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Exploring the effects of capital mobility on the saving–investment nexus: evidence from Icelandic historical data

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ABSTRACT

We explore the effects of capital mobility on the relationship between saving and investment using historical data for Iceland. First, we analyse the saving–investment (S-I) correlation for the period of restricted capital mobility using data from 1960 and 1994. We then 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 2016 period, when capital controls were imposed in response to the crisis. Institutions matter: We find institutional changes, in particular, Iceland's entry into the European Single Market in 1994, coincided with a fall in the long-run correlation between saving and investment. However, the correlation weakens further when we include the post-crisis regime of capital controls, suggesting a weaker relationship between savings and investment in this regime. We discuss the possible reasons for this pattern and also the implications of our findings for post-crisis policy in small open economies.

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Feldstein–Horioka puzzle; capital mobility; financial crisis

1. Introduction

This paper explores the relationship between saving and investment in one of the countries most affected by the recent global financial crisis. Iceland experienced large capital inflows during a credit boom from 2004 to 2008 that created a credit-led expansion of the economy, an appreciation of the currency and large current account deficits ending in a collapse of its financial system when the inflows stopped suddenly in the autumn of 2008 (see Calvo, 1998, on sudden stops). The period of free capital flows ended when capital controls were imposed as part of an IMF programme in November 2008.[1] The controls were intended to stop the outflow of capital, hence enabling Iceland to have lower interest rates during the financial restructuring that was necessary in the aftermath of the crisis.

Theoretically, the relationship between saving and investment is expected to be strong in regimes of capital controls or in regimes of low capital mobility. However, an important question is whether this also holds in a regime of capital controls in a country that experienced a sudden stop and a collapse of its financial system as was the case in Iceland. While investigating the relationship between saving and investment, known as the Feldstein–Horioka (FH) hypothesis, the vast empirical literature draws no distinction between capital controls in normal times and capital controls during and after a financial crisis. Part of our contribution is to make this distinction as well as to give an historical overview of the relationship between capital controls, saving and investment in Iceland.

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[1]See Benediktsdottir, Danielsson, and Zoega (2011), Hreinsson, Gunnarsson, and Benediktsdóttir (2011), Níelsson and Torfason (2012) and Johnsen (2014) on Iceland's financial crisis.

The history of capital inflow regimes in Iceland provides a good testing ground to explore whether the economic effects of capital controls (imposed in response to a sudden stop) differ from those capital controls that historically prevailed during more normal times. Iceland, being a very small country, has not received a great deal of attention in the previous literature on the FH hypothesis. A few studies that considered Iceland have only included it in a panel of advanced countries without highlighting its historical regime shifts.[2] The panel estimation strategy is not able to address the issue of historical phases of capital controls and capital mobility in Iceland satisfactorily, highlighting the importance of country-specific analyses such as ours.

We, for the first time, take advantage of Iceland's extraordinary economic turbulence and test whether the effect of capital controls on the saving–investment relationship depends on the level of economic turmoil. We focus on three major regimes; a period of limited capital mobility lasting from 1960 to 1994, a period of free capital mobility starting in 1994 when Iceland joined the European Union's single market and ending in 2008 and, finally, a period of capital controls reintroduced during a financial crisis in 2008 that were just relaxed in the spring of 2017.

Our findings indicate that the economic effects of recent capital controls (imposed in response to a sudden stop) differ from those capital controls that historically prevailed prior to 1994, as will be discussed. Our paper is the first attempt to distinguish between the effects of capital controls imposed in response to a financial crisis from the effect of capital controls that were used in more normal circumstances, i.e. before Iceland joined the European Single Market. We find that saving and investment are very weakly related during the recent period of crisis and capital controls. The reason for this weak relationship is that damaged balance sheets and general uncertainty about the future hampered investment for a number of years while saving increased for the same reason making the two series diverge. The collapse of the financial system added to this effect by removing the channel from savings to investment projects. Thus, despite strong capital controls the relationship between savings and investment is very weak as compared to the period of restricted capital mobility in normal times.

The debate about the effectiveness of capital controls is not new, and the understanding of capital controls is not very clear. Ghosh and Qureshi (2016) argue that economists have become generally more sceptical towards the implementation of capital controls. The explanation they put forward is that capital controls have normally been seen from a political perspective, where they are historically associated with autocratic, repressive, or failing regimes. The deliberate implementation of capital controls as an economic policy tool to reduce volatility and reclaim control over domestic capital flows are less well understood. In this regard, our work also contributes to the emerging literature on the economic effectiveness of capital controls, summarised in Fernández, Klein, Rebucci, Schindler, and Uribe (2016).

The remainder of the paper is as follows. Section 2 reviews the Icelandic crisis with a focus on different regimes of capital mobility. Section 3 discusses the data and methodology used in analysing the relationship between saving and investment. Section 4 discusses the results of the model. Section 5 concludes.

2. History of economic growth and capital flow regimes

A century ago, Iceland (pop. ~353,000) was one of the poorest countries in Europe and amongst the least financially developed countries until the privatisation of its banks and the deregulation of the financial sector in the 1990s. From a traditional economy, with two-thirds of the labour force employed in agriculture, Iceland over a period of one century became one of the advanced economies with two-thirds of its labour force employed in the service sector, fitting well into its Nordic group. Icelandic GDP per capita in 2017 exceeded that of Denmark, Finland and Sweden.[3]

[2]See, e.g. Oh, Kim, Kim, and Ahn (1999), Katsimi and Zoega (2016), and Raza, Zoega, and Kinsella (2018b).
[3]GDP per capita in 2010 dollars was 46,212 dollars in Iceland in 2017, 45,688 in Denmark, 39,504 in Finland and 45,486 in Sweden. Source: OECD.

Table 1. Real economic growth.

