the financial account even if these deposits are not transferred to the domestic banks.

It is worth mentioning that traditional models designed for conventional monetary policy, especially before the crisis, ignored the special role played by the banks in creating credit from a balance sheet perspective as discussed above. In general, the banking sector in these models in itself is not a source of shock and vulnerabilities (Benes et al., 2014). In contrast, based on the balance sheet approach, the banking sector in our framework can be a source of vulnerability and shocks by fulfilling all demand for credit due to their optimistic expectations concerning growth prospects. This feature of the financial sector, typically based on the post–Keynesian literature, is widely acknowledged by several authors (see Jakab and Kumhof (2015)).

Government
For completeness, we include a simple government sector in the model which finances its expenditures through taxes. The expenditure of the government is simply determined by its revenue (equation 6.35 – 6.36), hence, running a balanced budget. Regarding the government sector, this is a strong assumption but our setting here is based on the Icelandic experience where government sector had a minor or apparently no role to play in the accumulation of external debt. Icelandic firms and banks are generally held responsible for creating economic instability due to their large volume of debt accumulation as we discussed in Chapter 2.

**Balance of Payments and exchange rate setting**

The determination of trade flows in our model is based on the standard demand theory, which is also discussed in Thirlwall (1979). The volumes of exports and imports are presented in log-linear form (equation 6.40 – 6.43) in order to linearise the relationships, and satisfy Marshall–Lerner condition. Exports are modelled as partly exogenous, reflecting Iceland’s natural resource export base and partly dependent on the real exchange rate, reflecting the rise in price sensitive service exports such as tourism. The current account and capital account balances are presented in equations 6.48 and 6.49, taking into account net exports and factor payments in both directions.

The nominal exchange rate (equation 6.50), based on portfolio balance approach, is determined by the ratio of bills supplied and demanded in the FX market. During normal times, the traders consider a fundamental currency risk by taking into account the exchange rate misalignment, i.e., the deviation of exchange rate from its long-run path. This particular measure of risk is based on the model of Lavoie and Daigle (2011), however, the authors consider two type of agents in the FX market, speculators and fundamentalists, with fixed weights. Our setting of exchange rate risks and expectations differs from Lavoie and Daigle (2011). We allow for regime shift where investors during an event of a sudden stop change
their expectations as they anticipate a currency crisis. This will be discussed in more detail when we introduce a sudden stop in the model.

We do not allow deposits in the foreign branches of the banks to affect the exchange rate dynamics in the model. Deposits held in foreign branches do not directly affect the currency unless converted into local currency. This, however, is an internal operation of the banking system, and is not entirely clear from the literature or existing studies. We therefore will also investigate the effects of foreign deposits on exchange rate in the empirical section of this chapter. Finally, the real exchange rate in our model reflects price competitiveness vis-à-vis foreign countries measured in common currency.

Model equations

**FIRMS**

National income

\[
Y_{ice} = C_{ice} + I_{ice} + G_{ice} + X_{ice} - M_{ice}
\]  
(6.1)

Sales in Iceland

\[
S_{ice} = C_{ice} + I_{ice} + G_{ice} + X_{ice}
\]  
(6.2)

Value of real output

\[
Y_{k_{ice}} = S_{k_{ice}} - M_{k_{ice}}
\]  
(6.3)

GDP deflator

\[
PY_{ice} = Y_{ice}/Y_{k_{ice}}
\]  
(6.4)

Employment

\[
n_{ice} = Y_{k_{ice}}/P_{ice}
\]  
(6.5)

Wage bill

\[
WB_{ice} = W_{ice}(n_{ice})
\]  
(6.6)

Unit Cost

\[
UC_{ice} = (WB_{ice} + M_{ice})/Sk_{ice}
\]  
(6.7)

Price of sales

\[
PS_{ice} = (1 + \phi)(WB_{ice} + M_{ice})/Sk_{ice}
\]  
(6.8)

Domestic sales price

\[
PDS_{ice} = S_{ice} - X_{ice}/Sk_{ice} - X_{k_{ice}}
\]  
(6.9)

Real sales

\[
Sk_{ice} = Ck_{ice} + Gk_{ice} + Ik_{ice} + Xk_{ice}
\]  
(6.10)

Real investment

\[
Ik_{ice} = \tau(Y_{k_{ice}})
\]  
(6.11)

Nominal investment

\[
I_{ice} = Ik_{ice}(PDS_{ice})
\]  
(6.12)
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Nominal value of sales
\[ S_{\text{ice}} = S_{k_{\text{ice}}}(P S_{\text{ice}}) \] (6.13)

Profit of the firms
\[ F_{f_{\text{ice}}} = (S_{\text{ice}} - M_{\text{ice}} - W B_{\text{ice}})(1 - \theta) \] (6.14)

Demand for loans to finance investment
\[ L_{f,d_{\text{ice}}} = L_{f,d_{\text{ice}}(t-1)} + I_{\text{ice}} - f_{f_{\text{ice}}} + r_{L_{\text{ice}}}(L_{f,d_{\text{ice}}(t-1)}) + r_{L_{\text{eu}}}(L_{f,eu_{\text{ice}}(t-1)}) \] (6.15)

Demand for ISK and foreign denominated loans
\[ L_{f,eu_{\text{ice}}(t-1)} = L_{f,d_{\text{ice}}(t-1)}(\omega_1 - \omega_2 r_{L_{\text{ice}}} + \omega_3 r_{L_{\text{eu}}}) \] (6.16)
\[ L_{f,eu_{\text{ice}}(t-1)} = L_{f,d_{\text{ice}}(t-1)}(\omega_4 + \omega_5 r_{L_{\text{ice}}} - \omega_6 r_{L_{\text{eu}}}) \] (6.17)

Total demand for loans by firms
\[ L_{f,d_{\text{ice}}} = L_{f,eu_{\text{ice}}} + L_{f,ice_{\text{ice}}} \] (6.18)

Inflationary forces:
Sales Inflation
\[ \pi_{PS_{\text{ice}}} = PS_{\text{ice}}/PS_{\text{ice}(t-1)} \] (6.19)
Domestic sales inflation
\[ \pi_{PDS_{\text{ice}}} = PDS_{\text{ice}}/PDS_{\text{ice}(t-1)} \] (6.20)

HOUSSEHOLDS

Households disposable income
\[ YD_{\text{ice}} = \left( W B_{\text{ice}} + r_{B_{\text{ice}}(t-1)}(B_{\text{ice}_{\text{ice}}(t-1)}) + r_{B_{\text{eu}}(t-1)}(B_{\text{eu}_{\text{ice}}(t-1)}) + r_{P_{\text{ice}}(t-1)}(P_{\text{ice}_{\text{ice}}(t-1)}) \right)(1 - \theta) \] (6.21)

Haig-Simons disposable income
\[ YDHS_{\text{ice}} = YD_{\text{ice}} + (\Delta x T_{\text{eu}})B_{\text{eu}_{\text{ice}}} \] (6.22)
Wealth accumulation
\[ V_{\text{ice}} = V_{\text{ice}(t-1)} + YDHS_{\text{ice}} - C_{\text{ice}} \] (6.23)
Real Haig-Simons disposable income
\[ YDHS_{k_{\text{ice}}} = \frac{YD_{\text{ice}}}{PDS_{\text{ice}}} - \frac{V_{k_{\text{ice}}(t-1)}(\Delta PDS_{\text{ice}})}{PDS_{\text{ice}}} \] (6.24)
Real wealth
\[ V_{k_{\text{ice}}} = V_{\text{ice}}/PDS_{\text{ice}} \] (6.25)
Nominal consumption
\[ C_{\text{ice}} = \alpha_1(YDHS_{\text{ice}}) + \alpha_2(V_{\text{ice}(t-1)}) \] (6.26)
Real consumption
\[ C_{k_{\text{ice}}} = C_{\text{ice}}/PDS_{\text{ice}} \] (6.27)

Portfolio allocation:

Icelandic Households:
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Demand for deposits in Iceland

\[ D_{\text{ice},d} = V_{\text{ice}} \left( \lambda_{10} + \lambda_{11}(r_{\text{ice}}^{D}) - \lambda_{12}(r_{\text{ice}}^{B}) - \lambda_{13}(r_{\text{reu}}^{B} + dx_{\text{reu}}^{e}) \right) \]  (6.28)

Demand for Icelandic bills

\[ B_{\text{ice},d} = V_{\text{ice}} \left( \lambda_{20} - \lambda_{21}(r_{\text{ice}}^{D}) + \lambda_{22}(r_{\text{ice}}^{B}) - \lambda_{23}(r_{\text{reu}}^{B} + dx_{\text{reu}}^{e}) \right) \]  (6.29)

Demand for foreign bills

\[ B_{\text{ice},d} = V_{\text{ice}} \left( \lambda_{30} - \lambda_{31}(r_{\text{ice}}^{D}) - \lambda_{32}(r_{\text{ice}}^{B}) + \lambda_{33}(r_{\text{reu}}^{B} + dx_{\text{reu}}^{e}) \right) \]  (6.30)

Foreign households:

Demand for deposits in foreign banks

\[ D_{\text{eu},d} = V_{\text{eu}} \left( \lambda_{50} + \lambda_{51}(r_{\text{eu}}^{D}) - \lambda_{52}(r_{\text{eu}}^{B}) - \lambda_{53}(r_{\text{reu}}^{B} - dx_{\text{reu}}^{e}) \right) \]  (6.31)

