Capital inflows, crisis and recovery in small open eoconmies

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Abstract

The paper develops a theoretical framework to explain the main mechanisms behind the current account adjustment in two countries that differ in their currency arrangement, Iceland with an floating currency and Ireland in the eurosystem. The framework is tested using VAR approach. The evidence suggests that both the real exchange rate and compression in domestic demand have effectively served as the adjusting mechanisms for Iceland's current account. On the other hand there is no evidence of real exchange rate affecting the current account in Ireland, where domestic demand compression has served as the main adjusting mechanism.

JEL Codes: Current account deficits, exchange rates, demand compression.
Keywords:

1 Introduction

Financial development matters. Over the years the relationship between economic and financial development has been a reoccurring research theme in economics and the recent financial crisis has only made the issue more important. 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).

In the period preceding the crisis many countries in pursuit of financial development--regardless of their exchange rate regimes--developed large external imbalances. However, few witnessed such a rapid growth of the financial sector as Ireland and Iceland. The conditions for borrowing international credit in the two countries differed due to their exchange rate regime; Ireland's membership of the EMU, a combination of lower interest rates, and non-existent exchange rate risk development contributed to the expansion of the financial sector while high interest rates in Iceland attracted speculate capital inflows.

The excessive growth of the financial systems of Iceland and Ireland ended abruptly with the 2008 global crisis. Both the countries were severely affected by the first wave of the crisis, which exposed their financial fragility. The prevailing situation at the time forced Iceland to follow a more orthodox monetary approach of expenditure switching through the depreciation of the currency along with conventional fiscal consolidation to counter the crisis. Capital controls were imposed to prevent further depreciation of the krona. In contrast, Ireland's

membership in currency union called for bailout and austerity measures, 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, a) 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 Krugman 2015), b), a second 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 Dieppe *et al* 2012), c) 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.[1] The current policy measures in both Iceland and Ireland are a combination of, a) and b), however in a scenario of compressed and depressed domestic demand, these policies have further reduced domestic consumer and producer confidence by imposing tough measures on the deficit countries, resulting in longer recessions.

The aim of this paper 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 paper develops a theoretical framework and also 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 paper 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 paper makes two main contributions. First, we theoretically as well as empirically discuss the dynamics of recovery patterns in the two countries. We discuss and distinguish the adjustment mechanism in a fully sovereign regime from that in a currency union. Second, our paper contributes to the ongoing debate on recovery in small open economies operating under different exchange rate regimesby carefully discussing the policy implications in the light of our empirical findings.

The remainder of the paper is organised as follows. Section 2 explains the historical path from financial development to the financial crisis in Ireland and Iceland. Section 3 evaluates

[1] See Storm and Naastepad (2015) for a detailed discussion.

the policy response to the crisis in the two countries. Section 4 presents a theoretical framework of current account adjustment in small open economies. Section 5 empirically investigates the current account adjustment. Section 6 concludes the paper.

2. Financial development to financial crisis

2.1 Financial liberalisation

Ireland's small economy, with 4.68 million inhabitants, is roughly 14 times the size of Iceland's economy both in terms of population and GDP. Ireland financially liberalised in the 1980s and 1990s; the exchange controls were eased in 1988 and onwards. Financial liberalisation among other things (e.g. fiscal stabilisation, membership in the EU Single Market, a well-educated and young labour force, multi-national friendly tax policies) is widely accepted as a driver of high non-inflationary growth during the Celtic tiger era which ran from 1994 to 2002. A construction boom fuelled growth from 2002 to 2007. Iceland on the other hand, being the last developed country to abolish capital controls in 1994, adopted the policy of floating exchange rates in 2001 and completed the privatization of its banks in 2003.

At the turn of the 21st century, strong financial integration, high levels of financial innovation, and lower interest rates across global markets contributed to unprecedented levels of growth in the financial sectors of the two countries. The size of balance sheets of the Irish-owned banks reached almost 3.75 times its GDP in 2007; however after including international financial centres the estimated ratio equalled 7.1 times the 2007 GDP (see Darvas 2011, p.7). In Iceland, the size of the banks reached almost 9 times its GDP.

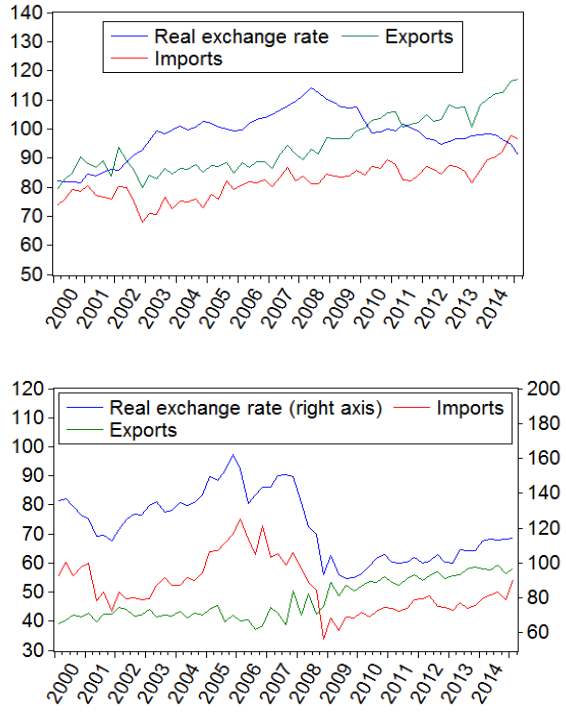
Apart from generating imbalances, large financial inflows created large investment booms as well as increased debt-led consumptions which resulted in overheating[2] of these small economies. The Icelandic central bank responded to the ensuing domestic investment boom by raising interest rates, which then attracted more inflows and a large appreciation of the real exchange rate, which raised the consumption of tradable goods, creating trade deficits (see Figure 1b). The subsequent capital outflow in 2008 made the real exchange rate fall.

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.

Figure 1: Real exchange and trade flows

[2] According to IMF, the Irish economy was perhaps the most overheated of all advanced economies as cited in Thorhallsson and Kirby 2011, p.17.

a. Ireland **b. Iceland**



Time: 1999Q1-2014Q4
Real exchange rate measured as relative prices, imports as a share of GDP, exports as a share of GDP.

Figure 1a and 1b shows a clear distinction in the dynamics of real exchange rates and trade flows in Iceland and Ireland. 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 competitive in the pre and post crisis period. This has played a vital role in the recovery process of both the countries.