Period	1945–49	1950–59	1960–69	1970–79	1980–89	1990–99	2000–07
Europe	–	3.4	4.9	3.7	2.4	2.3	2.4
OECD	–	3.6	5.1	4.3	2.9	2.7	2.7
Iceland	3.8	4.1	4.3	6.5	3.2	2.2	4.5

Sources: OECD statistics, Statistics Iceland.

Table 1 shows the Icelandic economy experiencing higher average real economic growth during the post-World War II period than the average for Europe and the OECD countries. The growth in the economy was largely at the extensive margin – caused by an increase in inputs into production – driven by advances in the fishing fleet, the extension of the fishing limits (expanding from 3 miles in 1904 to 200 miles in 1976) and the utilisation of hydroelectric and geothermal energy. For most of the twentieth century, unemployment rates were kept low and the country experienced very high and persistent inflationary pressures as compared to other OECD countries (Andersen & Gudmundsson, 1998). The inflation was caused by a lack of a nominal anchor and an effective monetary policy on top of regular supply shocks in a small economy that based its livelihood mainly on fishing.

The financial side of the economy presented a less favourable picture. Historically, most of the Icelandic economy was heavily regulated. Unlike its neighbouring countries, the regulations implemented during the Great Depression and World War-II lasted longer. The financial sector in particular was least developed where capital controls were in place for the most part of the century, an interest rate ceiling imposed by the central bank that made real interest rates negative for most of the 1970s, with credit rationing a key feature of state-owned commercial banks. Perhaps as a result, corruption was rampant and the nature of the credit rationing and corruption then influenced the structure of the economy, including which companies and industries would thrive. Nominal interest rates were set by the Central Bank, which was controlled by the government (Danielsson & Zoega, 2009). There were three governors, two of whom were political appointees. The authorities were not only responsible for some key interest rates but for the whole spectrum of rates, even dictating the manner of competition customers would experience (Jonsson, 1999). The persistent inflationary pressure and the negative interest rates – caused by the ceiling on nominal rates – gradually made saving fall. With the exception of a few small institutions, the banking sector was mostly owned by the government, and was highly politicised in its operations as politicians were involved in the banks' boards and lending decisions. As a means of political influence, capital was rationed between a few industries (mostly fishing, aluminium smelting and geothermal sectors) with vested interests, which resulted in a lack of investment in the sectors where credit was unavailable.

Controls on the flow of capital into and out of the Icelandic capital were in effect for most of the twentieth century. One has to go back to the *Scandinavian Monetary Union* from 1873 to 1920 to find a period of free capital flows. Iceland issued a currency for the first time in 1885 that was linked to the Danish Krona and backed by gold and hence also the currencies of Norway and Sweden. During this period, foreign capital financed the transformation of Iceland's economy, which now started to use fishing vessels that were propelled by motor engines as well as the emergence of some small-scale industry. When Iceland became independent in 1918 the authorities decided to continue membership of the monetary union. But events made the demise of this union inevitable when the First World War created a persistent current account surplus for Sweden and a deficit for Norway and Denmark, Sweden being an important source of steel for the German war effort. These imbalances created a divergence between the market value of the Danish and Norwegian Krona, on the one hand, and Swedish Krona, on the other hand. The appreciation of the Swedish currency in a currency union where the Swedish central bank had to keep the exchange rate viz-a-viz the Danish and Norwegian Krona unchanged created arbitrage opportunities when investors could buy the latter in the currency market and sell to the Swedish central bank. This caused the supply of Swedish Krona to expand which made the system unsustainable and it collapsed in 1918. During the war, the real exchange rate in Iceland increased due to an increase in the foreign price of fish but the export

price fell at the end of the war leaving the country with a large current account deficit that triggered a currency devaluation.

Iceland fixed its exchange rate to Sterling in 1925, and hence indirectly to gold. But real wages increased until 1930 because of internal deflation and constant nominal wages. This created problems when the price of Iceland's exports fell further in the Great Depression. This required a fall in the real exchange rate, which could only occur through a fall of nominal wages. But due to strikes and union opposition this turned out not to be feasible. While the British decision to abandon the Gold Standard in 1931 helped Iceland reduce its external imbalance, this was not sufficient and the authorities imposed capital controls that entailed both controls on capital flows as well as trade in goods and services. These capital controls were in effect for decades afterwards. Controls on imports lasted until 1959. Controls on capital flows lasted until 1994.

Authorities in Iceland were sceptical about the merits of competition and free markets, but there always existed a fraction of the population that supported the introduction of free markets. The process of liberalisation started in the 1960s, when Iceland relaxed capital controls on the current account so that imports were freed up while controls were still in effect when it came to capital flows. The country joined GATT in 1964, lowered trade barriers and substantially reduced subsidies to the fishing industry.[4] In 1969 the first aluminium smelter was built in Iceland as a way of diversifying the economy. Despite some important steps towards liberalisation, the exchange rate was still decided by the government and banks were still state-owned. In general, the tight hold of the government on the economy remained to a large extent unaffected (Gylfason, Holmstrom, Korkman, Soderstrom, & Vihriala, 2010) and there was widespread financial repression.

In the late 1970s, more important steps were taken to liberalise the economy. Thus, financial indexation was legalised in 1979 (Gylfason et al., 2010). Jonsson (1999) argues that allowing financial indexation encouraged saving by making real interest rates positive and reduced the distortion of the real economy caused by unequal access to cheap capital. Financial indexation also wiped out unprofitable firms and industries that previously relied on credit rationing.

The economy experienced a wave of liberalisation in the early 1990s and Iceland joined the European Single Market in 1994 with the effect that capital now moved freely into and out of the country. The 1990s brought capital inflows, a domestic credit expansion and a booming stock market. These ended in a sudden stop, a fall in the exchange rate and a fall of the stock market in 2001. Because the banks were state owned at the time the magnitude of the inflows was manageable, the reversal in 2001 did not cause a systemic crisis.