Demand for deposits in the foreign branches of Icelandic banks

\[ D_{\text{eu},d} = V_{\text{eu}} \left( \lambda_{60} - \lambda_{61}(r_{\text{eu}}^{D}) + \lambda_{62}(r_{\text{eu}}^{B}) - \lambda_{63}(r_{\text{reu}}^{B} - dx_{\text{reu}}^{e}) \right) \]  (6.32)

Demand for EU bills

\[ B_{\text{eu},d} = V_{\text{eu}} \left( \lambda_{70} - \lambda_{71}(r_{\text{eu}}^{D}) - \lambda_{72}(r_{\text{eu}}^{B}) + \lambda_{73}(r_{\text{reu}}^{B} - dx_{\text{reu}}^{e}) \right) \]  (6.33)

Demand for Icelandic bills

\[ B_{\text{ice},d} = V_{\text{ice}} \left( \lambda_{80} - \lambda_{81}(r_{\text{ice}}^{D}) - \lambda_{82}(r_{\text{ice}}^{B}) + \lambda_{83}(r_{\text{reu}}^{B} - dx_{\text{reu}}^{e}) \right) \]  (6.34)

GOVERNMENT

Tax revenue

\[ T_{\text{ice}} = \theta \left( W_{\text{ice}} + r_{\text{ice}}^{B} (B_{\text{ice},d}^{\text{ice}}(t-1)) + r_{\text{eu}}^{B} (B_{\text{eu},d}^{\text{ice}}(t-1)) + r_{\text{ice}}^{D} (B_{\text{ice},d}^{\text{ice}}(t-1)) + \theta (Y_{\text{ice}} - W_{\text{ice}}) \right) \]  (6.35)

Government budget balance

\[ G_{\text{ice}} = T_{\text{ice}} \]  (6.36)

BANKING SECTOR

Icelandic Banks:

Profit of the banks

\[ F_{\text{ice}} = r_{\text{ice}}^{L} (L_{\text{ice}}) + r_{\text{ice}}^{L} (L_{\text{ice}}) + r_{\text{ice}}^{L} (r_{\text{ice}}^{D}) + r_{\text{ice}}^{L} (r_{\text{ice}}^{B}) - r_{\text{ice}}^{D} (D_{\text{ice}}^{\text{ice}}) - r_{\text{ice}}^{B} (B_{\text{ice}}^{b,s}) \]  (6.37)
Bills supplied by the Icelandic banks

\[
\Delta B_{\text{ice},s}^{b} = z_2 (\Delta L_{\text{ice}} - (\Delta D_{\text{ice}}^{d} + F_{\text{ice}}^{b}))
\]

\[
z_2 = 1, \text{if } L_{\text{ice}} > (\Delta D_{\text{ice}}^{d} + F_{\text{ice}}^{b}), \text{otherwise } 0
\]

(6.38)

Foreign Bank:

Icelandic bills supplied to the foreign bank

\[
B_{\text{eu}}^{b,s} = B_{\text{ice}}^{b,s} - B_{\text{eu}}^{b,s} (\text{bills issued}) - B_{\text{eu}}^{b,s,d} (\text{bills demanded})
\]

(6.39)

BALANCE OF PAYMENTS AND TRADE

Import prices

\[
\log(PM_{\text{ice}}) = \nu_m + \nu_{m1} \log(PY_{\text{eu}}^{*}) + (1 - \nu_{m1}) \log(PY_{\text{ice}}) + \nu_{m1} \log(xr_{\text{eu}})
\]

(6.40)

Export prices

\[
\log(PX_{\text{ice}}) = \nu_x + \nu_{x1} \log(PY_{\text{eu}}^{*}) + (1 - \nu_{x1}) \log(PY_{\text{ice}}) + \nu_{x1} \log(xr_{\text{eu}})
\]

(6.41)

Real imports

\[
M_{\text{ice}} = \mu_0 - \mu_1 \log(PM_{\text{ice}}/PY_{\text{ice}}) + \mu_2 \log(Y_{\text{ice}})
\]

(6.42)

Real exports are determined as follows:

Tourism

\[
X_{\text{ice}}^{1} = \epsilon_0 - \epsilon_1 \log(PM_{\text{ice}}/PY_{\text{ice}}) + \epsilon_2 \log(Y_{\text{ice}}^{*})
\]

(6.43)

Exports based on natural resources

\[
X_{\text{ice}}^{2} = \epsilon_0 + \epsilon_2 \log(Y_{\text{eu}}^{*})
\]

(6.44)

Total exports

\[
X_{\text{ice}} = \alpha_4 (X_{\text{ice}}^{2}) + 1 - \alpha_4 (X_{\text{ice}}^{1})
\]

(6.45)

Nominal imports

\[
M_{\text{ice}} = M_{\text{ice}} (PM_{\text{ice}})
\]

(6.46)

Nominal exports

\[
X_{\text{ice}} = X_{\text{ice}} (PX_{\text{ice}})
\]

(6.47)

Current account balance

\[
CAB_{\text{ice}} = X_{\text{ice}} - M_{\text{ice}} + r_{\text{eu}(t-1)}^{B} (B_{\text{ice}(t-1)}^{h,eu,d}) - r_{\text{ice}(t-1)}^{B} (B_{\text{eu}(t-1)}^{h,ice,d}) xr_{\text{eu}}
\]

\[
- r_{\text{ic}(t-1)}^{D,eu} (D_{\text{eu}(t-1)}^{h,ice,d}) xr_{\text{eu}} - r_{\text{eu}(t-1)}^{B} (B_{\text{eu}(t-1)}^{h,eu,d}) xr_{\text{eu}}
\]

(6.48)

Financial account balance

\[
FAB_{\text{ice}} = (\Delta B_{\text{eu}}^{h,ice,d}) xr_{\text{eu}} + (\Delta B_{\text{eu}}^{b}) xr_{\text{eu}} + (\Delta D_{\text{eu}}^{h,ice,d}) xr_{\text{eu}} - \Delta B_{\text{ice}}^{h,eu,d}
\]

(6.49)

Exchange rate setting:
IFK per euro

\[
x_{r^{cu}} = \left( \frac{D_{h,ice,d}^{b,ice,d}}{B_{cu}} \right) \tag{6.50}
\]

Euro per ISK

\[
x_{r^{i\text{ce}}} = \frac{1}{x_{r^{cu}}} \tag{6.51}
\]

Real exchange rate

\[
r_{x_{r^{cu}}} = x_{r^{cu}} \left( \frac{PDS_{eu}^*}{PDS_{i\text{ce}}^*} \right) \tag{6.52}
\]

Exchange rate expectations

\[
d_{x_{r^{cu}}} = \frac{\Omega(x_{r^{cu}} - x_{r^{cu}})}{x_{r^{cu}}} \tag{6.53}
\]

**EQUILIBRIUM CONDITIONS IN THE ECONOMY**

Total demand and supply of bills

\[
B_{i\text{ce}}^b = B_{i\text{ce}}^{h,ice,s} \tag{6.54}
\]

Total demand and supply of loans

\[
L_{i\text{ce}}^d = L_{i\text{ce}}^{f,d} = L_{i\text{ce}}^s \tag{6.55}
\]

Total demand and supply of deposits in Icelandic banks

\[
D_{i\text{ce}}^d = D_{i\text{ce}}^{h,ice,d}(x_{r^{cu}}) + D_{i\text{ce}}^{h,ice,d} = D_{i\text{ce}}^s \tag{6.56}
\]

The description along with the values of the parameters, exogenous variables, and stocks is provided in the Appendix of this chapter.

### 6.4 Simulations

To understand the dynamics of the real and financial sector in a small open economy, we simulate the above model to achieve a baseline scenario.\(^9\) We then introduce two shocks in different time periods to see the response of the economy. The structure of our model is consistent throughout the simulation process, i.e., the rows and columns of the transaction flow matrix sum to zero. This implies there are no leakages in the model, and our framework does not contain any unexplained stocks and flows.

The shocks generated in the model are explained as follows:

\(^9\)We model the real sector of the rest of the world in order to determine the dynamics of wealth and prices. However, we do not explicitly model the financing decisions of the firms and the banking sector within the rest of the world and treat these variables as exogenous.
**Shock 1: increase in real investment**

First, we introduce a real investment (gross fixed capital formation) shock in 1970 where we increase the real investment by 15%. This increases the share of real investment in total output, making it the main driver of growth in the model. The increase in investment, however, requires financing through credit, therefore the economic growth in this sense is finance–led.

**Shock 2: increase in interest rate differentials**

While keeping the effects of shock 1 in the system, we introduce an interest rate differentials shock in 1990 in the model by increasing the Icelandic interest rates. We adjust all the interest rates so that the interest rates in Iceland are higher than the interest rates abroad. In particular, we increase the return on Icelandic bills and as a result also increase the interest rate on loans linked to domestic currency.

### 6.4.1 Discussion

Figure 1.3 below shows the dynamics of current account balance and financial account balance for three different scenarios, a) the baseline scenario, b) the scenario after investment shock, and c) the scenario in which investment shock is followed by an interest differentials shock in the system.

