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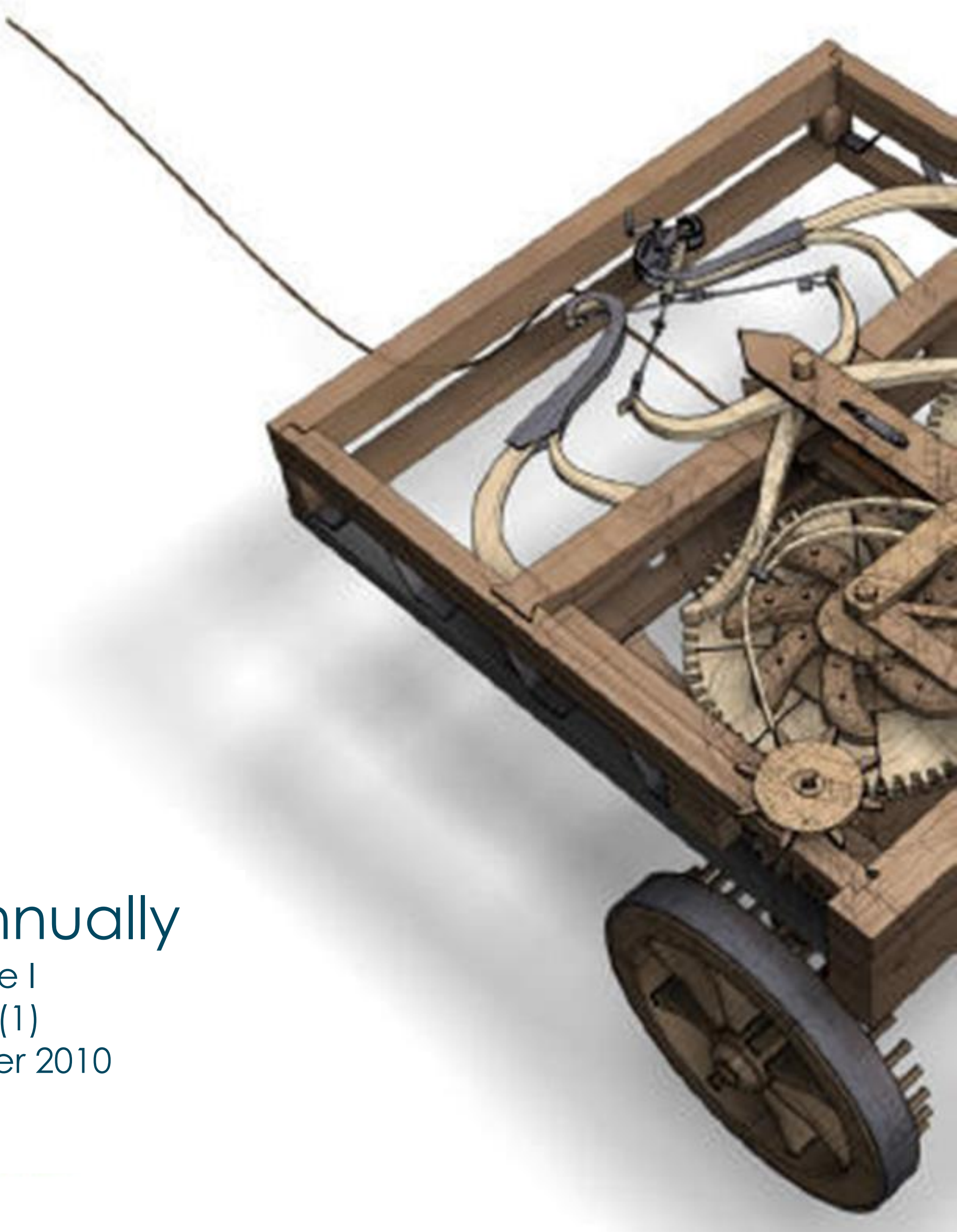

Biannually

Volume I

Issue 1(1)

Summer 2010

ISSN

Summer 2010
Volume I, Issue 1(1)

ASERS Publishing
http://www.asers.eu/asers-publishing
ISSN

Contents:

Call for Papers
Winter_Issue 2010

Theoretical and Practical Research in Economic Fields

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CAN SHIFT TO A FUNDED PENSION SYSTEM AFFECT NATIONAL SAVING? THE CASE OF ICELAND

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Abstract

Across industrialised and developing countries public pension systems have been heavily reformed during the last two decades. The major concern relates the financial sustainability of pay-as-you-go pension schemes. The proposals to privatize social security lead to the creation of a multipillar system. This study assesses the validity of the effect of pension reforms on domestic savings in two steps: first, to test for the existence of a long-run relationship, we use an ARDL model; second, we employ the Kalman filter algorithm, in order to recover the parameter dynamics overtime. We analyse the case of Iceland because its pension system is characterized by a large mandatory private pillar. The empirical evidence supports the widely held view that growing mandatory pension funds financial assets has significantly positive impact on national saving. Moreover, we show that the pattern of the pension funds' coefficients seems to capture well the economic dynamic of the period. The coefficients of the funded pillars illustrate a shift upward soon after the launch of the reforms in 1998. Later on, these coefficients show a negative trend till the middle of 2004 and they increase sharply until the beginning of 2006. Afterwards, following the Icelandic and international financial crisis, they strongly declines.

Keywords: national saving, pension funds, multipillar system, ARDL model, Kalman filter

JEL Classification: E21, G23, H55

1. Introduction

Within the past two decades many countries around the globe have implemented intense pension reforms, which have often involved an increased use of funded pension programmes managed by the private sector.

Most of the world's countries are characterized by public pension provision financed by tax contributions on a pay-as-you-go basis, even if there could be important differences in size and degree of targeting (universal and/or means-tested). Currently, the western countries are facing lower growth rates while declining fertility rates and lower mortality rates are leading to an increase in the dependency ratio. As a consequence, the most unfunded systems are faced with financial sustainability problems. Many countries have enacted reforms which cut benefits and increase contributions and consequently most reformed pension systems are increasingly based on the rejection of the *dominance* of the public pension pillar. Hence, the aim is to move to a multipillar[5] system with a greater role given to the private sector, so that it can provide a minimum floor income for the elderly.