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.

2.1 Sudden stop and crisis

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 destabilising 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 e.g. (Orhangazi, 2008); (Van Treeck, 2009)).

Figure 2 : Ireland

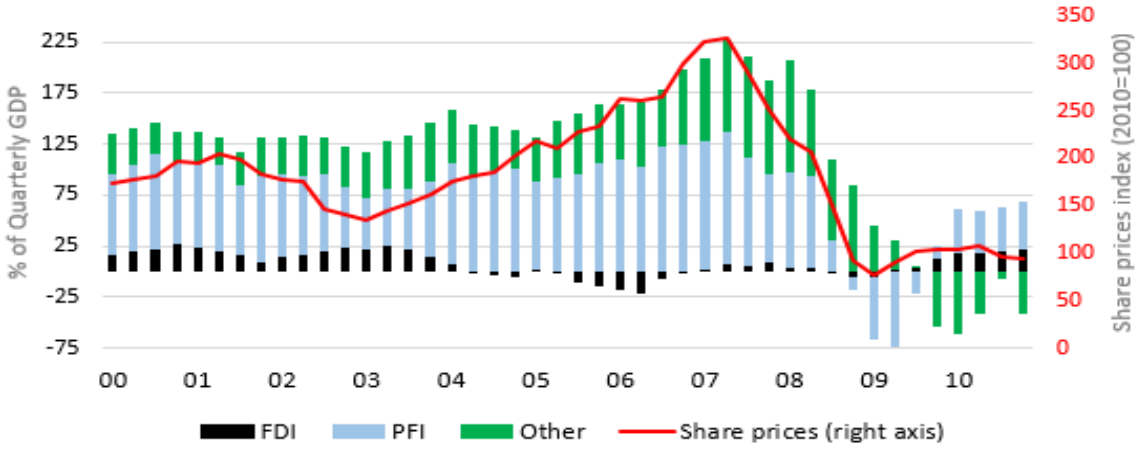
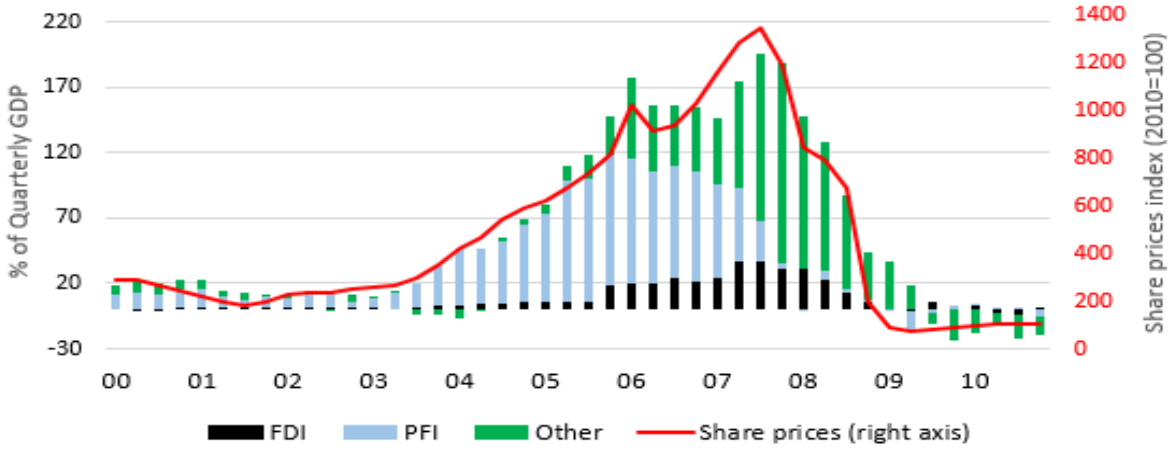


Figure 2 shows the composition of the capital inflows into Ireland along with the variation in share prices. During 2004-08, the proportion of PFI and OI considerably increased while FDI fell. Share prices during this period were entirely driven by PFI and OI inflows. Inflows into Ireland consisted of large amounts of both equities and debt securities.

For Iceland, the openness of financial (capital) accounts occurred at a time when financialisation[3] 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 3).

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 3 : Iceland



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

[3] Financialisation here is defined as increasing financial investment as compared to the real investment (See Stockhammer (2004); Van Treeck (2009); and Orhangazi (2008)).

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.

In 2008, liquidity dried up in the global markets leading to severe financial crisis in both the countries. In response, the Irish government on 29th September, 2008 decided to guarantee the deposits and all the liabilities (worth between 440-375 billion euros) of the domestic banking system. 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 the Irish government agreed to pay 17.5 billion euros from Nation Pension Reserve Fund as discussed in Thorhallsson and Kirby (2011).

Protecting the banks in response to the crisis was not possible for Iceland. Along with huge size of the banks, 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 discussed by Thorgeirsson and Van den Noord (2013); while the ratio of reserve to external debt was only 8 percent as noted by Benediktsdottir *et al* (2011, p.30). 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 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 delayed external assistance. 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 sustainability and c) developing a comprehensive strategy for restructuring the banks (IMF Report 2008, p.1)

3. Policy response and challenges

"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 responses to the crisis it is clear that the differences are partly related to exchange rate regimes and partly to the policies undertaken during the crisis and onwards. In particular, Iceland went through a massive restructuring of the financial sector where the government, apart from capital controls, immediately prepared an Emergency Legislation and took over all the three old banks (Glitnir, Kaupthing & Landsbanki) in order to protect the internal payment system. The balance sheets of these banks were then split into domestic and foreign liabilities and created as new banks. The newly formed banks consist of the domestic assets & liabilities that were transferred from the old banks. The foreign assets of the old banks were left within the old banks while their subsidiaries in the foreign countries were either sold or liquidated during the crisis. Iceland's response to the crisis by many economists is seen as heterodox approach that has never been tried in the past.

Iceland's heterodox approach to re-structuring of the financial sector is generally considered successful as compared to the policies undertaken by Ireland. The Icelandic policy response to the crisis helped the government to get better control over the budget. On the other hand, Ireland's policy stance due to its euro membership has 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. This cost increased to 64 billion euros in 2012 which is almost 40 percent of GDP as reported by Ireland's Department of Finance (2012). In Iceland, bank related losses increased public debt by almost 20 percent[4] of GDP as discussed in Darvas (2011, p.7).