---

10 The increases in interest rates – highlighted in red – can be seen in Table D1 in the appendix.
The small open economy in our model is a net borrower and is clearly running a mild current account deficit and a financial account surplus in the baseline scenario. The economy interacts with the rest of the world through trade and financial assets. The financial sector issues bills and holds deposits internationally to fulfill the demand for credit in the economy. An increase in the investment (gross fixed capital formation) will induce credit inflow into the economy while pushing the current account into a further deficit. This scenario reflects a simple stylised fact: if the demand for loans by firms is not fulfilled by domestic credit, banks internationally borrow to fulfill the demand for loans in the economy. Increased international borrowing generates a financial account surplus and a current account deficit.

If investment shock is followed by a rise in the interest rate differentials, the current account deficit further deteriorates. A rise in the interest rate differentials creates an opportunity for the carry trade. The international traders, despite considering...
exchange rate misalignment (i.e., the deviation of exchange rate from its long-run path), allocate their wealth into Icelandic assets, triggering inflow of credit in the economy. The introduction of shock 2 in the model allows a speculative attack on the currency.

The deteriorating balance of payments position, apart from a speculative attack, is due to an increase in the cost of borrowing in the economy, which in turn results in even higher demand for credit. The burden of higher interest rate in our model is directly borne by the firms.

We now turn to the real economic indicators in the model. Figure 6.4 below shows that an increase in the real investment boosts real output. A rise in the investment followed by a rise in the interest rate differentials further increases the real output. The transmission channel can be explain as follows: a rise in the interest rate differentials in Iceland (with good sovereign rating) makes Icelandic assets look more profitable than foreign assets. Thus, households allocate their wealth in assets with higher returns, which in turn increases their wealth as shown in Figure 6.5. The interest rate differentials increases real output through wealth effect in the model.

Focusing on the dynamics of exchange rate, Figure 6.8 shows that a rise in the interest rate differentials results in the deviation (appreciation in this case) of exchange rate from its baseline, which has negative effects on the trade balance. Investment shock alone (with no direct speculative attack on the currency) has negligible effects on the exchange rate. The asset traders do not change their wealth allocation if the investment returns on Icelandic and foreign assets are uniform. The mild depreciation in this case is the result of an increased wealth effect in the model. An increase in the Icelandic wealth as compared to its trading partners will increase the holding of foreign assets by the Icelandic households as they become richer.

Exchange rate dynamics in the model also affects domestic sales prices, i.e., a currency appreciation (depreciation) results in lower (higher) import prices, which decreases (increases) the domestic sales prices.
Figure 6.4: Real output

Figure 6.5: Real wealth

Figure 6.6: Real imports

Figure 6.7: Real exports

Figure 6.8: Nominal exchange

Figure 6.9: Price index
Figure 6.10: Consumption share

Figure 6.11: Investment share

Figure 6.12 & 6.13 shows two important financial indicators in the economy. The effects of both shocks in the model are clearly reflected in the rising external debt to gdp and increased M4 (money supply) to gdp. The dynamics of these stock flow norms following an increasing trend are consistent with the actual data presented in Chapter 2, where the main financial indicators relative to gdp were shown to follow an upward trend before the crisis. The increased trend in these financial indicators implies that the growth of financial sector is faster than the real growth of the economy.

Figure 6.12: debt to gdp

Figure 6.13: M4 to gdp

Figure 6.14 shows the demand for ISK and foreign denominated loans by the firms. An increase in the interest rate differentials will trigger borrowing in foreign
denominated loans. It can therefore be argued that when the channel of borrowing in foreign currency is open, as was the case in Iceland, the increase in interest rate is not very effective to control domestic demand. Apart from lower interest rates on FX loans, the rise in demand for FX borrowing could also be the result of currency appreciation as domestic sectors such as firms and households are encouraged to speculate and benefit from exchange rate movements.

Figure 6.15 shows the profit share of the firms, which increases with an increase in the real investment, and decreases due to higher cost of borrowing after rises in the interest rates.

In the section above, we showed that the main factor behind the real economic boom is the credit boom. The economy will keep growing as long as higher interest rates prevails and credit freely flows. This, however, comes at a cost of persistent current account deficits and growing external debt as discussed above. Such scenarios prevailed in many small open economies in the years preceding the crisis. As discussed in the previous chapters, the situation changed dramatically when a wave of international bankruptcies affected many small open economies. The sudden stop of capital inflows revealed the fragility and inability of small open economies to deal with the crisis.
Crisis and sudden stops

In order to capture the destabilising role of international credit in small economies, we create a scenario where shock 1 and shock 2 are followed by a sudden stop. We allow the external debt to GDP to reach 5 times the size of the economy. Such a high level of external debt relative to the economy raises concerns and the international creditors stop lending to the economy. We impose the following restriction on Equation 6.39:

Change in Icelandic bills supplied to the foreign bank:

\[ \Delta B_{eb,s} = 0, \text{if } \left( \frac{B_{ice}}{y_{ice}} \geq 5 \right) \]  

(6.39a)

The foreign banks stop holding Icelandic bills and the flow of credit comes to a halt.\(^{11}\) The firms are unable to finance their investments, resulting in the collapse of real investments.

After sudden stops, the credit rating of the economy falls, and the international traders re-adjust their strategy in the financial markets. The interest rate differentials, which in normal times with good credit rating is seen as an opportunity to make profit, during the crises is seen as a measure of risk premia. During such circumstances, an increase in the interest rate differentials induces capital reversals. Equation 6.39 can be augmented as follows:

Changes in expectations during the crisis:

\[ dx_{re} = \Omega (x_{eu}^* - x_{eu}) + \left( r^B_{ice} - r^B_{eu} \right) \]  

(6.53a)

Hence, any further increase in the interest rate differentials would further increase the expectations of a currency crises. The anticipation of a currency crisis is

\(^{11}\)It should be noted here that the flow of credit (inflows) goes to zero which means the stock of debt will remain constant. The stock of debt will only reduce when an outflow of credit takes place.
exactly what erupts a currency crisis, when international traders start selling the Icelandic assets.

During an event of a sudden stop, the sectors with higher debt are the first ones to go bankrupt as they fail to pay their liabilities. Bankruptcy form one sector quickly spreads to the other sectors of the economy. In our model firms cannot remain solvent even if the level of investment is significantly reduced, and no new borrowing takes place. The reason is that firms have to pay a higher interest on the large pile of existing debt, trapped in the economy. This triggers the balance of payments crisis. Figure 6.16 shows that the balance of payments identity is violated during the crises, which implies such a scenario is not possible, leaving no option other than to impose capital controls. The crisis makes the financial sector unable to repay their debt along with the interest payments on the current account as they go bankrupt.

Figure 6.16: Balance of payments crisis
The anticipated currency crisis in the model results in the foreign households selling their assets in Iceland, resulting into capital reversal as shown by an outflow on the financial account in Figure 6.16. This market run on the banking sector generates currency crisis as shown in Figure 6.22. It is important to highlight that reversal takes the form of foreign households selling their assets in Iceland to a certain limit after they realise that the foreign financial institutions have stopped lending to the economy. However, the debt held by foreign financial institutions remains trapped because no one is able as well as willing to buy such a large pile of a country’s debt that is going through the crisis.

The crisis due to sudden stop also results in the collapse of the real economy as shown in the figures below. The level of economic activities greatly reduces, resulting in a phase of economic recession which in our model is explained by a compression of domestic demand. Apart from domestic demand compression, currency depreciation after the crisis in our model results in a significant reduction in real imports, improving the trade balance. This transforms the growth engine of the economy from investment–led to export–led.

Our model assumes asymmetric effects regarding exchange rate dynamics, i.e., the depreciating effect of capital outflow on the currency is much stronger than the appreciating effect associated with the capital inflows in the years before the crisis. This, as explained earlier, is due to the shift in the strategy of international investors. This result is consistent with the Icelandic crisis as well as many other currency crisis of the past.
Figure 6.17: Real output

Figure 6.18: Real wealth

Figure 6.19: Real imports

Figure 6.20: Real exports

Figure 6.21: Sales price index

Figure 6.22: Exchange rate
Capital controls and leakages

As shown above, once the crisis hits, the balance of payment condition is violated and the economy is not able to finance the deficit on its current account. Consequently, the economy cannot pay any interest on its debt and has to implement capital controls in order to prevent any further outflows.

We now add the following conditions to equation 6.30 and 6.34:

\[ \Delta B_{ice}^{h,eu,d} = 0, \text{ if } \Delta B_{eu}^{eb,s} = 0 \]  
\[ \Delta B_{evu}^{h,ice,d} = 0, \text{ if } \Delta B_{evu}^{eb,s} = 0 \]  

Figure 6.25 shows a plausible scenario after the implementation of strong capital controls in our model. The country is not able to pay any interest on the external debt trapped in the economy as a wave of bankruptcies propagates through the balance sheets of all the sectors in the economy. This situation forces the economy to implement capital controls immediately in order to restrict outflows and prevent a currency crisis.
The situation in Figure 6.25 is based on a proactive response by the authorities, where capital controls with zero leakages are implemented before the outflow has occurred. In reality, international traders are quicker in selling their assets before the authorities can respond. Thus, implementation of capital controls can never fully prevent outflows. Moreover, tighter capital controls with zero leakages are practically impossible, and international traders will take their capital out of the economy whenever there is an opportunity. Capital controls, however, can slowdown the outflow of international capital.

