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Determinants of the Household Savings Rate in Sweden

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Abstract: The Swedish household savings rate remains on elevated levels despite record high house prices, a buoyant Swedish economy, and aggressive monetary policy by the Swedish Riksbank. Utilizing cointegration techniques, this paper examines the long- and short-run determinants of the Swedish household savings rate during the period Q1:1980-Q3:2016. We also test for a potential structural break in the effect of house prices, and find substantial support for the hypothesis that housing bubble concerns have raised the household savings rate post the financial crisis of 2008.

Our results indicate that the main determinants of the Swedish household savings rate are disposable income per capita growth, household interest payments, collective pension savings, house prices, the public sector budget balance, GDP growth, debt growth, and capital gains' share of disposable income. The results support the Precautionary Saving Hypothesis, the Permanent Income Hypothesis, and Ricardian Equivalence. We do however not find support for the Life-Cycle Hypothesis.

Keywords: Household savings rate, Uncertainty aversion, Cointegration, Structural break

JEL: C220, C320, E210, E270

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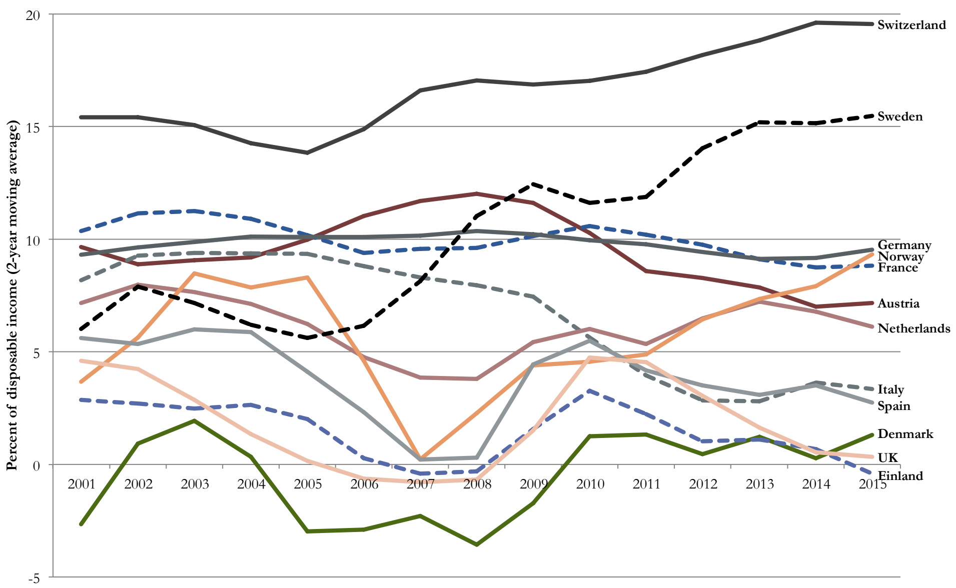
1. Introduction

Sweden is one of few countries where the household savings rate has increased substantially since the financial crisis in 2008 (see Figure 1). Despite record net wealth relative to income, negative central bank policy rates, and a buoyant economy, the Swedish household savings rate is at 35-year highs (see Appendix A). The Swedish Riksbank's monetary policy has since the beginning of 2015 consisted of a negative repo rate and quantitative easing. Since a higher savings rate entails lower consumption levels, the increasing savings rate directly counteracts the inflation raising efforts of the Swedish Riksbank, and stands in contrast to previous Riksbank saving forecasts (The Riksbank, 2014). We suspect that this partial policy failure to some extent originates from a too static view on the relationship between asset prices and household behaviour. Real house prices have increased by around 40 per cent between 2012 and 2016 (see Figure 2), and aggressive monetary policy is suspected to have further fuelled the booming market (Dermani et al., 2016). The rapid house price increases have resulted in widespread fear of a housing bubble (Nordea, 2016), fear that we believe could be responsible for the elevated household savings rate. Our intention is therefore to examine the long- and short-run determinants of the Swedish household savings rate, and look for potential structural breaks in the relationship, with a particular focus on house prices.

Figure 1. *Household savings rate by country*

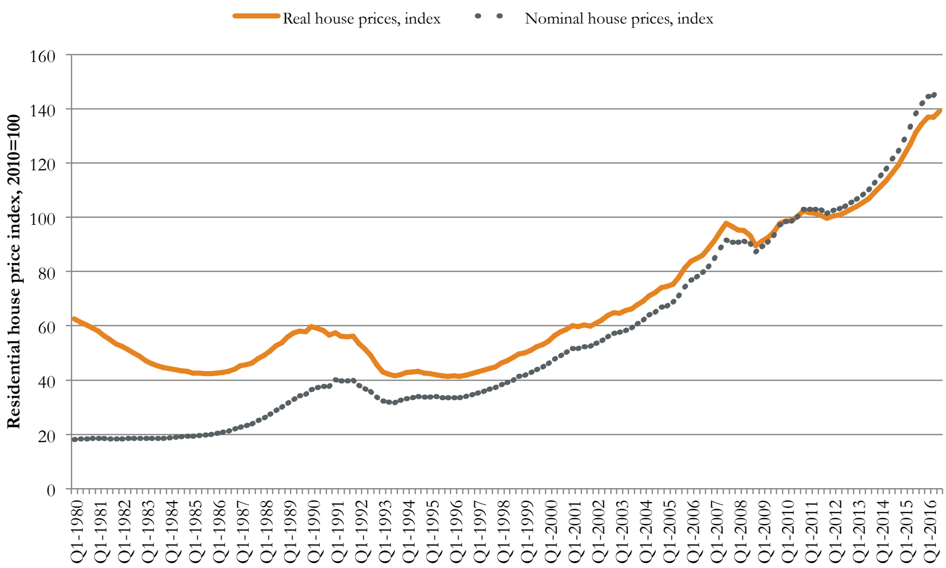


Source: OECD (2017a)

We suspect that there has been a shift in the relationship between the Swedish household savings rate and house prices around the financial crisis of 2008. In 2008 the world witnessed the dire effects of a credit-driven housing boom in the developed world. Swedes saw the economies of

Southern Europe, the US, and its close neighbour Denmark, collapse under the weight of too much debt and artificially high house prices. In Sweden, house prices plateaued, but then resumed their upward trend. It seems natural that Swedes should be more cautious towards rising house prices post the crisis, and perhaps not experience the wealth effect that higher net wealth generally is considered to be accompanied by. Having suffered a housing crisis of their own in the beginning of the 1990s, Swedes carry a collective memory that should make them more prone to housing bubble fears.

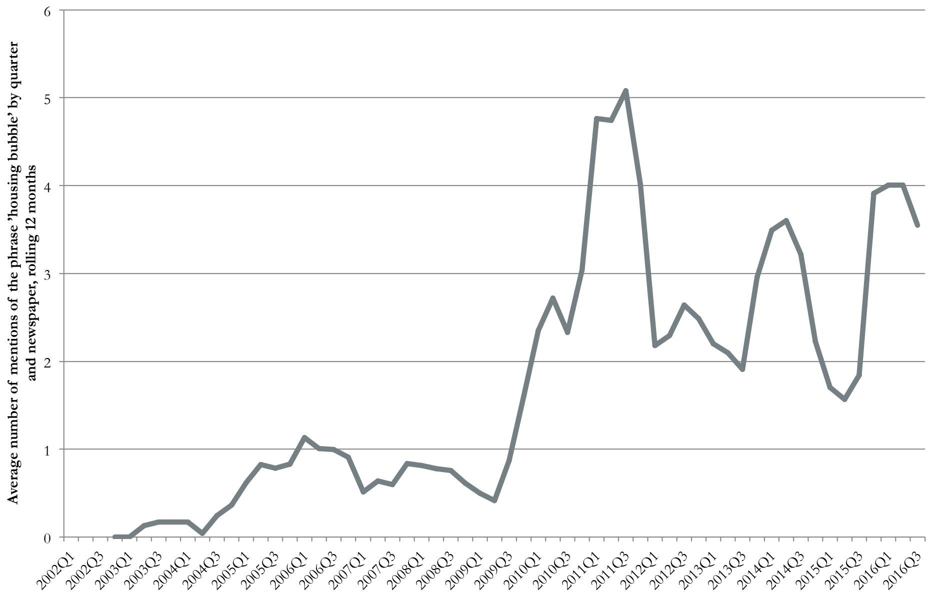
Figure 2. *Development of residential house prices in Sweden*



Source: OECD (2017b)

Although we expect the primary shift to have taken place around the financial crisis of 2008-2009, concerns regarding rising housing prices might have surfaced gradually from the early 2000s up until the financial crisis. In 2000-2001, real house prices in Sweden surpassed their pre-crisis levels from the early 1990s (see Figure 2). In connection to the surpassing of previous highs, the IT-bubble burst. Sweden had by then experienced both a housing and a stock market crash within a decade. The phrase '*housing bubble*' (*bostadsbubbla*) starts appearing in Swedish newspapers by 2003, with frequency of mention rapidly rising in 2005-2006 (see Figure 3). The number of mentions increased substantially when house prices started rising again after the financial crisis, and has remained on elevated levels since. In October of 2016, the Swedish bank Nordea reported that 61 per cent of Swedes believe the country is experiencing a housing bubble (Nordea, 2016). This indicates that a large part of the Swedish population could see the record high house prices as a reason for creating a savings buffer, rather than a reason to increase consumption.

Figure 3. *Number of mentions of the phrase 'housing bubble' in major Swedish newspapers*



Source: Our analysis index constructed through word-search of the newspapers Svenska Dagbladet, Dagens Nyheter and Dagens Industri

Household savings have attracted increasing interest during recent decades, both in academia and within public policy. Several studies have examined the relationship between household savings and its potential determinants. Studies have been conducted in both a cross-country context (Deaton, 1990; Hebbel et al., 1994; Paxson, 1996; Deaton and Paxson 2000; Loayza and Shankar, 2000a; Serres and Pelgrin, 2003) and with focus on specific countries (Ostry and Levy, 1995; Athukorala and Tsai, 2003; Ozcan et al., 2003; Athukorala and Sen, 2004; Kwack and Lee, 2005; Ahmad, 2015). Various drivers have been investigated, such as the effect of an ageing population (Kraay, 2000; Modigliani and Cao, 2004; Li et al., 2007; Hui, 2015), the relationship between the savings rate, income level and growth of income (Deaton, 1992; De Gregorio, 1992; Carroll et al., 2000; Paxson, 2000; Agrawal 2001;), the relationship between private and public savings (Edwards, 1996; Masson, et al., 1998), the effect of capital market globalization and release of liquidity constraints on private savings (Agénor and Aizenman, 2004; Prasad et al., 2005; Chowdhury, 2015), and consequences of recessions (Mody et. al., 2012; and Noy, 2015; Adema and Pozzi, 2015). However, the existing academic literature on the private savings rate in Sweden is scarce, and most studies that have analysed the Swedish context have done so within a cross-country framework (Disney, 2006; Hondroyiannis, 2006; Adema and Pozzi, 2015). Focusing on one country allows for a more in-depth analysis of country specific determinants, and allows us to better test for potential structural breaks.

The few studies that examine the Swedish household savings rate within a single-country framework (Bentzel and Berg, 1983; Berg, 1986), as well as many international studies, use simple regression models and Vector Autoregressive models on annual data. However, data is often found to be non-stationary, implying that standard statistical methods could result in spurious regression (Granger and Newbold, 1974). The results from studies based on standard models and techniques might therefore be misleading. It is consequently important to re-examine previous findings, considering the nature of the underlying data processes.

Since few studies, and to the best of our knowledge, no Sweden-specific studies, have handled the non-stationary nature of the time series in a presumably correct way, the utilization of cointegration techniques is one of the primary contributions of this thesis. We make use of the Autoregressive Distributed Lag (ARDL) model approach to cointegration on quarterly data covering the period 1980-2016. The higher frequency of the data is advantageous as it yields a reasonably large sample despite the relatively short study period. Structural break analysis will be performed to test whether relationships within the model have been stable over time. The purpose of this thesis is consequently to empirically determine the long- and short-run determinants of the household savings rate in Sweden, taking the non-stationarity nature of the data into account, and to test the hypothesis that housing bubble fears have caused Swedish households to raise their savings rate in response to higher house prices.

The rest of this paper is organized as follows: In Section 2 we present findings from previous theoretical and empirical literature. Section 3 outlines the empirical framework within which the research questions are studied. The dataset used is described in Section 4, and the econometric framework in Section 5. The empirical results are presented in Section 6 and further discussed in Section 7, where we also invite to further related research. Concluding remarks are outlined in Section 8.

2. Literature Review

Our literature review is divided into a theoretical and empirical segment. The theoretical segment describes the primary theories related to savings behaviour, without commenting on the empirical evidence for set theories. The empirical segment presents the variables that previous literature has identified as important drivers of the savings rate.

2.1 Theoretical Literature

Determinants of household consumption, and thus also savings, have been a widely discussed topic within economic theory for several decades. Keynes (1936) suggested that current disposable income is the main determinant of household consumption and savings decisions. In particular, he argued that consumers save a proportion of their additional income. Keynes' model implies that the average savings rate would increase as incomes increase. However, empirical studies of long-run saving behaviour (Kuznets 1946, and David and Scadding, 1974) indicated that increases in GDP per capita did not lead to a higher savings rate. Several new theories were developed in order to explain this empirical evidence, some that are still widely used today, notably the Precautionary Saving Hypothesis, the Life-Cycle Hypothesis, the Permanent Income Hypothesis, and its subcategory Ricardian Equivalence. Other important theories concern the effects of the real rate of return and inflation.

2.1.1 The Permanent Income Hypothesis

The Permanent Income Hypothesis (PIH) was first developed by Milton Friedman (1957), as a proposed solution to the discrepancy between Keynes (1936) and empirical evidence discussed above. The idea behind the theory is that households base their consumption decisions on what they expect to earn over a lifetime, and aim at smoothing consumption over time. According to this theory, current income can be divided into two components; permanent and transitory, where permanent income is defined as expected long-term income.

2.1.2 Ricardian Equivalence

The Ricardian Equivalence proposition is a subcategory of the PIH. The proposition states that government deficit spending (saving) will be offset by increased household savings (consumption). According to the theory, households will not consider income generated by government deficit spending permanent, and therefore expect to pay more in taxes in the future (and vice versa for government saving) (Barro, 1974). To some extent this assumes intergenerational altruism, meaning that even if individuals expect some of the deficit spending to be carried by future generations, they compensate through increased bequest saving.

2.1.3 The Life-Cycle Hypothesis of saving

Similar to the PIH, the Life-Cycle Hypothesis (LCH) of savings assumes that individuals make consumption and saving decisions based on their expected lifetime resources, rather than current income. The theory states that the main motive behind saving is to accumulate reserves in order to consume after retirement. Modigliani (1966) proposed that individuals save during working life, accumulate assets, with increasing propensity to save as the agent approaches retirement, and then dis-save after retirement. The relationship between consumption, income, and income expectations, was before that studied by Fisher (1930) and Harrod (1948).

The model, as proposed by Modigliani and Brumberg (1954), starts from the economic agent's utility function. Utility is assumed to be a function of his own aggregate consumption in current and future periods. The agent is then assumed to maximize his utility, subject to his lifetime available resources. In its simplest form the model assumes a homogeneous utility function at different points in time, perfect capital markets, perfect foresight of the agents, and that no bequests are received or left.

A sub-theory within the Life-Cycle model is the Bentzel mechanism, first proposed by Swedish economist Ragnar Bentzel (1959), and popularized by Modigliani (1975). According to the Bentzel mechanism, rising incomes and working age population growth will both raise the savings rate. This is because the working age population has a higher savings rate than the retired population. A working age population increase will increase the relative share of the high-saving population, and income growth primarily benefits the working age population, thereby increasing the saveable income for the high-saving population.

2.1.4 Wealth effect

The wealth effect theory is related to both the PIH and LCH. A wealth effect is an increase in consumption that takes place due to a rising ratio of assets relative to disposable income (Darby, 1987). Higher assets relative to disposable income reduce the savings needed for retirement (LCH), if considered permanent (PIH). Increases in net assets relative to disposable income primarily occur due to increased savings and rising asset prices.

2.1.5 The Precautionary Saving Hypothesis

The Precautionary Saving Hypothesis (PSH) states that uncertainty about future income will reduce current consumption and thus increase savings. As in the LCH, individuals strive to smooth consumption, but because of lack of information about future income, savings are adjusted in order to account for uncertainty.

Leland (1968) makes use of a two-period model to demonstrate the effect of uncertainty on savings and consumption. Income in the first period, as well as a subjective probability distribution of income in the second period, are assumed to be known. Consumers decide on how much to consume (and thus save) in the first period without knowing exact consumption and income in the next period. With this framework, Leland (1968) shows that savings increase with higher uncertainty, given the assumption that individuals are risk averse; they prefer to increase savings in earlier stages of life rather than having reduced consumption later on.

2.1.6 Inflation

Theoretically, inflation can affect savings in several manners, all of which point to a positive relationship. Inflation increases uncertainty about the future value of income and financial assets, which increases the savings rate in line with the PSH (Sandmo, 1970). Households could also raise their savings to preserve the real value of imperfectly inflation-hedged financial assets. If consumers mistake increases in the general price level for an increase in relative price, they could refrain from buying and increase their savings (Deaton, 1977).