There are several reasons to increase funding within public or private pension systems. Among others[6], the one that is strictly related to the object of this paper is that such a policy could produce an equivalent increase in national saving, reducing the burden placed on the future workers who must support the retired elderly. Since Feldstein's seminal work (1974), this topic has been on the research agenda for over two decades. A heated debate has developed over the merits of a social security reform based on the building of a multipillar system and, in particular, over its impact on saving. This paper intends to investigate whether this explanation for advanced funding is valid. In doing so we try to estimate the effect on national saving of an increase in mandatory private pension funding in Iceland, a country that is increasingly meeting the criteria of the prototype three pillar system as suggested by the World Bank (1994). Its social security system could be a typical example of a great

[5] Each pension pillar provides the three functions in different ways. The first pillar, public pay-as-you-go, usually defined-benefit and redistributive, should provide social safety net support to everyone. The second one is a privately managed funded pillar that handles peoples' mandatory retirement savings; unlike the public pillar – which is redistributive, centrally controlled, and tax-financed - the second mandatory pillar should highlight savings. Finally, the third pillar encourages discretionary retirement savings and capital development.

[6] Another justification for proposals to shift from pay go to private pension schemes is that such a policy will remedy to labour market distortions (Arrau, and Schmidt-Hebbel 1995; Feldstein 1996; Feldstein, and Samwick 1997; Kotlikoff 1996a, and 1996b). However, the aim of this paper is not to analyse the relationship between funded pension schemes and labour market.

role given to the second mandatory private pension pillar since it exhibits the largest pension funds in relation to the size of its economy.

Hence, the approach taken in this study is that of long-run equilibrium via cointegration. Instead of relying on the more common Johansen multivariate cointegration procedure, autoregressive distributed lag (ARDL) cointegration modelling of Pesaran, Shin, and Smith (1999) will be carried out to determine if there is a long-term equilibrium relationship between national savings and pension funds in Icelandic economy. In this regard, we test the hypothesis that the contemporaneous convergence of the variables in the system exhibits minimum systematic error due to the presence of an error correction mechanism (short-term relationship).

Moreover, this study implements an additional analysis based on the Kalman filter methodology in order to analyse the paths of the pension funds with respect to national savings. The time varying-parameter technique uses the basic idea that the parameter vector in an econometric relationship may be subjected to sequential variation over time because of the problems of structural change, misspecification and aggregation.

The results of this study reveal that there exists a long-run equilibrium relationship between national savings and pension funds. Additionally, the combined impact of private pension provision and life insurance on national savings is positive. Moreover, further evidence comes from the Kalman filter methodology where the behaviour of the coefficients of pension funds' variable shows a positive trend.

The innovative feature of our study is that, analysing Iceland, we consider a typical example of multipillar system characterized by a small public pension pillar, a large mandatory private pension pillar and a considerable voluntary pension saving. In order to be efficient a pension system should take into account lifetime risks facing individuals and society as a whole. Furthermore a certain degree of income equalisation should be built into the system. Then the pension system should have at least some degree of flexibility and scope for choice for the individuals. Finally, it should be designed in such a way as to promote economic performance that is, saving, growth and financial sector development.

Our findings indicate that increases in pension funds financial assets increase national saving when pension funds are the result of a mandatory pension program. An interesting feature of the results about Icelandic pension system, which are compatible with results from other developed countries, is that the shift to a multipillar system implemented by Iceland could give useful suggestions to policy makers that are facing problems with social security reforms. However despite the strong impact of the 2007 financial crisis on the Icelandic economy, the reformed pension system seems to work as well as the co integration relationship with the national savings. Moreover, a novelty of this work is that the contribution rate to pension funds, increasing national saving in Iceland, could be an important policy instrument whose effect can be twofold: **1.** to secure a minimum replacement rate at retirement; **2.** to raise the future national income through a faster capital formation.

The paper is organized as follows: Section 2 presents the relevant theoretical and empirical literature. Section 3 reviews the evolution of the Icelandic economy and the pension system. The data, the ARDL cointegration methodology, the Kalman filter and the empirical results are explained in Section 4. Policy implications and the main conclusions are summarised in the fifth section.

2. A Brief Literature Review

The impact of the pension system on individual saving has been a concern since Feldstein's (1974) pioneering paper, which centres around the funding status of social security and, in particular, on the degree to which an unfunded pension system reduces private saving. The latter is the central question of the current debate[7]. However, the question analysed in this study is the impact on national saving of the implementation of a multipillar system, consisting of public pay-as-you-go scheme and of compulsory saving in funded pension plans, as in the Icelandic pension system.

According to Feldstein (1996) one of the benefits claimed for the private funded pension schemes is that they rise national saving. The reduction of the size of public unfunded scheme could rise saving and wealth directly by reducing government debt and indirectly increasing saving through two other paths. On one side, the elimination of payroll tax may lead to an increase in labour supply thus boosting GDP and increasing saving. On the other side, the shift to funded pension scheme may stimulate the capital market, leading to an increase in the efficiency of investment and thereby to an increase in economic growth and saving, depending on the extent of

[7] This literature is reviewed and summarized in CBO (1998) and Atkinson (1987).

capital market development prior the reform[8]. While theoretical arguments tend to be consistent with the view that higher private savings are associated with funding than with PAYG, convincing empirical support is missing.

Several studies have analysed transition from unfunded to fully funded system in an overlapping generation framework (Arrau, and Scmidt-Hebbel 1999; Cifuentes, and Valdes Prieto 1997, and Kotlikoff, Smetters, and Walliser 1998). The most significant burden due to this shift has to be supported by the transitional generations since they have to pay double contributions, their own and that of current retirement individuals under the unfounded system.

As Samwick (2000) remarks, the intergenerational allocation of the transition cost is the most important consideration to determine the effect of the regime change on saving.

How the government manages this additional financing requirement is crucial to the effect of the transition on saving, as discussed in Holzmann (1997). If the government tries to finance the implicit pension debts by issuing explicit debt, then public savings would decrease, so the overall national saving rate might be unchanged or even fall (Cesaratto 2006). For example, a simulation study by Hviding and Merette (1998) gives evidence that debt financed transitions may not have considerable effects on national saving and output; all that may happen is that the government has altered the form of the debt.

Another possibility is to finance the transition increasing taxation. As a consequence, the disposable income of current workers will decline and if their consume will fall by the same amount, the national saving will raise by an equal amount of tax increase. According to the life-cycle model, individuals will try to smooth the tax raise over their entire life time. Hence part of tax income will be financed by a lower private saving (Samwick 2000).

Auerbach and Kotlikoff (1987), Kotlikoff (1996a), Mitchell and Zeldes (1996) underline that if individuals are completely rational life-cycle savers, the introduction of a mandatory saving program would not have any net effect on national saving because rational individuals will reduce their previous saving by an equal amount. An investment based program should raise aggregate saving only if individuals are myopic or do not save for other reasons (for instance, bequest).

Two well-known cross sectional studies by Cagan (1965) and Katona (1965) have shown that employees covered by private pensions do not save less and may even save more than employees not covered by private pensions.