Because the allocation of capital by state-owned banks was both corrupt and inefficient, there were several attempts to privatise the state-owned banks. The objective of the privatisation drive was to allocate capital more efficiently, reduce interest rate margins, and provide a better environment for saving. In the following two years, that is 2002 and 2003, the country's banks were privatised. Iceland's integration into the European Single Market allowed the banks to open branches in other countries and borrow from foreign banks, subject to EU regulations. The mixture of private banks, capital mobility and low-risk premium in international capital markets brought unprecedented speculation. In addition, the commercial banks borrowed amounts directly from European banks that dwarfed the GDP of the country. In effect, the privatisation of the banking system involved the privatisation of the state's credit rating which was AAA at the beginning of the decade. Each of the three banks was deemed to be too big to fail and this made it possible for them to borrow from European banks as well as issue bonds at low-interest rates. The borrowing was then used to fund the acquisition of foreign businesses by Icelandic firms, the latter often owned by people close to the three banks.

The combination of a floating exchange rate regime and capital mobility turned out to present challenges for the Icelandic central bank. Foreign borrowing created a domestic expansion and a tight labour market that called for higher interest rates. The central bank policy rate increased

[4]The fishing industry prior to the reduction in subsidies was absorbing more than 40% of government expenditures.

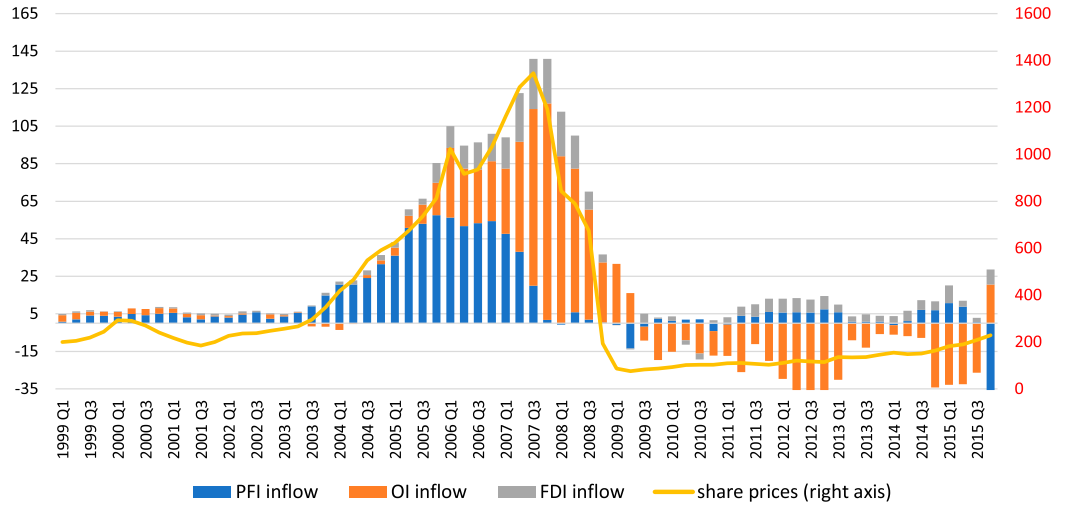

Figure 1. Composition of capital inflows and share prices. Source: Central Bank of Iceland.
Note: Gross inflows are represented as four-quarter moving averages.

gradually from 2004 to 2008, reaching a height of 15.5% in the summer of 2008. But due to European Union regulations and a lack of proper macro-prudential regulation, the domestic banks were allowed to make loans in foreign currencies to unhedged households, firms and local communities. The wedge between domestic and foreign interest rates turned out to be too large to resist. Thus 80% of non-financial business debt was in foreign currencies and 20% of household debt in 2008. In addition, foreign investors started to issue bonds in the Icelandic currency to profit from the interest rate differential and the appreciation of the currency. This hot money inflow amounted to 37% of GDP in the middle of 2008.

Figure 1 shows that a large proportion of gross inflows into Iceland were speculative, taking the form of portfolio investments (PFI), while the proportion of FDI remained smaller in the first years of liberalisation. There was an increase in FDI in Iceland during 2006–2008, where a large proportion of investment was in export projects (e.g. aluminium smelting).

The capital inflow raised the exchange rate and generated a stock market and a housing market boom. Stock prices increased by 35% per year and house prices by 12% per year.[5] Consumption and investment increased at a rapid rate and the current account deficit averaged 14 per cent from 2003 to 2008. Unemployment fell below 3%. Gross foreign debt grew from a stable level of about 60% of GDP in the 1990s to nearly 700%.

The phase of free capital mobility, generating a credit boom from 2004 to 2008, ended when inflows suddenly stopped in the fall of 2008, as shown in Figure 1. When world financial markets started to freeze up in 2007–2008 the carry trade unwound rapidly, causing the currency to depreciate. This depreciation raised the domestic currency value of business and household debt, making most businesses on the island technically insolvent. As a result, the banks were insolvent and their liquidity problems – aggravated by a lack of a lender of last resort in foreign currencies – caused them to fail in October 2008. Iceland faced a systematic crisis which included a temporary collapse of the international payments system. The domestic payments system also faced difficulties but functioned throughout the crisis as noted by Danielsson and Zoega (2009). The collapse thus brought about a perfect storm of a currency crisis, rising inflation and unemployment and a failed banking system. The sudden stop of the capital inflows caused the currency to lose half of its value, the price

[5]The OMX15 covering the 15 largest corporations increased six-fold over the same period and nearly by a factor of nine from its bottom in 2001 to its peak value in 2007. See Aliber (2011) and Halldorsson and Zoega (2010).

of imports surged and the fall in imports and investment made the current account go from a deficit to a surplus in 2009. Stock prices fell by 95% and house prices plummeted.[6] Due to the prevalence of foreign currency loans, the exchange rate depreciation made large sections of the economy insolvent.