2.1.7 Income, substitution and revaluation effect of the real interest rate

The net result of changes in the real interest rate is by nature ambiguous. The determining theories are generally considered to be the income, substitution, and revaluation effect (Elmendorf, 1996). The intertemporal substitution effect indicates that a higher interest rate today should induce more saving in order to consume more in the future. The intertemporal substitution effect indicates a positive relationship between saving and the real interest rate. The direction of the so-called income effect depends on if the household is a net lender or a net borrower. For a net lender the income effect is negative, since a higher interest rate reduces the savings needed for future consumption (Böhm and Haller, 1987). This can be connected to pension target saving. For net lenders, the net effect of fluctuations in the real interest rate is therefore ambiguous. A higher real interest rate also results in lower human wealth, since it lowers the discounted value of current and future after-tax income. Through this revaluation effect, higher interest rates reduce current consumption in order to maintain the real value of human wealth. The overall effect of real interest rates, adjusting for all three theories, is generally considered positive.

2.2 Empirical literature

The literature reveals several variables that have been found to affect the household savings rate. There are however few consistent results, especially since many studies focus on the broader private savings measure, which includes corporate savings. Conclusion from this literature can to a certain degree be applied to studies on household savings, but direct comparisons should be conducted cautiously. Based on the literature review, the real interest rate, inflation, GDP per capita, income growth, financial development, and volatility, tend to have significantly positive effects on the savings rate. The economic significance of the real interest rate does however tend to be relatively small. Traditional negative relationships are the government budget balance, dependency ratios, and net wealth to income.

In line with the PIH, Flavin (1981) concluded that consumption should change by the same amount that permanent income changes. Reversely, only transitory increases in income will increase the savings rate. Flavin (1981), and Kotlikoff and Pakes (1984), found that US consumers react stronger to income changes than predicted by the PIH. Dawson et al. (2001) find support for the PIH in advanced countries, but not in developing countries.

Bérubé and Côté (2000) study the long-term determinants of the personal savings rate in Canada. They test their theories both using the official savings rate and a self-created measure reflecting the change in personal net wealth. Their results suggest that the most important determinants of the personal savings rate over the period 1965-1996 were the real interest rate, expected inflation, government fiscal balance in relation to GDP, and the ratio of household net worth relative to personal disposable income. The real interest rate coefficient was generally positive during the period, indicating that lower rates lead to lower levels of saving. The inflation rate was positively correlated with savings, and as expected net worth relative to disposable income was negatively correlated with savings. Findings regarding the government budget balance were in support of the Ricardian Equivalence theorem.

Existing evidence for industrial countries suggests that each dollar increase in the government deficit is associated with an increase in private saving of about 0.5 to 0.6 dollars (Bernheim 1987; Masson, et al. 1998). This is in accordance with the Ricardian Equivalence theorem, stating that an unfunded government spending will be offset by increases in household savings.

Several studies identify wealth as an important driver for the savings rate, supporting the existence of a wealth effect (Bovenberg and Evans, 1989; Bosworth et al., 1991; Bérubé and Côté, 2000). A study by Iacoviello (2012) suggests that a 10 per cent change in real assets changes consumption by around 1 per cent. The study also suggests a significantly higher propensity to spend housing wealth than non-housing related wealth. There are some Sweden specific studies within the subject. A Swedish Study by the National Institute for Economic Research (2012) points to a 2.4 per cent change in consumption per 10 per cent change in real assets. Johnsson and Kaplan (1999) predict a more modest consumption change of 0.5 per cent.

A Norwegian study by Erlandsen and Nymoen (2008) point to a 1.5-2.0 per cent consumption change. Overall, international studies indicate a marginal propensity to consume out of housing wealth in the 0.05-0.1 range (Brayton and Tinsley, 1996; Case et al., 2005; Campbell and Cocco, 2007). Several studies (Ludwig and Slok, 2002; Case et al., 2005; Dvornak and Kohler, 2007; Carroll et al., 2011) indicate that changes in house prices have a larger effect on consumers than other changes to wealth.

Uncertainty has been proxied in several ways throughout the literature, with evidence supporting the PSH in both developing and developed nations. Adema and Pozzi (2015) investigate the cyclicality of the household savings rate in 16 OECD countries over the period 1969-2012. The results suggest that the household savings ratio is countercyclical on average, and thus higher during periods of recessions. The observed counter cyclicality can be attributed to unemployment risk faced by households, household wealth, and credit availability. Ostry and Levy (1995) model the relative importance of factors affecting household savings in France over the period 1970-1993. They make use of quarterly data in order to empirically test the model and find that the increase in savings observed in the later part of the sample can be attributed to a less optimistic outlook on future earnings. Studying a group of industrial countries, Koskela and Viren (1982), find a positive relationship between savings and surprise inflation. They also identify a positive relationship with the real interest rate.

Armelius and Dillén (2011) find that a low savings rate relative to historical values raises the likelihood of a drop in house prices in the coming 1-3 years to 43 per cent, from 23 per cent in the unconditioned case. An unusually high savings rate does however not lower the risk of a drop in house prices substantially relative to the unconditioned case. The authors find slight support for an unusually high savings rate lowering the real economic consequence of a large drop in house prices.

GDP and income per capita levels are primarily found significant in studies on developing countries, a fact supported by cross-country studies including both developing and developed countries. Statistical significance of demographic variables is also more common in studies on developing countries, although evidence is mixed. Chamon and Prasad (2010) aim to explain postponement of consumption in an environment of rapid income growth in urban China. Their findings suggest that demographic changes have a limited explanatory power with regard to the evolution savings, and that there is very little consumption smoothing over the life cycle. Loayza and Shankar (2000a) make use of cross-country time-series macroeconomic data in order to investigate why saving rates differ so much across countries and time periods. They find that private savings rise with both the level and growth of real per capita income but that this effect is larger in developing than in developed countries. Their achieved dependency ratio coefficient supports the LCH. Furthermore, using inflation as a summary measure of macroeconomic volatility, they find evidence supporting the precautionary motive for savings. Loayza and Shankar (2000b) study the trend of private savings in India during 1960-1995 using an Error Correction model. Their results indicate that there is a positive relationship between private savings and income per capita, real interest rate and agriculture share of GDP, but a negative relationship between private savings rate and financial development, inflation growth and dependency ratios. The dependency ratio and fiscal deficits are found to only explain long-run changes.

Athukorala and Sen (2004) study determinants of the private savings rate in India. They find that the savings rate increases with both the level and growth rate of disposable income. Furthermore, the real interest rate on bank deposits, the spread of banking facilities in the economy, and the inflation rate are found to have a positive impact on the savings rate, whereas changes in external terms of trade have a negative impact. The results indicate that public savings crowd out private savings to a certain degree. Athukorala and Tsai (2003) achieve similar results in a study on Taiwanese data. Ozcan et al. (2003) investigate the relationship between private savings and several economic, demographic and policy related variables in Turkey between 1968 and 1994, using linear regression. They find that the inflation rate, income level and financial depth have a positive impact on private savings, while the effect of income growth is insignificant. The authors find limited support for the Ricardian Equivalence theory, but in line with the LCH they find a negative relationship between life expectancy and the savings rate. Ahmad (2015) is one of few studies that find a negative relationship between GDP per capita and the savings rate. The study utilizes cointegration techniques to study long- and short-run determinants of private savings in Pakistan over the period 1972 to 2012. The findings suggest that GDP per capita, the inflation rate, financial and fiscal development as well as the dependency ratio have an impact on the savings rate. GDP per capita and financial development have a negative impact on the private savings rate, both in the short and long run.

Kwack and Lee (2005) analyse determinants of the domestic real savings rate in Korea during the time period 1975 to 2002, extending the LCH by incorporating capital imperfections, and precaution and bequest motives for saving. Their results indicate that the growth rate of income, and variance of income growth, have positive effects on the private savings rate, whereas young and old dependency ratios have a negative effect. Based on this, they conclude that the age structure of the population has an impact on aggregate savings rate.

3. Empirical framework

The following section motivates the choice of variables included in the empirical analysis, based on economic theory, literature review, and our hypothesis. The main variables used are the household savings rate net of collective pension savings, growth in real disposable income per capita, GDP per capita, GDP growth, pension savings as a share of disposable income, the public sector budget balance, the real interest rate, interest payments as a share of disposable income, real residential house prices, house price growth volatility, debt growth, expected inflation, capital gains' share of disposable income, stock market development, the total dependency ratio, and the Economic Policy Uncertainty Index for Europe. The expected sign of the coefficients and their respective theory connections are summarized in Table 1.

Table 1. *Variables, expected sign and theory connections*

Variable	**Expected coefficient sign**	**Theory connections**
Real disposable income per capita growth (DispInc)	+(potentially - in short run)	Bentzel mechanism, Permanent Income Hypothesis (PIH)
Pension savings as a share of disposable income (Pension)	-	Life-Cycle Hypothesis (LCH)
Government budget balance (Bud.bal)	-	Ricardian Equivalence
GDP per capita (GDPcap)	+	PIH
GDP growth QoQ (GDPqoq)	-	Precautionary Saving Hypothesis (PSH)
Real Residential House Prices (ln(Housep))	- (period 1), + (period 2)	LCH, PIH, PSH
Real Interest Rate (Realint)	+	Income, substitution, and revaluation effect
Interest payments as share of disposable income (Int.share)	- (potentially + in short run)	PIH
Economic Policy Uncertainty Index Europe (uncEUR1y)	+	PSH

Capital gains share of disposable income (Capgains)	+	PIH
Stock market development QoQ (Stockqoq)	-	Wealth effect, PSH
House price growth volatility, trailing 12m (Housevol)	+	PSH
Expected inflation (Ex.pcpif)	+	PSH, PIH, LCH
Debt growth (Debtg)	-	Technical effect, LCH
Dependency ratio (Dep.Tot)	-	LCH

Real disposable income growth (*DispInc*): The Bentzel mechanism indicates a positive relationship between income growth and the household savings rate (Modigliani, 1975). We also wish to test if there are differences between short- and long-run propensities to consume. If consumption carries a slight inertia, then increases in disposable income should raise a person's savings rate short-term, but lower it long-term. The lagged effect of growth in disposable income could therefore be negative, as income is gradually incorporated into consumption patterns and permanent income.

Collective pensions savings relative disposable income (*Pension*): Between 1994 and 1999 the Swedish parliament carried out several reforms of the Swedish pension system, raising the mandatory contributions (Pensionsmyndigheten, 2017). In progress with the reforms, pension savings share of disposable income gradually increased from around 3-4 per cent of disposable income to roughly 8-10 per cent. In accordance with the LCH, higher pensions savings should reduce other household savings, indicating a negative relationship between our pension variable and the savings rate. Theoretically households should reduce other savings by an amount equal to the increase in mandatory pension savings.

Public sector budget balance (*Bud.bal*): The government budget balance is one of the most consistently significant variables found throughout previous literature. A negative coefficient would support the Ricardian Equivalence hypothesis, indicating that households increase their savings in response to public sector deficit spending, and vice versa.

GDP per capita (*GDPcap*): The GDP per capita level could potentially have a positive effect on the household savings rate. As discussed in the literature review, the evidence for this is mixed and significant results are primarily received in studies on developing countries (Athukorala and Sen, 2004; Loayza and Shankar, 2000a; 2000b; Ozcan et al, 2003). Richer countries do tend to have a higher savings rate, but it is unclear in which direction the causation goes.

GDP growth (*GDPqoq*): A high GDP growth signals a buoyant economic climate, which should lower the savings rate in accordance with the PSH. PIH related effects of GDP growth should be captured by disposable income growth.

Real residential house prices (*ln(Housep)*): Extensive evidence points to a negative relationship between real house prices and the savings rate. Through the wealth effect, higher wealth relative to disposable income should induce higher spending and lower savings (Darby, 1987). This can be interpreted through the PIH or LCH framework. Higher net assets relative to disposable income reduce the savings needed for retirement, and raise your permanent income. The literature reveals a relatively strong empirical support for this relationship (Bovenberg and Evans, 1989; Bosworth et al, 1991; Bérubé and Côté, 2000; Iacoviello, 2012).

As discussed in the introduction, we intend to test whether the relationship between real house prices and the household savings rate changed sometime during our studied period, which would indicate that fears of a housing bubble outweigh the effects of a potential wealth effect. Our hypothesis can mainly be framed within the PIH and PSH. It is possible that Swedes do not view the rising housing prices post the 2008 and Eurozone crisis as permanent, but as transitory. Fear of a subsequent bust would similarly raise the savings rate in line with the PSH.

Real interest rates (*Realint*): There is no consistent evidence on how the real interest rate affects household saving behaviour. As discussed in the literature review, the real interest rate may affect household savings through several channels. Most results that find a statistically significant effect, point to a positive relationship with the savings rate, but economic significance is generally low (e.g. Bérubé and Côté, 2000; Ozcan et al., 2003; Ahmad, 2015). Central banks generally consider the interest rate to have a positive relationship with savings (Armelius et al., 2014), and we expect a positive sign in line with previous literature.

Interest payments as a share of disposable income (*Int.share*): In addition to a measure of the real interest rate we include the share of disposable income that households spend on interest payments. In line with the PIH, households could view short-term fluctuations in interest rates as transitory. This could indicate a short-term negative coefficient, and lags with positive coefficients. Interest payments could also be Swedish households' primary source of information regarding interest rate levels, potentially capturing the effect of the real interest rate.

Economic Policy Uncertainty Index (*uncEUR1y*): Being a small, open economy, Sweden has a high dependence on the outside world. We therefore include the so-called Economic Policy Uncertainty Index for Europe. The European Economic Policy Uncertainty Index is based on work made by Baker et al. (2013), and measures policy uncertainty through word search in newspaper articles. This index captures fear arising from events such as Brexit, the US Presidential election, and the French presidential election. This explains why the index has shown a steady upward trajectory since the financial crisis in 2008. Due to substantial fluctuations between quarters we use a one-year trailing average of the index.

Capital gains' share of disposable income (*Capgains*): Capital gains are part of disposable income. We include a measure of capital gains relative to disposable income because capital gains could be considered more volatile, and thus less permanent than other types of income. According to the PIH, the propensity to save capital gains should then be higher than for other sources of disposable income.

Stock market development (*Stockqoq*): Through the wealth effect, and in line with the PSH, a rising stock market should reduce the household savings rate. Evidence however points to a higher likelihood of consuming out of housing wealth (Ludwig and Slok, 2002; Case et al., 2005; Dvornak and Kohler, 2007).

House price growth volatility (*Housevol*): We include a variable that measures the 12-month trailing volatility in the growth of house prices. This variable primarily captures the effect of falling housing prices since that is when prices tend to fluctuate the most. This should have a large effect on the Swedish household savings rate given the high homeownership rate (Eurostat, 2017). It also captures large fluctuations in the growth of house prices, which could raise uncertainty as well. One of the primary intentions behind adding the variable is to allow for a negative effect from falling house prices after a potential structural break in house prices. Although we expect a positive relationship between rising house prices and the savings rate after the breakpoint, the relationship with falling house prices is likely to remain negative. This indicates that the variable should become more significant in the version of our model that allows for a structural break.

Expected inflation (*Ex.cpif*): We expect inflation to have a positive relationship with the household savings rate, in line with previous literature (Balassa, 1993; Bérubé and Côté, 2000; Athukora and Sen, 2004). High inflation generates uncertainty regarding future income and wealth, raising savings in line with the PSH.

Debt growth (*Debtg*): Debt growth could indicate that some households are financing consumption with debt, something that technically lowers the savings rate. If this consumption is financed through increased savings in other households, the aggregate savings rate is however not affected. Higher credit availability also reduces budget constraints, something that should reduce the need for savings according to basic consumption smoothing theory.

Dependency ratio (*Dep.Tot*): In line with the majority of previous studies, we measure demographic change through the dependency ratio. In accordance with the definition used by the Statistics Sweden, the dependency ratio is defined as the non-working age population (<19 and >65 years) in relation to the working age population (19-64 years old) (Statistics Sweden, 2017a). A rising dependency ratio should lower the savings rate since it increases the low- or dis-saving share of the population. Studies using cross-country data have generally been more successful in finding significant effects from demographic changes than single-country studies (Bérubé and Côté, 2000). This is probably an effect of the relatively modest demographical changes that take place in studies for individual countries.

The dependency ratio could be correlated with a rising life expectancy. A rising life expectancy increases the amount of people above 65, and thereby the dependency ratio, everything else equal. However, a rising life expectancy also increases the savings rate needed during working age. An increasing dependency ratio should technically reduce aggregate savings (through increasing the share of the population consuming savings), but could become biased through the correlation with life expectancy.

Overall, the effect of demographic variables should be limited. The SEB Welfare Index (SEB, 2016) shows that the belief in the pension system has fallen slightly since 2010, but the change is of low economic significance. According to the index, the trust in the system increased between 2005 and 2008, which is when the rise in the household savings rate began (See Figure 1). One possibility is that households increase their savings rate in response to a rising life expectancy after 65, which could be correlated with the dependency ratio. This means that households would need to save for a longer retirement period. The SEB Welfare Index however shows that Swedes have gradually raised their expected retirement age. Between 2008 and 2016 the expected retirement age of individuals actually increased by substantially more than the expected life expectancy after 65 (by around 3 years for people aged 18-49, compared to a roughly 1 year increase in life expectancy post 65). Assuming rationality, this should lower the savings rate rather than raise it, which could explain non-significant results for the dependency ratio.

4. Data

The study is based on quarterly data ranging from Q1:1980 to Q3:2016, yielding 147 observations. However, some variables have a shorter sample period (see Table 2). The data has been collected from multiple sources, including Statistics Sweden (SCB), the Swedish Riksbank, and the Organisation for Economic Co-operation and Development (OECD). Variables with a clear seasonal pattern have been seasonally adjusted using X-13 ARIMA-SEATS Seasonal Adjustment program developed by the United States Census Bureau[1]. These include the household savings rate, GDP per capita, real disposable income per capita growth, capital gains' share of disposable income, and interest payments as a share of disposable income.