Figure 6.25: Balance of payments after strong capital controls
We introduce capital leakages in our model by allowing a small fraction of foreign capital to escape in every period. Figure 6.26 below shows the dynamics of exchange rate after capital leakages in every period. If the capital continues to leak, the exchange rate will continuously depreciate as shown in Figure 6.26. The gradual depreciation due to leakages is still less harmful than a full-blown currency crisis taking place in a very short period of time. In our model, small leakages have some effect on the currency but in reality small leakages may or may not put any pressure on the currency.

Capital controls give a country enough time to restructure the financial structure and stabilise the economy. During strong capital control regime or even with low leakages, the country can gradually lower the interest rates which can restore domestic demand by channelling savings into investment having little or no impact on the currency as was the case in Iceland. Thus, the economy can retain export-led growth and ease the burden of interest repayments on current account. The
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trade surplus in the economy can be used to repay its debt. The effects of lowering interest rates as opposed to IMF’s insistence on keeping them high under capital control regime in the case of Iceland are previously discussed in detail in Chapter 5.\textsuperscript{12}

6.5 Sensitivity analyses

We address the sensitivity of the model from two different perspectives. First, we change the magnitude of the shocks to more extreme values in order to test the response of the model to more extreme fluctuations. Second, we test the sensitivity of the model by changing the values of the key parameters, which are critical in our analysis as will be discussed.

Effects of extreme shocks

Focusing on the effects of shocks, we begin by creating two strong real investment shocks in the model where we increase and decrease the real investment by 50% in two separate experiments. A strong investment shock results in an increase in real output and a larger current account deficit due to the channels explained earlier. A reduction in the real investment, on the other hand, reduces output and shifts the current account into a surplus. A reduction in real investment decreases the demand for loans in the economy, generating a large difference in banks’ assets (loans) and liabilities (deposits). The excessive funds (deposit liabilities in this case) available in the banking sector – due to lower demand for credit in the economy – are used by the banks to purchase bills internationally to increase their assets. The financial sector in our small open economy instead of borrower now transforms into an international creditor.

\textsuperscript{12}See Gudmundsson and Zoega (2016) for an extensive discussion on the effects of lowering interest rates under capital control regime in Iceland.
Second, we create two interest rate differentials shocks in the model where we first create a strong positive and then a slight negative interest rate differentials in two separate experiments.\footnote{A slight reduction is due to the fact that the interest rates in our baseline are low.} A strong positive interest rate differentials shock pushes the current account into a larger deficit. The transmission channel of rising interest rates in our model remains the same, as discussed in previous section. A slight

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{balance_of_payments_sensitivity}
\caption{Balance of payments sensitivity}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{real_gdp}
\caption{Real GDP}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{exchange_rate}
\caption{Exchange rate}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{trade_balance}
\caption{Trade balance}
\end{figure}
negative interest differential shock improves the current account balance due to lower interest payments and a mild capital outflow as the returns on the Icelandic assets fall relative to the returns on international assets. The currency depreciation after negative interest rate differentials is also the result of international traders taking their capital out of Iceland and investing it in the assets abroad with higher returns.

Figure 6.31: balance of payments sensitivity

Figure 6.32: Real GDP
Figure 6.33: Exchange rate
Figure 6.34: Trade balance
Effects of parameter changes

We now turn to the analysis of changes in key parameter values used in the model. In this regard, we first change the values of our key parameters, and then simulate the new model for two shocks - investment shock followed by interest rates differential shock - defined in the Section 6.4. We focus on the parameter values determining the balance of payments and exchange rate dynamics in the model.

We perform three experiments as follows: First we change the portfolio allocation of the foreign investors, i.e., we reduce the proportion of foreign investors’ wealth allocated in Icelandic assets. In particular, we reduce the value of $\lambda_{80}$ from 0.25 to 0.10 in equation 6.34, and increase the value of $\lambda_{70}$ from 0.25 to 0.40 in equation 6.33. This implies that the foreign investors’ allocate only 10% of their wealth in the Icelandic assets and prefer to invest 40% of their total wealth in their domestic assets. We simulate this model for two shocks – investment shock followed by interest differential shock – as shown in the figures below.

![Figure 6.35: Balance of payments sensitivity](image)

Figure 6.35: Balance of payments sensitivity
A reduction in allocation of foreign wealth in Iceland makes the economy to run a current account surplus in the baseline. An investment shock transforms the surplus into a deficit on the current account as demand for credit increases to finance investment expenditures. The demand for credit is fulfilled by the banks through international borrowing. The current account further deteriorates after an interest differentials shock in the economy. The country, however, experiences less severe current account deficit than in the original model due to running a surplus in the pre-shock phase, and then receiving a milder inflow after an interest rate differentials shock.

The lower allocation of wealth in Iceland also has a positive effect on the real output, primarily due to the direct effect of trade balance. The improved trade balance in this scenario is due to a depreciated currency as compared to the original model. Moreover, a rise in the interest rate differential shock increases the output through domestic wealth effect.

Second, we change the value of our strategic parameter we introduced in the exchange rate setting in equation 6.53, i.e., the currency risk premium considered by the international investors when considering their investment returns on Icelandic assets. We eliminate the currency risk premium from the model, i.e., the value of parameter, \( \Omega \), from 0.25 is changed to 0.

The simulations of the model after international investors ignore the currency risk are reported below. The currency risk eliminations results in an aggressive capital inflow shock into the economy. An interesting result to highlight in this scenario
is that the output falls after interest differentials shock. In all previous results, an interest rate differential was associated with a positive increase in the output due to wealth effect. The fall in output in this particular case is due to the trade balance effect dominating the wealth effect in the model, i.e., aggressive inflow in the absence of currency premium strongly appreciates the Icelandic currency, which in turn induces the demand for imports, thereby adversely affecting output.
Third, we change the value of one of the parameters determining imports, i.e., we increase the income elasticity of imports, $\mu_2$, from 1 to 1.05 in equation 6.42. The effect of the changes in this parameter replicates some stylised facts. The rise in imports results in a larger current account deficit, lower output, and an appreciated currency as compared to the original model.

Figure 6.43: Balance of payments sensitivity

Figure 6.44: Real GDP

Figure 6.45: Exchange rate

Figure 6.46: Trade balance
Overall, our model is not sensitive to changes in the values used in the baseline. The structure of our model, despite looking complex, is largely based on accounting identities and does not involve a very large number of strategic parameters, which makes it quite robust.

### 6.6 Empirical analyses

#### 6.6.1 SFC to SVAR

The use of SVAR models to test the structure of the models is common in macroeconomics. In particular, SVAR is often used to test the structure of the DSGE models. The structure of the model is log-linearised and the key observable variables are imported in SVAR framework. The purpose of this exercise is to either compare the effects of shocks between SVAR and the calibrated model (see, e.g., Poilly (2010)) or to estimate the parameters of the model for the Data generating process (DGP).

Our SFC model does not contain any unobservable variables, and therefore can be directly tested by importing data for relevant variables. However, due to data limitations in Iceland’s particular case, we are not able to test the entire structure of the model. We therefore will adopt a SVAR method to investigate the relationship amongst our key variables and compare the effects of shocks in SVAR with the calibrated SFC model. While the SVAR identification does not test the exact structure of the SFC model, it also does not violate the structure of our theoretical model. We will discuss this in more detail when implementing restrictions on the matrices.

The effects of shocks in SFC and SVAR should be compared carefully due to different nature of the shocks. We introduced permanent shocks in SFC model where

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14See Pagan and Robinson (2016) for an extensive discussion on the relationship between DSGE and SVAR.
the system enters a new phase after a shock, while the shocks in SVAR are temporary and the system converges to its pre-shock state. The purpose of introducing permanent shocks in SFC model was to generate the crisis by accumulating foreign debt, which eventually led to a sudden stop.\footnote{Alternatively, if we would have created temporary shocks in the system, the economy would have never accumulated a large pile of debt and we would have no reason to create a sudden stop.}

In order to draw a direct comparison between SVAR and SFC dynamics, we will also simulate SFC model with a temporary shock in some cases as will be discussed. However, it is not always possible to draw a direct comparison between the shocks of SVAR and SFC. The reason is that SVAR can create an orthogonal shock in any particular variable in the system. On the other hand, SFC consists of many endogenous variables which cannot be shocked, e.g., SVAR can exogenously generate a currency crisis (exchange rate shock) but the currency crisis in SFC model is the result of a sudden stop when foreign traders sell Icelandic assets.

### 6.6.2 Methodology

In order to empirically investigate some features of the SFC framework, we employ a structural VAR (SVAR) approach while mainly focusing on the exchange rate and balance of payments dynamics.

A VAR model in general has several advantages over a single equation dynamic model, a) it is not affected by endogeneity problem, b) it has a reinforcing mechanism between variables, c) it allows us to define structural shocks on the basis of economic theory or real world experiences, d) it reveals too much information which would remain hidden in other traditional macro models, e) the implementation and interpretation of the model is simple.

