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Determinants of the Private Savings Rate

-A Study of the Swedish Case

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ABSTRACT

It is clear that the private savings rate varies between countries and over time. Several studies have looked into this but the results vary and no general conclusion can be drawn. With the lack of a comprehensive up to date study taking into consideration the Swedish case, I in this thesis look into the determinants of the private savings rate with the aim of creating a model that takes into account the characteristics of the Swedish economy. In doing so I present an econometric model covering the period 1970-2006 where the private savings rate is determined by income, the liquidity constraint and the government fiscal balance. I test whether the model holds for the whole period and find that it does.

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1. INTRODUCTION

One of the leading contributors to the theory of economic development was the work of Harrod and Domar (Agrawal, 2001). Their model of development and also the refined model by Robert Solow, focused much of the attention on the accumulation of savings. Lately, the behaviour of savings rates has again received an increased amount of attention as part of the literature on economic growth. The long-debated relationship between savings and the level and growth rate of income has increased researchers' interest for analysing savings more thoroughly. (Metin Ozcan et al., 2003)

Except for growth reasons, several other reasons have been presented on why it is interesting to investigate savings more closely. One of the most hotly debated issues today in many developed countries is how societies should collectively make provisions for the increasing numbers of elderly. (Deaton, 2005) Berube and Cote (2000), when studying savings in Canada found that the savings rate had fallen steadily from the 1980s and questioned whether the household consumption level was sustainable. Thus, understanding the determinants of the aggregate savings rate is a crucial prerequisite in designing a number of policy interventions, ranging from the design of the tax and social security system to the layout of financial markets regulation. (Jappelli and Pagano, 1998) With these issues today receiving a lot of attention it is not surprising that the analysis of savings behaviour is important.

The savings rate has been shown to vary both between regions and over time. Loayza et al. (2000) show that the savings rates have increased steadily in East Asia, stagnated in Latin America and fallen in sub-Saharan Africa. The development of the savings rate over time has been studied for example for the OECD countries in a report by Serres and Pelegrin (2003) with the result of no general pattern of development in the savings rate. This finding is also supported by Marchante et al. (2000), who find that the average savings propensity is neither uniform over time nor between regions. Wilson (2000) even argues that we know little about how savings rates vary over time and also about what determines the rate of savings.

The determinants of the savings rate have been examined in several studies. Often the focus has been on focusing on one or a number of variables to see how they affect savings, see e.g. Berg (1996), Beverly and Sherraden (1999) and Leff (1974). There are also several studies on the development of the savings rate and its determinants for groups of countries and regions but the focus has seldom been to investigate determinants of savings for a specific country. (Metin Ozcan et al., 2003) By examining one country it is possible to handle the problem that savings rates vary because of cultural differences, highlighted by Marchante et.al. (2001). By focusing on one country it is also possible to make a contribution to the multi-country studies because it is then possible to avoid the problem of unreliable data, a problem highlighted by Metin Ozcan et.al. (2003). This can be helpful in creating a better understanding of the complex relationship between the savings rate and its determinants.

An investigation of determinants of savings for Sweden has been done by Serres and Pelegrin (2003) at the OECD, but this is in a framework developed for OECD countries and lacks focus on and analysis of Sweden. The Swedish experience has been investigated by Berg (1996) with the main focus of investigating the correlation between age and the savings rate. With the lack of a comprehensive up to date investigation of the determinants of the private savings rate for Sweden I argue that it is interesting to examine the determinants of the private savings rate in Sweden with the characteristics of the Swedish economy in mind. In this thesis I aim to investigate and answer the question below.

What factors determine the private savings rate in Sweden and have the determinants changed over time?

The purpose is to construct a macroeconomic model that takes into account the Swedish experience and characteristics that are important for understanding the development of the savings rate in Sweden. By investigating what determines the private savings rate in

Sweden, I hope to contribute by providing an understanding of the development of the Swedish private savings rate.

The thesis is structured as follows. To create a basic understanding of savings, I start by reviewing earlier research mainly by describing two of the main theoretical bodies in the field of savings; the Life Cycle Hypothesis of Savings and the Permanent Income Hypothesis and also by reviewing existing studies of the private savings rate in Sweden. Thereafter I review the research on determinants of savings and present the theoretical framework used in this thesis. In the methodology I describe the model to be tested and the method used for specifying variables and collecting data. In the empirical data section I present the results and in the discussion I analyse the information. The general findings are concluded in the final section.