From an empirical point of view, different findings were obtained by Munnel (1976). She used a sample of 5,000 men with ages included between 45 and 59 in 1966. The author presented evidence showing that the saving of employees covered by private pensions is largely less than the saving of employees not covered by private pensions. From cross-country empirical evidence, Baillu and Reisen (1997) studied the effect of funded pension wealth as a determinant of private saving working with a sample of 10 countries and a panel of more than 100 observations. The authors showed that funded pension wealth increases private saving rates in developing countries with mandatory funded pension programs.

More recently, Murphy and Musalem (2004) conducted an empirical study on the effect of the accumulation of pension fund financial assets on national saving, using a panel of 43 industrial and developing countries. The authors divided the countries into two groups: the first one includes countries whose data on pension asset are mainly due to compulsory funded pension program; the second group of countries is instead characterized by data that are the result of voluntary funded pension program. They focused on pension funds financial assets and their impact on national saving rate. Their findings suggested that increases in pension funds financial assets increase national saving when pension funds are the result of a mandatory pension program.

Despite the goals underlined by Murphy and Musalem (2004), we are interested into studying the effect of the reforms implemented by Iceland on national saving. The aim of the present paper is to verify if, reforms consisting in a shift from a pay-as-you-go to a multipillar system with a greater role give to the second pillar (mandatory pension funds), foster national saving.

The largest pension funds in relation to the size of their respective economies are the ones that have had mandatory or quasi mandatory pension funds for many years, like Australia, Iceland, the Netherlands and

[8] Orszag and Stiglitz (1999) explore – in a deliberately provocative manner – the multipillars system of the "World Bank model" with a particular attention to the private mandatory defined contribution component. They debunk ten myths to stress that the general opinions most frequently used to support investment-based programs are often not confirmed in theory and practice. Among them, the first myth is about the common idea that private defined contribution plans raise national saving.

Switzerland[9]. The largest voluntary pension fund systems are those in the United States, United Kingdom and Canada (OECD 2005). In this paper we focus our analysis on Iceland that is increasingly meeting the criteria of the prototype three pillar system.

3. Icelandic Economic and Pension System

The economic effects of reformed pension systems are important. It is always those who are economically active today who support today's pensioners, irrespective of the specific economic system. However to better analyse the impact of the reformed pension provision on the economic performance it is useful to summarize the evolution of the Icelandic economy.

3.1. Economic performance of Icelandic economy within the past twelve years

The first attempt of transforming the structure of the Iceland economy started in the sixties when a primitive process of liberalization was not accompanied by the necessary process of de-politicization of the economic life. Nor was the second, begun in the late eighties. The latter involved the deregulation of domestic interest rates and the flow of foreign capital, the indexation of financial obligations, the partnership agreement with the European Economic Community in 1994 and, from 1998 to 2003, the privatization of banks, investment funds and the reform of the pension system. The two main banks were sold simultaneously at a price considered low by the National Audit Office. Moreover, they were not sold to foreign banks, as was the case of banking privatization in Eastern Europe, but to people very close to the ruling political parties.

In 2001, banks were deregulated in Iceland. This set the stage for banks to upload debts when, at the same time, the share of the Icelandic assets hold by foreign institutions increased. According to the official statistics about the key indicator of the Icelandic economy, the middle of the 2004 is considered a sort of turning point. In fact, we have found at least four important changes in the main macroeconomic variables: **1.** the growth rate of GDP per capita changes its trend becoming negative after a decade of continuous positive movement; **2.** the wages started increasing; **3.** the monetary policy changed implying a turn towards a tight or restrictive monetary policy; **4.** the current account balance reached its negative peak in 2005.

The 2007 crisis stretched out when banks became unable to refinance their debts. It was estimated that, in 2008, the three major banks hold foreign debt in excess of €50 billion that is, almost 6 times the Iceland's GDP. The króna, was under pressure because the international markets considered it an overvalued currency. Due to the fact that Iceland has a small domestic market, Iceland's banks financed their expansion with loans on the interbank lending market and abroad, increasing the external debt of about 213 per cent of disposable income. Finally, the inflation rate rose in all the period but from 2004 the house component increased considerably.

3.2. Icelandic social security system

The Icelandic pension system is based on three pillars. The first pillar, according to the accepted terminology in this field, is a tax-financed public pension. The occupational pension funds are the second mandatory pillar. The third pillar is voluntary pension saving with tax incentives[10]. A comprehensive pension reform took place in 1997 and 1998 that affected the second and third pillar.

Iceland is not facing the problems of the most developed countries due to the aging population. First of all, Icelandic people are younger and, according to the predictions for 2030, its dependency ratio will remain lower than the other European countries. Moreover, labour participation rates of the elderly are also higher and the effective retirement age is higher than the most industrialized nations. This happens because of the particular Icelandic social security system in which individuals are entitled to receive public pension only from the age of 67 and pension funds are regulated so that no incentives are given for early retirement.

The first pension pillar provides an old age, disability and survivors pension. It is divided into a basic and supplementary pension, both are means-tested.

The second pillar is based on occupational pension funds. It is mandatory by law to pay at least 10 per cent of all wages and salaries into fully funded pension plans that provide lifelong retirement and disability benefits. Many of the funds were established through a collective labour agreement in 1969. Most of them are

[9] In Iceland, however, the participation in pension funds, which should be left to individual choice, is instead mandatory in agreements between unions and employers; that private pensions receive not only the effective regulation and supervision of financial markets but also of a public guarantee reintroducing elements of PAYG financing (Castellino, and Fornero 2007).

[10] For more details see Gudmundsson (2001, 2004) and Gudmundsson, and Baldursdóttir (2005).

managed jointly by representatives from the trade unions and employers. Only in 1998, a more comprehensive legislation covered the operation of pension funds into the financial markets.

In the 1980s and 1990s pension fund assets grew from 14% to 80% per annum in real terms of GDP. This placed Iceland fourth among EU and EFTA countries in terms of the size of second pillar pension fund assets as a percentage of GDP, after the Netherlands, Switzerland and the UK. At the beginning of 2005 there were forty-eight pension funds in Iceland. Ten of them were no longer receiving contributions.

The *third* pillar is characterized by voluntary private pension savings for which in 1998 tax incentive legislation was adopted as part of the general pension reform.