A simple VAR model is represented as follows.

\[ Bx_t = A(L)x_{t-1} + \varepsilon_t \] (6.57)
where \( B \) is a \((n \times n)\) matrix of contemporaneous relationships in the system. In the above recursive VAR model, \( B \) is an identity matrix \((B = I_n)\). \( x_t \) is a \((n \times 1)\) dimensional matrix, which includes endogenous variables. \( A(L) = A_1 L + ... + A_p L^p \) is \( P^{th} \) order lag polynomial. \( \epsilon_t \) is a white noise process (serially uncorrelated) with zero mean and positive definite covariance matrix.

After setting up reduced VAR models, we impose contemporaneous restrictions to estimate SVAR. We then shock our baseline models and estimate the orthogonal impulse response functions. The SVAR is represented as follows:

\[
x_t = \Pi(L)x_{t-1} + u_t
\]

where \( \Pi = B^{-1} A(L) \) and \( u_t = B^{-1} \epsilon_t \). To estimate the above SVAR model, we allow the off-diagonals of \( B \) matrix non-zero and impose short-run restrictions on the matrix.

Model A

We investigate the role of capital inflows in Iceland, using quarterly data from 1999Q1 to 2013Q4. First, we model inflows attracted by interest rate differentials, and its subsequent impact on the current account, nominal exchange rate, and borrowing linked to foreign currency. We also analyse several reinforcing mechanisms within the same system.

We define a 5 variable model for Iceland as follows;

\[
\text{Model A : } x_t = [\Delta r, \Delta x_t^{eu}, CAB, \Delta L_{h,eu,d}^{ice}, F]
\]

where \( \Delta r \) represents the difference of interest rate differentials between Iceland and ECB interest rate which is defined as:

\[
r = r_{ice} - r_{eu}
\]

\( \Delta x_t^{eu} \) is the log difference of the nominal exchange rate which is defined as
\( \varepsilon / ISK \). \( CAB \) represents the moving average of Current Account Balance (nominal). \( \Delta L_{\text{ice}}^{h,\text{eu},d} \) represents the log difference of Icelandic households’ loans (linked to foreign currency). \( F \) represents the moving average of capital inflows into Iceland.

We include two dummies in this model to control for structural breaks; 1) a dummy variable for regime shift (i.e., for capital controls) which takes the value of zero before structural break (i.e., 2008Q2) and the value of 1 afterwards, 2) a dummy for pulse intervention which takes the value of 1 for the observations occurring at 2008Q2 – 2008Q4 or zero otherwise.\(^{16}\)

We impose the following restrictions on SVAR to identify structural shocks.

\[
\begin{pmatrix}
\varepsilon_r & \varepsilon_{xr} & \varepsilon_L & \varepsilon_{CAB} & \varepsilon_F \\
\Delta r & 1 & 0 & 0 & 0 \\
\Delta x_{r^{eu}} & X & 1 & 0 & 0 \\
\Delta L_{\text{ice}}^{h,\text{eu},d} & 0 & X & 1 & 0 \\
CAB & X & X & 0 & 1 \\
F & X & 0 & X & 1 
\end{pmatrix}
\]

Following the sequence of events in the structure of our SFC model, we carefully identify the structural shocks in our VAR framework as follows. The interest rate differentials contemporaneously affects the inflows. The exchange rate contemporaneously affects the current account balance and forex denominated loans. The current account balance responds with a lag to inflow shocks but the current account shocks contemporaneously affect the inflows. The reason is that financing current account balance requires inflows in the same period. Moreover, shocks to FX denominated loans also affect inflows contemporaneously, i.e., any demand for loans in every period is fulfilled without any delay. This, as explained earlier, is an essential feature of the banking sector incorporated in our SFC model.

\(^{16}\)Dummy for capital controls is only significant for the equation of capital inflow in the model therefore we only keep it in the capital inflow equation by manually restricting VAR. Dummy for pulse intervention is not significant for any of the equations, we therefore remove it from our final model.
Model B

We then examine the type of inflows associated with the real exchange rate variation. We break down the capital inflows into two components a) fixed income securities and equities, b) deposits. We then include these inflows in a VAR model along with the real exchange rate. We use quarterly data from 1998Q2 to 2014Q3.

Model C:  

\[ x_t = [\Delta r_{xr}^{eu}, B_{eu}^{h,ice,d}, D_{eu}^{h,ice,d}] \]  

(6.60)

where \( \Delta r_{xr}^{eu} \) represents the log difference of the real exchange rate, \( B_{eu}^{h,ice,d} \) represents the moving average of fixed income securities and equities as a percentage of GDP, and \( D_{eu}^{h,ice,d} \) represents foreign deposits as a percentage of GDP.\(^7\) We include dummy for structural break in the model which takes the value of 1 from 2007Q2 – 2008Q4 and zero otherwise.\(^8\)

In order to identify structural shocks, we impose the following restrictions.

\[
\begin{bmatrix}
\varepsilon_{rxr} & \varepsilon_B & \varepsilon_D \\
\Delta r_{xr}^{eu} & 1 & 0 & 0 \\
B_{eu}^{h,ice,d} & X & 1 & 0 \\
D_{eu}^{h,ice,d} & X & X & 1 \\
\end{bmatrix}
\]

Model C

Finally, we address the question of exchange rate pass through to CPI. In addition, we analyse the nexus of exchange rate, inflation and share prices in Iceland within the same framework.\(^9\) In this regard, we define a 3 variable model for Iceland.

\(^7\)We have used average value of the quarterly GDP from 2000 to 2014 in order to keep the original variation in the series and also create a shock of meaningful magnitude.

\(^8\)These dummies are based on the potential break points, suggested by Zivot and Andrews (1992) test for the unit-root structural break. The potential break points for variables coincide with the crisis.

\(^9\)All the variables in Model B are integrated of order I(1) which allows for possible cointegration in this framework but we are using a small sample and are only interested in the short-run dynamics therefore we will not test the cointegrating vectors in this chapter.
using monthly data from 2000M1 to 2014M9;

\[ x_t = [\Delta r_{x e u}, \Delta P_{S_{ice}}, \Delta S] \] (6.61)

where \( \Delta r_{x e u} \) represents the log difference of the nominal exchange rate which is defined as \( \varepsilon / \text{ISK} \). \( \Delta P_{S_{ice}} \) represents the log difference of CPI. \( \Delta S \) represents the log difference of share price index in Iceland. On the basis of unit-root structural break analyses, we include a dummy for pulse intervention that takes the value of 1 for the period 2008M4 – 20098M12 and zero otherwise.

\[
\begin{pmatrix}
\varepsilon_{xr} & \varepsilon_P & \varepsilon_s \\
\Delta r_{x e u} & 1 & 0 & 0 \\
\Delta P_{S_{ice}} & X & 1 & 0 \\
\Delta S & X & X & 1 \\
\end{pmatrix}
\]

6.6.3 Data treatment

We test the data for seasonality and find that none of the variables is affected by seasonal patterns. The decision of variable-differencing is based on several tests. We analyse the data by using ADF and PP test. We then test for potential break points using unit root structural break test by Zivot and Andrews (1992). All the variables incorporated in our model are stationary which means following a shock, the model returns to its pre-shock level at some point in the future. Moreover, in the analysis of current account and inflows, we use 4 quarter moving average in all our models in order to reduce the effect of the crisis in the series.
6.6.4 Results

Impulse responses

Model A

Figure 6.47 shows the impulse response of capital inflows to an increase in the interest differential between Iceland and the eurozone. We shock our baseline model with a +100 bps interest rate differential. Capital inflows into Iceland rapidly respond to the rise in interest differentials and reach a maximum level of 40 billion Icelandic krona (nominal) between 4th – 5th quarter. The effect of the shock totally disappears after 4 years.

Positive interest rate differentials could either be due to lower global interest rates or higher interest rates in the home country. For Iceland, it was the combination of both, but more importantly the latter as Iceland’s interest rate increased more frequently than the fall in global interest rates.

![Figure 6.47: ∆r Shock (+100 bps)](image1)

![Figure 6.48: Capital Inflow Shock (1bn ISK)](image2)

Figure 6.48 shows the response of current account balance to an inflow shock of 1 billion Icelandic krona (nominal), which pushes the current account into a deficit of 190 million Icelandic krona in the second year. Inflows initially improve the CA balance but this effect is statistically insignificant.
Figure 6.49 shows the effect of temporary interest differential shock in the SFC model. The impulse responses of current account balance and inflows to an interest differentials shock in SVAR are consistent with the simulations of our SFC model, as shown in Figure 6.49. Inflows immediately respond to interest rate differential shock while the response of current account balance is sluggish. It takes a while for the current account to go into a deficit after the economy receives financial flows.

\(^{20}\)The magnitude of the temporary shock is the same as discussed earlier.
Figure 6.50a shows the response of Icelandic nominal exchange rate (€/ISK) to an inflow shock of 1 billion Icelandic kronas (nominal). Following an inflow shock, the nominal exchange rate appreciates by 0.05 percent in the 4th quarter but the effect of the shock is statistically significant. The effect of the shock completely disappears after 2 years. The dynamics of exchange rate, responding to capital inflows in our SFC can be compared with SVAR. The effect of temporary interest rate differential shock in SFC is also coming from the capital inflow channel, i.e., temporary interest rate differentials triggers capital inflows, which appreciates the exchange rate. The exchange rate in both the SFC and SVAR quickly converges to its pre-shock level.