The remaining variables were either seasonally adjusted when collected or did not show any seasonal pattern. Descriptive statistics of the variables, as well as their order of integration [2] are presented in Table 2. For more detailed information about the data, including data transformation and calculations, graphs over the respective time series, and pairwise correlations between the variables included in the analysis, see Appendix A.

[1] Detailed description will not be covered in this thesis, see e.g., https://www.census.gov/srd/www/x13as/ for more information.
[2] Concept described in Section 5 and full results in Appendix B2

Table 2. *Descriptive statistics of main variables*

	mean	sd	min	max	N	I(*d*)*	Description
Dependent variable							
SRnet	0.832	4.356	-8.505	9.500	147	I(1)	Saving as share of disposable income, per cent
Independent variables							
Pension	6.098	2.834	0.802	12.351	144	I(1)	Collective pension savings as share of disposable income, per cent
Disp.Inc	1.395	2.814	-7.487	7.310	143	I(1)	Growth in real disposable income per capita, per cent
Int.share	8.809	3.608	3.588	16.571	147	I(1)	Interest payments as share of disposable income, per cent
Realint.	3.197	2.533	-1.800	9.443	135	I(1)	Real interest rate, per cent
Ex.cpif	3.595	3.120	0.181	10.849	145	I(1)	Expected inflation, per cent
l.Housep	4.151	0.357	3.721	4.936	147	I(1)	Natual logarithm of real residential house prices (Index, 2010=100)
Bud.bal	0.206	2.881	-6.912	4.704	144	I(0)	Public sector budget balance, per cent of GDP
GDPqoq	0.562	0.965	-3.700	2.500	142	I(0)	Real GDP growth QoQ, per cent
House.vol	2.022	1.432	0.163	8.044	144	I(0)	House price growth volatitlity
Debt.g	7.048	4.282	-3.773	18.767	141	I(0)	Debt growth YoY, per cent
Cap.gains	12.761	2.084	7.795	18.559	147	I(0)	Capital gains' share of disposable income, per cent
uncEUR1y	116.298	42.032	57.870	237.329	116	I(0)	1-year trailing average of European Uncertainty Index, long-term avg=100
uncSWE1y	102.449	17.032	65.217	128.861	144	I(0)	1-year trailing average of Swedish Uncertainty Index, long-term avg=100
Stock.qoq	3.611	10.112	-25.073	38.295	147	I(0)	Stock market development QoQ, per cent
GDPcap	83.144	15.427	58.881	108.688	143	I(1)	Real GDP per capita per quarter, TSEK
Dep.Tot	72.299	1.563	69.885	74.715	147	I(0)	Dependency ratio, per cent
Dep.Old	30.474	1.455	28.362	34.560	147	I(0)	Old dependency ratio, per cent
Dep.Y	41.824	1.882	39.208	46.209	147	I(0)	Young dependency ratio, per cent
Dep.Old+15	33.026	3.146	29.144	38.934	147	I(0)	15-year leading old dependency ratio, per cent

5. Econometric framework

For many time series techniques, an important and simplifying assumption is that the underlying data processes are stationary. Stationarity implies that the mean, variance and covariance of the time series are constant over time. If a non-stationary process can be made stationary after being differenced once it is said to contain a unit root or a stochastic trend. A stationary time series is also referred to as being integrated of order zero, I(0), and a unit root-process as being integrated of order one, I(1)[3] (Stock and Watson, 2008).

Most macroeconomic variables tend to be non-stationary, and a large part of previous literature on the savings rate has found the data used to be non-stationary. As noted by Granger and Newbold (1974), regression results might be spurious in the presence of non-stationary variables, calling into question the validity of many previous findings. A spurious regression tends to have high R^2 and *t*-statistics that appear to be significant despite the variables being independent of each other. That is, if the variables of interest are non-stationary, conventional inference and time series analysis cannot be used to examine the potential relationship between the variables. Testing for stationarity is therefore a crucial first step in determining the appropriate empirical strategy. In this study, the DF-GLS unit-root test proposed by Elliot, Rothenberg and Stock (1996) is utilized[4]. The test results indicate that our dataset contains a combination of stationary and unit root processes (see Appendix B, Table B1).

Given that several variables are found to be non-stationary, a natural next step is to test for cointegration. Two or more I(1) processes are said to be cointegrated if they share a stochastic trend, meaning it exists a linear combination of the series that is stationary. In the case of more than two variables, there can be multiple cointegrating relationships; for *n* variables, there can be a maximum of *n-1* cointegrating relationships. Cointegration techniques can make regression analysis involving I(1) variables meaningful (i.e. non-spurious), and in contrast to taking the first difference of the variables (ergo, making them stationary), it prevents loss of information. Furthermore, cointegrating relationships are of interest because they define stationary relationships between non-stationary variables. Such relationships are often referred to as "long-run equilibria", since they tend to convergence upon divergence from the long-run relationship (Hendry and Juselius, 2001).

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[3] In general, a series that becomes stationary after being differenced *d* times is said to be integrated of order *d,* I(d)

[4] The more commonly used ADF test was also applied, yielding the same outcome (but not reported here). We proceed with the DF-GLS test as it has an advantage over, for example, Dickey-Fuller types of tests, in having higher power against near unit root alternatives. Furthermore, the issue regarding deterministic regressors is less critical (Enders, 2010). Detailed description of the test will not be covered in this thesis but can be found in e.g., Stock and Watson (2008) 15.5 and 16.3 .

As a first step, the rank test proposed by Johansen (1988) is used to determine the number of underlying cointegrating relationship. Results from the rank test show that we cannot reject that there is only one cointegrating relationship among the non-stationary variables (see Appendix B, Table B2). We proceed by using the ARDL approach to cointegration, which allows for at most one cointegration relationship among the variables.

The ARDL approach is the preferred technique in our case, with several advantages over other cointegration techniques that could be employed on our data set and study. The ARDL approach, and the corresponding bound test, is preferred over Johansen's method in sample sizes up to 150 observations (Persaran and Shin, 1998). Furthermore, Pesaran et al (2001) show that the ARDL model yields consistent estimates, irrespectively of whether the underlying data processes are stationary, I(1) or cointegrated. As our sample consists of 147 observations and the variables are a mixture of I(0) and I(1) processes, these are important characteristics of the estimation technique. The ARDL approach also allows for flexibility in the lag length of the regressors, and is hence not afflicted by the curse of dimensionality associated with VAR and ECM models (Pesaran et al., 2000).

5.1 The empirical model

The ARDL model is a dynamic model where the dependent variable can depend on both current and lagged values of explanatory variables, as well as lagged values of the dependent variable itself. The error correction representation of the ARDL model allows us to distinguish between long- and short-run determinants. A general specification of the error correction representation of the ARDL model can be written as follows:

$$\Delta Y_t = \alpha \underbrace{\left(Y_{t-1} - \beta_0 - \sum_{k=1}^{K} \beta_k X_{k,t-1} \right)}_{Long-run\ equation} + \underbrace{\sum_{m=1}^{M} \gamma_m \, \Delta Y_{t-m}}_{Lags\ of\ dep.variable} + \underbrace{\sum_{k=1}^{K} \sum_{i=1}^{I_k} \delta_{k,ik} \, \Delta X_{k,t-ik}}_{Short-run\ dynamics} + \underbrace{\sum_{j=1}^{J} \delta_j Z_j}_{Exog.var} + \epsilon_t \qquad (1)$$

where $\boldsymbol{\Delta Y_t = Y_t - Y_{t-1}}$ is the error correction term.. Since a cointegrating relationship is traditionally defined between non-stationary variables, I(1) variables enter in the long-run equation and as short-run dynamics, while stationary variables, I(0), are included as exogenous regressors. The order of integration of the variables used in this study is summarized in Table 2, and full results from the unit root tests are presented in Appendix B, Table B1.

The right hand side (RHS) of (1) can be separated into four parts in order to simplify interpretation. The first term,

$$\alpha\left(Y_{t-1} - \beta_0 - \sum_{k=1}^{K} \beta_k X_{k,t-1}\right) \tag{1.1}$$

is the long-run equation and the corresponding adjustment coefficient, α. The long-run equation represents the cointegrating relationship among the I(1) variables, and thus the long-run equilibrium relationship. The adjustment coefficient tells us what proportion of a deviation from this equilibrium that is adjusted for in each period. β_0 is a constant[5] , X_k are the I(1) variables, β_k their corresponding coefficients and *K* the number of explanatory I(1) variables. The second term on RHS in (1),

$$\sum_{m=1}^{M} \gamma_m \, \Delta Y_{t-m} \tag{1.2}$$

represents the M lagged first differences of the dependent variable (ΔY_{t-m}) and γ_m their corresponding coefficients. The third term on the RHS in (1),

$$\sum_{k=1}^{K} \sum_{i=1}^{I_k} \delta_{k,i} \, \Delta X_{k,t-i_k} \tag{1.3}$$

contains the I_k lagged differences of the I(1) variables, X_k. These represent the short-run dynamics of the convergence to the long-run equilibrium in (1.1). The fourth term on the RHS in (1),

$$\sum_{j=1}^{J} \delta_j Z_j \tag{1.4}$$

represents the *J* stationary exogenous regressors, $\boldsymbol{Z_j}$, and their corresponding coefficients, $\boldsymbol{\delta_j}$.

[5] The constant could be instead be specified outside the long-run relationship and would then be $-\alpha\beta_0$. One can also include a deterministic trend component in the long-run relationship, but is insignificant in all model specification tested for and is therefore excluded from (1)

The number of lags of dependent and independent variables (i.e., $\mathbf{M}$ and $\mathbf{I_k}$) are determined based on Schwarz Bayesian Information Criterion (BIC), proposed by Schwarz (1978).

Once the full model is specified, we apply ARDL bounds testing, suggested by Pesaran et al (2001), to test for the existence of a cointegrating relationship among the I(1) variables. The null hypothesis is no cointegration and a test statistic (*F*-statistic) larger than the critical value is thereby interpreted as evidence for a cointegration. Ultimately, various robustness tests are conducted, and the Ljung-Box (1978) white-noise test is used to test for remaining serial correlation in the residual.

5.2 Test for parameter instability

Many studies have found that severe recessions and policy changes can cause structural breaks in macroeconomic variables (e.g., Papell and Prodan, 2011; Ferreira et al., 2013). Our sample covers, among other things, the introduction of an inflation target, two financial crises, and the implementation of a negative central bank steering rate. We therefore apply tests for parameter instability and structural breaks in the cointegrating relationship.

To test for a structural break in the cointegrating relationship, we test for parameter instability of the variables in the long-run relationship, as well as in the constant. This is done using the Quant Likelihood Ratio (*QLR*) test (Quandt, 1960). The *QLR*-test has the same setup as a Chow test, but in contrast to a Chow test it does not require a priori knowledge of the break date.

The *QLR*-test can be conducted using binary variable interaction for all possible break dates. Re-writing the long-run relationship (1.1) as a conventional regression model, but allowing for change in the constant and the long-run coefficients, the long-run relationship in (1) can be written as follows:

$$Y_t = \beta_0 + \gamma_0 D_t(\tau) + \sum_1^k \beta_k X_{k,t-1} + \sum_1^k \gamma_k D_t(\tau) X_{k,t-1} \qquad where \;\; D_t(\tau) = \begin{cases} 0 \;\; for \;\; t < \tau \\ 1 \;\; for \;\; t \geq \tau \end{cases}$$

Using an *F*-test, one can then test for the null hypothesis of no break:

$$H_0: \qquad \gamma_i = 0 \quad for\ all\ i$$

against the alternative of either a pure structural break model (all coefficients change):

H_{A1}: $\gamma_i \neq 0 \quad for\ all\ i$

or of a partial structural change model (a subset of coefficients changes):

H_{A2}: $\gamma_i \neq 0 \quad for\ some, but\ not\ all, i$

The *QLR*-statistic is then the maximum of all *F* statistics over the range of $\tau,\ \tau_0 \leq \tau \leq \tau_1$. That is,

$$QLR = max[F(\tau_0), F(\tau_0 + 1), F(\tau_0 + 2), \dots, F(\tau_1 - 2), F(\tau_1 - 1), F(\tau_1)]$$

where $F(\tau)$ is the *F*-statistic when testing for a breakpoint at time τ. Since the *QLR*-statistics is the largest of several *F*-statistics, it does not follow standard *F*-distribution. Critical values are hence obtained from a special distribution. The critical values depend on the number of restrictions being tested and the start and end points of the sub-sample over which the *F*-statistics are computed (τ_0, τ_1). A common choice, which will be applied in this thesis, is to set $\tau_0 = 0.15$T and τ_1=0.85T (Stock and Watson, 2003). Critical values for the *QLR*-statistics are obtained from Stock and Watson (2003) Table 12.5.[6] The null hypothesis of no structural break is rejected if the *QLR*-statistic exceeds the critical value for the given significance level and number of restrictions tested for. The test is computed allowing for parameter instability in all coefficients jointly (H_0 against H_{A1}), as well as each coefficient individually (H_0 against H_{A2}) for each the independent variables included in (1.1)

6. Results

In this section we present estimation results for the ARDL model, the structural break analysis, and our robustness tests. Unit root tests and the Johansen's rank test are only used to confirm the appropriateness of the chosen econometric model, with full results presented in Appendix B. The unit root test shows that our set of variables contains both stationary and non-stationary

[6] Provided that the maximum number of break dates is known, the test can be extended to more than one break. However, we will only test for one break point, and evidence thereof would then point the strongest (most significant one). Testing for more breaks will be left for future studies.

variables. Results from Johansen's rank test are somewhat ambiguous, with the *max*-statistic pointing to one cointegrating relationship whereas the *trace*-statistic indicates two. However, due to the mentioned advantages with the ARDL approach, we proceed by assuming only one cointegrating relationship[7]. The Ljung-Box test shows that we do not have a problem with remaining serial correlation in the residual. These results are also presented in Appendix B.

6.1 Estimation results assuming parameter stability

Based on the p-values, model fit, and a preference for parsimonious models, our final baseline model includes the following explanatory variables[8]:

Long-run determinants: Pension savings, Disposable Income per capita growth, House prices, Interest rate payments and Expected inflation.

Short-run determinants: Current and lagged differences of the long-run determinants, Capital gains' share of disposable income, GDP growth, House price volatility, and the Public sector budget balance.

Table 3 shows the results for the baseline model, *Model(1)* and five model specifications where additional explanatory variables have been included. These are GDP per capita (*Model(2)*), the Real interest rate (*Model(3)*), Stock market development (*Model(4)*), Total dependency ratio (*Model(5)*) and Uncertainty Index Europe (*Model(6)*), where the former two are included as long-run determinants and the latter three as short-run determinants (based on order of integration as described in Section 5).

The subsequent analysis is based on *Model(1)*, unless otherwise stated. *Model(2)-(6)* include variables that have proven important in previous literature, but fail to do so in our framework (except for the Dependency ratio). The non-significant results are therefore a finding in itself. They also serve as evidence of the robustness of variables included in *Model(1)*, given the low variance in the coefficient magnitude across models.

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[7] Studying the determinants of the savings rate in a system of equations, such as the VECM methodology proposed by Johansen(1988) is thus left for future studies.

[8] A selection of additional model specifications can be found in Appendix C

Table 3. *Estimation results*

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Dependent variable	D.SRnet	D.SRnet	D.SRnet	D.SRnet	D.SRnet	D.SRnet
Adj. coef.	-0.419*** (0.0589)	-0.417*** (0.0590)	-0.425*** (0.0621)	-0.433*** (0.0622)	-0.466*** (0.0599)	-0.403*** (0.0725)
LR						
Pension	-0.830*** (0.266)	-0.803*** (0.270)	-0.743*** (0.268)	-0.823*** (0.258)	-0.583** (0.244)	-0.781** (0.309)
Disp.Inc	0.876*** (0.118)	0.903*** (0.125)	0.806*** (0.121)	0.856*** (0.117)	0.915*** (0.106)	0.792*** (0.147)
ln(Housep)	12.36*** (0.836)	13.96*** (2.219)	12.45*** (1.076)	12.34*** (0.811)	10.57*** (0.933)	12.15*** (1.100)
Int.share	-0.497** (0.234)	-0.577** (0.258)	-0.482* (0.262)	-0.479** (0.228)	-0.510** (0.205)	-0.475* (0.274)
Ex.cpif	0.195+ (0.131)	0.158 (0.139)	0.266+ (0.182)	0.175 (0.130)	0.178+ (0.114)	0.232 (0.188)
GDPcap		-0.0692 (0.0882)				
Realint.			0.0283 (0.174)			
Constant	-47.99*** (3.605)	-48.02*** (3.629)	-48.72*** (4.469)	-48.12*** (3.503)	-81.75*** (12.28)	-47.49*** (4.214)
SR						
D.Pension	-0.616*** (0.0957)	-0.605*** (0.0969)	-0.619*** (0.0973)	-0.622*** (0.0963)	-0.567*** (0.0948)	-0.558*** (0.109)
D.Disp.Inc	0.422*** (0.0386)	0.429*** (0.0399)	0.418*** (0.0395)	0.415*** (0.0400)	0.444*** (0.0385)	0.403*** (0.0451)
LD.Disp.Inc	-0.131*** (0.0444)	-0.136*** (0.0448)	-0.112** (0.0467)	-0.135*** (0.0448)	-0.159*** (0.0443)	-0.0991* (0.0517)
L2D.Disp.Inc	-0.148*** (0.0383)	-0.153*** (0.0389)	-0.135*** (0.0398)	-0.151*** (0.0386)	-0.171*** (0.0382)	-0.115*** (0.0423)
L3D.Disp.Inc	-0.122*** (0.0312)	-0.125*** (0.0314)	-0.116*** (0.0322)	-0.123*** (0.0313)	-0.129*** (0.0305)	-0.114*** (0.0344)
D.l.Housep	-13.88*** (4.920)	-12.84** (5.103)	-15.22*** (5.025)	-13.68*** (4.940)	-14.37*** (4.792)	-15.62*** (5.406)
D.Int.share	-1.200*** (0.230)	-1.201*** (0.230)	-1.159*** (0.242)	-1.246*** (0.240)	-1.171*** (0.224)	-1.168*** (0.255)
LD.Int.share	0.588** (0.229)	0.618*** (0.232)	0.574** (0.231)	0.544** (0.238)	0.543** (0.223)	0.618** (0.262)
L2D.Int.share	-0.306 (0.217)	-0.257 (0.226)	-0.330+ (0.219)	-0.313 (0.217)	-0.245 (0.212)	-0.329 (0.237)
L3D.Int.share	0.604*** (0.213)	0.658*** (0.223)	0.578*** (0.215)	0.596*** (0.213)	0.730*** (0.212)	0.513** (0.230)
D.Ex.cpif	0.0818+ (0.0545)	0.0658 (0.0582)	0.113+ (0.0763)	0.0755 (0.0553)	0.0832+ (0.0530)	0.0935 (0.0754)