Both Ireland and Iceland have not fully recovered from the crisis and it is hard to judge the long run consequences of the two regimes but it is also important to highlight that Iceland's adjustment has been much faster than its trading partners. However, it is yet to be seen how main policy tools available to Iceland play out in the future e.g. exchange rate flexibility has played a mixed role in Iceland. It contributed in build-up of the crisis as well as facilitated the adjustment process but at the cost of higher 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-

[4] According to Benediktsdottir *et al* (2011) government injected 12 percent of GDP to recapitalize the banks and 11 percent to recapitalize the central bank; this excludes Icesave debt.

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.

4. Theoretical Framework

We setup a simplified theoretical framework[5] to understand the current account adjustment in small open economies.

Focusing on the current account dynamics, we assume a small economy consuming two type of goods, tradable *T*, and non-tradable, *N*. There are 2 periods, *i* and *j* in which the economy exchanges tradable goods with the rest of the world. Total production in period *j* takes place according to $Y_j = f(AK_i)$.[6] A and K_i represents productivity and capital respectively. Note that capital investment K_i in period *i* determines the level of output Y_j in the future period *j*. Similarly the production of tradables in period *j* is given by $Y_j^T = f(A^T K_i^T)$ and that of the non-tradables by $Y_j^N = f(A^N K_i^N)$

From an accounting perspective, we can write total output as follows,

$$Y_i = C_i + I_i + PX_i - P^* M_i e \tag{1}$$

Y_i, C_i and I_i represents the total output, consumption and investment in period i. X_i and M_i represents the volume of exports and imports, *P* and *P** represents domestic and foreign prices. *e* represents the nominal exchange rate, defined as the domestic price of foreign currency.

$$C_i - Y_i + I_i = P^* M_i e - PX_i \tag{2}$$

We assume the country at the start of period *i* has no investment so that the following holds,

$$C_i - Y_i = P^* M_i e - PX_i \tag{3}$$

We split total production into tradable and non-tradable goods, so we can re-write the identity as follows,

$$C_i^N - Y_i^N + C_i^T - Y_i^T = P^* M_i e - PX_i \tag{4}$$

where in the case of non-tradables $C_i^N = Y_i^N$ always holds. On the other hand in the case of tradable goods, C_i^T could be greater, equal or less than Y_i^T, which actually reflects the trade balance in the national accounts. In the case of $C_i^T > Y_i^T$, the country has to borrow internationally to finance its deficit.

[5] The framework is based on Giavazzi and Spaventa (2010). However, we include an analysis of sovereign currency and explain the intertemporal budget constraint from the perspective of National Accounts.
[6] We make a simple assumption and exclude labour from the production.

Let's assume the country borrows internationally to finance investments and payoff the deficit on its current account in period *i*. Hence the capital F_i enters the country, which is given by,

$$F_i = F_i^{CA} + F_i^K \quad (5)$$

F_i^{CA} is the borrowing used to finance current account deficit (i.e. $F_i^{CA} = PX_i - P^*M_i e$) whereas F_i^K is the share of inflow available for investment ($F_i^K = I$). Consequently, F_i^K is invested into capital K_i according to,

$$F_i^K = \Delta K_i \quad (6)$$

where $\Delta K_i = K_i - K_{i-1}(1-\delta)$. For simplicity we assume that the depreciation rate of capital $\delta = 0$, so that $\Delta K_i = K_i - K_{i-1}$.

The borrowed amount of capital is allocated into tradables K_i^T and non-tradables K_i^N,

$$F_i^K = \Delta K_i = \Delta K_i^T + \Delta K_i^N \quad (7)$$

$$F_i = C_i^T - Y_i^T + \Delta K_i^T + \Delta K_i^N \quad (8)$$

The economy's intertemporal budget constraint can be written as:

$$(C_i^N - Y_i^N) + F_i(1+r) = Y_j^T - C_j^T + (Y_j^N - C_j^N) \quad (9)$$

Equation (9) implies that the economy has to run surplus in period *j* to repay F_i along with the interest. We can re-write equation (9) as follows,

$$(C_i^N - Y_i^N) + (C_i^T - Y_i^T + \Delta K_i^T + \Delta K_i^N)(1+r) = Y_j^T - C_j^T + (Y_j^N - C_j^N) \quad (10)$$

Introducing the relevant production function in equation 10, we can write the following equation,

$$(C_i^N - Y_i^N) + (C_i^T - Y_i^T + \Delta K_i^T + \Delta K_i^N)(1+r) = q^T A^T K_i^T - C_j^T + (q^N A^N K_i^N - C_j^N) \quad (11)$$

Since $C_i^N = Y_i^N$ and $C_j^N = Y_j^N$, we get the following,

$$(C_i^T - Y_i^T + \Delta K_i^T + \Delta K_i^N)(1+r) = q^T A^T K_i^T - C_j^T \quad (12)$$

Case 1: If there is new investment in tradable goods, i.e. $\Delta K_i^T > 0$

If the capital inflows are invested in tradables in period *i*, the production of tradables in period *j* increases i.e. $Y_j^T > Y_i^T$. In other words, investing into tradables makes the country able to increase its production capacity of tradable goods and the country can run a surplus in period *j*.

Case 2: If there is no new investment in tradable goods, i.e. $\Delta K_i^T = 0$

If all the inflows are invested in the non-tradable sector and there is no new investment in tradable goods, then $K_i^T = K_{i-1}^T$. This implies that the production capacity of the tradables

remains the same i.e. $Y_j^T = Y_i^T$ and the intertemporal budget constraint of the country is violated. On the other hand, investments in non-tradables can still increase the output but has no effect on the current account because $Y_j^N = C_j^N$. Similarly, a rising demand for non-tradables (e.g. housing construction) will require a larger amount of investment in this sector, crowding out investment in tradables (see equation 7).

Moreover, the adjustment in the current account can also take place due to compression in the consumption of tradables due to depreciation. Substituting equation (3) into (12) we get,

$$(P^* M_i e - PX_i + \Delta K_i^T + \Delta K_i^N)(1 + r) = PX_j - P^* M_j e \quad (13)$$

where the volume of imports and exports are determined by

$$M = (eP^*/P)^{\phi}(Y)^{\varepsilon}; \phi < 0, \varepsilon > 0 \quad (13a)$$

$$X = (eP^*/P)^{\psi}(Y^*)^{\eta}; \psi < 0, \eta > 0 \quad (13b)$$

Equation (13a) and (13b), based on well-established empirical facts, show that the volume of trade is a function of relative prices (i.e. domestic prices *P* and foreign prices *P**) and income (i.e. domestic income *Y* in the case of imports and trading partners' income *Y** in the case of exports. ϕ and ε denote the price and income elasticities of imports. ψ and η denote price and income elasticities of exports.