(a) Interest differential shock

(b) capital inflow shock

Figure 6.50: Exchange rate response: SFC vs SVAR

(a) Response: Forex denominated loans
Figure 6.51a shows the impulse response of households’ loans (linked to foreign currency) following an unexpected shock of 10 percent depreciation of the krona. The borrowing of these loans decreases by 18 percent immediately. The effect of the shock is highly significant in the first year but later on becomes insignificant. This result indicates that exchange rate overvaluation in Iceland immediately triggered households’ loans (linked to foreign currency).

**Model B**

**Do inflow types matter for real exchange rate?**

Figure 6.52a and 6.52b shows the accumulated response of real exchange rate to inflow shocks of different nature. Inflow shock in the form of fixed income securities and equities significantly appreciate the real exchange rate (a rise in the real exchange rate implies appreciation in our analyses). In particular, the real exchange rate rapidly appreciates in response to a 1 percentage point increase in fixed income securities and equities relative to GDP. The accumulated response reaches its maximum level of 0.5 percent (i.e., appreciates by 0.5 percent) after 10 quarters. Although the real exchange rate responds rapidly, it is insignificant in the initial quarters, and only becomes significant after 6 quarters.

![Inflow shock (excluding deposits)](image1)

![Inflow shock (Deposits)](image2)

Figure 6.52: Response of real exchange rate

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We use accumulated impulse responses because the impulse responses of individual lags are insignificant as these inflows are highly volatile and sensitive to global conditions. Due to their volatile nature they frequently fluctuate which makes it challenging to grasp their relationship with the real variables.
In the initial periods of liberalisation until 2006, flows into Iceland mostly comprised of fixed income securities. The exchange rate fluctuation in this period could therefore be attributed to high interest bearing debt. On the other hand, the impact of currency and deposits on real exchange rate is not different than zero, which could be due to two main reasons. First, these deposits were in the foreign branches of Icelandic banks and had no direct impact on the exchange rate. Second, these inflows dramatically increased in 2006 just before the crisis. This empirical result also supports our behavioural equations 6.31 – 6.34 in the SFC model where we have refrained from allowing the exchange rate expectations to directly affect foreign investors’ demand for deposits in the foreign branches of Icelandic banks.

Model C

Is there ERPT to CPI in Iceland?

Figure 6.53a shows the orthogonalised impulse responses of inflation to a currency crisis in Iceland. A depreciation of 20 percent in the nominal exchange rate immediately increases monthly CPI inflation by a maximum of 2 percent. However, a currency crisis of the same magnitude increases annual inflation by almost 7-8 percent as shown in Figure 6.53b. The accumulated response reaches a level of 7-8 percent after 12 months. The rise in inflation is likely due to direct ERPT to CPI as a large portion of Iceland’s CPI basket consists of imported goods (e.g., petroleum and food products). The depreciation of currency made imported goods more expensive. The shape of the impulse response in Figure 6.53a from SVAR is also reflected in our SFC simulations, shown in Figure 6.21.
Is there any interaction between krona and stock prices in Iceland?

While we did not model share prices in our SFC model, we extend the SVAR analysis to explore the dynamics of share prices and exchange rates in Iceland. Figure 6.54 shows the effect of currency crisis on the stock prices in Iceland. A 20 percentage point shock of nominal depreciation decreases the share prices by 15 percent in the same quarter. The impact of the shock becomes insignificant after one year and disappears after 12 quarters.

We then analyse the reinforcing mechanism and shock our baseline model with a stock market boom, where the share prices unexpectedly increases by 20 percentage points. The share price boom appreciates the nominal exchange rate by 2 percent after 7 to 8 quarters as shown in Figure 6.55.
This interaction of exchange rate and stock market in our model indicates that the impact of share prices on exchange rate is not very strong, but the effect of a depreciation on the share prices is much stronger. This is consistent with the fact that during the crisis, both the speed and magnitude of depreciation is much stronger than its appreciation during the period of economic boom. The collapse of share prices during the crisis often creates currency crisis in small economies with sovereign currencies.

6.6.5 Robustness

We pay considerable attention to the robustness of the models in this chapter. In this regard, we perform additional experiments on our models to test the sensitivity of our results by changing the assumptions that we imposed on SVAR. We performed some general robustness tests as well as model–specific robustness tests.

All the variables in our models are stationary and the roots lie within the boundary of unit circle, which means that our models are stable and converge to an equilibrium level. The CUSUM results of all the models are reported in the appendix, which satisfy the stability criteria.
The setting for our baseline models includes a deterministic trend. We re-estimate the models without a deterministic trend and find that impulse responses are not sensitive to such setting.

In our baseline model, we have restricted the diagonal coefficients of our matrix to a value of 1. We relax this assumption by allowing the model to estimate the diagonal coefficients. We find that a violation of this assumption has no effect on the impulse responses in any of the models.

To avoid the influence of inflation and trade on our results in the case of Model A, we include CPI inflation and then imports as exogenous variables separately, finding no considerable effects on the results. To ensure that our impulse responses are not affected by over-parameterisation problem in the case of Model A, we restrict our baseline model to 4 lags and conclude that it has little impact on the impulse responses but does not change the interpretation of our results in any fundamental way. We also exclude one variable from our baseline model at a time and re-estimate the impulse responses for 6 lags as well as 4 lags. First, we estimate a model (with 4 variables) without households’ loans, then a model (with 4 variables) without exchange rate, and finally a model (with 4 variables) excluding capital inflows. This experiment exposes the sensitivity in the relationship of inflows and exchange rate in the model. From these experiments, we conclude that the relationship between inflows and exchange rate is non-robust but their relationship with all other variables in the model is quite robust. In addition, variations in the lag length have no considerable impact on the impulse responses.

Finally, we re-estimated both Model B and C for varying lag lengths, finding that the impulse responses are quite robust. Moreover, both the models are unaffected by varying the definition of dummy for structural breaks.
6.7 Conclusion

This chapter proposed a framework for a small open economy with sovereign currency while focusing on the role of international financial flows. We demonstrated that borrowing to finance real investment under lower interest rates has a mild impact on the current account balance and a stronger impact on the real output. However, international borrowings in a small open economy with sovereign currency often require offering better incentives to international investors than its competitors due to exchange rate risks. This in Iceland took the form of higher interest returns on Icelandic financial assets relative to foreign assets. In this regard, our findings – both theoretically and empirically – suggested that positive interest rate differentials attract a large amount of short-term inflows by creating an opportunity for short-term profits. These persistent inflows are found to overvalue exchange rate, deteriorate trade balance, and generate an economic boom with a fast growing debt.

The accumulation of external debt may or may not reach unsustainable levels, but nonetheless will at some point create concerns in the markets regarding the potential of debt repayments. These market fears take the form of a sudden stop as international short-term capital due to its fleeting nature flows out of the economy in a very short-period of time. These sudden outflows convert liquidity crises into solvency crises and sustainable debts into unsustainable debts, creating serious financial and real economic crises.

A sudden outflow severely impacts the whole economy. It generates a balance of payments crisis and also compresses domestic demand, resulting in a severe recession. A small open economy reliant on international credit is not able to finance its economic activities after the channel of international capital is closed. An appropriate immediate response in the short-run is to impose strong capital controls in order to stabilise the currency and gain enough time to restructure the economy. To facilitate the balance of payments adjustment and a quick economic recovery, capital controls requires the backing of careful monetary policy decisions. The cost of borrowing at the time of the crisis skyrockets, and a financial crisis
usually leaves the country to operate in an environment of high interest rates. This further triggers the ‘paradox of thrift’ effect with a rise in savings and a considerable decline in real investments due to economic uncertainties and heavy costs of borrowing.

Monetary authorities can gradually reduce interest rates to recover domestic demand in order to facilitate economic growth. In a capital control regime, interest rates can have weak or no significant effects on the currency as the channel of trading financial assets is restricted. Thus, lowering interest rates will not affect the export–led growth in the capital control regime but ease the burden of interest payments to international creditors, further improving the balance of payments. This argument in Iceland’s particular is supported by Gudmundsson and Zoega (2016) and was also explained in Chapter 5. The removal of capital controls, however, still remains a challenge for small open economies going forward. The effects of relaxation in capital controls, and the future strategy regarding capital inflows in Iceland are discussed in Zoega (2016).