Table 3.*cont'd*

Cap.gains	0.202***	0.198***	0.192***	0.210***	0.143**	0.178***
	(0.0583)	(0.0586)	(0.0590)	(0.0595)	(0.0608)	(0.0626)
GDPqoq	-0.151*	-0.138+	-0.167*	-0.148*	-0.171**	-0.181*
	(0.0862)	(0.0879)	(0.0888)	(0.0865)	(0.0842)	(0.0988)
House.vol	0.105*	0.119**	0.0866+	0.102*	0.187***	0.0899
	(0.0548)	(0.0576)	(0.0558)	(0.0552)	(0.0611)	(0.0637)
Debt.g	-0.0670**	-0.0780**	-0.0629**	-0.0613**	-0.0903***	-0.0599
	(0.0282)	(0.0315)	(0.0287)	(0.0294)	(0.0288)	(0.0465)
Bud.bal	-0.416***	-0.398***	-0.434***	-0.438***	-0.425***	-0.385***
	(0.0896)	(0.0924)	(0.0970)	(0.0952)	(0.0873)	(0.114)
D.GDPcap		-0.0288				
		(0.0364)				
D.Realint.			0.0120			
			(0.0738)			
Stock.qoq				-0.00552		
				(0.00785)		
Dep.Tot					0.271***	
					(0.0988)	
uncEUR1y						0.00173
						(0.00314)
N	139	139	135	139	139	116
Adj. R-Square	0.704	0.703	0.709	0.702	0.719	0.673
Rmse	0.756	0.757	0.757	0.757	0.735	0.756
Bound test, Fstat	8.729***	7.692***	7.076***	8.648***	9.952***	5.631***

*Standard errors in parentheses, + p<0.15, * p<0.1, ** p<0.05,*** p<0.01*

According to the estimation results of *Model (1)*, the long-run relationship between the *Savings rate*, *Pension savings*, *Disposable income per capita growth*, *House prices*, *Interest payments* and *Expected inflation* is:

$$\widehat{SRnet} = -47.99 - 0.83 \times \text{Pens.} + 0.88 \times \text{Disp.Inc} + 12.36 \times \ln(\text{Housep}) - 0.50 \times \text{Int.Sh} + 0.20 \times \text{Ex.cpif} \quad (6.1)$$

Table 4 compares our coefficient results to the expected coefficient signs presented in Table 1 (Section 3). The results are generally in line with previous expectations, although several variables fail to reach statistical significance.

Table 4. *Actual coefficient sign versus expected*

Variable	**Expected coefficient sign**	**Actual coefficient sign**
DispInc	+(potentially - in short run)	+ long-run, - short-run
Pension	-	-
Bud.bal	-	-
GDPcap	+	non-significant
GDPqoq	-	-
ln(Housep)	- (period 1), + (period 2)	+ long-run, - short-run
Realint	+	non-significant
Int.share	- (potentially + in short run)	- long-run, primarily + short-run
uncEUR1y	+	non-significant
Capgains	+	+
Stockqoq	-	non-significant
Housevol	+	+
Ex.cpif	+	+
Dep.Tot	-	+

The corresponding adjustment coefficient is -0.419, implying that about 42 per cent of deviations from the long-run relationship in (6.1) are corrected for in the next period.

The long-run relationship between pension savings and the household savings rate shows that households almost fully offset other savings by changes in pensions savings. The result points to an 83 per cent adjustment of other savings in response to changes in pension savings. The coefficient is negative and significant in the short-run as well, which could capture the effect of the general economic climate, as pension savings tend to vary with the business cycle.

As expected, the long-term relationship between disposable income per capita growth is positive, rendering support for the Bentzel mechanism and the higher inertia of consumption relative to income. The lagged short-run dynamics of disposable income growth is as expected negative, indicating a lowering of the savings rate as income growth gradually becomes more permanent.

The long-run relationship between the savings rate and interest payments' share of disposable income is negative. If households use interest payments as a source of information about interest rate levels, this suggests that a negative income effect outweighs the revaluation and substitution effect in Sweden. It could also imply that the lowering of central bank policy rates has actually contributed to raising the household savings rate. The short-run coefficients for interest payments show a tendency similar to that of disposable income coefficients, with the first lag having a negative coefficient, and the second and fourth lag positive coefficients. This supports the earlier discussed inertia proposition. According to our results, the real interest rate does not have a statistically significant effect on the savings rate (*Model(3)*), which does not greatly contrast previous findings. The real interest rate is not consistently found statistically significant, and seldom achieves economic significance. Our results imply that the share of disposable income spent on interest payments is a better determinant of the household savings rate than the real interest rate. We test if this is an effect of correlation with the nominal interest rate in our robustness segment, but the nominal interest rate also fails to reach significance.

When residential house prices increase, Swedish households tend to save more in the long run but decrease their savings somewhat in the short run. The short-run effects seem to be in accordance with the wealth effect and the PSH; high house price growth leads to a lower savings rate. The long-run effects could capture the general need to save more of your income as house prices rise. This effect should be concentrated to younger generations, but could possibly affect older generations as well. If this mechanism exists, it should be especially high in a country with Sweden's high homeownership rate. The positive long-run relationship could also indicate that Swedish households have been hesitant towards viewing rising house prices as something purely positive for a long-time, possibly an effect of the housing crisis suffered in the early 1990s.

Expected inflation is in practice significant on the 10% significance level, given that the actual hypothesis tested for is one-sided (positive coefficient)[9]. Based on the 0.195 coefficient, a one percentage point higher inflation rate should increase the household savings rate by around 0.2 percentage points.

A positive coefficient for capital gains' share of disposable income points to a higher propensity to save capital gains relative other income. The result is significant on the 1% significance level, and implies that the savings rate for capital gains is 20 percentage points higher than for other income. Capital gains' share of disposable income is likely to be correlated with the business cycle. Since we control for income growth, this could add a negative relationship between capital gains and the savings rate. The strongly positive coefficient is therefore a strong indication of differences in propensity to consume between capital gains and other income.

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[9] *p*-value for the two-sided test is $<0.15 \rightarrow$ *p*-value for one-sided test <0.075. However, we also estimate the model excluding expected inflation in our robustness check, see Section 6.3 and Appendix C

GDP growth shows a negative relationship with the savings rate, which is as expected given our adjustment for disposable income growth. A higher GDP growth signals a buoyant economic climate, reducing the savings rate in line with the PSH (and vice versa). The coefficient for debt growth is negative and significant on the 5% level, indicating that high debt growth reduces the household savings rate. High debt growth indicates increased borrowing, which should lower the household savings rate unless it is compensated by increased saving in non-borrowing households.

In line with the Ricardian Equivalence proposition, the public sector budget balance shows a negative relationship with the household savings rate, significant on the 1% level. The achieved coefficient indicates a 0.4 percentage point increase in the household savings rate to every percentage point increase in deficit spending by the government. Since disposable income on average corresponds to around 50 per cent of GDP, households only compensate for around 20 per cent of government saving/dissaving. This is lower than the 50 to 60 per cent implied in previous studies, but could be an effect of us looking at the household savings rate rather than the total private savings rate.

Our measure of house price growth volatility is significant on the 10% significance level, and shows the expected positive sign. The variable is intended to capture the effect of housing price slowdowns, as well as the effect of housing price declines in our model that incorporates a structural break in the effect of house prices. Even though we expect rising house prices to raise the household savings rate post the financial crisis, falling house prices should have a similar effect on both sides of the breakpoint.

Stock market development does not seem to have a statistically significant effect on the savings rate, which is somewhat in line with previous literature. Housing wealth is generally found to have a higher effect on consumption than financial wealth, most likely an effect of the low share of the population owning stocks directly (Statistics Sweden, 2015).

Estimation results of *Model(2)* show that GDP per capita is not statistically significant. Previous significant results are generally from studies on developing nations; a status Sweden did not have at any point of the studied period. The European Uncertainty index also fails to reach statistical significance, meaning that the elevated Swedish household savings rate it not an effect of the unusually high policy uncertainty present in Europe during recent years.

The dependency ratio has a positive and statistically significant coefficient (*Model(5)*). This could indicate that the dependency ratio captures the effect of a rising life expectancy, since the variable otherwise technically should have a negative coefficient. However, the risk of the dependency ratio coincidentally capturing trends is high. During the period 1980 to 2003 the dependency ratio fell steadily while life expectancy rose, which makes the positive coefficient of the dependency ratio hard to explain (Statistics Sweden, 2017). Included in our robustness test section is a 15-year leading old dependency ratio, which should capture the effect of a rising life expectancy given evidence of individuals only beginning to save seriously for retirement around the age of 50 (Carroll, 1992 and 1997). The leading indicators non-significance points to a coincidental correlation between the dependency ratio and the household savings rate. Our view is that our sample period probably is too short to study demographical changes, which is why the dependency ratio is ultimately excluded from the baseline model.

6.2 Structural break analysis

Next we test for a structural break in the relationship between the savings rate and its long-run determinants, building on *Model(1)*. First, we perform the *QLR*-test, allowing for a change in the coefficient of all variables in the cointegrating relationship. The test is subsequently performed on each of the five variables individually. These test results are presented in Table 5.

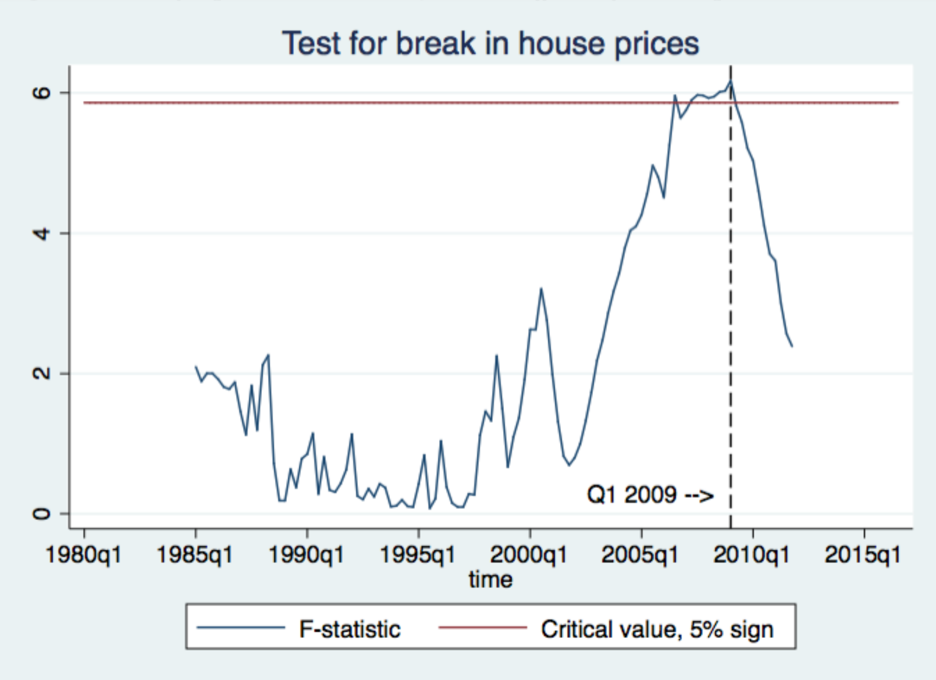
Table 5. *QLR-test results*

Testing for parameter instability in:	QLR-statistic	Number of restrictions	Crit. Value (5% sign.)
All variables	3.05	6	3.37
Pensions	4.18	2	5.86
Income growth	5.38	2	5.86
House prices	6.18**	2	5.86
Interest payments	5.53	2	5.86
Expected Inflation	4.14	2	5.86

** $p<0.05$

The *QLR*-test results imply a breakpoint in the coefficient of house prices, but not in any of the other variables. The breakpoint is located in the first quarter of 2009, illustrated in Figure 4. The timing of the break confirms our hypothesis, indicating that Swedish households have changed their reaction to house price increases after the financial crisis of 2008. The change is of high economic significance, both in the long- and short-run relationship between house prices and the household savings rate. This could imply that concerns regarding a housing bubble have raised the household savings rate substantially.

Figure 4. *Test for parameter instability in the coefficient for house prices*



As we find evidence of a structural break in the coefficient for house prices in the first quarter of 2009, we adjust *Model (1)* in Table 3 by allowing for a breakpoint. The new model, presented next to our baseline model in Table 6, allows for changes in the long- and short-run coefficients of house prices, and in the intercept.

Table 6. *Comparing model with and without break*

Model	**(1)**	**(7)**
Dependent variable	D.SRnet	D.SRnet
Adjustment coef.	-0.419*** (0.0589)	-0.480*** (0.0602)
LR		
Pension	-0.830*** (0.266)	-0.582** (0.233)
Disp.Inc	0.876*** (0.118)	0.861*** (0.0991)
ln(Housep)	12.36*** (0.836)	10.06*** (1.232)
Int.share	-0.497** (0.234)	-0.363* (0.198)
Ex.cpif	0.195+ (0.131)	0.195* (0.110)
ln(Housep)09q1		9.286*** (2.660)
Constant09q1		-42.39*** (12.20)
Constant	-47.99*** (3.605)	-40.06*** (5.059)

Table 6. *cont'd*

SR		
D.Pension	-0.616*** (0.0957)	-0.582*** (0.0935)
D.Disp.Inc	0.422*** (0.0386)	0.435*** (0.0375)
LD.Disp.Inc	-0.131*** (0.0444)	-0.151*** (0.0432)
L2D.Disp.Inc	-0.148*** (0.0383)	-0.163*** (0.0372)
L3D.Disp.Inc	-0.122*** (0.0312)	-0.123*** (0.0300)
D.l.Housep	-13.88*** (4.920)	-16.16*** (4.867)
D.Int.share	-1.200*** (0.230)	-1.170*** (0.224)
LD.Int.share	0.588** (0.229)	0.474** (0.223)
L2D.Int.share	-0.306 (0.217)	-0.302 (0.209)
L3D.Int.share	0.604*** (0.213)	0.695*** (0.208)
D.Ex.cpif	0.0818+ (0.0545)	0.0933* (0.0531)
Cap.gains	0.202*** (0.0583)	0.176*** (0.0589)
GDPqoq	-0.151* (0.0862)	-0.181** (0.0836)
House.vol	0.105* (0.0548)	0.165*** (0.0576)
Debt.g	-0.0670** (0.0282)	-0.0761*** (0.0274)
Bud.bal	-0.416*** (0.0896)	-0.472*** (0.0879)
D.ln(Housep)09q1		4.453*** (1.329)
N	139	139
Adj. R-Square	0.704	0.725
Rmse	0.756	0.727
Bound test, *F*-stat.	8.729***	8.573***

standard errors in parentheses
*+ p<0.15, * p<0.1, ** p<0.05, *** p<0.01*

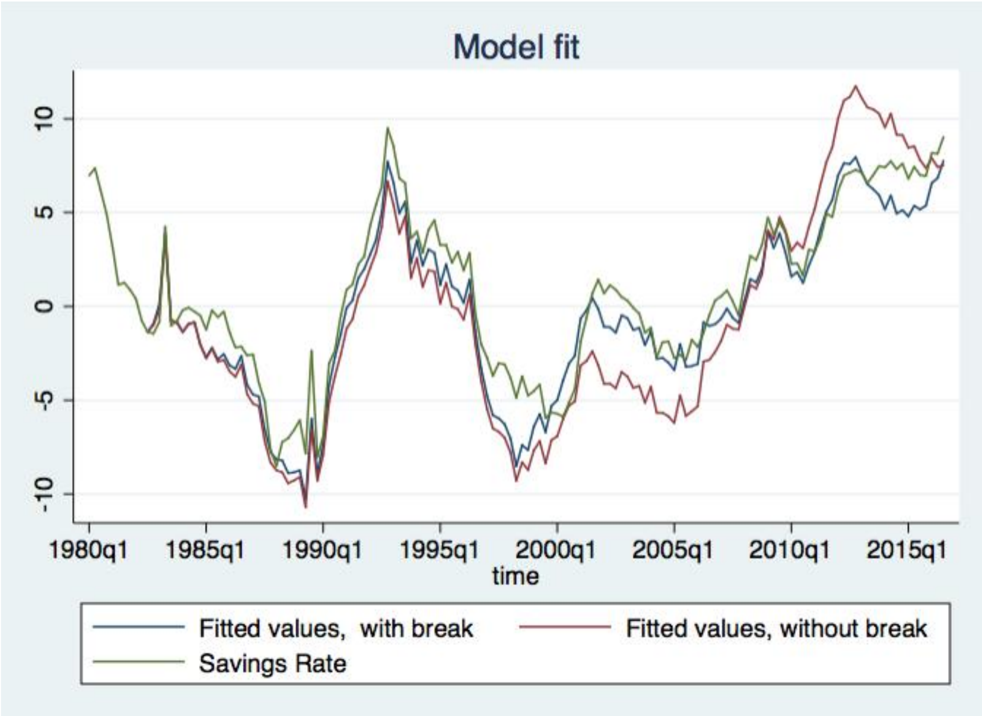
Both the long- and short-run interaction term for house price development post Q1-2009 are statistically significant on the 1% level, rendering support for our hypothesis regarding housing bubble fears. According to our results, the interaction term with housing prices post-2008 has been responsible for raising the long-run level of the savings rate by 3.4 percentage points between Q1-2009 and Q3-2016 (adjusting for changes to the Constant. 4 percentage points otherwise). Considering that the household savings rate was 9 per cent in our latest observation, the change in the household response to rising house prices could be a greatly important factor behind today's elevated levels.