On the basis of the framework presented here, we can argue that the adjustment in the current account can take place through 2 channels. First channel of the current account adjustment is the increased competiveness having a trade balance effect. Increased competiveness in our framework is due to, a) Investment in tradables which increases the production capacity of tradable goods, and b) Depreciation of the currency.

Second important channel through which current account adjustment can take place is the reductions in investment financed by foreign borrowing – fall in investments would require less amount of international borrowing – resulting in lower current account deficit. In other words, a fall in the domestic demand (i.e. debt-led consumption or foreign-financed investments) would result in a lower deficit. However, this type of adjustment normally takes place after a sudden stop of the capital inflows i.e. countries with deficits normally keep borrowing as long as international credit is available.

5. Empirical Analysis

5.1 Data and Methodology

In this section, we analyse 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.[7]

The variables used in the empirical section are the real domestic demand *(D),* interest rate *(r),* real exchange rate *(REX),* 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[8] (*REX_M*) 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 paper implies an overvaluation. We also estimate the deviation of the current account (*CAB_D*) balance from its long-run path. Time series plots of all the variables are reported in Figure A1 and A2 in the appendix while descriptions and the sources of these data are reported in Table A4.

Unit root Structural Break

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'[9] (here after IO) test by Perron (1997). The IO model with a dummy for the shift in mean and trend[10] is represented as follows:

$$\Delta y_t = c + \alpha_1 y_{t-1} + \beta t + \theta_1 DU_t + \gamma_1 DT_t \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \qquad (14)$$

where Δ is the lag operator, ε_t is a white noise, T is the time index (t=1,...,T). DU_t in the model is a dummy for shift in mean at a potential break point TB, and DT_t is a dummy for the shift in trend; $DU_t = 1$, $DT_t = t - TB$ *if* $t>TB$, and zero otherwise.

The results of the ADF and PP test indicate that domestic demand *(D)* and the real exchange rate *(REX)* 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 in the appendix. While accounting for structural breaks, IO test also suggests that

[7] A brief description of the data and methodology for these countries is provided in the appendix.
[8] We estimate the misalignment by using a Hodrick-Prescott (HP) filter, where $\lambda = 1600$ for the quarterly data.
[9] 'Innovational Outlier' of Perron (1997) allows for a gradual shift in the time series.
[10] For real exchange rate misalignment *(REX_M)* and current account deviations *(CAB_D),* we do not include trend in the model as these are deviations from long-run path and do not exhibit a deterministic trend.

(CAB) is stationary while *(REX)* 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 *(REX)* are *I(1),* whereas current account balance *(CAB)* is *I(0).*

We perform the above testing procedure on the current account deviations *(CAB_D),* real exchange rate misalignment *(REX_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 ZA 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_D)* and *(REX_M*) are stationary and do not exhibit a unit root.

5.2 Model

We set up 2 models based on a VAR approach.

The unrestricted VAR model in levels is:

$$x_t = \mu_0 + \prod_1 x_{t-1} + \cdots + \prod_p x_{t-k} + \phi Q + \varepsilon_t, \qquad (t=1,2...T) \tag{15}$$

where μ_0 is a $p \times 1$ vector of constants, x_t is a $p \times 1$ vector of variables in the model, $\prod_i$ is a $p \times p$ matrix (*with i =1,..k*) of parameters, ε_t is a $p \times 1$ vector of error terms, and Q is a $p \times 1$ vector for the crisis dummy[11].

Model A

In our first model, we discuss the current account adjustment by setting up a 3 variable VAR model for Iceland and Ireland. 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 setting up a VAR model of the following order:

$$\text{Model A:} \qquad x_t = [\Delta REX, \Delta D, CAB_{ma}\,]$$

[11] 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 the implementation of capital controls, and this takes a value of 1 during the crisis and onwards, i.e. [2008Q2-2014Q3], and zero before the crisis period.

ΔREX represents log difference of real exchange rate, ΔD represents the log difference of domestic demand, and CAB^{*}_{ma} represents the four period moving average of current account balance to GDP. We orthogonalise the residuals by imposing the Cholesky structure on the system and estimate structural VAR (SVAR) as follows:

$$\begin{array}{c} \\ \Delta REX \\ \Delta D \\ CAB_{ma} \end{array} \begin{array}{c} \begin{array}{ccc} \varepsilon_{REX} & \varepsilon_{D} & \varepsilon_{CAB} \end{array} \\ \begin{bmatrix} 1 & 0 & 0 \\ X & 1 & 0 \\ X & X & 1 \end{bmatrix} \end{array}$$

where, ε_{REX}, ε_{D}, $\varepsilon_{CAB,}$ represents a real exchange rate shock, demand shock, and current account balance shock respectively.

The structure we impose on the model implies that current account contemporaneously responds to the changes in the real exchange rate and domestic demand. Model A is tested for Italy, Spain and Portugal using the same structure and ordering. However later on, we will impose a different structure and order to test the sensitivity of our model.

Model B

In our second model, we analyse the impact of the policy rate on current account deviations and real exchange rate misalignments in Iceland and Ireland. In the previous section, we argued the Icelandic central bank responded to domestic demand boom (mainly to domestic investment boom) by increasing interest rates which created an opportunity for profits from the carry trade and attracted yet 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 of real exchange rate and current account in both the countries. The model is represented with the following ordering:

$$\text{Model B:} \qquad x_t = [r, REX\_M, CAB\_D]$$

where *r* is the interest rate, *REX_M* is the real exchange rate misalignment; *CAB_D* is the deviation of current account to GDP. We impose the same type of structure (Cholesky) as in Model A to estimate SVAR. The structure we impose on the model implies that real exchange rate misalignments and current account deviations contemporaneously respond to changes in policy rates. Later on, we will change the ordering of the variables and impose a different structure on the model to test its robustness.