Iceland sought the help of the IMF and with the IMF's assistance an economic programme was implemented by the authorities. The programme consisted of a plan for monetary policy, fiscal policy and the restructuring of the banking system. To shore up the currency, interest rates were increased to very high levels – the policy rate was increased to 18% in November 2008 and was then gradually lowered in subsequent years. Capital controls were used to reign in the outflows so that interest rates would not have to be raised further. As a response to the currency crisis the IMF and the government imposed capital controls in November 2008, in effect prohibiting all capital outflows but permitting current account transactions, thereby allowing investors to convert interest revenue from local-currency investments into foreign currency. As a result of the capital controls, significant amounts of foreign capital, in the form of ISK-denominated assets, remained in Iceland. These capital controls differed from those in effect from 1930 to 1960 in that there were no restrictions on the imports of foreign goods and services, while the capital account was shut down and only the paying of interest and the principal of existing foreign debt was permitted.

Fiscal policy was expansionary in the years after the collapse as the automatic stabilisers were allowed to have an effect, but the deficit was gradually reduced. Meanwhile, the authorities created a new banking system by effectively cutting off the banks' foreign operations and putting them into receivership while recapitalising the domestic operations under a new name. A recovery started in the middle of 2010. Real GDP has at the time of this writing increased beyond its peak in 2007, unemployment is currently around 4% and the current account has been in surplus in every year since 2009. The capital controls were removed in 2017 and there remains only a special reserve requirement that applies to the buying of listed, domestic bonds by foreign residents intended to prevent the re-emergence of the carry trade. The crisis, in other words, has passed.

In what follows, we explore the relationship between saving and investment from 1960 to 2016 during which there were capital controls from 1960 to 1994, then capital mobility until 2008 and capital controls under crisis conditions from 2018 to 2016. We formulate our analysis in the framework of the Feldstein and Horioka (1980) study.

3. Empirical analysis

After relying heavily on international capital for financing its mainly foreign investments in the years preceding the crisis, Iceland operated in a regime of heavily restricted capital mobility from 2008 to 2016. The implementation of capital controls following a sudden stop made domestic savings the only source of financing for economic growth as well as for servicing what remained of foreign debt. Against this background, we investigate how the aforementioned regimes of capital mobility affected the relationship between domestic saving and investment in Iceland, and what implications it may have for economic growth and the balance of payments in general. In particular, we analyse how the economic effects of recent capital controls (imposed as we mentioned above in response to a sudden stop) differed from those capital controls that historically prevailed prior to 1994.

3.1. Data and methodology

To investigate the relationship between investment and saving under different capital flow regimes in Iceland, we use annual historical data from 1960 to 2016. The data are taken from *Statistics Iceland*. Our sample covers three main regimes of capital mobility as shown in Figure 2. Both saving and investment follow a similar downward trend, indicating the possiblity of a long-run relationship.

[6]Source: Registers Iceland (skra.is/Markadurinn/Talnaefni).

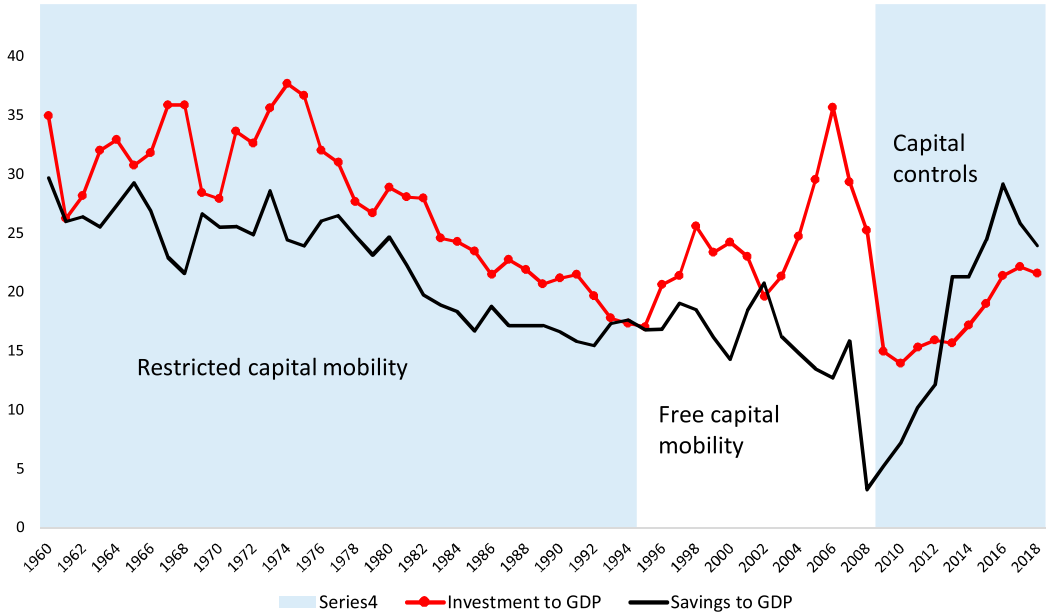

Figure 2. Saving and investment in Iceland. Source: Statistics Iceland.

Saving has been considerably lower than investment in Iceland until the crisis of 2008. Thus there was a persistent current account deficit but, because of economic growth, the ratio of external debt to GDP did not explode. The gap between the two series began to increase during the era of free capital mobility that started with Iceland's membership of the European Economic Area (EEA) in 1994. In the first years of free capital mobility, there was a relatively moderate increase in the saving–investment gap, which was the result of a capital inflow boom which ended in a sudden stop in 2001. This episode of boom and bust was of a relatively smaller scale as discussed in Section 2. During 2004–2008, there was a much larger divergence between the two variables, which was the direct effect of the international expansion of the banking sector that attracted large capital inflows. During this phase, saving kept on falling whereas investment increased very aggressively, resulting in large deficits on the current account. The period of free capital mobility temporarily ended with the introduction of capital controls during the financial crisis of 2008, which lasted until March 2017. During the 2008 crisis, investment collapsed and remained low in the first period of capital controls whereas saving increased, resulting in higher saving than investment for the first time in the available statistics.