In 2003 and 2004 the *assets* of Icelandic pension funds and life insurance was respectively 138.4 and 146.2 as a percent of GDP (OECD 2005). The reason is that contribution to pension funds exceed benefits paid from them because of pensioners are few in proportion to working fund members. Furthermore, most of them have contributed to the fund only for short period of their working life ad so they are entitled only to relatively small benefits. As a consequence, pension funds fed on their own investments. In 2006 and 2007 the importance of pension funds relative to the size of the economy were 132,7 and 134 per cent of GDP, respectively. The situation changed dramatically in the 2008 when the assets of pension funds fell to 99.5 per cent of GDP. Due to the sharp decline of GDP to -7.2 per cent in 2009, the ratio of assets of pension funds on GDP does not give any useful information.

4. Data, methodology and empirical results

The principal task in this paper is to search for a long-run equilibrium relationship and short-term dynamics between national savings and a set of explanatory variables (here after, "Z") like public pension provision and private pension funds that could affect savings patterns. In doing so we follow three steps. Firstly, we consider the orthogonal problem that usually arises when we work with financial variables. To overcome this peculiar aspect we implement the SURE methodology. Secondly we move our analysis to the study of the long-run relationship between national saving and a vector of exogenous variables "Z". Finally we estimate, using a Kalman filter approach, a 'backward-looking' process for national savings with parameters varying with fundamental component of the private pension plans. The time varying methodology allows us to recover an unobservable factor that could affect national savings. For each endogenous variables of the model it is therefore possible to observe how the respective coefficients have changed over time.

4.1. Data analysis

The choice of the sample 1997-2009 using monthly observation was essentially based on the need of analysing the behaviour of savings after substantial reforms of the pension systems took place. For the estimation of the Equations used in this work, the variables considered are[11]: SAV is the national aggregate saving of Iceland based on the current account definition of savings as the residual difference between total income, consumption and all the retirement saving generated by the three pillars.

PAYG is defined as the logarithm of total expenditure on public pension benefits. The variable is from the Central Bank of Iceland. We expect a negative relationship between PAYG and national saving; PENS is defined as the logarithm of total expenditure on private pension funds and is expected with a positive sign. The Iceland PENS is mandatory by law to pay at least 10% of all wages and salaries into fully funded pension schemes that provide lifelong retirement and disability pensions; INS is the logarithm of insurance providing payment of a sum of money to a beneficiary on the death of the insured person or if the insured person reaches a certain age also known as life insurance and should have a positive impact on national savings. The monthly statistics for assets of pension funds including life insurance are compiled from monthly reports from 23 pension funds published by Central Bank of Iceland; INT is the nominal interest rate. We use money market rate (average rate on money market) as a measure of interest. The impact of interest rates on household savings is ambiguous because income and substitution effects work in opposite directions. Finally, the variable DR is the dependency ratio. It is calculated as the ratio of people over 64 to people aged 20-64 years. According to the life-cycle model, the higher the ratio of the elderly population to the working-age population, that is DR, the lower could be the aggregate saving because the old are retired and do not save while the young work and do save. Hence we expect a negative relationship between dependency ratio and national saving. The logarithms transformation of pension variables (PENS, PAYG and INS) reflects the general interest emphasized in the social security literature in relative versus absolute effect of this variables on national saving.

[11] Data source: IMF – Financial Statistics, Iceland Central bank and OECD statistics.

4.2. Methodology and empirical results

4.2.1. A preliminary analysis

One of the central conditions to achieve identification when we deal with financial variables is that the structural form shocks are orthogonal to one another. That is, we assume that the error term is orthogonal to the variables on the right side of the Equation (1) below. In reality, this condition may not be satisfied. Common shocks for such variables within a country may be news about economic fundamentals or announcements of releases of relevant macroeconomic data. Moreover, there may be common shocks among countries, such as oil price shocks.

Following the approach commonly used in the related literature we address the issue that the three series $PENS_t$, $PAYG_t$, and INS_t are nearly orthogonal or uncorrelated. The correlation between them measures the extent to which each series provide "orthogonal information". The former problem is related to the possibility that these variables are simultaneously determined. This can occur either because they cause each other or because they have some common omitted determinants. For instance, we assume that pension funds assets are nearly orthogonal to the life insurance assets. One reason for a violation of this condition would be a contemporaneous response of interest rates to pension and life insurance funds.

Generally speaking, ignoring this potential correlation might reduce the efficiency of the estimates, or even produce biased estimates if these variables are correlated with other included explanatory variables. To examine the impact of controlling for this correlation, we estimate a Seemingly Unrelated Regression Estimation (SURE) system of four Equations: one for private pension (PENS), one for the public pension (PAYG), another for the additional private pension (INS) and another for the interest rate (i_t), while allowing for their error terms to be correlated. The below set of Equations has contemporaneous cross-Equation error correlation so that, the Equations seem unrelated which states that the idiosyncratic shocks of the four markets are independent.

$$\begin{cases} PENS_t = \alpha_{1t} + \sum_{n=1}^{k_1} \beta_{1,j} PAYG_{t-n} + \sum_{m=1}^{k_2} \beta_{2,j} INS_{t-m} + \sum_{h=1}^{k_3} \beta_{3,j} i_{t-h} + \mu_{pens_t} \\ PAYG_t = \alpha_{2t} + \sum_{s=1}^{k_4} \beta_{4,j} PENS_{t-s} + \sum_{f=1}^{k_5} \beta_{5,j} INS_{t-f} + \sum_{g=1}^{k_6} \beta_{6,j} i_{t-g} + \mu_{payg_t} \\ INS_t = \alpha_{3t} + \sum_{v=1}^{k_7} \beta_{7,j} PAYG_{t-v} + \sum_{l=1}^{k_8} \beta_{8,j} PENS_{t-l} + \sum_{d=1}^{k_9} \beta_{9,j} i_{t-d} + \mu_{ins_t} \\ i_t = \alpha_{4t} + \sum_{e=1}^{k_{10}} \beta_{10,j} PAYG_{t-e} + \sum_{r=1}^{k_{11}} \beta_{11,j} PENS_{t-r} + \sum_{u=1}^{k_{12}} \beta_{12,j} INS_{t-u} + \mu_{i_t} \end{cases} \tag{1}$$

In Equation (1) we use impulses in a separate system so we can investigate the relationship among the impulses (PENS, PAYG, INS and *i*). The estimated results are presented in Table 1.