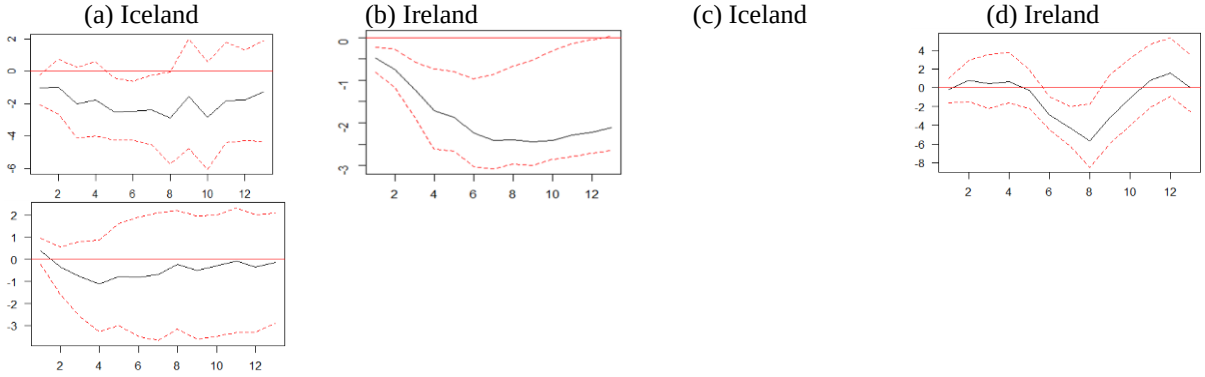
5.3 Results and discussion

Model A

While considering several lag length criteria[12], we estimate VAR(5) for Ireland and a VAR(8) for Iceland based on Hannan-Quinn criterion and final prediction error (FPE). Figures 4a and 4b show 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. This argument is also valid for other periphery countries in the Eurozone. Figure A3 in the appendix provides impulse responses for Portugal, Spain and Italy in the case of Model A. The evidence clearly suggests that compression in domestic demand significantly affects the current account balance in these countries.

Figure 4: Impulse responses of Model A



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 5% point change in the residual of domestic demand. Shock in (c) and (d) is 10% point change in the residual of real exchange rate.

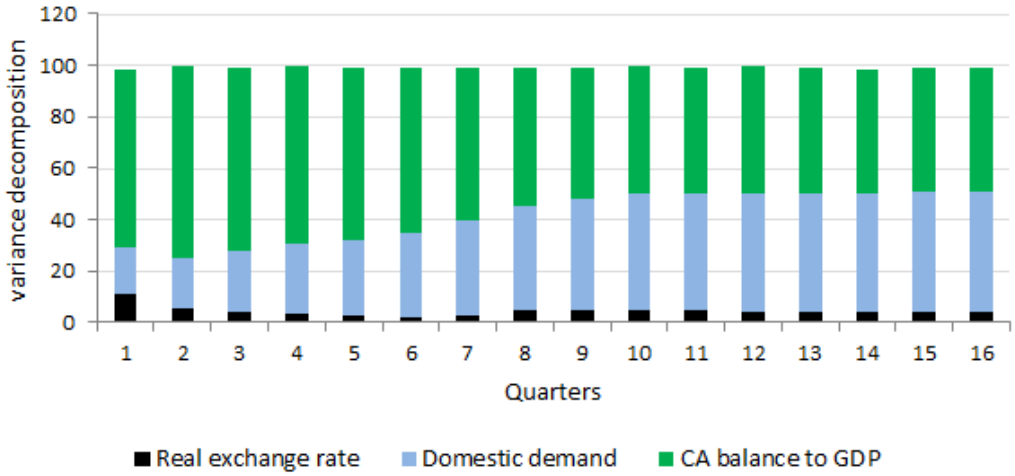
Figure 4c and 4d shows the orthogonalised impulse responses of CA balance to a real appreciation (increase in the real exchange rate is an appreciation) in Iceland and Ireland. Following a 10 percent point increase in the real exchange rate, the CA experiences a deficit in Iceland while the effect is completely insignificant in Ireland. The response of CA balance to a real appreciation in Iceland reaches its maximum after 2 years. Again, the finding in the case of Ireland is also similar to other periphery countries where real exchange rate is ineffective in adjusting the current account balance (see Figure A4 in the appendix).

[12] For Ireland, AIC also suggests 5 lags whereas for Iceland it suggests 10 lags.

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 5 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.

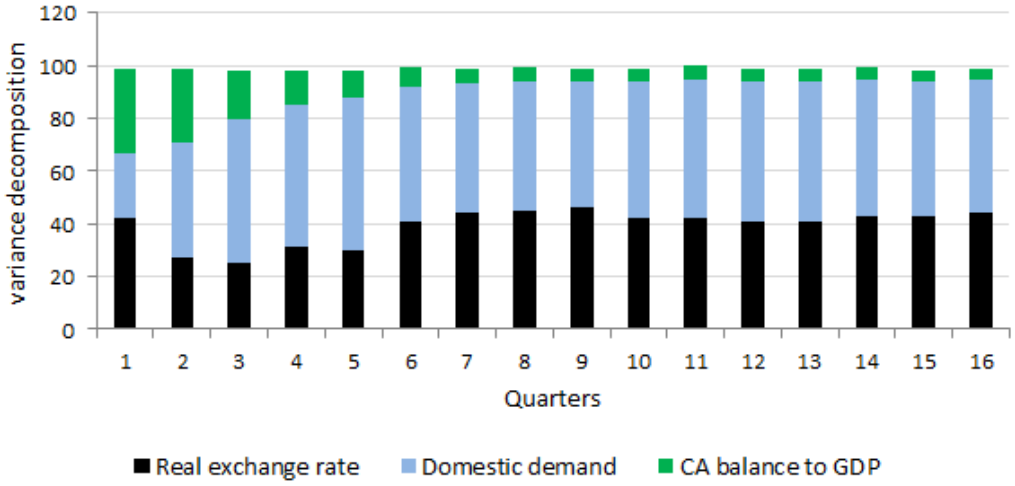
In contrast for Iceland, the variation in CA balance in the initial quarters is mainly explained by real exchange rate shock as well as domestic demand shock. This strongly validates the argument that the adjustment mechanism in Iceland is strongly influenced by real exchange rate as well as domestic 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 5: Forecast error variance decomposition (FEVD) of CAB in Ireland



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

Figure 6: Forecast error variance decomposition (FEVD) of CAB in Iceland



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 7 and 8.