2. A REVIEW OF EARLIER RESEARCH

Two of the most well-known theories of savings are the Life Cycle Hypothesis and the Permanent Income Hypothesis (Beverley and Sherraden, 1999). These theories are examined in this chapter as well as the previous research on the Swedish private savings rate.

2.1 THE LIFE CYCLE HYPOTHESIS

Life Cycle theory appears first in a paper by Modigliani with Richard Brumberg from 1954. They worked out a theory of spending based on the idea that people make intelligent choices about how much they want to spend at each age, constrained only by the resources available over their life time. For each individual, it is assumed that an increase in life-time resources leads to a proportionate increase in consumption in all periods of life. As a result, consumption is proportional to lifetime resources or, what is more or less the same thing, to average income over the life time. (Deaton, 2005) This is the essence of the Life Cycle Hypothesis. One of the main implications of the Life Cycle model is that individuals can separate consumption from income, that is, consumption is not affected by the timing of income. (Berube and Cote, 2000)

Individuals tend to dissave when they are young, because of relatively low levels of income and high expenditures due to household formation while they tend to save in their middle years, with asset holdings reaching their maximum at retirement age. Individuals again dissave during retirement by using their accumulated assets, which are entirely exhausted at death. (Berube and Cote, 2000)

The Life Cycle theory leads to important and more advanced predictions about the economy as a whole, for example that national saving depends on the rate of growth of national income, not its level, and that the level of wealth in the economy bears a simple relation to the length of the retirement span. Further, it is the Life Cycle Hypothesis that helps us think about a number of important policy questions about which we would otherwise have very little to say, for example how societies should collectively make

provision for the increasing numbers of elderly and how does government provision interact with private provision. (Deaton, 2005)

While there have been many challenges to the theory of consumption over the years, the Life Cycle Hypothesis remains an essential part of economists' toolbox because it helps us to think about things such as the private and public provision of social security, the effects of demographic change on national saving and the role of saving in economic growth. It is sometimes questioned whether the Life Cycle Hypothesis of savings is still supported empirically. In many aspects it has been rejected. But even though the ways in which the theory is used have changed, the Life Cycle Hypothesis continues to provide the framework in which economists think about intertemporal issues at both individual and economy-wide levels. (Deaton, 2005)

2.2 THE PERMANENT INCOME HYPOTHESIS

The Permanent Income Hypothesis follows the logic of the Life Cycle Hypothesis; that consumption should not depend on current income alone. Unlike the Life Cycle Hypothesis, which anticipates that income follows a regular pattern over a lifetime, the Permanent Income Hypothesis instead emphasizes that people experience random and temporary fluctuations in income from year to year. Friedman divides income into a permanent part, which is the income people expect to persist into the future, and transitory part, which is the income that people do not expect to persist. More simply, permanent income is average income and transitory income is deviations from this level of income. Friedman argued that consumption should primarily depend on permanent income because people save and borrow to smooth consumption in response to transitory changes in income. (Mankiw, 2007)

If shocks to income are permanent, then all future levels of income will be revised upwards or downwards by the same amount leading to a change in consumption, which is equal to the change in current income. Central is that the consumption plan does not depend on the transitory components. (Meghir, 2004) Friedman argued that individuals

with high permanent income consume the same fraction of permanent income as individuals with low permanent income. (Dynan et al., 2000)

DeJuan et al. (2006) and also Dynan et al. (2000) take up several studies of the Permanent Income Hypothesis and conclude that the evidence for the hypothesis is mixed at best, with some studies supporting it and some studies rejecting it. A problem with the theorem, emphasized by Meghir (2004), is that the loose definition of permanent income makes it difficult to measure. However, the reason that the Permanent Income Hypothesis has endured so much is that, beyond its simple intuitive appeal, it focuses on inter-temporal optimisation of consumer behaviour, which is logical and consistent. (Meghir, 2004)

2.3 STUDIES OF THE SWEDISH SAVINGS RATE

There are two relatively recent studies of the private savings rate in Sweden. The savings rate in 15 OECD countries, including Sweden, has been studied in an Error Correction Model by Serres and Pelegrin (2003). They examine a number of variables and find that the Swedish savings rate is determined by the terms of trade, the dependency ratio and the public savings ratio. However, they do not discuss the results for Sweden. Berg (1996) takes a more experimental approach in studying the savings rate in Sweden and focuses on whether demographics affect the savings rate. He concludes that the dependency ratio affects the savings rate.