There are few major differences in the coefficients between the model with and without interaction terms. The most sizable coefficient changes take place in the long-run relationship with pensions and interest payments. The long-run adjustment to pension savings falls from 83% to 58%, which could mean that there is an upward bias in the coefficient when the break is not accounted for. The long-run coefficient of interest payments decreases somewhat in magnitude when the break is accounted for. It is not unreasonable that the level of interest payments captures part of the structural change related to house prices, given the strong negative correlation between interest payments and house price levels.

As expected, house price volatility experiences a substantial increase in both significance and magnitude. Although the savings rate will have a larger positive response to rising house prices post 2008, the response to falling house prices should remain the same (negative). Since volatility tends to be higher in downturns, the volatility index primarily captures the effect of falling house prices. Potential housing bubble concerns could also raise the general aversion to volatility in house prices.

In Figure 5 the fitted values of estimation results for both the break and non-break model are compared to actual values. A simple visual inspection reveals that the structural break model is a better fit with the actual savings rate, compared to the non-structural break model. The adjusted R^2 of the model increases slightly when allowing for a structural break, with several variables gaining in significance.

Figure 5. *Model fit, comparing model estimated with and without break point*



6.3 Validity and Robustness

This thesis uses the ARDL approach to cointegration and although the method is considered appropriate for our study it also comes with some limitations. First of all, the ARDL framework assumes at max one cointegrating relationship among the variables. The results from Johansen's rank test are ambiguous with the *max*-statistic indicating one relationship whereas the *trace*-statistic is pointing to two. This could imply that we are underestimating the number of cointegrating relationship and thus relevant equilibrium-correction mechanisms being omitted (Hendry and Juselius, 2001). A second potential threat to the validity of our results is the risk of endogeneity. As an example, the savings rate could affect the disposable income growth or housing prices rather than the other way around. This issue is somewhat controlled using lags; the long run equation is estimated using the first lag of the explanatory variables and lags of their first differences are included. It is a reasonable assumption that current values of the savings rate do not cause past values of the explanatory variables. However, the risk is not eliminated with this approach and the risk of potential endogeneity has to be kept in mind when interpreting the results. It should however be mentioned that the attained coefficient signs support our approach. One example being the long-run disposable income coefficient, which theoretically should be negative if the savings rate was a major determinant of disposable income growth. One way to deal with the issues discussed above could be to study determinants of the household savings rate in a system of equations rather than in a single-equation framework. As discussed in section 5, the ARDL-approach was chosen for this thesis due to several advantages relevant to this thesis. Nevertheless, we encourage future studies to study the determinants of the household savings rate in a system of equations, if deemed appropriate.

In addition to the econometric framework applied, other potential threats to the validity of results can stem from omitted variables bias and sensitivity to variable definitions. We therefore estimate several additional specifications of the model in order to test the robustness of our findings. The robustness tests primarily consist of model specifications with different definitions of our explanatory variables, models including different sets of variables (independent and dependent), and variations of the structural break model. The model specifications are estimated both with lag length chosen according to BIC and, when they differ, lag length mirroring that of our main model, *Model(1)*. This is to assure that potential variations are not primarily the result of lag variations. A selection[10] of the estimated model specification used for robustness checks are presented in Appendix C, with the main findings discussed in this section. Overall, the main results are relatively robust across model specifications.

- In Table C1 in Appendix C, we test our main model with the total household savings rate as dependent variable, instead of the household savings rate net of pension savings (removing pension savings as an explanatory variable). This tests for potential problems arising from a high correlation between *Pension* and *ln(Housep)* and *Int.share* (both >0.8). The results show that there are only minor changes in the magnitude of the coefficients, implying limited multicollinearity problems with regards to *Pension*. Table C1 also shows that the exclusion of *Ex.cpif* from the model has minor effects on other coefficients.
- We estimate the model only including the I(1) variables to verify that the existence of the long-run relationship is not dependent on what exogenous regressors that are included. Table C2 shows that the exclusion of the I(0) regressors has a relatively large impact on the magnitude of the coefficients, but the sign and significance only changes for *Ex.cpif*. Previous tests did however show that excluding *Ex.cpif* from the model has a neglectable effect on other coefficients. The Bound-test still shows that we reject the null hypothesis of no level relationship among the variables at the 1% significance level.
- To robustness test the results for our interest payments variable we run the baseline model with both the real and nominal interest rate (Table C3). Both the real and nominal measure

[10] To refrain from excessive model specification, only the most crucial robustness tests are presented.

of interest rates fails to reach significance, regardless of including interest payments or not.

- To support our conclusion that the significance of the total dependency ratio is primarily random, we replace it by combinations of three other dependency ratio versions: the young, old, and 15-year leading old dependency ratio (Table C4). The old dependency ratio is positive and significant both when included on a stand-alone basis and in combination with the young dependency ratio. This indicates that the significant and positive effect of total dependency ratio primarily derives from the old dependency ratio, which could support increased savings in response to a rising life expectancy. This argument is however weakened by the fact that the leading version fails to reach significance, and that the old dependency ratio declined between 1990 and 2003 despite a rising life expectancy.
- Adding a deterministic trend variable to the long-run relationship reveals that the increased savings rate is not driven by an exogenous trend (Table C5 model C5.1).
- The non-significance of the European Economic Policy Uncertainty Index suggests that uncertainty not captured by real economic variables has not been an active determinant of the household savings rate. To test the robustness of these results, we replace the Economic Policy Uncertainty Index with its Swedish counterpart. The index is constructed by Armelius et al. (2017), using the Baker et al. methodology. This index also fails to reach statistical significance, confirming our primary results (Table C5, model C5.2).
- We add the percentage change in the unemployment rate to *Model(1)*, primarily to test the robustness of disposable income and GDP growth. Disposable income and GDP growth remain statistically significant, while the unemployment measure fails to reach significance (Table C5, model C5.3).
- Based on their comparatively large coefficient change in the breakpoint model, we estimate our model allowing for a break in the variables *Pensions, Ex.cpif* and *House price volatility.* None of the variables seem to experience a coefficient change at the breakpoint (Table C6)
- We test for a structural break in the reaction to house prices by replacing the variable *ln(Housep)* with year-on-year house price growth. While significant and negative before 2009, the net effect is positive and of economic significance after 2009, meaning that the response to rising house prices has switched sign (Table C7).
- It is hard to test whether or not the structural break in the relationship with house prices originates from housing bubble concerns or something else. That a majority of Swedes believe Sweden is experiencing a housing bubble supports our chosen hypothesis. Our index of the number of mentions of the phrase housing bubble in Swedish newspapers displayed in

Figure 3 also correlates well with the savings rate. Changes to Sweden's mortgage regulations regarding amortization levels and allowed LTV ratios might have affected the savings rate, but relevant changes are too recent to explain a structural break in 2009. Another hypothesis is that banks have raised their equity share requirement for house purchases after the financial crisis, which would raise the need for saving prior to purchasing a house. This should however only affect a small part of the population, and would not cause a break of the magnitude found.

- We test a model with *ln(Housep)* replaced by a measure of net wealth to disposable income. The variable does not show significant signs of a structural break, but is positive and significant in the non-breakpoint model. The variable could fail to reach significance in the breakpoint model since it reflects several asset classes, and not just house prices.

7. Discussion

Our findings support the Permanent Income Hypothesis, Precautionary Saving Hypothesis, and Ricardian Equivalence. We do not find support for the Life-Cycle Hypothesis, which could be an effect of our relatively short study period. Cross-country studies generally have a higher variation in demographic statistics, making them better equipped to test the Life-Cycle Hypothesis (Masson et al., 1995). As discussed, it is not impossible that the technical effect of a rising dependency ratio and the theoretical effect of a rising life expectancy neutralize each other. Our results in support of Ricardian Equivalence are highly significant, but only indicate a roughly 20 per cent compensation of public sector saving/dissaving among households. Previous literature has generally found a 0.5-0.6 compensation factor, but has primarily been performed on the entire private sector. We invite further research into the saving behaviour of the Swedish corporate sector, to examine if it has a higher compensation factor than the household sector.

We are among the first to have studied the difference in propensity to consume between capital gains and other income. Not controlling for the share of capital gains in disposable income risks biasing the effect of example given stock and house market development. While positive stock and housing market development is generally considered to lower the savings rate, their correlation with capital gains' share of disposable income adds a positive relationship. We are also, to the best of our knowledge, the first to test for evidence of inertia of consumption relative to interest rate payments. Intuitively households save enough to cover recent levels of interest payments, meaning that reductions in interest payments relative to disposable income are not fully consumed in the present period. These results warrant further research, since they potentially could improve the forecasting models of the Swedish Riksbank, among others.

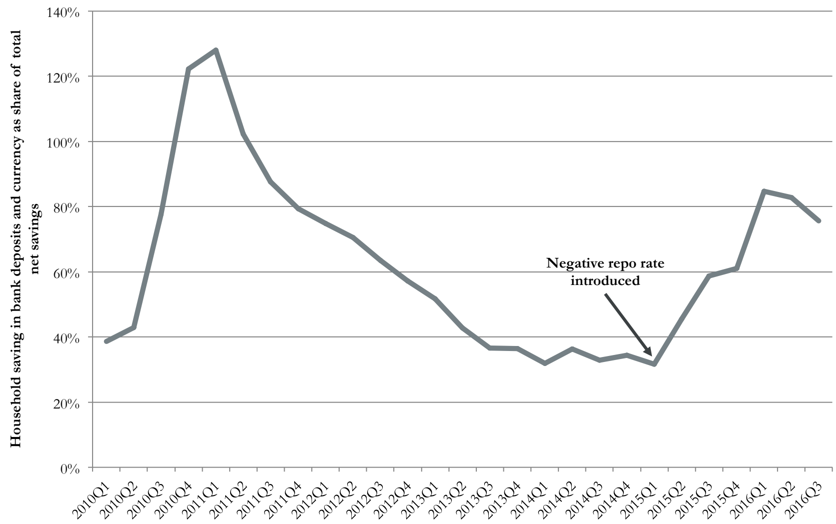
The risk of a housing bubble is one of the most widely discussed subjects in Sweden today, and has been for several years. We are not going to comment on the potential existence of a housing bubble. We can however say that the high and rising savings rate marks an important difference between the current Swedish situation and the prelude to the 2007-2008 crisis in the US and Southern Europe. As mentioned in the literature review, Armelius and Dillén (2011), find that a low savings rate relative to historical values raises the likelihood of a drop in house prices. An unusually high savings rate does not lower the risk of a drop in house prices relative to the unconditioned case, but a higher savings rate seems to mitigate the real economic consequences of a house price drop. Considering the magnitude of the current "savings gap" in Sweden relative to historical values, the mitigating effect could be significant.

What we interpret as fear of a housing bubble has caused households to raise their savings rate to record levels, offsetting potential wealth and interest rate effects. Given the current unconventional monetary policy of the world's central banks, potential adverse effects need to be studied further. We invite further research into the subject, especially into the household reaction to negative interest rates. We would have liked to study the effects of negative policy rates within our current framework, but unfortunately the treatment period was too short. There are however some early indications of zero and negative rates affecting households in non-textbook manners, especially in Northern Europe. *"People look at that and see negative interest rates as a warning signal that the future is even less safe than it is today"*, warned Paul Achleitner, Chairman of Deutsche Bank, in 2016 (Long, 2017). Swedish Bank SEB's Chief Economist Robert Bergqvist highlighted the phenomenon in 2016 (Tuvhag, 2016). He has reportedly been hearing two reasons behind high savings during his daily work. Firstly, people are wondering what problems Sweden might have, given the need for negative interest rates. Secondly, they are worried that the negative interest rate is creating a housing bubble and therefore feel the need to create a buffer for the subsequent correction further down the road. Part of the positive relationship between house prices and the savings rate captured in our study could thereby stem from an interaction with negative interest rates.

The development of saving in bank deposit accounts further supports unintended effects of the Swedish Riksbank's monetary policy, and strengthens the plausibility of our results. When the Swedish Riksbank moved its main policy rate below zero, the share of household savings placed in close-to-zero yielding bank deposits rapidly rose from around 30 to above 80 per cent (see

Figure 6). The theoretical response would have been to increase the share of riskier assets, such as stocks and bonds. Lower interest rates can increase the savings necessary to reach pension targets, thereby increasing the savings rate. The increased weighting towards deposit saving does on the other hand indicate a pure uncertainty aversion related to negative interest rates.

Figure 6. *Household saving in bank deposits and currency as a share of total household savings in Sweden*



Source: Statistics Sweden (2017d), with authors' calculations. The share of saving in deposits can surpass 100 per cent since savings are measured on a net basis. If the ratio surpasses 100 per cent, it indicates that other financial assets are sold-off, and that proceeds are kept in bank deposits.

Arguably, one way to raise economic activity is to reduce concerns regarding housing prices. Speculatively, phasing out negative interest rates could play an important part. We do of course not know the sign of the net effect from such action, but our results indicate a considerable strain on growth arising from housing bubble concerns. Disposable income has on average represented around 50 per cent of GDP, meaning that each percentage point on the household savings rate corresponds to roughly 0.5 per cent of Swedish GDP. As mentioned in our results segment, the relationship change in our house price variable raised our long-run modelled savings rate by 3.4 percentage points. Although a proper analysis would need to take a range of other variables into account, the strain on consumption growth arising from the relationship change seems to have been of large economic significance.

8. Conclusion

The purpose of this study was to identify the long- and short-run determinants of the Swedish household savings rate, and to test if a shift in the household reaction to house prices after 2008 could be an explanation to today's elevated levels. Many previous studies, especially Sweden-specific studies, have used simple regression models despite the presence of non-stationary data. An additional important contribution of this study is therefore the utilization of appropriate cointegration techniques, since results from other techniques could result in spurious regression. We conclude that the primary drivers of the Swedish household savings rate are disposable income growth, interest rate payments as a share of disposable income, GDP growth, pension savings, debt growth, the public sector budget balance, inflation, capital gains' share of disposable income, and house prices. Our results support the Permanent Income Hypothesis (PIH), Ricardian Equivalence, and the Precautionary Saving Hypothesis (PSH), but not the Life-Cycle Hypothesis (LCH). Lack of evidence for the latter could arise from the simultaneous but opposing forces of a rising dependency ratio and a rising life expectancy. The primary finding within the PSH is a structural break in the effect of house price development around the financial crisis, pointing to rising precautionary saving among households in response to housing bubble concerns. This counteracts the wealth effect that traditionally accompanies higher asset prices relative to disposable income, and points to substantial uncertainty avoidance among Swedish households. An uncertainty phenomenon of this magnitude has not been examined in previous literature, but its implications for both monetary policy and financial forecasting warrant further research.

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Appendix A – Data specifics

Household Savings Rate Net of Collective Pension Savings (SRnet): The total household savings rate is calculated by subtracting household consumption from household disposable income, and dividing the residual by disposable income. The savings rate can be divided into three parts; financial savings net of pension savings, pension savings, and real savings. Pension savings represent payments to the collective pension system. Financial savings include savings in e.g. stocks, funds, bonds, currency, and ownership shares in condominiums. Real savings is theoretically a measure of savings in small residential housing (not condominiums, which are included in financial assets) and other real assets, but is in practice a residual of disposable income, consumption, pension savings and financial savings. In our main model, we use the household savings rate net of collective pensions, which includes financial and real savings. Pensions are instead included as an explanatory variable. The total household savings rate is included in our robustness tests.