Table 1. SURE estimation for Iceland

	Coefficient	S.E.
α1	-1.165762**	0.425066
β1	0.805752**	0.057489
β2	-0.569065**	0.057638
β3	0.076296**	0.007398
α2	2.035606**	0.296579
β4	0.765641**	0.054627
β5	0.798689**	0.027706
β6	-0.036351**	0.008338
α3	-2.238607**	0.448642
β7	1.174182**	0.040732
β8	-0.794957**	0.080517
β9	0.044685**	0.010199
α4	-3.078200	4.244247
β10	-3.116786**	0.714934
β11	6.216143**	0.602711

β_{12}	2.606142**	0.594818
Determinant residual covariance		2.44E-07
Sample 1997:01 2009:12 obs. 156		
Equation PENS = $\alpha_1 + \beta_1$ PAYG + β_2 INS + β_3 i		
R^2 0.4695		Adj. R^2 0.4589
Equation PAYG = $\alpha_2 + \beta_4$ PENS + β_5 INS + β_6 i		
R^2 0.7925		Adj. R^2 0.7884
Equation INS = $\alpha_3 + \beta_7$ PAYG + β_8 PENS + β_9 i		
R^2 0.7237		Adj. R^2 0.7183
Equation i = $\alpha_4 + \beta_{10}$ PAYG + β_{11} PENS + β_{12} INS		
R^2 0.2238		Adj. R^2 0.2084

The residuals from this system of Equations are then the new variables ($\mu_{pens_{it}}$ =RPENS, $\mu_{payg_{it}}$ =RPAYG, $\mu_{ins_{it}}$ =RINS and $\mu_{i_{it}}$ =R*i*, henceforth).

4.2.2. The Cointegration analysis

The second step of the empirical analysis is related to the concept of cointegration. It is developed from the belief that certain economic variables should not diverge from each other by too far a distance or diverge without bound. Such variables may drift apart in the short-run but if they continue to be too far apart in the long-run, then economic forces will bring them together again (Granger 1986). As such, an error correction model can be established to capture the short-run equilibrium. Hence, cointegration techniques seem to be ideally matched with the many economic theories that are contained in long-run equilibrium terms (McKenzie 1997).

In light of this, the autoregressive distributed lag (ARDL) approach to cointegration (Pesaran, Shin, and Smith 2001) will be used as it has good small sample properties in comparison with these techniques, as well as circumventing the problem of the order of integration of the individual variables.

The main advantage of the ARDL approach is that it can be applied regardless of whether the regressors are *I(0)* or *I(1)*, and this avoids pre-testing problems associated with the standard cointegration analysis such as Full Information Maximum Likelihood (FIML) which requires the classification of the variables into *I(1)* and *I(0)*.

The ARDL approach to cointegration involves estimating the following model:

$$SAV_t = \alpha_0 + \alpha_1 \sum_{i=1}^{n-1} SAV_{t-i} + \alpha_2 \sum_{i=1}^{n-1} Z_{t-i} + u_t \qquad (2)$$

where n is the sample size, SAV_t is the log of national savings and Z_t is a vector of exogenous variables described in Section 4.1.

It may be of interest to test the stability of regression coefficients in Equation (2) because a change in parameters between two periods can be seen as an indicator of structural changes. We run a basic regression of Equation (2) in order to investigate the stability of the coefficients and, consequently, to set also the right number of dummies. We use the recursive residual test to identify a likely break in Equation (2) and then test for its statistical significance using a Chow test. In Figure 1 the plot of the recursive residuals about the zero line ± two standard errors are shown at each point. Since residuals outside the standard error bands suggest instability in the parameters of the Equation, we need to construct several binary variables.

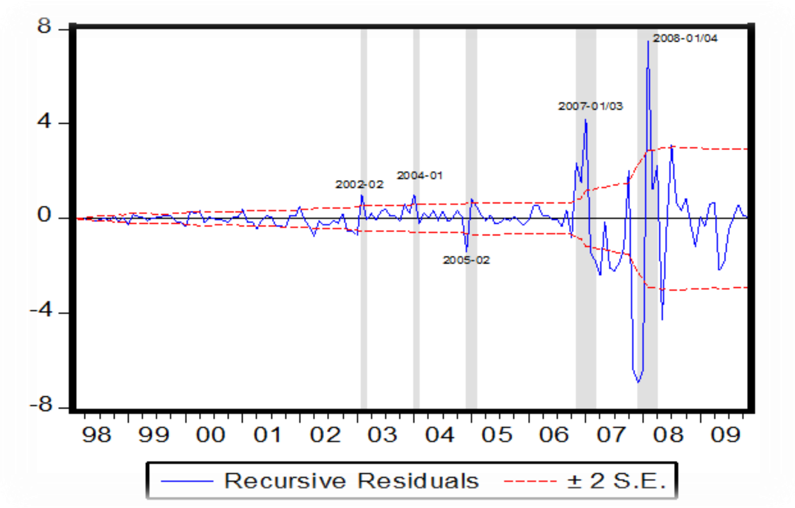


Figure 1. Recursive residual test for Iceland

Moreover, we also checked the Chow test for structural breakpoints in the sample of Equation (2). Table 2 shows the results of this test.

Finally, based on the results obtained from the above two tests, the following dummies were generated[12]: 2004:01-02 (dummy1), 2004:12-02 (dummy2), 2006:11-03 (dummy3) and 2007:12-04 (dummy4).

Table 2. Stability test results

Chow tests results* of Equation (2): $SAV_t = \alpha_0 + \alpha_1 RPENS_{t-1} + \alpha_2 RPAYG_{t-1} + \alpha_3 RINS_{t-1} + \alpha_4 GRW_t + \alpha_5 SAV_{t-1} + \varepsilon_t$	
2002:02-03	1.49312 (no break)
	(0.174)
2004:01-02	3.6028
	(0.0013)
2004:12-02	9.84656
	(0.000)
2006:11-03	19.2155
	(0.000)
2007:12-04	200.252
	(0.000)

* F-statistics with levels of significance in parentheses. Null Hypothesis: No breaks at specified breakpoints

4.2.3. Testing for cointegration

For investigating the presence of a long-run relationship between the variables we will use two separate statistics. The first involves an F-test on the joint null hypothesis that the coefficients on the level variables are jointly equal to zero (*see* Pesaran, Shin, and Smith 1999, 2001). The second is a t-test on the lagged level dependent variable. The statistics have a non-standard distribution and depend on whether the variables are individually *I(0)* or *I*(1).

To implement the "*bound testing procedure*" it is essential to model eq. (2) as a conditional autoregressive distributed lad model (ARDL). Basically, the lagged level terms are added to an error correction form of the underlying ARDL model and the F-statistic is computed[13]. Instead of the conventional critical values, this test involves two asymptotic critical value bounds, depending on whether the variables are *I*(0) or *I*(1) or a mixture of both.

[12] These dummies are defined as one in the specified period and zero elsewhere.

[13] Pesaran, Shin and Smith (2001) tabulate two sets of asymptotic critical values to provide *critical value bounds* for all classifications of the regressors into pure *I(1)*, purely *I(0)* or mutually cointegrated.