We now proceed to exploring the relationship between domestic saving and investment, known as the Feldstein–Horioka hypothesis using historical data covering different regimes of capital mobility as discussed above. We estimate the following long-run model.

$$I_t = \alpha_0 + \beta_1 S_t + \varepsilon_t \quad (1)$$

where I_t represents the investment to GDP ratio, S_t represents the saving to GDP ratio, α_0 is the intercept, and ε_t is the error term in the model. With perfect capital mobility across countries, we would find the coefficient β_1 to be close to zero, indicating changes in saving in one country do not affect interest rates or investment in that country.[7] FH found that the coefficient of the saving

[7]There is now a very large empirical literature investigating the FH hypothesis. For a survey see, Apergis and Tsoumas (2009) and Kumar and Bhaskara (2011).

rate was 0.887 in a cross section of industrialised countries for the period 1960 and 1974. They attributed the finding to barriers in capital mobility.[8]

Following the econometric approach used in Narayan (2005) and Abbott and Vita (2003), we analyse the S-I correlation for different regimes by estimating the model in Equation (1) for different samples. We perform three main sets of estimations as follows:

(1) First, we estimate the model for 1960–1994, only covering the period of restricted capital mobility.
(2) We then add the phase of free capital mobility corresponding to the period 1994–2008. However, the phase of capital mobility includes two different monetary regimes. There was an adjustable peg from 1994 to 2001 and then a floating regime with inflation targeting. While our focus remains on understanding the effects of capital mobility regimes on the saving–investment correlation, we supplement our analysis by investigating how the correlation was affected by moving from an adjustable peg to a floating exchange rate regime within the free capital mobility regime.
(3) Finally, we include the phase of post-crisis capital controls in our sample, and estimate the model for the whole sample using sample 1960–2016.

The estimation across different regimes of capital mobility allows us to investigate the effects of these regimes on the saving–investment correlation. As shown in Frankel (1992) and explored by Katsimi and Zoega (2016), a zero correlation between saving and investment implies real interest parity. The real interest rate differential can be written as:

$$(r - \pi^e) - (r^* - \pi^{e*}) = (r - r^* - fd) + (fd - \Delta s^e) + (\Delta s^e - (\pi^e - \pi^{e*})) \quad (2)$$

where r and r^* denote domestic and foreign nominal interest rates, π^e and π^{e*} are the domestic and foreign expected rates of inflation, fd is the forward discount rate on the domestic currency and Δs^e is the expected depreciation of the domestic currency. The first term on the right-hand side of Equation (2), defined as the 'country premium' by Frankel (1992), is the covered interest differential. This term captures country-specific factors that may not allow real interest rate differential, such as capital controls or default risk. The second and third terms represent the exchange risk premium and the expected real depreciation, respectively. These two terms together form the 'currency premium'. Clearly the membership of the EEA could be expected to decrease the country premium by making the imposition of capital controls less likely. However, in the case of Iceland, the currency premium would be unaffected since the country never joined the Eurozone. Thus we expect the country premium to have fallen in 1994 when Iceland joined the European single market as one of the member countries of the European Economic Area. The country premium would then have increased markedly in 2008 when the banking system collapsed, the currency tanked and capital controls were imposed.

Before estimating the long-run model in equation (1), we need to determine whether a long-run relationship between saving and investment exists. We do so by using cointegration tests, which require testing the variables for stationarity and determining their orders of integration. We test the data for stationarity by using the traditional Augmented Dicky Fuller (ADF) and Phillip–Perron (PP) unit root tests. However, a weakness of both these tests is that the result might be contaminated by the presence of a structural break in the series. In other words, the presence of a structural break might manifest itself as non-stationarity in the data, leading to false inferences. We therefore extend our analysis to the unit root structural break test by implementing Zivot and Andrews (1992), which accounts for an endogenous structural break in the model. There are three versions of Zivot and

[8]A variety of explanations have been proposed for the FH puzzle. Coakley, Kulasi, and Smith (1996) argue that large and persistent current account deficits may reduce access to international capital markets. According to Tobin (1983) and Summers (1988), governments may try to avoid deficits for financial stability as well as surpluses.

Andrews (hereafter ZA); 'Model A' allows for a break in the intercept, 'Model B' allows for the break in trend, and 'Model C' allows for a break in both the intercept and trend. There is no consensus on which version is preferable. We implement Model C for completeness.

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.

$$\Delta y_t = c + \alpha_1 y_{t-1} + \beta t + \theta_1 DU_t + \gamma_1 DT_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \tag{3}$$

where Δ is the lag operator, ε_t is a white noise term, t is the time index ($t = 1, \ldots, T$). DU_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.