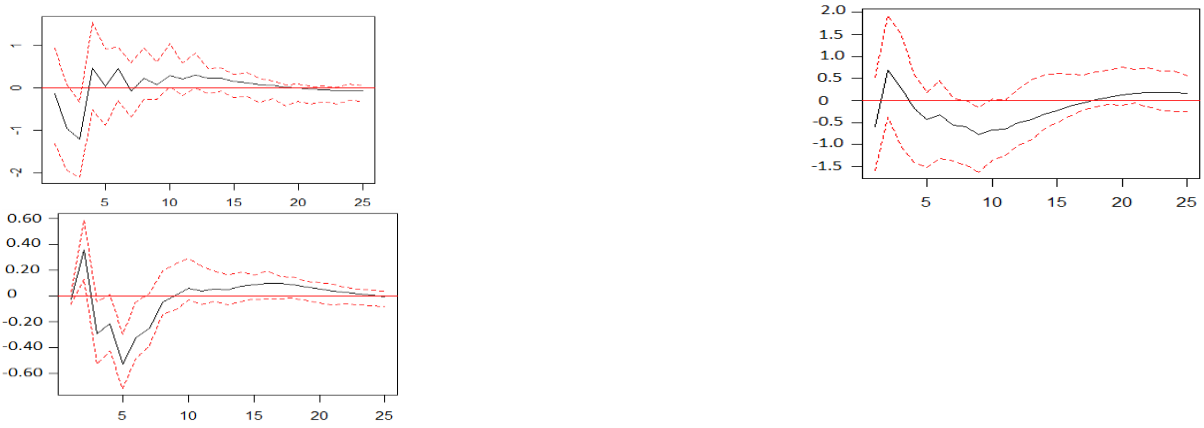
The effect of unexpected interest rate shocks on the current account deviation is significant in both countries (see Figure 7a and 8a). The interest rate shock in the case of Ireland, although with a mild effect, is significant for a longer time span than in Iceland, i.e. the shock is significant for 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 7b and 8b). This finding reflects a stylised fact that on the one hand, 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 during crises.

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 7c). 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 8c). This also provides additional evidence in the favour of our results in the case of Model A.

Figure 7: Impulse responses for Iceland (Model B)

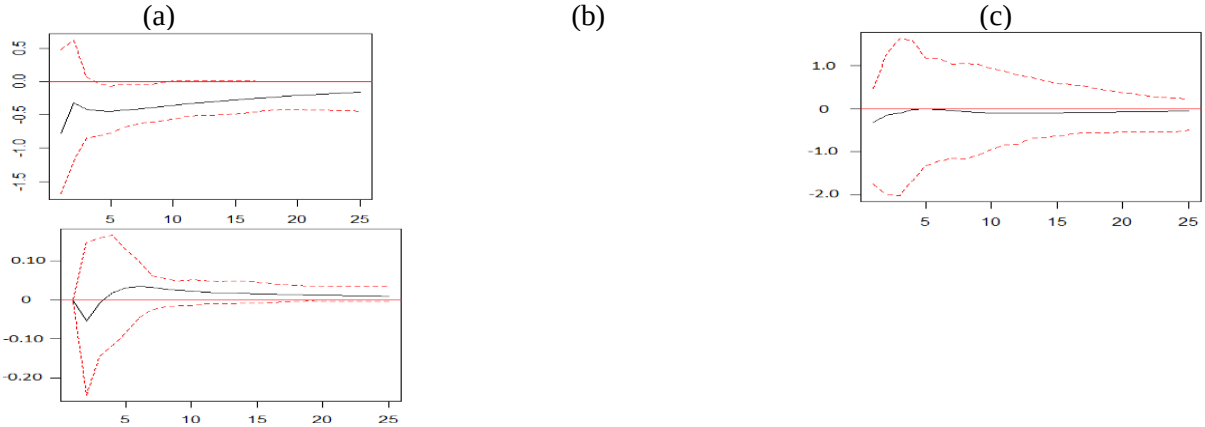
(a) (b) (c)



(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): respone of current account deviation after real exchange rate misalignment shock

Figure 8: Impulse responses for Ireland (Model B)

(a) (b) (c)



(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): respone 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 1b). 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 (see Figure 1a). 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.

5.4 Robustness

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

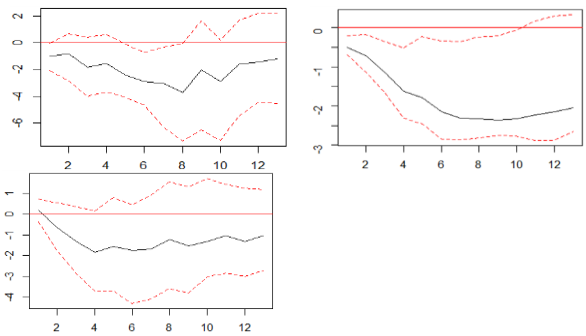
All the variables in our models are stationary and the roots lie within the boundary of the unit circle, which means that the models are stable[13] and converge to an equilibrium level. In our baseline model, we have restricted the diagonal coefficients of the matrix to a value of 1. We relaxed this assumption by allowing the model to estimate the diagonal coefficients. We find that this restriction has no effect on the impulse responses of the models.

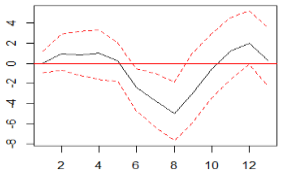
Regarding Model A, our baseline model includes a deterministic trend. We re-estimate the models without a deterministic trend and find the shapes of impulse responses do not change in any fundamental way. We perform several sensitivity tests. We change the ordering of the variables in Model A to the following; $[\Delta D, \Delta REX, CAB_{ma}]$. We then impose a Cholesky structure on the system. We find that the ordering of variable has no effect on the impulse responses as shown in Figure 9. Moreover, we also estimate the model for varying lag lengths and find that the model is not sensitive to changes in lag lengths.

Figure 9

(a) Iceland (b) Ireland (c) Iceland (d) Ireland

[13] All the models also satisfy the stability criteria using CUSUM tests.