**Appendix D**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\phi$</td>
<td>Mark–up</td>
<td>0.23</td>
</tr>
<tr>
<td>$p_{ice}$</td>
<td>productivity in Iceland</td>
<td>1.3</td>
</tr>
<tr>
<td>$w_{ice}$</td>
<td>nominal wage rate in Iceland</td>
<td>1</td>
</tr>
<tr>
<td>$\theta$</td>
<td>tax rate</td>
<td>0.25</td>
</tr>
<tr>
<td>$I_{k_{ice}}$</td>
<td>real investment</td>
<td>10–11.5</td>
</tr>
<tr>
<td>$r_{B_{ice}}$</td>
<td>interest on Icelandic bills</td>
<td>0.02–0.040</td>
</tr>
<tr>
<td>$r_{B_{eu}}$</td>
<td>interest on foreign bills</td>
<td>0.02</td>
</tr>
<tr>
<td>$r_{L_{ice}}$</td>
<td>interest on ISK denominated loans</td>
<td>0.04–0.045</td>
</tr>
<tr>
<td>$r_{L_{eu}}$</td>
<td>interest on FX denominated loans</td>
<td>0.04</td>
</tr>
<tr>
<td>$r_{D_{ceu}}$</td>
<td>interest on deposits in foreign branches of Icelandic banks</td>
<td>0.015</td>
</tr>
<tr>
<td>$r_{D_{ice}}$</td>
<td>interest on deposits in domestic branches of Icelandic banks</td>
<td>0.015</td>
</tr>
<tr>
<td>$r_{D_{eu}}$</td>
<td>interest on deposits in foreign banks</td>
<td>0.015</td>
</tr>
<tr>
<td>$\omega_1$</td>
<td>proportion of loans demanded in local currency</td>
<td>0.6</td>
</tr>
<tr>
<td>$\omega_4$</td>
<td>proportion of loans demanded in foreign currency</td>
<td>0.4</td>
</tr>
<tr>
<td>$\omega_2 = \omega_3 = \omega_5 = \omega_6$</td>
<td>sensitivity of loans to changes in interest</td>
<td>8</td>
</tr>
<tr>
<td>$\alpha_1$</td>
<td>propensity to consume out of disposable income</td>
<td>0.8</td>
</tr>
<tr>
<td>$\alpha_2$</td>
<td>propensity to consume out of wealth</td>
<td>0.2</td>
</tr>
<tr>
<td>$\lambda_{10}$</td>
<td>Icelandic wealth allocation in deposits in local banks</td>
<td>0.5</td>
</tr>
<tr>
<td>$\lambda_{20}$</td>
<td>Icelandic wealth allocation in domestic bills</td>
<td>0.25</td>
</tr>
</tbody>
</table>
Icelandic wealth allocation in foreign bills 0.25
foreign wealth allocation in deposits in foreign banks 0.25
foreign wealth allocation in deposits in Icelandic banks 0.25
foreign wealth allocation in foreign bills 0.25

sensitivity of Icelandic portfolios to interest changes 1.5
sensitivity of foreign portfolios to interest changes 0.75
sensitivity of foreign portfolios to interest changes 0.5

Exogenous component of import prices -0.00001
Import prices sensitivity to prices in Iceland and trade partners 0.7
Export prices sensitivity to prices in Iceland and trade partners 0.5
Price elasticity of imports 0.7
Income elasticity of imports 1
Price elasticity of imports 0.7
Income elasticity of imports 1
Speed of convergence towards long-run exchange rate 0.25
Long-run path of exchange rate 1

Table D1: Parameters and exogenous variables

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>B_{h,ice,d}^{ice}</td>
<td>Demand for Icelandic bills by Icelandic households</td>
<td>7.0</td>
</tr>
<tr>
<td>B_{h,eu,d}^{ice}</td>
<td>Demand for EU bills by Icelandic households</td>
<td>7.0</td>
</tr>
<tr>
<td>B_{h,eu,d}^{eu}</td>
<td>Demand for EU bills by EU households</td>
<td>7.0</td>
</tr>
<tr>
<td>B_{h,ice,d}^{eu}</td>
<td>Demand for Icelandic bills by EU households</td>
<td>7.0</td>
</tr>
<tr>
<td>B_{s}^{ice}</td>
<td>Bills supplied by Icelandic banks</td>
<td>14.3</td>
</tr>
<tr>
<td>B_{b}^{ice}</td>
<td>Icelandic bills held by foreign banks</td>
<td>0.3</td>
</tr>
<tr>
<td>D_{h,ice,d}^{ice}</td>
<td>Total bills issued by Iceland</td>
<td>14.3</td>
</tr>
<tr>
<td>D_{h,ace,d}^{ice}</td>
<td>Demand for deposits in Icelandic domestic banks by Icelandic households</td>
<td>14.0</td>
</tr>
<tr>
<td>D_{h,ace,d}^{ice}</td>
<td>Demand for deposits in Icelandic domestic banks by EU households</td>
<td>14.0</td>
</tr>
<tr>
<td>D_{h,ace,d}^{eu}</td>
<td>Demand for deposits in EU banks by EU households</td>
<td>7.0</td>
</tr>
<tr>
<td>D_{h,ace,d}^{eu}</td>
<td>Demand for deposits in Icelandic banks by EU households</td>
<td>7.0</td>
</tr>
<tr>
<td>D_{s}^{ice}</td>
<td>Total demand for deposits in Icelandic banking system</td>
<td>21</td>
</tr>
<tr>
<td>L_{f}^{s}</td>
<td>Total demand for loans by firms</td>
<td>34.0</td>
</tr>
<tr>
<td>L_{f,ace,d}^{ice}</td>
<td>Demand for ISK denominated loans by firms</td>
<td>23.8</td>
</tr>
<tr>
<td>L_{f,ace,d}^{ice}</td>
<td>Demand for FX denominated loans by firms</td>
<td>10.2</td>
</tr>
<tr>
<td>L_{s}^{ice}</td>
<td>Total demand for loans in Iceland</td>
<td>34.0</td>
</tr>
<tr>
<td>L_{s}^{ice}</td>
<td>Total supply of loans</td>
<td>34.0</td>
</tr>
<tr>
<td>V_{ice}</td>
<td>Stock of wealth in Iceland</td>
<td>14.0</td>
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Table D2: Initial values of stocks
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAB&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Current account balance</td>
</tr>
<tr>
<td>C&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Nominal private consumption</td>
</tr>
<tr>
<td>CK&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Real consumption</td>
</tr>
<tr>
<td>D&lt;sub&gt;ice&lt;/sub&gt;&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Total demand for deposits in Icelandic banking system</td>
</tr>
<tr>
<td>d&lt;sub&gt;ext&lt;/sub&gt;&lt;sup&gt;euro&lt;/sup&gt;</td>
<td>changes in exchange rate expectations</td>
</tr>
<tr>
<td>F</td>
<td>Gross capital inflows</td>
</tr>
<tr>
<td>F&lt;sub&gt;ice&lt;/sub&gt;&lt;sup&gt;f&lt;/sup&gt;</td>
<td>Profit of the firms</td>
</tr>
<tr>
<td>F&lt;sub&gt;ice&lt;/sub&gt;&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Profit of the banks</td>
</tr>
<tr>
<td>FAB&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Financial account balance</td>
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<tr>
<td>G&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Government expenditure</td>
</tr>
<tr>
<td>I&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Nominal investment</td>
</tr>
<tr>
<td>Ik&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Real investment</td>
</tr>
<tr>
<td>L&lt;sub&gt;ice&lt;/sub&gt;&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Total demand for loans in Iceland</td>
</tr>
<tr>
<td>L&lt;sub&gt;ice&lt;/sub&gt;&lt;sup&gt;s&lt;/sup&gt;</td>
<td>Total supply of loans</td>
</tr>
<tr>
<td>M&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Nominal imports</td>
</tr>
<tr>
<td>Mk&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Real imports</td>
</tr>
<tr>
<td>n&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Employment</td>
</tr>
<tr>
<td>PS&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Total sales price</td>
</tr>
<tr>
<td>PDS&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Domestic sales price</td>
</tr>
<tr>
<td>PM&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Import prices</td>
</tr>
<tr>
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<td>Export prices</td>
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<td>PY&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>GDP deflator</td>
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<tr>
<td>T&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Taxes</td>
</tr>
<tr>
<td>x&lt;sub&gt;euro&lt;/sub&gt;&lt;sup&gt;r&lt;/sup&gt;</td>
<td>Nominal exchange rate (ISK per euro)</td>
</tr>
<tr>
<td>Y&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Nominal GDP</td>
</tr>
<tr>
<td>Y&lt;sub&gt;ice&lt;/sub&gt;&lt;sup&gt;r&lt;/sup&gt;</td>
<td>Real GDP</td>
</tr>
<tr>
<td>YD&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Nominal disposable income</td>
</tr>
<tr>
<td>YD&lt;sub&gt;ice&lt;/sub&gt;&lt;sup&gt;r&lt;/sup&gt;</td>
<td>Real disposable income</td>
</tr>
<tr>
<td>YDHS&lt;sub&gt;ice&lt;/sub&gt;</td>
<td>Haig–Simon disposable income</td>
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</table>

Table D3: List of endogenous variables
Chapter 7

Conclusion

7.1 Summary

At the turn of the 21st century, strong financial integration, high levels of innovation, and lower interest rates across global markets paved a path for extensive financial development in many open economies. Less emphasis was placed on the risks associated with international borrowing. This allowed a sizeable expansion of the financial sector relative to the real sector in many small economies. The expansion of financial sector took place regardless of the prevailing currency regimes, e.g. European peripheral countries (currency union), the Baltics (fixed exchange rate), and Iceland (floating regime).

In 2007–08, the financial crisis erupted in the US sub–prime mortgage market with the bursting of housing bubble, which eventually turned into a full–blown global crisis. Small open economies, reliant on international credit, experienced capital reversals, balance of payments crisis, and recessions, all resulting in high unemployment, large fiscal costs, and spending cuts on welfare.