Pesaran, Shin and Smith (2001) provide critical values for this bounds test from an extensive set of stochastic simulations under differing assumptions regarding the appropriate inclusion of deterministic variables in the error-correction model (ECM)[14]. The investigation involves testing the existence of a long-run relation among national savings, private pension funds, and public pension provision and life insurance funds.

The model in Equation (2) is more appropriately regarded as representing the equilibrium relationship in the long-run, but is unlikely to hold exactly in every single period. Hence a dynamic specification is required in order to allow the model to capture the short-run adjustment process without losing important information about the long-run equilibrium behaviour of the variables. This study uses an ECM with unrestricted intercept and no trend[15]. The empirical relationship of the error-correction model has the following general dynamic representation:

$$\Delta SAV_t = \alpha_0 + \alpha_1 T + \alpha_2 ecm_{t-1} + \sum_{i=1}^{p} \beta_{1,i} \Delta Z_{t-i} + \sum_{i=1}^{p} \beta_{2,i} \Delta SAV_{t-i} + \sum_{i=1}^{p} \gamma_{1,i} Z_{t-i} + \sum_{i=1}^{p} \gamma_{2,i} SAV_{t-i} + \sum_{j=1}^{7} \gamma_{3,j} D_j + \boldsymbol{\varepsilon}_t \quad (3)$$

where α_0 is the drift component, T is the deterministic trend, ΔSAV_t is the variation of national savings, Z_t is a vector of pension variables (private pension funds, pay-as-you-go, life insurance funds), ecm_{t-1} is the equilibrium correction term (μ_t) given in Equation (2), D_j are dummies (dummy1 to dummy4) as described in Section 4.2.2, with γ's as the long-run multipliers, β's as short-run dynamic coefficients, (p) as the order of the underlying ARDL-model (p), and ε_t are white noise errors. This dynamic model shows that the movement of the variables in any period is related to the previous period's gap from long-run equilibrium. In other words, from Equation (3) whenever ΔSAV_t turns out to differ from Z_{t-1}, some sort of adjustment must occur to restore the equilibrium in the subsequent period.

Following Pesaran, Shin and Smith (2001) we try to determine the proper lag length p in Equation (3) with and without a deterministic linear trend. Table 3, presents these results using the Akaike's, Schwarz's Bayesian Information Criteria (AIC and SBC) and the Lagrange Multiplier (LM) statistics for testing the hypothesis of residual correlation of order 1 and 4. The results of the AIC and SBC suggest the use of four lags or more, while $\chi^2_{SC}(1)$ and $\chi^2_{SC}(4)$ recommend the use of a lag order of four. Since it is of a particular importance for the validity of the bound test the assumption of serially uncorrelated errors, for the sake of parsimony, we use the lag selection criterion with p=4.

Table 3. Lag-length selection criteria

	With deterministic trend				Without deterministic trend			
Lags	AIC	SBC	$\chi^2_{SC}(1)$	$\chi^2_{SC}(4)$	AIC	SBC	$\chi^2_{SC}(1)$	$\chi^2_{SC}(4)$
p=1	130.0160	117.8423	59.70	70.69	130.0170	119.3650	62.61	75.27
p=2	232.5858	221.9565	5.288	16.44	232.8846	223.7738	6.433	34.64
p=3	237.5847	222.4325	0.004	14.20	237.0085	223.3715	0.360	33.22
p=4	243.3617	222.1945	4.195♦	9.582♦	235.0044	221.3969	3.413♦	11.48♦
p=5	255.8904	225.7176	0.319	14.77	249.6885	224.0416	2.317	15.82
p=6	259.3507	227.7391	2.236	7.326	248.3567	224.2717	6.814	10.61

Notes: the lag order is selected on the basis of AIC and SBC and ♦ indicates the lag length choice according to the two criteria respectively.

Based on the previous discussion, we test for the absence of a long-run relationship between the national savings and the pension funds variables employing an F-test for the joint null hypothesis $\gamma_{1,i} = \gamma_{2,i} = 0$, under the alternative hypotheses that there is a stable long-run level relationship between the aforementioned variables.

[14] If the calculated test statistic (which is a standard F test for testing the null hypothesis that the coefficients on the lagged levels terms are jointly equal to zero) lies above the upper bound, the result is conclusive and implies that a long-run relationship does exist between the variables. If the test statistic lies within the bounds, no conclusion can be drawn without knowledge of the time series properties of the variables. In this case, standard methods of testing would have to be applied. If the test statistic lies below the lower bound, no long-run relationship exists.

[15] Pesaran, Shin and Smith, 2001, p. 296.

The bounds test results for the complete sample period are presented in Table 4 where Equation (3) is estimated and then the F- statistics are computed.

Table 4. Bounds test

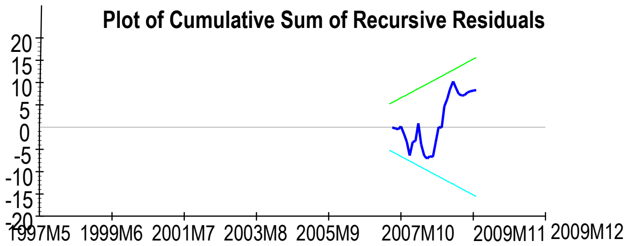
Unrestricted intercept and no trend			
	F-stat	Upper critical value	Upper critical value
K=4	F(3, 147)= 6.1213**	2.86	4.01

Notes: *the F*-statistic is used to test for the joint significance of the coefficients of the lagged levels in the ARDL-ECM. Asymptotic critical values are obtained from Table CI(iii) Case III: unrestricted intercept and no trend for k=1 and K=2 and from Table CI(iv) Case IV: unrestricted intercept and restricted trend for k=1 and K=2 (Pesaran, Shin and Smith, 2001, pp. 300-301).

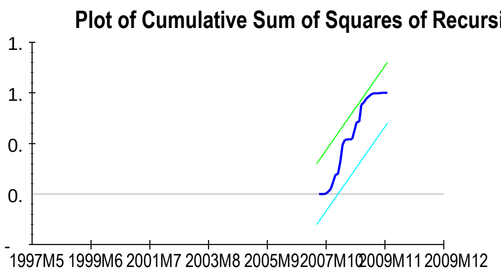
** indicates that the statistic lies above the 0.05 upper bound; * that it falls within the 0.10 bounds; • that it lies below the 0.10 lower bound.