Domestic demand shock **Real exchange rate shock**

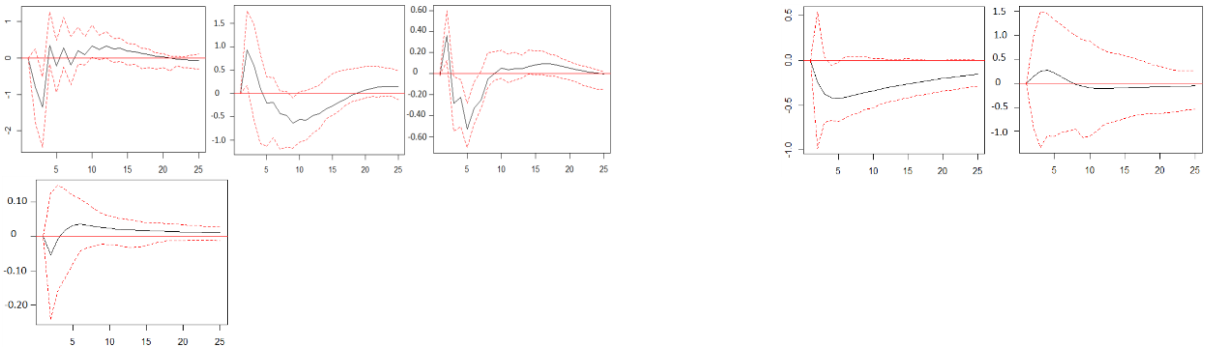
x-axis represents quarters, y-axis represents CAB (as a percentage of GDP).
red-dotted line represents 90% confidence band, shock in (a) and (b) is 5% point change in the residual of domestic demand. Shock in (c) and (d) is 10% point change in the residual of real exchange rate.

In case of Iceland, we included a dummy for regime shift in our baseline model. To test the sensitivity, we changed the dummy to pulse intervention, which takes the value of 1 during the crisis period of [2008Q2-2009Q1], and zero for the rest of the sample. We find that this has little impact on the impulse responses and do not fundamentally change our results (see Figure 1A in the appendix). We conclude that the results of Model A are quite robust.

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 $[REX\_M, CAB\_D, r]$, 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 10). 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.

Figure 10: impulse responses from Model B

Iceland **Ireland**



(a) (b) (c) (a) (b) (c)

(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): respone of current account deviation after real exchange rate misalignment shock

6. 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 as well as improved trade balance. 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. The 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. The adjustment in current account has been the result of domestic demand compression due to sudden stops.

From the Icelandic and Irish experiences, it is obvious that higher debt and economic recessions are the direct consequences of financial instability. Financial instability is rooted in

excessive credit growth due to less supervision by regulators which results in high debt burden. But increasing size of banks' balance sheets and high debt burden which led to the economic crisis mostly went unnoticed or perhaps ignored.

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Appendix

Table A1: Unit root structural break test (IO test)

	Iceland			Ireland		
variables	CAB	D	REX	CAB	D	REX
TB(break point)	2008Q3	2005Q1	2008Q1	2012Q1	2006Q2	2002Q1
θ_1		-0.04 (0.03)	0.06 (0.05)	-1.59*** (0.55)	-0.06** (0.02)	-0.01 (0.01)
γ_1	0.57*** (0.13)	-0.004*** (0.001)	0.001 (0.001)		-0.01*** (0.003)	-0.004*** (0.001)
Test-statistics	-4.53(9)	-4.77(8)	-4.49(0)	-4.82(11)	-4.54(5)	-4.79(6)
Critical values						
1% 5% 10%	-5.06 -4.52 -4.26	-5.71 -5.17 -4.89	-5.71 -5.17 -4.89	-5.34 -4.85 -4.60	-5.71 -5.17 -4.89	-5.71 -5.17 -4.89

Table A2: Unit root structural break test (IO test)

	Iceland			Ireland		
variables	CAB_D	REX_M	r	CAB_D	REX_M	r
TB(break point)	2008Q2	2008Q4	2006Q4	2008Q3	2008Q3	2002Q1
θ_1	0.57 (1.52)	-1.18*** (0.39)	-0.00 (0.01)	0.38 (0.36)	-0.65*** (0.12)	0.009* (0.005)
Test-statistics	-6.86(0)	-4.45(7)	-3.97(3)	-4.44(1)	-5.73(1)	-4.86(6)
Critical values						
1%	-4.94	-4.94	-4.94	-4.94	-4.94	-4.94
5%	-4.44	-4.44	-4.44	-4.44	-4.44	-4.44

10%	-4.19	-4.19	-4.19	-4.19	-4.19	-4.19

Table A3

variables	Exchange rate misalignment	
Test	IO test	ZA test
TB(break point)	2007Q4	2007Q4
Test-statistics	-4.74(3)	-4.75(3)
1%	-5.34	-5.34
5%	-4.85	-4.80
10%	-4.60	-4.58

Table A4: Description and source of data

Symbol	Variable	description	Source
r	Interest rate	Policy rate of the Icelandic central bank and the ECB.	Central Bank of Iceland Website of ECB
Rex	Real exchange rate	Based on relative prices	OECD database
CAB	Current account balance	Current account balance to quarterly GDP	Statistics Iceland, Eurostats
D	Real domestic demand		Statistics Iceland, Eurostats

Figure A1: Iceland

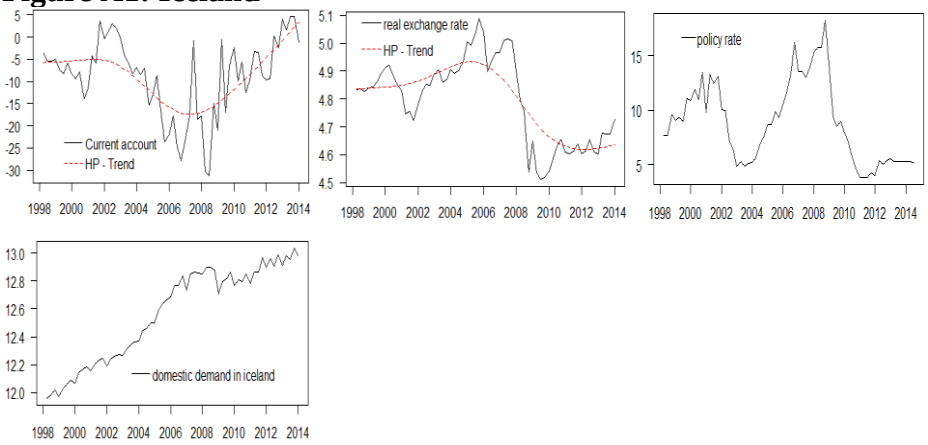
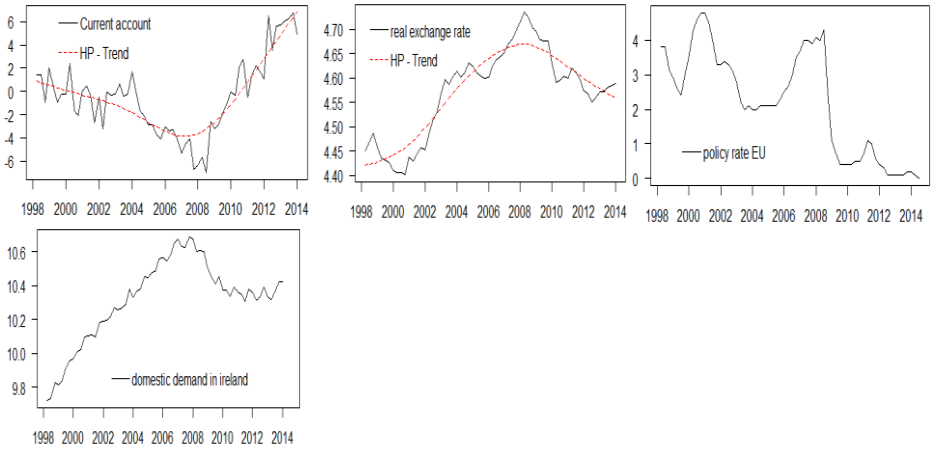