The recent experience of the crisis–hit countries clearly suggests that a very large financial sector amplified by large financial inflows is potentially destabilising as it is more vulnerable to external shocks. Consistent with the boom–bust experiences of the past, sudden stops in 2007–08 initially created instability in the financial
sector of many small open economies but the problems in the balance sheets of the financial sectors eventually permeated into all other sectors of the economy, generating real crisis. The experience of Iceland with a floating currency and Ireland as a member of the currency union in this regard is largely similar to other crisis–hit economies, but nonetheless serves as a good natural experiment due to the two economies’ exceptional financial and real sector growth prior to the crisis, and their recovery and adjustment after the crisis.

The absence of exchange rate risk in the euro zone allowed countries like Ireland to borrow at lower costs, while Iceland attracted large inflows, initially benefiting from its good sovereign rating, and later through higher interest rates. The sudden stop of inflows resulted in balance of payments problems which eventually turned into a full-blown crisis in both countries.

The two countries responded differently to the crisis, mainly because of their institutional setups and different currency regimes. Iceland’s banks collapsed because of a lack of a lender of last resort while the Irish banks received sufficient liquidity support to survive. Iceland imposed capital controls during a wave of bankruptcies in the non-financial corporate sector while restructuring their banking system, and forcing foreign creditors to finance mortgage debt relief. This sharply contrasted with the scenario that developed in Ireland. The Irish household debt remained at historically high levels with no debt resolution while the senior creditors of all banks were made whole via a banking guarantee.

Since the onset of the crisis, an interesting scenario developed with regards to the recovery of small open economies, mainly due to their exchange rate regimes and economic policies during the crisis and onwards. Iceland and Ireland operating under different currency regimes are two appropriate examples in this regard. The different institutional setup and post-crisis policies of the two countries led them to a different recovery pattern.

The rebalancing approach in the currency union placed the entire adjustment burden on the deficit countries. This approach largely focused on reducing the
saving–investment gap and adopting fiscal consolidation measures. Structural reforms, calling for internal devaluation in order to improve competitiveness, were agreed to be implemented in the crisis-hit countries of the eurozone. Such measures resulted in the slowdown of overall economic activities, resulting in high unemployment. The only exception where such reforms are believed to have been effective is Ireland. Contrary to the Irish recovery path is the case of a sovereign currency regime in Iceland, where the domestic demand restored relatively faster than in other crisis-hit countries. In general, the Icelandic economy had to face less severe impacts of the crisis, reflected in its sharp current account adjustment, low unemployment, and positive economic growth since 2010–11.

### 7.2 Findings

This thesis addressed several questions related to the process of financial development, crisis, and recovery in small open economies under different currency regimes. In this regard, we tested three core hypotheses.

- Our first core hypothesis tested whether the process of financial development and its transmission channels to the real sector in Iceland and Ireland were similar. We found that the two economies shared large similarities in the interaction between their real and financial sectors. Our results indicated that financial development in both the countries was positively linked with the wage share, household debt, and non-residents investment income. The transmission channel between financial and real economy which sets these economies apart is the trade effect, primarily due to different currency regimes.

- Our second hypothesis tested whether a sovereign currency regimes leads to a rapid rebalancing and crisis recovery. The evidence suggested that the real exchange rate and compression in domestic demand effectively served as the adjusting mechanisms for Iceland’s current account. Moreover, Iceland
also had the option of capital controls and autonomous re-structuring of the financial sector which played a central role in its recovery process. On the other hand there was no evidence of real exchange rate affecting current account in Ireland, where domestic demand compression served as the main adjusting mechanism. The findings in the case of Ireland were found to hold for other periphery countries as well.

- Our third and final hypothesis tested whether the implementation of capital controls in response to crisis an appropriate measure. In this regard, we investigated the saving–investment relationship with a focus on regime shifts in Iceland. Our results suggested that the saving–investment coefficient depends on the level of capital mobility. The lifting of capital controls in Iceland in 1994–2008 reduced the value of the coefficient and the imposition of capital controls in Iceland in 2008 raised it. We drew a clear distinction between the effects of capital controls on the investment–saving correlation in the ‘normal’ times and the ‘crisis’ period. The main difference between these two periods was a forced current account surplus in the latter period when foreign creditors needed to be repaid, which was created by lower investment and higher private savings.

During a crisis, the country risk premium increases which makes it necessary to both impose capital controls as well as raise domestic interest rates in small open economies. For small open economies, capital controls in particular can alter their potential growth rates, both positively and negatively, in both the medium and long run.

### 7.3 Contribution

This study contributes to the existing literature on financial development, crisis, and recovery in small open economies. The thesis has four core contributions as follows.
• First, this study explains the 2008 crisis in Iceland and Ireland with an emphasis on the role of financial inflows in destabilising these countries’ economies. Our analyses in this regard differ from previous studies on two grounds. First, we investigated the dynamic interaction of financial development with the transmission channels that affected the real sectors. Second, we showed that the transmission channels of financial inflows in apparently similar looking economies can greatly differ in their relationship with the real economy.

While the previous studies on the relationship between financial development and real economy have derived positive relationship, the transmission mechanisms behind this relationship had largely been ignored. This encouraged countries to allow sizeable expansion of financial sector while ignoring the risks, and the transmission channels of financial development on economic growth.

• This study highlighted the importance of exchange rate regimes in small open economies. Our study provides an important contribution regarding the recovery pattern in small open economies. We theoretically as well as empirically discussed the dynamics of recovery patterns. We distinguished the adjustment mechanisms in a fully sovereign regime from that in a currency union.

• Our study revisited Feldstein–Horioka, the mother of all puzzles in macroeconomics, as described by (Obstfeld and Rogoff, 2000, p.175). Our analyses offer two important contributions to the existing empirical literature. First, we investigated the S–I correlation in Iceland and 16 OECD countries, allowing for asymmetric effects. Second, we investigated the S–I nexus with a focus on regime shifts in Iceland, which currently operates under restricted capital mobility. We distinguished the scenarios of capital controls imposed in response to the crisis from the capital controls which prevailed historically in normal circumstances.
Finally, this study as an alternative to conventional macroeconomic models proposed a framework for open economy with sovereign currency. We focused on the role of international capital inflows, creating economic booms. We also demonstrated the subsequent destabilising effects of capital inflows on the economy, allowing for sudden stops and reversals.

7.4 Limitations of the research

In common with all studies, our analyses are subject to several limitations as follows.

The measure of ‘financial development’ used in the literature is one aspect of financialisation often based on the size and depth of the financial sector. Due to data limitations our proxies, also based on size and depth of financial sector, reflects only one dimension of financialisation.

Regarding our empirical models, we only tested for one structural break in the data but in most cases the data clearly seem to have multiple breaks. We therefore had to use our visual analyses to detect other possible breaks in the data.

In the analyses of recovery pattern, we assumed linear and symmetric relationships in our empirical models due to data limitations. Allowing for asymmetric dynamics in the empirical models could have revealed more interesting information in the recovery pattern of small open economies. Moreover, the type of goods in the trade balance are also vital for recovery pattern e.g. countries trading in price–inelastic goods might have a different recovery pattern than the ones we have analysed in our empirical section. This might require microeconometric analyses on firm–level data.

In our SFC model, we did not not model the Central Bank and treated interest rates as exogenous. This is oversimplification of the Icelandic experience. The Icelandic central bank responded to the ensuing domestic investment boom by raising interest rates, which then created profit opportunities for the carry trade
and attracted more inflows. Hence, introducing the role of central bank would be an interesting feature.

The exchange rate determination in chapter 6 is very specific to the Icelandic experience. Based on our empirical findings, we allowed the interaction of bills market to determine the nominal exchange rate while the amount of deposits having no impact. This might not be applicable to the case of exchange rates in all floating regimes.

The generalisation drawn from previous experience in this study cannot be applied to all situations unless they are similar. A small economy switching from currency union to sovereign currency, for example, might not have the desired outcome immediately like a sovereign currency had for Iceland.

### 7.5 Policy recommendations

Policy makers require new tools to track credit flows to sectors, while the international dimension of small open economies like Iceland and Ireland remains a concern going forward. In particular, there are several policy lessons to be drawn from the episode.

First, even though the channels through which the capital inflows differ between the countries, it is clear that speculative capital inflows create financial instability. Thus the first lesson is to adopt macroprudential polices that limit the size of such inflows and thus prevent a sudden stop of the inflow from creating unmanageable financial and macroeconomic disturbances. The types of policies differ depending on the currency arrangement.

Second, small economies should not have large banking sectors even if they have a lender of last resort in the Eurozone because the sovereign has to be able to recapitalize the banks if they suffer losses. Without such a lender of last resort, which was the case of Iceland, a large banking system is inherently fragile since
a suspicion about liquidity problems can easily cause a bank run. A large well-diversified economy is needed to support a large banking system.

Third, recovery of domestic demand as a short-run policy measure is essential to end recessions and reduce unemployment. The current policies of internal devaluation have so far resulted in a bitter experience of large spending cuts instead of restoring confidence. This has resulted in long-lasting recessions, deflation and high unemployment. Moreover, the policy of internal devaluation might help in the current account adjustment but does not warrant economic growth and reduction in unemployment, if domestic demand is declining.

Finally, the policy framework should keep pace with the innovations in the markets. Otherwise, a decade of stable economic growth and introduction of new methods of financing may result into forgetting the past lessons, encouraging speculative and risky activities of a different nature.


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