3.1.1. Testing for a long-run relationship

After testing the variables for a unit root, we proceed to testing for the existence of a long-run relationship between saving and investment. If both variables are found to be stationary at first-differences, i.e. if they both have $I(1)$ order of integration, we use a residuals-based test for cointegration, in which the residuals of the model in Equation (1) are simply tested for stationarity. If the residuals are found to be stationary, this simply implies that the linear combination of the variables is stationary and they share a long-run path.[9] Since, the residuals-based test is only valid when the variables have a unit root and the order of integration is similar, we therefore supplement our analysis by using ARDL bounds test of cointegration, which is relatively more flexible. This approach allows us to test for a long-run relationship irrespective of whether the regressors are $I(0)$, $I(1)$ or mutually cointegrated. Nonetheless, 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.[10]

The ARDL bounds test is represented as follows:

$$\Delta I_t = \alpha_0 + \theta_1 I_{t-1} + \theta_2 S_{t-1} + \sum_{j=1}^{p} \gamma_i \Delta I_{t-i} + \sum_{k=0}^{q} \beta_k \Delta S_{t-k} + \varepsilon_t \tag{4}$$

where θ_1 and θ_1 represent long-run relationships, while γ_i and β_k represent the short-run dynamics of the model and Δ is the first difference operator. Standard Wald test and F-test are used to test the null hypothesis, H_0: $\theta_1 = \theta_2 = 0$, which indicates no cointegration between the variables. The alternative hypothesis, H_1:$\theta_1 \neq \theta_2 \neq 0$, implies the presence of a long-run relationship between the variables. We compare the F-statistics with the set of critical values (i.e. lower and upper bounds) provided by Narayan (2005) for small samples. If the F-statistic is larger than the upper bound, we reject the null hypothesis of no cointegration and conclude that the regressors are purely $I(1)$. In the presence of cointegration, the long-run coefficient on saving is represented by $-\left(\frac{\theta_1}{\theta_2}\right)$. If the F-statistic is smaller than the lower bound, we accept the null hypothesis of no cointegration, while the result is inconclusive if the F-statistics lies between the two bounds.

If there exists a long-run relationship between saving and investment, we estimate the long-run coefficients using simple OLS, Fully Modified OLS (FMOLS), and Dynamic OLS (DOLS) models, along with obtaining both the short-run and long-run coefficients within the ARDL framework. Both FMOLS and DOLS estimation strategies are generally preferred over simple OLS as they tend to eliminate endogeneity and serial correlation, and have also proven to provide robust results in small samples.

[9]Conversely, non-stationarity of the residuals implies that the variables do not share a common long-run path.
[10]See Pesaran, Shin, and Smith (2001) for a detailed discussion.

Table 2. Unit root structural break test (ZA: Model C).

	Investment				Saving			
Sample	1960–1994	1960–2001	1960–2008	1960–2016	1960–1994	1960–2001	1960–2008	1960–2016
Break point	1972	1976	1991	2002	1981	1981	2000	2007
θ_1	6.48***	2.57	−2.60	6.12***	−4.51***	−6.32***	6.32***	−12.07**
	(1.50)	(2.81)	(1.66)	(1.95)	(1.34)	(1.58)	(1.85)	(2.03)
γ_1	−1.03***	0.34***	0.70***	−0.50**	0.01	0.08	−1.30***	3.02***
	(0.30)	(0.18)	(0.18)	(0.22)	0.13	(0.08)	(0.33)	(0.45)
Test-statistics	−6.57 (4)	−3.70 (0)	−4.85 (1)	−4.70 (1)	−4.68 (0)	−5.04 (1)	−4.10 (0)	−3.89 (0)
Critical values								
1%	−5.57	−5.57	−5.57	−5.57	−5.57	−5.57	−5.57	−5.57
5%	−5.08	−5.08	−5.08	−5.08	−5.08	−5.08	−5.08	−5.08
10%	−4.82	−4.82	−4.82	−4.82	−4.82	−4.82	−4.82	−4.82

Notes: ***, **, and * denote that the null hypothesis of non-stationarity in the residuals can be rejected at 1%, 5%, and 10% significance level, respectively.

Table 3. Cointegration tests.

	ARDL bounds test							
	1960–1994		1960–2001		1960–2008		1960–2016	
F-statistic	9.42		7.70		6.61		8.80	
Critical Value Bounds								
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
1%	5.76	6.48	5.59	6.33	5.50	6.24	5.37	6.04
5%	3.95	4.53	3.93	4.52	3.86	4.44	3.79	4.93
10%	3.22	3.75	3.21	3.86	3.17	3.65	3.14	3.67
Residual-based test								
T-statistics	−4.82***		−3.90***		−4.86***		−4.74***	

Notes: *** denotes that the null hypothesis of non-stationarity in the residuals can be rejected at 1% significance level. For residual-based test, the two samples 1960–2008 and 1960–2016 include a crisis dummy.

3.2. Results and discussion

The results of the PP and ADF test in the case of all four samples (see Table A1 in appendix) suggest that both investment and saving are non-stationary at the 1% significance level. The results of the ZA test are reported in Table 2.

Using ZA test, we find sufficient evidence to argue that investment and saving exhibit unit roots in general. The only result going in the other direction is found in the case of investment using the sample period 1960–1994 when ZA indicates stationarity of the series in levels while PP and ADF on the other hand indicate the presence of a unit root. Although the result in this particular case is inconclusive, it is a well-established empirical fact that investment exhibits a unit root and is integrated of order one, i.e. $I(1)$ (e.g. Bajo-Rubio, 1998; Oh et al., 1999; Abbott & Vita, 2003; Narayan, 2005). Furthermore, the findings of all the tests are similar in rejecting the presence of a unit root when implemented in the case of first order differences, supporting the argument that the data are $I(1)$. Based on this evidence, we proceed to testing the model for the existence of a long-run relationship. First, we estimate ARDL model in equation (4), using the Akaike Information Criterion (AIC) for the lag-selection, and test for the existence of a long-run relationship. The results indicate the presence of a long-run relationship between saving and investment as shown in Table 3. The ARDL bounds test indicates that the null hypothesis of no cointegration is rejected at 1% for all four samples. Second, we test the model for a long-run relationship using residuals-based test. The residuals of the models for the four samples are stationary at 1% significance level, indicating

Table 4. FMOLS and DOLS estimates.