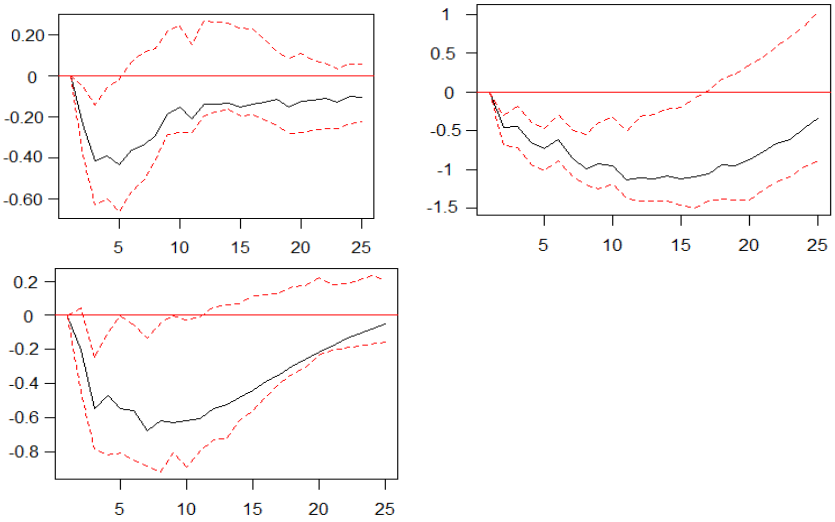
Figure A2: Ireland



Impulse responses of Model A for other periphery countries

Figure A3

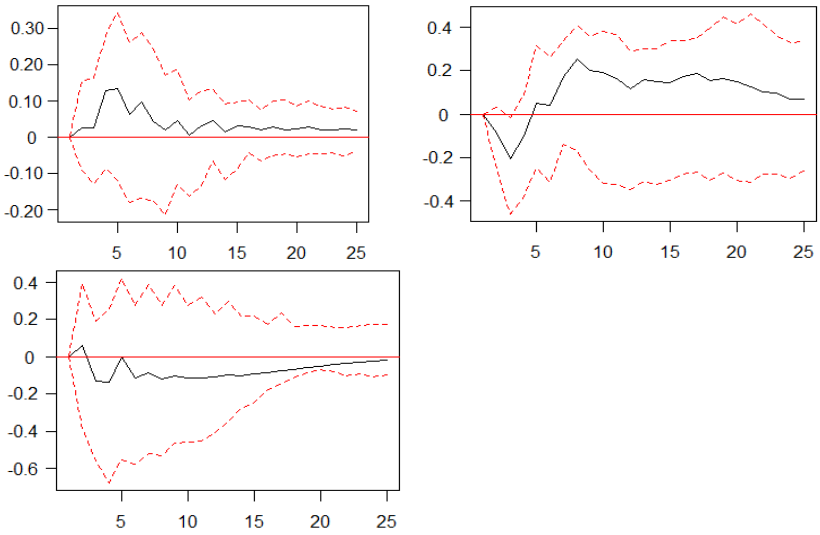
Italy **Spain** **Portugal**



x-axis represents quarters, y-axis represents CAB (as a percentage of GDP).
red-dotted line represents 90% confidence band, shock in Figure A3 is 1% point change in the residual of real domestic demand.

Figure A4

Italy **Spain** **Portugal**

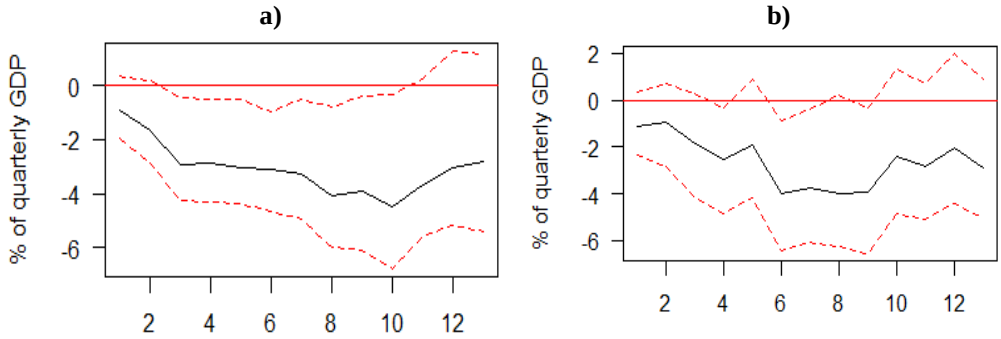


x-axis represents quarters, y-axis represents CAB (as a percentage of GDP).
red-dotted line represents 90% confidence band, shock in Figure A4 is 1% point change in the residual of real exchange rate.

The impulse responses in Figure A3 and A4 are obtained using the same structure and order as specified in Section 4. We use data sample 1999Q1-2015Q2. Moreover, we test all the variables for seasonal variation and stationarity before estimating VAR. We also perform robustness

tests by changing the lag-lengths and ordering, finding that the impulse responses are quite robust.

Figure A5: Impulse responses of Iceland (Model A) after change in definition of dummy.



CAB response to: a) real domestic demand shock, b) real exchange rate shock

Icelandic responses when dummy is considered as pulse intervention instead of a permanent regime shift.