Figure A1a. *Graph of Household Savings Rate Net of Collective Pension Savings (Statistics Sweden, 2017b)*

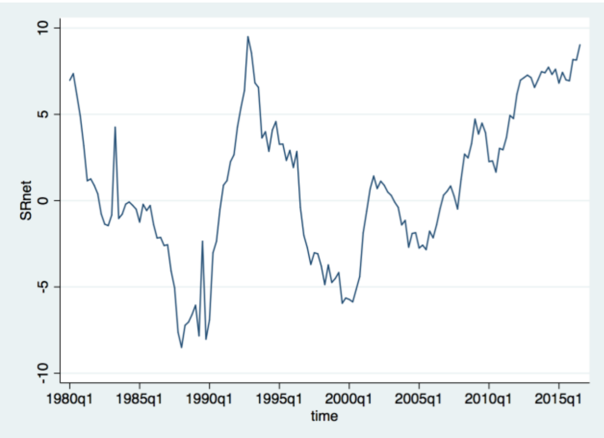
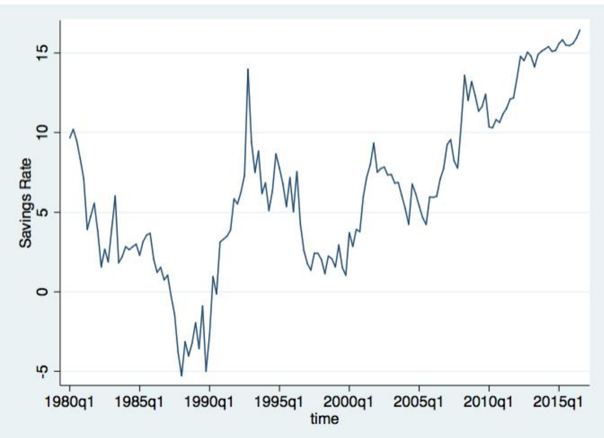
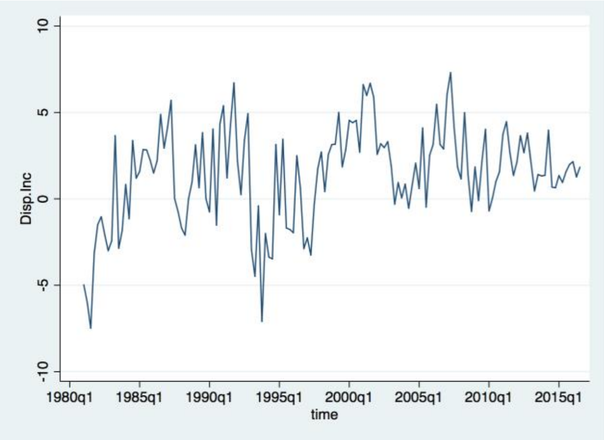


Figure A1b. *Graph of Total Household Savings Rate (Statistics Sweden, 2017b)*



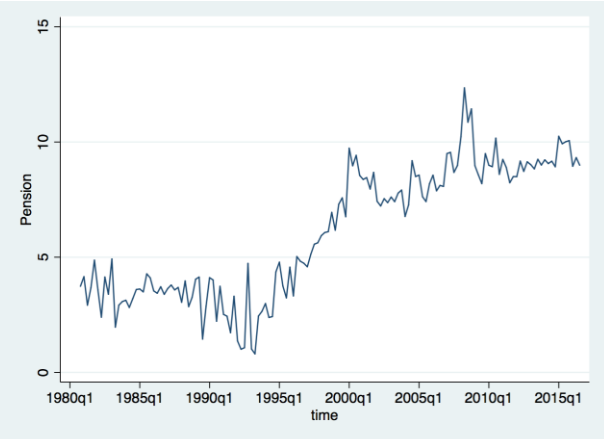
Real Disposable Income per Capita Growth YoY (DispInc): Disposable income primarily measures income from wages less taxes, social benefits (including pensions), and capital gains/losses. Disposable income and population data are obtained from Statistics Sweden (SCB). Disposable income data are published on a quarterly basis. Population data are published on an annual basis and has been converted into quarterly data by assuming an equal population increase over each quarter within a year.

Figure A2. *Graph of Real Disposable Income per Capita Growth YoY (Statistics Sweden, 2017c and 2017i)*



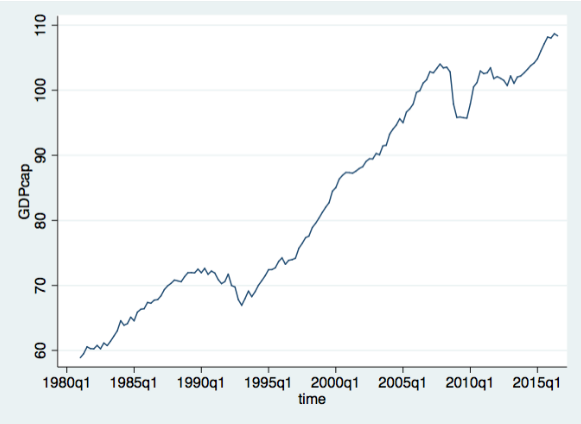
Collective Pension Savings as a Share of Disposable Income (Pension): Pensions savings as a share of disposable income describes the payments to the collective pension system as a share of disposable income. Data are obtained from Statistics Sweden (SCB) and published on a quarterly basis.

Figure A3. *Graph of Collective Pension Savings as a Share of Disposable Income (Statistics Sweden, 2017c)*



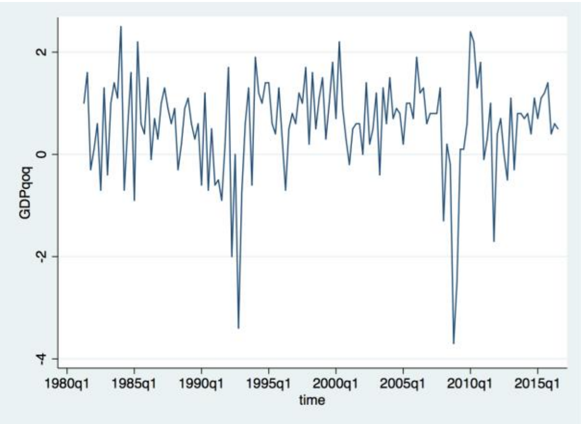
GDP per Capita (GDPcap): GDP per capita is calculated using quarterly GDP data (in constant 2015 SEK) from Statistics Sweden (SCB). Population data has been converted from annual into quarterly data by assuming an equal population increase over each quarter within a year.

Figure A4. *Graph of GDP per Capita (Statistics Sweden, 2017e and 2017i)*



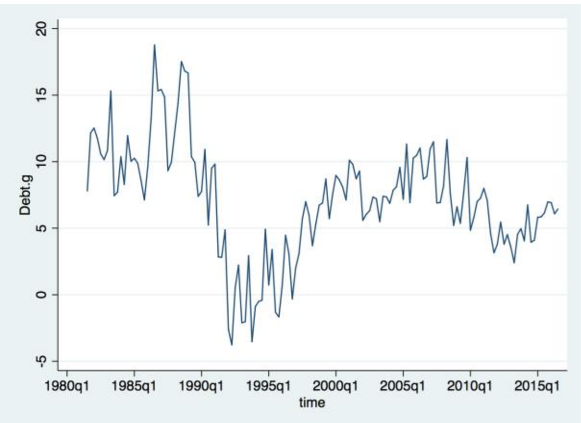
GDP Growth QoQ (GDPqoq): GDP growth is obtained from Statistics Sweden (SCB), and measures the volume change in GDP year over year.

Figure A5. *Graph of GDP Growth QoQ (Statistics Sweden, 2017e)*



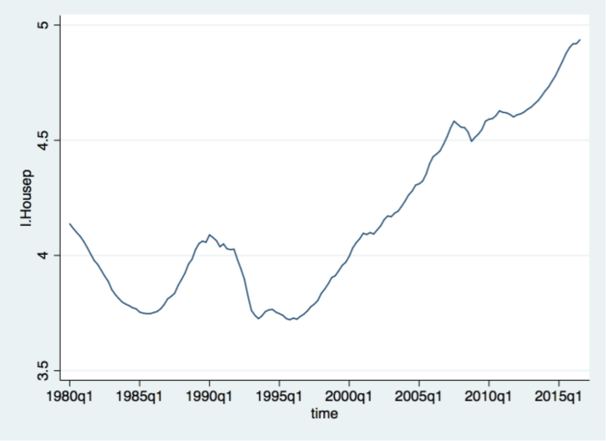
Debt Growth (Debtg): Debt growth is calculated based on data on household debt relative to disposable income, and growth in disposable income. Both variables are obtained from Statistics Sweden (SCB).

Figure A6. *Graph of Debt Growth (Statistics Sweden, 2017b)*



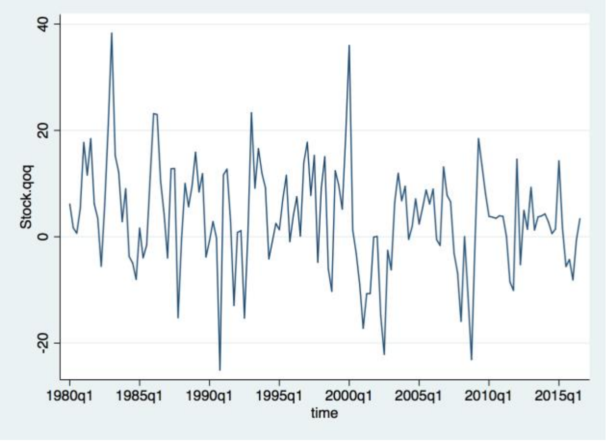
Real Residential House Prices (ln(Housep)): Our measure of real residential house prices is an index published by OECD, with 100 indexed to the year 2010. Data is published on a quarterly basis. We use the natural logarithm of the index to maintain the effect of percentage changes across time.

Figure A7. *Graph of Real Residential House Prices (OECD, 2017b)*



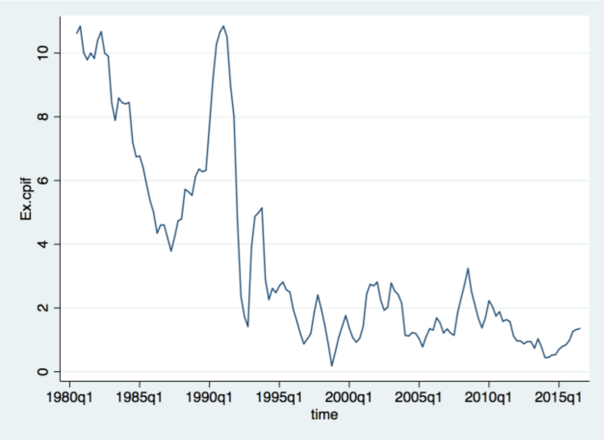
Stock market development QoQ (Stockqoq): Stock market development is calculated by quarter on quarter division of quarterly averages for the Affärsvärlden General Index, obtained from Affärsvärlden.

Figure A8. *Graph of Stock Market Development (Affärsvärlden, 2017)*



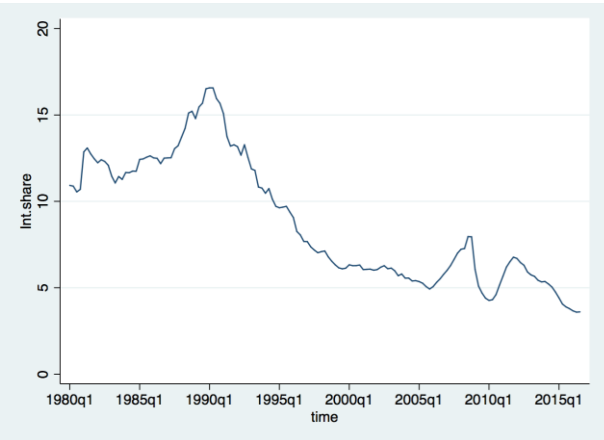
Expected Inflation (Ex.cpif): Our measure of expected inflation is constructed through using lags of KPIF inflation, which is inflation with constant interest rates (KPIX until Q4:1987, and KPIF thereafter). The weights of the lags are geometrically declining (0.5 weighting in the present period, then 0.25, 0.125 etc). Both KPIF and KPIX are published by Statistics Sweden (SCB)). Inflation data is published monthly and has been converted into quarterly data through averaging.

Figure A8. *Graph of Expected Inflation (Statistics Sweden, 2017f and 2017g)*



Interest Payments as a Share of Disposable Income (Int.share): Interest payments as a share of disposable income describes the percentage share of disposable income spent on interest payments among Swedish households. Data are collected from Statistics Sweden (SCB), and are published on a quarterly basis.

Figure A9. *Graph of Interest Payments as a Share of Disposable Income (Statistics Sweden, 2017b)*



Real and Nominal Interest Rate (Realint): The nominal interest rate is defined as the interest rate on 5-year government bonds. The real interest rate is calculated by adjusting the nominal interest rate by our measure of expected inflation (discussed above). Interest rate data are obtained from the Swedish Riksbank's database.

Figure A10a. *Graph of the Real Interest Rate (The Swedish Riksbank, 2017)*

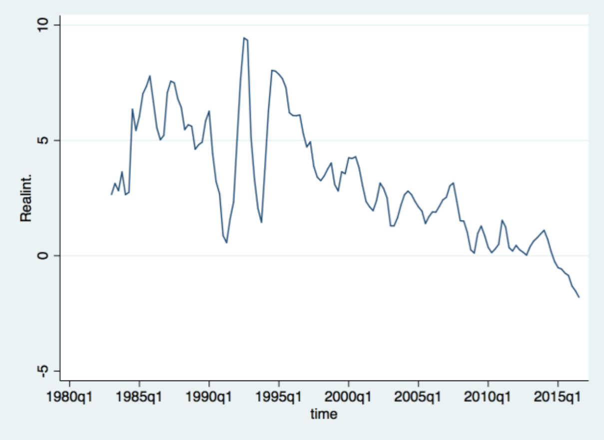
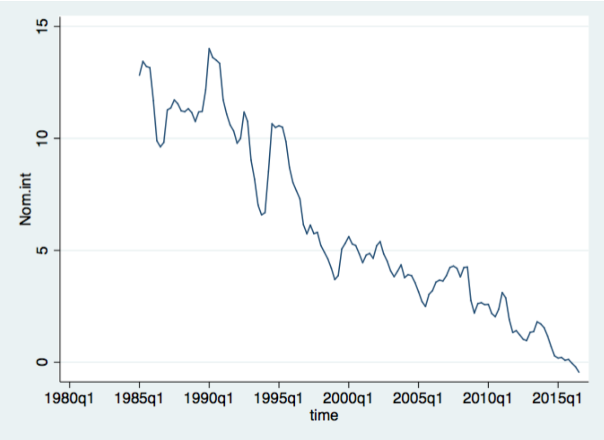


Figure A10b. *Graph of the Nominal Interest Rate (The Swedish Riksbank, 2017)*



Economic Policy Uncertainty Index (uncSWE1y, and uncEUR1y): We use both the European and Swedish Policy Uncertainty Index, which is published by Scott R. Baker, Nicholas Bloom and Steven J. Davis at www.Policyuncertainty.com. The European uncertainty index is constructed through analysis of two newspapers each from the the larger European economies; Germany, UK, Spain, Italy and France. The index measures the number of newspaper articles containing the terms uncertain or uncertainty, economic or economy, and one or more policy-relevant terms. The Swedish Policy Uncertainty Index is based on the Baker et al. (2015) methodology, and developed by Armelius et al. (2017). The indices are published on a monthly basis, and have been transformed into quarterly data through averaging.

Figure A11a. *Graph of Economic Policy Uncertainty Index Europe (Baker et al., 2017)*

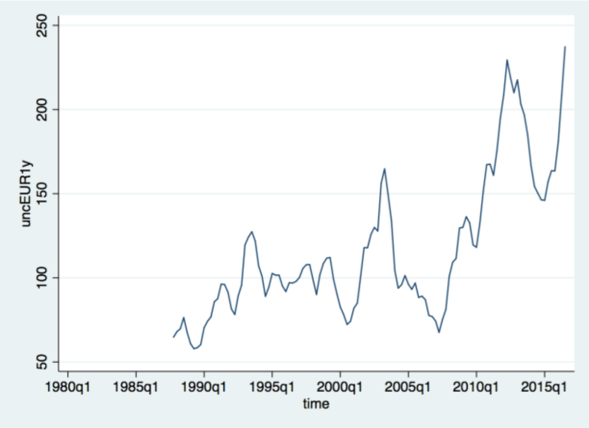
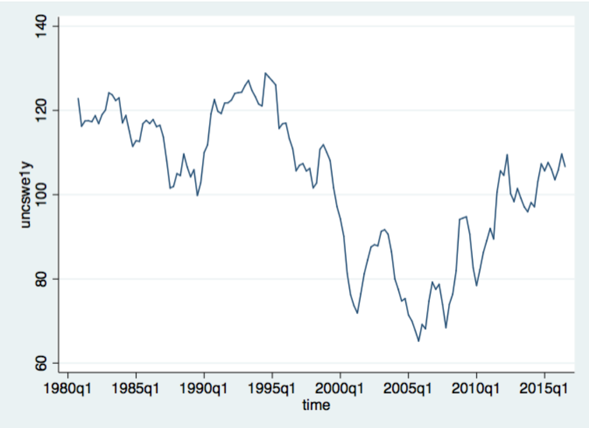
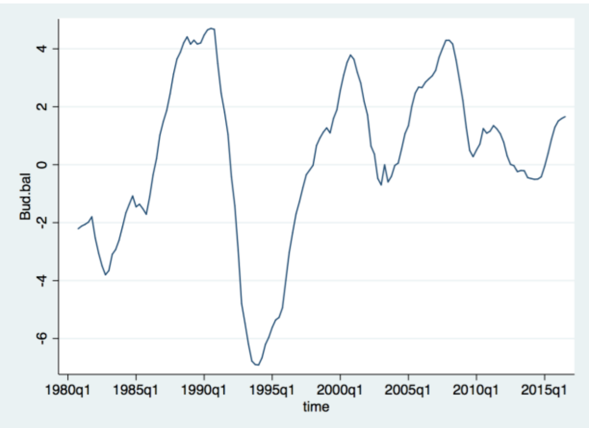


Figure A11b. *Graph of Economic Policy Uncertainty Index Sweden (Armelius et al., 2017)*



Public sector budget balance (Bud.bal): The government budget balance variable is a moving 12 month average of Statistics Sweden's (SCB) measure of public sector saving relative to GDP. GDP data have also been obtained from Statistics Sweden (SCB). The variable reflects saving in the entire public sector, not only on state level. The difference between the two is marginal, so the choice of definition should have very limited effect on results.

Figure A12. *Graph of Public sector budget balance (Statistics Sweden, 2017d)*



Dependency ratio (DepTot, Dep.Y, Dep.O, Dep.Old+15): as a demographic variable, we include the dependency ratio and a 15-year leading indicator of the old dependency ratio. The dependency ratio is defined as the non-working age population (<19 and >64 years) relative to the working age population (19-64 years), and the old dependency ratio the elderly population (>64) relative to the working age population. The data is obtained from Statistics Sweden (SCB).