	FMOLS				DOLS			
	1960–1994	1960–2001	1960–2008	1960–2016	1960–1994	1960–2001	1960–2008	1960–2016
S_t	1.25***	1.21***	1.29***	0.71***	1.29***	1.25***	1.02***	0.94***
	(0.15)	(0.17)	(0.15)	(0.14)	(0.15)	(0.14)	(0.22)	(0.15)
Constant	−0.35	0.44	−1.13	11.25***	−1.13	−0.29	4.25	6.79**
	(3.46)	(3.83)	(3.46)	(3.04)	(3.46)	(3.09)	(4.81)	(3.13)

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

Table 5. ARDL and OLS estimates.

	ARDL				OLS			
	1960–1994	1960–2001	1960–2008	1960–2016	1960–1994	1960–2001	1960–2008	1960–2016
S_t	1.35***	1.25***	1.05***	0.92***	1.03***	1.02***	0.74***	0.71***
	(0.22)	(0.14)	(0.22)	(0.19)	(0.14)	(0.12)	(0.14)	(0.12)
Constant	−2.93	−0.79	4.44	7.24*	4.71	4.92*	11.43***	11.08***
	(2.63)	(3.13)	(4.81)	(4.00)	(3.27)	(2.71)	(2.99)	(2.58)
Dummy							11.36***	11.81**
							(5.24)	(5.61)
Short-run elasticities								
ECT	−0.56***	−0.54***	−0.37***	−0.33***				
	(0.09)	(0.11)	(0.09)	(0.06)				
ΔS_t	−0.09	−0.05	−0.24*	−0.18				
	(0.24)	(0.15)	(0.13)	(0.11)				
ΔS_{t-1}	−0.39***	−0.36**	−0.35*					
	(0.14)	(0.18)	(0.18)					

Notes: ***, ** and * indicate that the null hypothesis is rejected at the 1%, 5% and 10% levels, respectively. For OLS estimations, the two samples 1960–2008 and 1960–2016 included a crisis dummy.

strong evidence of a long-run relationship between the two variables. Thus, we proceed to estimating the long-run relationships in the next section.[11]

3.2.1. Long-run relationships

The long-run coefficients for DOLS and FMOLS reported in Table 4 whereas the results for ARDL and OLS are reported in Table 5. Note that Table 5 reports the long-run coefficients for ARDL and OLS as well as the short-run dynamics associated with the ARDL method.

Overall, the long-run coefficients are consistent across the four methods. 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). The correlation has a clear tendency to fall during periods of free capital mobility. In particular, when we include the first years of free capital mobility under an adjustable peg regime, the correlation weakens. And when we include the entire phase of free capital mobility, the correlation weakens further. Our analysis up to this point in the sample confirms the FH hypothesis that the correlation depends on capital mobility. This result is consistent with that of Katsimi and Zoega (2016) who studied the correlation between saving and investment for member countries of the European Single Market.

However, the correlation does not increase when the period of capital controls after the crisis is included, contradicting the FH hypothesis in this case. This implies that the relationship between saving and investment in capital controls after the crisis tends to be weaker than in capital controls in normal times.

[11]Throughout our empirical analysis, we include a dummy for the potential break points in our models as indicated by ZA test. We only keep the dummy in the model, if found to be statistically significant.

As an additional check, the weak correlation is also confirmed by using two conventional approaches. First, we include an interacting dummy variable that takes the value of one (otherwise zero) when Iceland switched from a regime of free capital mobility to a regime of capital controls in 2008 (see Table A3 in the appendix). Second, we estimate the model for every regime separately by creating three sub-periods, i.e. restricted capital mobility (1960–1994), free capital mobility (1995–2008), and capital controls (2009–2016), see Table A4 in the appendix.[12] The results in all cases indicate that despite strong capital controls in the post-crisis period, the saving–investment correlation is much weaker as compared to the correlation in the earlier restricted period of capital mobility.

The lower part of Table 5 reports the short-run dynamics of ARDL model along with the speed of adjustment (i.e. error correction term, ECT). During the period of restricted capital mobility (1960–1994), short-run deviations (due to shocks) between saving and investment are corrected by 56% in the next year (i.e. the model converges to its long-run path in 2 years). Overall, the ECT for the phase of free capital mobility (1960–2008) is lower than the period of restricted capital mobility (1960–1994). The speed of adjustment drops yet further when the period of capital controls after the crisis is included.

Note that the speed of convergence towards a long-run equilibrium tends to lower as the saving–investment correlation becomes weaker, which in other words indicates a prolonged period of divergence between saving and investment. This finding chimes with our discussion of the recent history of Iceland in Section 2.

3.2.2. Effects of capital controls in normal times and during the crisis

We now focus on explaining the different effects of capital controls on the saving–investment correlation in the 'normal' 1960–1994 and the crisis period 2008 to 2016. In the era of restricted capital mobility (1960–1994), there was credit rationing leading to a stronger relationship between saving and investment in the economy since there was an external constraint on the current account due to limited access to foreign capital. This external constraint, in effect the result of imperfect mobility of capital, forced saving to be close to investment over time. In contrast, there was a weak relationship between saving and investment in the early phase of post-crisis capital controls. We can broadly identify three major factors, leading to a weak saving–investment correlation during the post-crisis capital controls.

First, as a result of the high interest rates, damaged balance sheets and general uncertainty about the future, investment was low for a number of years until the economy started to recover while saving was high due to the same factors. This made the two series diverge, leading to a weak correlation between saving and investment despite capital controls. The difference between saving and investment was used to pay off foreign debt. The post-crisis divergence in the two series can also be seen in Figure 2. In Iceland, the saving to GDP ratio went from 3.11% in 2008 to 20.34% in 2014, while investment to GDP went from 25% in 2008 to 16% in 2014. No such deleveraging occurred during the earlier period of capital controls.

Second, the financial system of the country collapsed and the wave of bankruptcies also transmitted shocks to the balance sheets of many firms. There was no stable financial system in place that could have efficiently facilitated credit intermediation channelling savings to investment projects. Also, during the financial restructuring of insolvent firms kept investment from growing.