Using the asymptotic critical value bounds computed by Pesaran, Shin and Smith (2001), the F-statistic lies above the 0.10 upper bound. Hence the null hypothesis of no long-run relationship is rejected. At this stage of the ARDL method, it is also possible to perform a parameter stability test for the appropriately selected ARDL representation of the model. The stability of coefficients are, by and large, tested by means of Hansen (1992), and Hansen and Johansen (1993). The Chow stability test requires *a priori* knowledge of structural breaks in the estimation period and its shortcomings are well documented.

In Hansen (2002) and Hansen and Johansen (1993) procedures, stability tests require I(1) variables and they check the long-run parameter constancy without incorporating the short-run dynamics of a model into the testing – as discussed in Bahmani-Oskooee and Chomsisengphet (2002). However, it is possible to overcome these shortcomings by employing the Brown *et al.* (1975)[16] procedure if we follow Pesaran and Pesaran (1997). These tests are usually implemented by means of graphical representation. It can be seen from figure 2 the plots of CUSUM and CUSUMSQ statistics are within the critical bounds implying that the coefficients in the model are stable.



The straight lines represent critical bounds at 5% significance level



The straight lines represent critical bounds at 5% significance level

Figure 2. CUSUM and CUSUMSQ plots for Stability Tests

[16] The Brown *et al.* stability testing technique, also known as cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests, is based on the recursive regression residuals. The CUSUM and CUSUMSQ statistics are updated recursively and plotted against the break points of the model. Providing that the plot of these statistics fall inside the critical bounds of 5% significance then we assume that the coefficients of a given regression are stable.

Once established that a long run cointegration exists, Equation (3) is estimated. A maximum lag order of one is allowed in the ARDL model using the Schwarz Bayesian Criteria since it presents the smaller residual sum of squared. The following ARDL (4,3,2,3) specification is used.

Table 5 reports the results of the ARDL where the regressions fit reasonably well and pass the main diagnostic tests. All levels estimates are highly significant and have also the expected signs. The results suggest that there is a strong evidence between what the theory predict (about the relationship between savings and pension funds) and the estimated variables. The constant term is positive and highly significant at 0.01 level.

The estimated retirement savings variables (RPENS, RPAYG and RINS) show the coefficients with correct signs and are statistically significance at 0.01 and 0.05. The variable DR is with the right signs and statistically significant at 0.01 level.

Table 5. ARDL (4,3,2,3) Equation (3)

Section 1, Short-run coefficient estimates				
Lag order	**1**	**2**	**3**	**4**
ΔSAV		0.6874** (8.971)	0.3213** (3.466)	-0.1703* (-1.972)
ΔRINS			7.9250** (4.0295)	
ΔRPENS		0.25532♦ (1.6884)		
ΔRPAYG			9.9141** (4.0232)	
ecm	-0.028164♦ (-1.8313)			

Section 2, Long-run coefficient estimates					
C	**RINS**	**RPAYG**	**RPENS**	**DR**	
1.679842** (3.156399)	0.62959* (2.352)	-0.93436* (-2.3852)	0.09025* (1.689)	-0.128499** (-4.0493)	
Dummy4					-0.04248* (-2.2338)

Section 3 Diagnostics

Adjusted R-squared: 0.84591; Durbin-Watson stat: 1.8272;

Serial Correlation $\chi^2_{SC}(2) = 1.412[0.235]$;

Functional Form $\chi^2_{FF}(1) = 0.52528[0.469]$;

Normality $\chi^2_{N}(2) = 6.847[0.6321]$;

Heteroscedasticity $\chi^2_{H}(1) = 0.33334[0.564]$.

♦significant at the 0.10 level; *significant at the 0.05 level; **significant at the 0.01 level ; *Obs. 152 (* monthly)

The results of Equation(3) for the short run estimations show the complex dynamics that seem to exist between changes in saving and changes in the pension funds. The coefficients are all significant. Among them, ΔRPENS is the only one statistically significant at 0.10 level.

The equilibrium correction coefficient (*ecm*), estimated (*-0.028*) is statistically significant at 0.10 per cent and has the correct sign, implying that a deviation from the long-run equilibrium, following a short run shock, is corrected by about 2.8 per cent after one month. Finally, Table 5 (Section 2) shows the results of the dummy4 used[17]. It is statistically significant at 0.01 level and the coefficients' value is -0.0242.

Overall, our results are consistent with the ones by Granville and Mallick (2004) that found evidence suggesting that increases in mandatory pension funds financial assets increase national saving.

As regards the relation between dependency ratio and changes in national saving, it should be noted that population ageing will itself generate changes in saving which may have a major macroeconomic impact. According to the life cycle theory, savings rates tend to decline in countries where there are larger numbers of

[17] We made estimations including all the dummies selected in 4.2.2. and dropped those not significant.

retired people (Disney 2000). The changes in savings lead to changes in demand for financial assets. Econometric studies find a strong effect of aging population on private saving as in Masson *et al*. (1998) who found the total dependency ratio to have a significant negative effect on private saving in a panel of both advanced and developing countries.

4.2.4 The Kalman filter

In this final section we estimate, using a Kalman filter approach, a 'backward-looking' process for national savings with parameters varying with fundamental component of the private pension plans. The choice of this methodology is stringently related to the economic evolution of Iceland within the past twelve years. As stressed in Section 3.1, Iceland has faced at least with three main different economic periods (1997-2004, 2004-2006, and 2006-2009). Therefore, it is important to analyse the timing path of each single coefficient of the explanatory variables. The Kalman filter is a recursive procedure of computing the optimal estimator of the state vector at time *t*, based on the information available at time *t*. One of the reasons for the central role of the Kalman filter is that "[...] when the disturbances and the initial state vector are normally distributed, it enables the likelihood function to be calculated via what is known as the prediction error decomposition. This opens the way for estimation of any unknown parameters in the model"[18]. The time varying methodology allows us to recover an unobservable factor that could affect national savings. For each endogenous variables of the model it is therefore possible to observe how the respective coefficients have changed over time.

Assuming that saving, SAV_t, is driven by a AR(n) process, we apply the following time varying parameters model:

$$SAV_t = \beta_{0,t} + \beta_{1,t} RPENS_{t-n} + \beta_{2,t} RPAYG_{t-n} + \beta_{3,t} RINS_{t-n} + \mu_t \tag{5}$$

where μ_t is an independent white noise, the coefficients are assumed to be random walks. This can be written in state space form where the observation Equation is given by (5) above and the state Equations are given by:

$$\begin{bmatrix} \beta_{0,t} \\ \beta_{1,t} \\ \beta_{2,t} \\ \beta_{3,t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \beta_{0,t-1},\dots\beta_{0,t-n} \\ \beta_{1,t-1},\dots\beta_{1,t-n} \\ \beta_{2,t-1},\dots\beta_{2,t-n} \\ \beta_{3,t-1},\dots\beta_{3,t-n} \end{bmatrix} + \begin{bmatrix} \mu_t \\ \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \end{bmatrix} \tag{6}$$

Where Equation (6) is the measurement Equation with S_t and ε_t are *[nx1]* vectors[19]. The relevant results and estimates are reported in Figure 3 and Table 6.