We include the 15-year leading indicator for the old dependency ratio since previous literature has indicated that people generally start saving substantially for their retirement after the age of 50. This indicator is therefore intended to capture the effect of demographic changes within the working age population. The coefficient for the old dependency ratio should theoretically be negative, and the coefficient for the leading indicator potentially positive.

Figure A13a. *Graph of Total Dependency Ratio (Statistics Sweden, 2017h)*

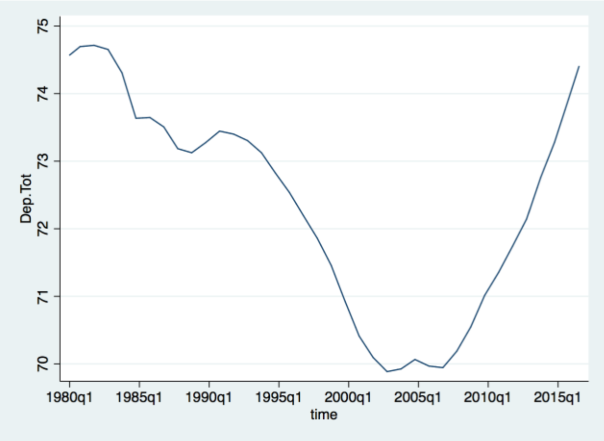


Figure A13b. *Graph of Dependency Ratio Old (Statistics Sweden, 2017h)*

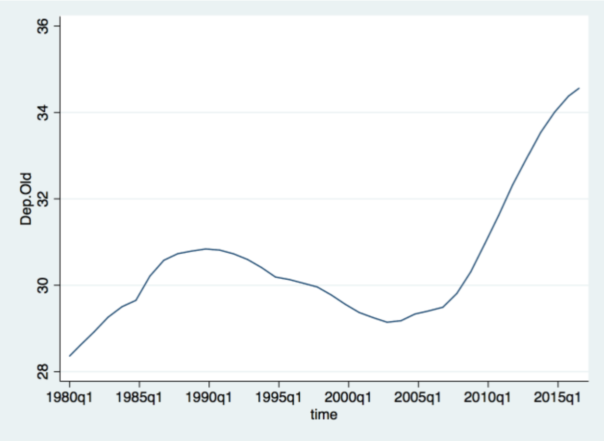


Figure A13c. *Graph of Dependency Ratio Young (Statistics Sweden, 2017b)*

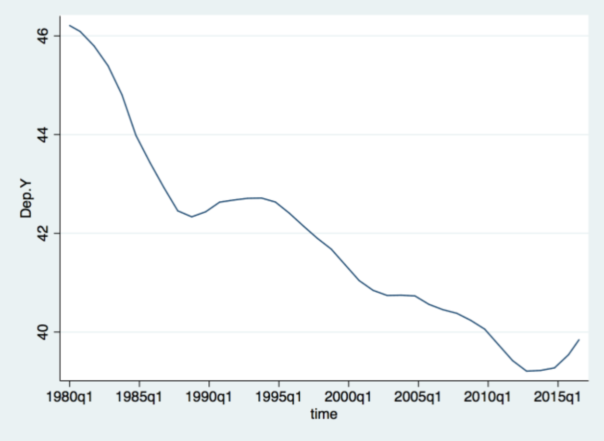
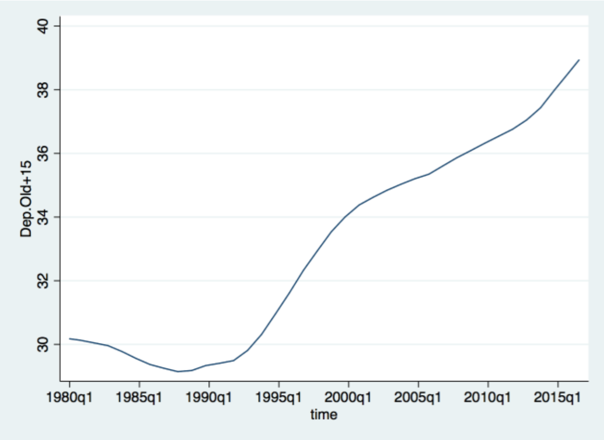
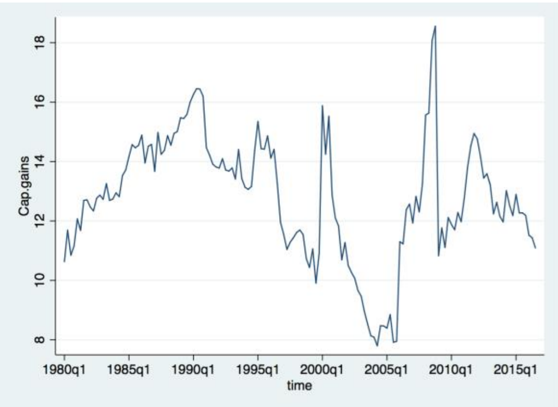


Figure A13d. *15-year leading old dependency ratio (Statistics Sweden, 2017b)*



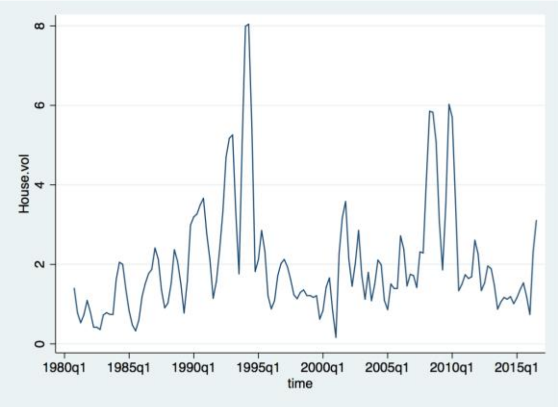
Capital gains' share of disposable income (Cap.gains): Describes the percentage share of disposable income represented by capital gains (not net of interest rate payments). Data are collected from Statistics Sweden (SCB), and are published on a quarterly basis.

Figure A14. *Graph of Capital Gains' Share of Disposable Income (Statistics Sweden, 2017c)*



House price growth volatility (House.vol): House price growth volatility is calculated by taking the 12-month trailing standard deviation of year-on-year house price growth. House price growth is based on our residential house price index, collected from OECD.

Figure A15. *Graph of House price growth volatility (OECD, 2017b)*



Net wealth to disposable income (Netass): Net wealth excludes collective pensions, and is obtained from the Swedish Riksbank. The Riksbank data ends in 2013, and is thereafter extrapolated using financial and real wealth statistics from Statistics Sweden (SCB). Data is published on a quarterly basis, except for real wealth statistics that are published on an annual basis.

Figure A15. *Graph of Net wealth to disposable income (The Riksbank, 2013; SCB, 2017j ;2017k)*

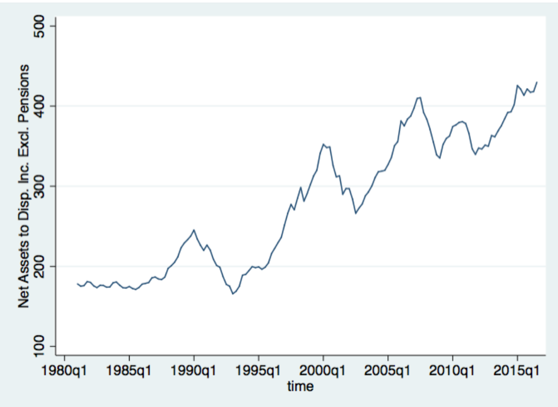


Table A1. *Pairwise correlations*

	SRnet	Pension	Disp.Inc	Int.share	Realint.	Ex.cpif	ln(Housep.)	Budbal	GDPqoq	House.vol	Debt.g	Cap.gains	uncEUR1y	Stock.qoq	GDPcap	Dep.Tot	Dep.Old	Dep.Y
SRnet	1.000																	
Pension	0.234	1.000																
Disp.Inc	-0.015	0.375	1.000															
Int.share	-0.311	-0.856	-0.249	1.000														
Realint.	-0.425	-0.695	-0.108	0.650	1.000													
Ex.cpif	-0.187	-0.679	-0.313	0.797	0.273	1.000												
ln(Housep.)	0.477	0.807	0.253	-0.655	-0.811	-0.452	1.000											
Budbal	-0.429	0.431	0.502	-0.105	-0.296	-0.113	0.427	1.000										
GDPqoq	-0.198	0.019	-0.001	-0.172	0.009	-0.094	-0.028	-0.050	1.000									
House.vol	0.252	-0.015	-0.061	0.049	0.039	-0.109	0.029	-0.111	-0.208	1.000								
Debt.g	-0.520	0.054	0.367	0.196	0.025	0.317	-0.004	0.516	0.123	-0.312	1.000							
Cap.gains	-0.023	-0.309	0.014	0.580	0.348	0.326	-0.197	0.064	-0.249	0.223	0.038	1.000						
uncEUR1y	0.700	0.478	-0.027	-0.532	-0.665	-0.400	0.626	-0.208	-0.047	-0.080	-0.257	-0.166	1.000					
uncSWE1y	0.199	-0.640	-0.387	0.589	0.350	0.505	-0.428	-0.493	-0.156	0.072	-0.246	0.413	0.043					
Stock.qoq	-0.099	-0.211	-0.279	0.106	0.073	0.124	-0.203	-0.250	0.166	-0.184	0.058	-0.069	-0.034	1.000				
GDPcap	0.380	0.910	0.374	-0.838	-0.772	-0.737	0.909	0.429	0.040	0.063	-0.095	-0.317	0.602	-0.244	1.000			
Dep.Tot	0.214	-0.640	-0.399	0.644	0.284	0.661	-0.305	-0.408	-0.042	-0.134	0.021	0.403	0.129	0.197	-0.611	1.000		
Dep.Old	0.517	0.326	0.089	-0.269	-0.460	-0.337	0.628	0.085	-0.044	0.033	-0.216	0.217	0.690	-0.087	0.502	0.224	1.000	
Dep.Y	-0.222	-0.812	-0.421	0.742	0.710	0.829	-0.738	-0.419	-0.001	-0.142	0.201	0.167	-0.710	0.231	-0.942	0.657	-0.587	1.000
Dep.Old+15	0.397	0.927	0.275	-0.926	-0.782	-0.747	0.865	0.274	0.059	0.001	-0.164	-0.394	0.680	-0.190	0.960	-0.577	0.496	-0.862

Appendix B – Additional tests

B1. Unit Root tests

The results in Table B1 show that the variables we are dealing with are a combination of stationary and non-stationary processes.

Table B1. *Unit Root test, DF-GLS*

	Trending?	***Lags(#)[1)]***	***Test statistic***	***5% crit. Value***	***Outcome***
SRnet	No	1	-0.924	-2.070	I(1)
First difference		*2*	*-4.715*	*-2.064*	
Pension	Yes	3	-1.560	-2.952	I(1)
First difference		*1*	*-10.119*	*-2.073*	
Disp.Inc	No	2	-1.212	-2.066	I(1)
First difference		*2*	*-6.369*	*-2.067*	
Int.share	Yes	1	-1.411	-2.974	I(1)
First difference		*1*	*-5.404*	*-2.071*	
Realint.	Yes	4	-1.843	-2.944	I(0)
First difference		*1*	*-6.282*	*-2.081*	
Ex.cpif	Yes	5	-1.939	-2.924	I(1)
First difference		*4*	*-4.539*	*-2.050*	
l.Housep	Yes	1	-0.784	-2.974	I(1)
First difference		*1*	*-2.398*	*-2.071*	
Bud.bal	No	4	-2.162	-2.050	I(0)
GDPqoq	No	*1*	*-5.049*	*-2.074*	I(0)
House.vol	No	2	-3.107	-2.065	I(0)
Debt.g	No	1	-2.913	-2.968 *-2.690(10%sign.)*	I(0)[2)]
Cap.gains	No	1	-2.197	-2.070	I(0)
Stock.qoq	No	2	-6.760	-2.070	I(0)
uncEUR1y	Yes	5	-2.971	-2.940	I(0)
GDPcap	Yes	2	-1.706	-2.978	I(1)
First difference		*1*	*-5.564*	*-2.074*	

1) Based on the *min SC* criteria provided by STATA
2) on 10% sign. level

B2. Johansen's rank test

The results of Johansen's rank test are somewhat inconclusive as the trace statistic and max statistic indicate different ranks. However, the results show that we cannot reject that there is only one cointegrating relationship among the variables.

Table B2. *Johansen's rank test*

Maximimum rank	Trace statistic	5% critical value	Max statistic	5% critical value
0	121.67	94.15	50.13	*39.37*
1	71.55	68.52	29.15**	*33.46*
2	42.39**	47.21	24.66	*27.07*
3	17.74	29.68	12.75	*20.97*
4	4.99	15.41	4.63	*14.07*
5	0.35	3.76	0.36	*3.76*

*** $p<0.05$*

B3. Ljung-Box test

We fail to reject the null hypothesis of a white noise residual and can thereby conclude that there is no serial correlation left in the residual. These results are presented in table B3.

Table B3. *Portmanteau test for white noise of the residual*

		K=1	K=4	K=8
Model with break	*Test statistic*	0.029	5.798	*12.612*
	p-value	0.864	0.215	*0.126*
Model without break	*Test statistic*	0.001	5.626	*7.564*
	p-value	0.977	0.229	*0.477*

K=the number of autocorrelations

Appendix C –Robustness tests

Table C1. *Model specifications excluding Expected inflation and with Total savings rate as dependent variable*

Model	**(1)**	**C1.1**	**C1.2**	**C1.3**
Including Ex..cpif:	Yes	No	Yes	No
Dependent variable	D.SRnet	D.SRnet	D.SR	D.SR
Adj. coef.	-0.419***	-0.411***	-0.560***	-0.548***
	(0.0589)	(0.0590)	(0.0562)	(0.0561)
LR				
Pension	-0.830***	-0.757***		
	(0.266)	(0.267)		
Disp.Inc	0.876***	0.827***	0.790***	0.749***
	(0.118)	(0.114)	(0.0871)	(0.0853)
ln(Housep)	12.36***	12.55***	11.17***	11.41***
	(0.836)	(0.852)	(0.553)	(0.550)
Int.share	-0.497**	-0.319+	-0.567***	-0.463***
	(0.234)	(0.204)	(0.0923)	(0.0691)
Ex.cpif	0.195+		0.161*	
	(0.131)		(0.0965)	
Constant	-47.99***	-49.70***	-42.03***	-43.31***
	(3.605)	(3.528)	(2.674)	(2.641)
SR				
D.Pension	-0.616***	-0.598***		
	(0.0957)	(0.0954)		
D.Disp.Inc	0.422***	0.407***	0.436***	0.419***
	(0.0386)	(0.0376)	(0.0387)	(0.0377)
LD.Disp.Inc	-0.131***	-0.119***	-0.161***	-0.147***
	(0.0444)	(0.0439)	(0.0441)	(0.0437)
L2D.Disp.Inc	-0.148***	-0.136***	-0.191***	-0.179***
	(0.0383)	(0.0378)	(0.0372)	(0.0368)
L3D.Disp.Inc	-0.122***	-0.116***	-0.137***	-0.131***
	(0.0312)	(0.0311)	(0.0313)	(0.0314)
D.ln(Housep)	-13.88***	-17.00***	-12.78**	-16.28***
	(4.920)	(4.484)	(4.982)	(4.546)
D.Int.share	-1.200***	-1.174***	-1.279***	-1.272***
	(0.230)	(0.230)	(0.220)	(0.221)
LD.Int.share	0.588**	0.534**	0.506**	0.460**
	(0.229)	(0.227)	(0.227)	(0.227)
L2D.Int.share	-0.306	-0.383*	-0.366*	-0.444**
	(0.217)	(0.212)	(0.215)	(0.212)
L3D.Int.share	0.604***	0.563***	0.650***	0.617***
	(0.213)	(0.212)	(0.210)	(0.210)
D.Ex.cpif	0.0818+		0.0904*	
	(0.0545)		(0.0545)	
Cap.gains	0.202***	0.183***	0.271***	0.257***
	(0.0583)	(0.0572)	(0.0512)	(0.0508)
GDPqoq	-0.151*	-0.129+	-0.230***	-0.209**
	(0.0862)	(0.0854)	(0.0846)	(0.0843)
House.vol	0.105*	0.0850+	0.134**	0.113**
	(0.0548)	(0.0534)	(0.0549)	(0.0538)
Debt.g	-0.0670**	-0.0523*	-0.0627**	-0.0438*
	(0.0282)	(0.0266)	(0.0278)	(0.0255)
Bud.bal	-0.416***	-0.402***	-0.554***	-0.530***
	(0.0896)	(0.0896)	(0.0790)	(0.0782)
N	139	139	139	139
Adj. R-Square	0.704	0.701	0.752	0.749
Rmse	0.756	0.760	0.767	0.772
Bound test, *Fstat*	8.729***	9.705***	18.28***	21.07***