Third, restructuring the financing of investment projects and the setting up of new projects required time. In addition, there was increasing international pressure from the creditors who needed to be repaid.[13] This is typical of a crisis situation, when all negative forces gain momentum

[12]Note that the results in Table A4 are only based on simple OLS with no lags. Due to less no. of observations in free capital mobility and capital control regime, it is not possible to estimate a model with lags.

[13]This pressure tends to be stronger in countries without sovereign currencies, making them bow to the demand of international creditors as was the case in some Eurozone countries. In most Eurozone countries, the current account balances have rebounded but the economies experienced longer recessions.

at the same time, making the recovery path difficult and keeping investment down, especially when uncertainty is highest.

The causes of the breakdown of the saving–investment correlation in a post-crisis period can be generalised to other countries and periods. The crisis affects balance sheets and financial intermediation adversely and creates uncertainty. These factors tend to raise saving and reduce investment.[14] It follows that merely implementing strong capital controls in response to a crisis is *not* sufficient to channel increased saving into investment and promote economic growth. A second instrument is needed, which is an independent monetary policy. Without the ability to lower interest rates it is difficult to find ways to channel saving into investments to facilitate economic recovery.[15] Thus capital controls that prevent a currency from depreciating and are not accompanied by falling interest rates come at a greater cost of falling aggregate demand that has negative consequences for growth. In contrast, a country with its own currency can better afford to use capital controls to its advantage. Here the capital controls affect the level of the exchange rate while the central bank interest rates affect domestic consumption and investment.

Iceland's experience in the later years of capital controls provides a good example. The central bank started lowering interest rates in 2011–2012 from a very high level step by step, which facilitated the recovery of investment without having any major impacts on the exchange rate due to the capital controls.

One key lesson from the Iceland crisis is that two instruments are required in the post-crisis environment to achieve the two goals of non-inflationary demand growth and stable exchange rates. Capital controls and higher interest rates after the crisis helped stabilise the economy in the short run – the subsequent lowering of rates helped foster the recovery of the economy, while the capital controls reduced the volatility of the exchange rate.

4. Conclusion

We have explored the relationship between saving and investment using Icelandic data in order to test for the effect of capital mobility on the Feldstein–Horioka coefficient. Following a review of the performance of the Icelandic economy over the last century, we found that institutional changes, in particular, Iceland's entry into the European Single Market in 1994, coincided with a fall in the long-run correlation between saving and investment as well as the short-run speed of adjustment, as measured by the error correction term. This confirms the interpretation of Feldstein and Horioka (1980) that a positive value of the coefficient of saving in an investment equation reflects the effect of limited capital mobility. However, the reintroduction of capital controls in 2008 neither increased the long-run correlation nor the error correction term due to the effect of the financial crisis and the ensuing currency crisis that forced Iceland to run persistent current account surpluses to pay back foreign loans. Thus, capital controls in response to a financial crisis can have a very different effect on the saving–investment correlation than capital controls in a more stable environment.

Further research is required to understand precisely how the presence of capital controls affects the saving/investment relationship for larger economies, and for economies within larger currency areas, such as Cyprus and Greece. The interaction of capital controls and current account surplus targets, in particular, should be investigated.

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[14]See Zoega (2010), amongst others.
[15]See Raza et al. (2018a) for the comparison of economic recovery in Iceland and Ireland.

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Appendix

Table A1. Philip–Perron test.

	Investment				Saving			
Sample	1960–1994	1994–2001	1960–2008	1960–2016	1960–1994	1960–2001	1960–2008	1960–2016
Test-statistics	−1.02	−1.77	−2.19	−2.31	−1.59	−1.91	−0.16	−1.98
	Critical values							
1%	−3.63	−3.60	−3.57	−3.55	−3.63	−3.60	−3.57	−3.55
5%	−2.95	−2.93	−2.92	−2.91	−2.95	−2.93	−2.92	−2.91
10%	−2.61	−2.60	−2.59	−2.59	−2.61	−2.60	−2.59	−2.59

Table A2. ADF test.

	Investment				Saving			
Sample	1960–1994	1994–2001	1960–2008	1960–2016	1960–1994	1960–2001	1960–2008	1960–2016
Test-statistics	−1.15	−1.82	−2.22	−2.15	−1.66	−0.73	−0.76	−1.98
	Critical values							
1%	−3.63	−3.61	−3.57	−3.55	−3.63	−3.61	−3.57	−3.55
5%	−2.95	−2.94	−2.92	−2.91	−2.95	−2.94	−2.92	−2.91
10%	−2.61	−2.60	−2.59	−2.59	−2.61	−2.60	−2.59	−2.59

Table A3. Long-run estimates allowing for regime shift.

	ARDL	DOLS	FMOLS	OLS
	0.92***	1.15***	0.94***	0.78***
	(0.18)	(0.12)	(0.12)	(0.09)
S_t*PCC	−0.18	−0.20	−0.37***	−0.42***
	(0.12)	(0.17)	(0.12)	(0.09)
Dummy	6.61*	15.22***	13.59***	11.96***
	(3.75)	(3.23)	(3.28)	(2.43)
Constant	7.31*	2.39***	6.89***	10.28***
	(4.10)	(2.72)	(2.74)	(2.00)

Note: ***, ** and * indicate that the null hypothesis is rejected at the 1%, 5% and 10% levels, respectively. PCC (dummy for Post-crisis Capital Controls)

Table A4. Long-run estimates for each regime using simple OLS.

	1960–1994	1995–2008	2009–2016
S_t	1.03***	-0.46	0.24***
	(0.14)	(0.29)	(0.05)
Constant	4.71	31.45***	12.67***
	(3.27)	(4.80)	(0.98)

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