The pattern of the coefficients "*β*" seems to capture well the economic dynamic of the period. The most important result is that the model "works" as shown in figure3 in which the behaviour of the pension funds for Iceland vary over time. In particular, the coefficients β_1 (RPENS) illustrates a shift upward soon after the launch of the reforms in 1998. Later on, this coefficient shows a negative trend till the middle of 2004 and it increases sharply until the beginning of 2006. Afterwards, following the Icelandic and international financial crisis, β_1 strongly declines.

Table 6. The Kalman estimations

	$\beta_{1,t}$	$\beta_{2,t}$	$\beta_{3,t}$	$\sigma^2_{\mu,t}$
AIC=13.41	0.4602**	- 0.7565**	0.0686*	-0.485**
Schwarz=12.42	(93.932)	(-230.68)	(148.212)	(-217.92)
Obs. 155 (M)	[0.000]	[0.000]	[0.000]	[0.000]

*significant at the 0.05 level; **significant at the 0.01 level ; z-statistics in brackets; p-value in squared brackets; (M)=monthly

[18] Harvey (1989, p. 10).

[19] For a more complete explanation of the Kalman filter approach, the state space form and the measurement and transition equations, see Harvey (1989).

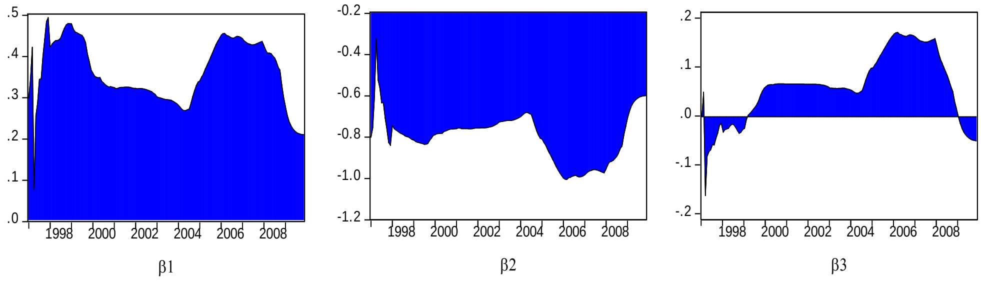


Figure 3. Time varying coefficients for Iceland

As for β_1, the coefficient β_3 (RINS) shows a similar trends for the same periods. It rises sharply reaching the peak at the beginning of 1999 and it remained stable till the end of 2003. Afterwards, it continues to rise till 2006 when it starts to decline dramatically inverting the sign in 2009. A possible explanation of this positive trend (1998-2006) of the value of β_3 could be related to tax incentive legislation adopted in 1998 as part of the general social security reform.

Finally the coefficient β_2 (RPAYG) shows a quite stable trend from 1998 till 2004 in which it sharply decline reaching its minimum value of -1.03 and inverting its path soon after.

It is worth noting that β_2 path is specular to the paths of β_1 and β_3. This could be due to the opposite impact on national saving of an unfunded and a funded pension benefits as asserted by the economic theory (Feldstein 1974, 1996, and Samwick 2000).

5. Policy Implications and Conclusion

According to Munnell (1982) a perfect world should be characterized by perfect capital and labour markets, no uncertainty, no taxes and, in this framework, pension saving should be a perfect substitute for other kinds of savings. Unfortunately we live in a not perfect world in which there are imperfect markets, taxation, uncertainties and several different opportunities for savings. Because of that, the complete substitution of pension saving for other forms of savings may not occur. Hence, should be reasonable to expect that countries which have funded occupational pension scheme would have higher national savings rate than countries which do not.

In this work we have tried to examine the pension systems of Iceland in a more general perspective with the purpose to analyse how its retirement income provisions have evolved into a multi-pillar arrangement and its impact on national saving. Moreover, we would like to ask – without completely answering the question – if there are important lessons for others in Iceland's pension experience.

Icelandic occupational fully funded pension plans have become just as important as the public pay-as-you-go system, while the latter is the dominant pillar in many other OECD countries. It is also worth noting the differences in aging population structure and in social security history of this country as describe in section 3.2.

The novelty aspects of our results can be summarized as follow.

Firstly, in this work a combinations of different econometric methodologies have been implemented. The innovative use of these methodologies allowed us to overcome the critics about the ambiguous impact of social security variables on national saving and to get time varying coefficients in order to show the reaction of national saving to the implementation of private second pension pillar.

Secondly, we have found substantial evidence that a mandatory pension fund has a positive impact on national saving in Iceland. Moreover the results showed that unfunded pension pillar had a negative influence on national saving as predicted by the theory. These findings are consistent with the current empirical literature. Moreover, using the Kalman filter methodology we were able to show that, the pattern of the coefficients of private pension, pay-as-you-go and life insurance, capture the economic dynamic of the period.

Nevertheless, the following two elements can be considered as the main policy implications for others.

As discussed in section one, the results exhibit that the social security reform that takes the form of three-pillar system is, in particular, beneficial for small open economies. In fact, in small open economy, the effects on financial market development are much clearer due to the contribute of inflow of capital on pension funds. This effect can be different in magnitude depending on the degree of openness and the financial integration of the economy. For instance, in Iceland the percentage of foreign assets of pension funds moved from 2 percent in 1990 to 16 percent in 2002. As it is confirmed by our empirical analysis, the change of magnitude of these assets has a significant effect on national saving.

In addition, our empirical findings showed that a mandatory retirement saving policy could have improved the financial sustainability of social security systems and, through the positive impact on national saving, could be seen as an additional engine of economic growth.

Noticeably, general principles will always have to be applied with a great degree of attention to the specific economic situation in each country. In fact the implementation of the funded pension system started in a period characterized by a demographic crisis and high returns of financial assets. This made necessary to move, completely or partially, to a reformed pension system.

However we have found that, despite the strong impact of the 2007 financial crisis on the Icelandic economy, the reformed system seems to remain valid as well as the cointegration relationship with the national savings. Nevertheless we do not know how the pension system will evolve in the future. That is why, in light of the current financial crisis, it should be interesting to investigate the reaction of the new designed pension systems to changes into the economic environment. In other words, what will be the future of the second funded pension pillar in a more risky and volatile financial markets?

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