*Standard errors in parentheses, + p<0.15, * p<0.1, ** p<0.05,*** p<0.01*

Table C2. *Model specifications without exogenous regressors*

Model *Lag selection:*	**(1)** BIC	**C2.1** Mirror (1)	**C2.2** BIC
Dependent variable	D.SRnet	D.SRnet	D.SRnet
Adj. coef.	-0.419*** (0.0589)	-0.127*** (0.0309)	-0.157*** (0.0320)
LR			
Pension	-0.830*** (0.266)	-1.145+ (0.740)	-1.499** (0.657)
Disp.Inc	0.876*** (0.118)	1.029** (0.457)	0.709** (0.302)
.ln(Housep)	12.36*** (0.836)	15.91*** (3.224)	17.03*** (2.858)
Int.share	-0.497** (0.234)	-0.170 (0.546)	-0.164 (0.459)
Ex.cpif	0.195+ (0.131)	-0.475 (0.389)	-0.720** (0.310)
Constant	-47.99*** (3.605)	-54.99*** (12.51)	-56.94*** (10.66)
SR			
D.Pension	-0.616*** (0.0957)	-0.469*** (0.0912)	-0.364*** (0.0938)
LD.Pension			0.221** (0.0885)
D.Disp.Inc	0.422*** (0.0386)	0.341*** (0.0362)	0.325*** (0.0362)
LD.Disp.Inc	-0.131*** (0.0444)	-0.0580 (0.0432)	
L2D.Disp.Inc	-0.148*** (0.0383)	-0.0842** (0.0404)	
L3D.Disp.Inc	-0.122*** (0.0312)	-0.0956*** (0.0342)	
D.l.Housep	-13.88*** (4.920)	-26.59*** (4.841)	-27.67*** (5.015)
D.Int.share	-1.200*** (0.230)	-1.041*** (0.228)	-1.165*** (0.236)
LD.Int.share	0.588** (0.229)	0.869*** (0.244)	0.520** (0.216)
L2D.Int.share	-0.306 (0.217)	-0.479** (0.240)	-0.269 (0.213)
L3D.Int.share	0.604*** (0.213)	0.437* (0.229)	0.421** (0.212)
D.Ex.cpif	0.0818+ (0.0545)	-0.0605 (0.0516)	-0.113** (0.0491)
Controlling for:			
	Cap.gains GDPqoq House.vol Debt.g Bud.bal	–	–
N	139	139	142
Adj. R-Square	0.704	0.621	0.583
Rmse	0.756	0.854	0.894
Bound test, *Fstat*	8.729***	7.632***	8.801***

*Standard errors in parentheses, + p<0.15, * p<0.1, ** p<0.05,*** p<0.01*

Table C3. *Variations of Interest rates*

Model *Int. rate; lag selection*	**(1)** Int.share; BIC	**C3.1** Realint; m(1)[1)]	**C3.2** Realint;BIC	**C3.3** Nom.int; m(1)[1)]	**C3.4** Nom.int;BIC
Dependent variable	D.SRnet	D.Srnet	D.Srnet	D.Srnet	D.Srnet
Adj. coef.	-0.419*** (0.0589)	-0.371*** (0.0669)	-0.335*** (0.0640)	-0.372*** (0.0684)	-0.387*** (0.0667)
LR					
Pension	-0.830*** (0.266)	-0.351+ (0.214)	-0.271 (0.236)	-0.372 (0.284)	-0.252 (0.206)
Disp.Inc	0.876*** (0.118)	0.811*** (0.155)	0.759*** (0.158)	0.821*** (0.161)	0.798*** (0.150)
ln(Housep)	12.36*** (0.836)	10.90*** (1.716)	11.79*** (1.441)	11.37*** (1.504)	11.75*** (1.306)
Ex.cpif	0.195+ (0.131)	0.160 (0.185)	0.159 (0.204)	0.317+ (0.211)	0.282+ (0.183)
Constant	-47.99*** (3.605)	-44.31*** (7.445)	-48.39*** (6.185)	-46.04*** (7.341)	-48.74*** (5.637)
	Int.Share	*Realint*	*Realint*	*Nomint*	*Nomint*
Interest rate	-0.497** (0.234)	-0.303 (0.316)	-0.170 (0.209)	-0.220 (0.300)	-0.0817 (0.204)
SR					
D.Pension	-0.616*** (0.0957)	-0.403*** (0.0926)	-0.439*** (0.0869)	-0.431*** (0.103)	-0.411*** (0.0949)
D.Disp.Inc	0.422*** (0.0386)	0.418*** (0.0470)	0.438*** (0.0410)	0.421*** (0.0470)	0.431*** (0.0440)
LD.Disp.Inc	-0.131*** (0.0444)	-0.102** (0.0507)		-0.118** (0.0529)	-0.105** (0.0507)
L2D.Disp.Inc	-0.148*** (0.0383)	-0.0872** (0.0436)		-0.0893* (0.0458)	-0.0854* (0.0446)
L3D.Disp.Inc	-0.122*** (0.0312)	-0.135*** (0.0354)		-0.143*** (0.0375)	-0.132*** (0.0361)
D.l.Housep	-13.88*** (4.920)	-10.89* (6.011)	-17.96*** (5.542)	-12.34** (6.206)	-14.01** (6.086)
D.Ex.cpif	0.0818+ (0.0545)	0.0592 (0.0685)	0.0531 (0.0670)	0.118+ (0.0803)	0.109+ (0.0742)
Cap.gains	0.202*** (0.0583)	0.108** (0.0537)	0.0866* (0.0501)	0.101* (0.0519)	0.0951* (0.0510)
GDPqoq	-0.151* (0.0862)	-0.265*** (0.0908)	-0.313*** (0.0904)	-0.309*** (0.0990)	-0.282*** (0.0945)
House.vol	0.105* (0.0548)	0.0331 (0.0595)	0.0443 (0.0579)	0.0271 (0.0690)	0.0182 (0.0639)
Debt.g	-0.0670** (0.0282)	-0.0896*** (0.0331)	-0.0732** (0.0304)	-0.0845** (0.0349)	-0.0836** (0.0335)
Bud.bal	-0.416*** (0.0896)	-0.394*** (0.111)	-0.340*** (0.0970)	-0.395*** (0.116)	-0.432*** (0.111)
LD.Srnet			-0.178*** (0.0659)		
Interest rate:	*Int.Share*	*Realint*	*Realint*	*Nomint*	*Nomint*
D	-1.200*** (0.230)	-0.264** (0.118)	-0.0567 (0.0718)	-0.200 (0.168)	-0.0740 (0.143)
LD	0.588** (0.229)	0.219* (0.121)		0.176 (0.188)	
L2D	-0.306 (0.217)	-0.0784 (0.113)		0.0609 (0.170)	
L3D	0.604*** (0.213)	0.135 (0.117)		-0.102 (0.165)	
N	139	131	135	123	126
Adj. R-Square	0.704	0.580	0.623	0.592	0.589
Rmse	0.756	0.822	0.861	0.832	0.828
Bound test, *Fstat*	8.729***	5.356***	5.737***	5.186***	5.847***

*Standard errors in parentheses, + p<0.15, * p<0.1, ** p<0.05,*** p<0.01*
1) Lag selected to mirror lag length of the main model, Model(1)

Table C4. *Variations of the dependency ratio*

Model *Dependency ratio:*	**C4.1** Total	**C4.2** Old & young	**C4.3** Old	**C4.4** Leading 15y
Dependent variable	D.SRnet	D.SRnet	D.SRnet	D.SRnet
Adj. coef.	-0.466*** (0.0599)	-0.494*** (0.0623)	-0.496*** (0.0618)	-0.428*** (0.0613)
LR				
Pension	-0.583** (0.244)	-0.587** (0.229)	-0.599*** (0.224)	-0.891*** (0.284)
Disp.Inc	0.915*** (0.106)	0.863*** (0.103)	0.854*** (0.0958)	0.880*** (0.116)
ln(Housep)	10.57*** (0.933)	9.012*** (1.303)	8.872*** (1.185)	11.26*** (2.108)
Int.share	-0.510** (0.205)	-0.533*** (0.193)	-0.536*** (0.191)	-0.353 (0.342)
Ex.cpif	0.178+ (0.114)	0.294** (0.130)	0.311*** (0.113)	0.200+ (0.129)
Constant	-81.75*** (12.28)	-57.95*** (18.72)	-53.01*** (3.308)	-55.14*** (13.18)
SR				
D.Pension	-0.567*** (0.0948)	-0.579*** (0.0946)	-0.584*** (0.0928)	-0.634*** (0.101)
D.Disp.Inc	0.444*** (0.0385)	0.437*** (0.0385)	0.435*** (0.0374)	0.418*** (0.0392)
LD.Disp.Inc	-0.159*** (0.0443)	-0.155*** (0.0441)	-0.153*** (0.0433)	-0.137*** (0.0457)
L2D.Disp.Inc	-0.171*** (0.0382)	-0.167*** (0.0381)	-0.165*** (0.0373)	-0.150*** (0.0387)
L3D.Disp.Inc	-0.129*** (0.0305)	-0.123*** (0.0306)	-0.122*** (0.0300)	-0.124*** (0.0316)
D.ln(Housep)	-14.37*** (4.792)	-17.92*** (5.299)	-18.41*** (4.955)	-14.44*** (5.036)
D.Int.share	-1.171*** (0.224)	-1.163*** (0.223)	-1.164*** (0.222)	-1.159*** (0.242)
LD.Int.share	0.543** (0.223)	0.536** (0.222)	0.537** (0.221)	0.561** (0.235)
L2D.Int.share	-0.245 (0.212)	-0.260 (0.211)	-0.265 (0.209)	-0.329+ (0.221)
L3D.Int.share	0.730*** (0.212)	0.740*** (0.211)	0.735*** (0.209)	0.578*** (0.218)
D.Ex.cpif	0.0832+ (0.0530)	0.145** (0.0665)	0.154*** (0.0573)	0.0854+ (0.0550)
Cap.gains	0.143** (0.0608)	0.137** (0.0605)	0.139** (0.0597)	0.203*** (0.0585)
GDPqoq	-0.171** (0.0842)	-0.188** (0.0845)	-0.190** (0.0840)	-0.148* (0.0867)
House.vol	0.187*** (0.0611)	0.194*** (0.0609)	0.190*** (0.0593)	0.111** (0.0559)
Debt.g	-0.0903*** (0.0288)	-0.0722** (0.0309)	-0.0683** (0.0272)	-0.0567* (0.0339)
Bud.bal	-0.425*** (0.0873)	-0.469*** (0.0912)	-0.475*** (0.0883)	-0.428*** (0.0927)
Dep.ratio	*Total*	*1)Old & 2)Young*	*Old*	*Lead.15*
1)	0.271*** (0.0988)	0.334*** (0.107)	0.328*** (0.104)	0.138 (0.249)
2)		0.0473 (0.176)		
N	139	139	139	139
Adj. R-Square	0.719	0.723	0.725	0.702
Rmse	0.735	0.731	0.728	0.758
Bound test, *Fstat*	9.952***	10.18***	10.33***	8.203***

*Standard errors in parentheses, + p<0.15, * p<0.1, ** p<0.05,*** p<0.01*

Table C5. *Specifications including a deterministic trend, Economic Policy Uncertainty Index for Sweden and unemployment*

Model *Additional variable:*	**(1)** –	**C5.1** Trend	**C5.2** Unc. Sweden	**C5.3** Unemployment
Dependent variable	D.SRnet	D.SRnet	D.SRnet	D.SRnet
Adj. coef.	-0.419*** (0.0589)	-0.427*** (0.0608)	-0.431*** (0.0603)	-0.426*** (0.0658)
LR				
Pension	-0.830*** (0.266)	-0.843*** (0.263)	-0.751*** (0.269)	-0.674** (0.270)
Disp.Inc	0.876*** (0.118)	0.870*** (0.117)	0.876*** (0.115)	0.810*** (0.127)
ln(Housep)	12.36*** (0.836)	11.30*** (1.998)	12.11*** (0.846)	12.48*** (0.844)
Int.share	-0.497** (0.234)	-0.441* (0.248)	-0.497** (0.227)	-0.375+ (0.236)
Ex.cpif	0.195+ (0.131)	0.241+ (0.151)	0.189+ (0.127)	0.229* (0.132)
Trend		0.0179 (0.0308)		
Constant	-47.99*** (3.605)	-45.55*** n.a[1)]	-48.85*** (3.617)	-49.31*** (3.640)
SR				
D.Pension	-0.616*** (0.096)	-0.624*** (0.097)	-0.601*** (0.0970)	-0.605*** (0.0976)
D.Disp.Inc	0.422*** (0.039)	0.414*** (0.041)	0.419*** (0.0387)	0.406*** (0.0401)
LD.Disp.Inc	-0.131*** (0.044)	-0.136*** (0.045)	-0.139*** (0.0451)	-0.133*** (0.0488)
L2D.Disp.Inc	-0.148*** (0.038)	-0.148*** (0.038)	-0.153*** (0.0387)	-0.148*** (0.0408)
L3D.Disp.Inc	-0.122*** (0.031)	-0.122*** (0.031)	-0.123*** (0.0312)	-0.120*** (0.0324)
D.l.Housep	-13.88*** (4.920)	-14.930*** (5.260)	-14.17*** (4.930)	-18.49*** (5.414)
D.Int.share	-1.200*** (0.230)	-1.172*** (0.236)	-1.163*** (0.233)	-1.196*** (0.234)
LD.Int.share	0.588** (0.229)	0.586** (0.229)	0.594** (0.229)	0.469* (0.241)
L2D.Int.share	-0.306 (0.217)	-0.318+ (0.219)	-0.302 (0.217)	-0.373* (0.220)
L3D.Int.share	0.604*** (0.213)	0.591*** (0.214)	0.607*** (0.213)	0.583*** (0.214)
D.Ex.cpif	0.082+ (0.055)	0.103+ (0.066)	0.0816+ (0.0545)	0.0975* (0.0574)
Cap.gains	0.202*** (0.058)	0.200*** (0.059)	0.181*** (0.062)	0.171*** (0.0614)
GDPqoq	-0.151* (0.086)	-0.153* (0.086)	-0.150* (0.086)	-0.183** (0.0887)
House.vol	0.105* (0.055)	0.098* (0.056)	0.124** (0.0582)	0.0826+ (0.0558)
Debt.g	-0.067** (0.028)	-0.051 (0.040)	-0.065** (0.028)	-0.0570* (0.030)
Bud.bal	-0.416*** (0.090)	-0.434*** (0.095)	-0.412*** (0.090)	-0.447*** (0.102)
uncSWE1y			0.009 (0.009)	
Unempl.ch				-0.378 (0.317)
N	139	139	139	134
Adj. R-Square	0.704	0.702	0.704	0.714
Rmse	0.756	0.758	0.756	0.753
Bound test, *F*-stat	8.729***	8.404***	8.852***	7.624***

*Standard errors in parentheses, + p<0.15, * p<0.1, ** p<0.05,*** p<0.01*

1*) Coefficient of restricted constant based on own calculation according to the linear relationship between restricted and unrestricted constant and thus exact standard error not available*

Table C6. *Structural break tests*

Model	**/7)**	**C6.1**	**C6.2**	**C6.3**	**C6.4**
Break in (apart from house p):	–	House vol.	Pensions	Int.share	All 3
Dependent variable	D.SRnet	D.SRnet	D.SRnet	D.SRnet	D.SRnet
Adjustment coef.	-0.480***	-0.487***	-0.477***	-0.482***	-0.484***
	(0.0602)	(0.0609)	(0.0606)	(0.0609)	(0.0617)
LR					
Pension	-0.582**	-0.612***	-0.558**	-0.580**	-0.588**
	(0.233)	(0.232)	(0.239)	(0.233)	(0.239)
Disp.Inc	0.861***	0.855***	0.859***	0.854***	0.858***
	(0.0991)	(0.0975)	(0.0998)	(0.101)	(0.101)
ln(Housep)	10.06***	9.891***	10.04***	10.01***	9.880***
	(1.232)	(1.224)	(1.242)	(1.240)	(1.245)
Int.share	-0.363*	-0.403**	-0.347*	-0.365*	-0.386*
	(0.198)	(0.200)	(0.203)	(0.198)	(0.205)
Ex.cpif	0.195*	0.208*	0.194*	0.194*	0.210*
	(0.110)	(0.110)	(0.111)	(0.110)	(0.112)
ln(Housep)09q1	9.286***	8.337***	9.974***	10.13**	8.300*
	(2.660)	(2.800)	(3.062)	(3.921)	(4.517)
Pensions09q1			-0.322		-0.436
			(0.684)		(0.723)
Int.Share09q1				0.157	-0.148
				(0.535)	(0.612)
Constant09q1	-42.39***	-37.25***	-42.70***	-47.11**	-32.25
	(12.20)	(13.16)	(12.32)	(20.27)	(24.71)
Constant	-40.06***	-39.25***	-40.25***	-39.94***	-39.47***
	(5.059)	(5.049)	(5.115)	(5.073)	(5.137)
SR					
D.ln(Housep)	-16.16***	-16.17***	-15.97***	-16.32***	-15.77***
	(4.867)	(4.871)	(4.900)	(4.917)	(4.979)
D.ln(Housep)09q1	4.453***	4.063***	4.763***	4.877**	4.017*
	(1.329)	(1.396)	(1.485)	(1.973)	(2.233)
D.Pensions09q1			-0.154		-0.211
			(0.325)		(0.347)
D.Int.Share09q1				0.0754	-0.0715
				(0.259)	(0.295)
Housevol09q1		-0.142			-0.167
		(0.154)			(0.171)
Also controlling for					
D.Ex.cpif(1lag), D.Int.share(4lags), D.Disp.Inc(4lags), D.Pension(1lag),Cap.gains, GDPqoq, House.vol, Debt.g,Budbal					
N	139	139	139	139	139
Adj. R-Square	0.725	0.725	0.723	0.723	0.721
Rmse	0.727	0.728	0.730	0.730	0.733

*Standard errors in parentheses, + p<0.15, * p<0.1, ** p<0.05,*** p<0.01*
** Do not change notably across model specifications and are thus not reported*

Table C7. *Test for structural break in a model replacing ln(Housep) with YoY House price growth*

QLR-statistic	7.497**
Break point	2008q1
Coefficient on House price growth	
Break point 2008q1 as indicated by QLR-test	
Before breakpoint	-0.057*
After[1)]	0.108***
Break point 2009q1 as in main break model	
Before breakpoint	-0.055**
After[1)]	0.119***

** p<0.1, ** p<0.05,*** p<0.01*

1) Total effect after break