3. THEORETICAL FRAMEWORK

The theoretical framework in this chapter builds upon the central variables used for explaining the private savings rate in similar studies. The variables chosen are income growth and income level, demographics, liquidity constraints and financial deregulation, the real interest rate, variation in inflation, the government fiscal balance and the stock market development. I examine each of these in more detail below.

3.1 THE SAVINGS RATE

There are several explanations for saving out of personal income. The Life Cycle Hypothesis captures one important reason; that people want to smooth income over their life time. Another reason is that people want to invest in tangible assets e.g. accommodation and are not allowed to borrow the full amount of money needed. Yet another reason is that people save out of precautionary motives for the uncertain future, to have money when they may need it. (Mankiw, 2007) Further, people may save out of desire to leave bequests. (Berube and Cote, 2000) The personal savings rate is the fraction of savings out of income that a person saves during a year. The most basic definition of saving is the difference between income and consumption. (Hopf, 2006)

3.2 INCOME GROWTH AND INCOME LEVEL

The theoretical foundation regarding the relation between economic growth and the savings rate is relatively vast; however, it offers no general conclusion about the relationship between economic growth and the savings rate. The relationship can be traced back to the growth models of Harrod and Domar. Their simplest model implies that the growth rate in the economy is proportional to the savings rate. It has then been further developed in the Solow model and in the endogenous growth model. (Agrawal, 2001)

On the other hand, the Permanent Income and the Life Cycle Hypotheses imply that savings depend on current income and expectations of future income. The simplest version of the Life Cycle Hypothesis implies a positive relation between savings and

income growth. Assuming no income or population growth in such a model implies that the dissaving of the old exactly matches the savings of the young making aggregate savings zero. With income growth, the young will be richer than the old, resulting in a positive correlation between savings and growth. Another way to view the same issue is to assume that aggregate growth will make forward-looking consumers feel wealthier and thereby consume more and save less. That is to say that the correlation between income growth and savings is negative. As can be seen, the theory is ambiguous about the relation between income growth and the savings rate. (Agrawal, 2001)

Several studies have examined the relationship between savings and growth empirically. The finding has often been that the savings rate and the rate of economic growth are correlated, see e.g. Agrawal (2001), Deaton (2005) and Hopf (2006). However, Agrawal (2001) argues that the work on the issue of causality between the savings rate and growth is an area which has not been examined thoroughly. Agrawal (2001) and Hopf (2006) show that the causality has mainly been found to run from growth to savings, while Jappelli and Pagano (1998) argue that the long-run historical record and the international data point to a strong and simultaneous correlation between saving and growth.

While the rate of growth of income is often included, Agrawal (2001) argues that also its level should be included. This is supported in an empirical study by Dynan et al. (2000) who finds that higher level of life-time income leads to a higher savings rate. Theory tells us that predictable changes in income should not lead the far-sighted to change consumption and savings pattern. If income is expected to fall or rise, consumers should have adjusted their consumption pattern in response to that information whereby predictable changes in income should not affect the savings rate. However, this appears not to be supported by data, which instead finds that predictable changes in income lead to predictable changes in consumption and savings. One possible explanation is that some consumers may fail to have rational expectations and instead base their expectations of future income predominantly on current income. Yet another reason may be that consumers are borrowing constrained and base their current consumption and saving on

current income rather than expected income. Whichever the reason, it means that current income has a role in determining the consumption and savings rate. (Mankiw, 2007)

3.3 DEPENDENCY

The Life Cycle Hypothesis has convincingly shown that population growth and age distribution will affect the trend of saving (Berg, 1996). The Life Cycle Hypothesis implies that individuals will have negative savings when young and have low or no income, positive savings during their productive years and again negative savings when they are old and retired. Thus, the distribution of population will affect the savings rate. (Agrawal, 2001)

The Life Cycle Hypothesis of Savings is also useful for understanding how the rate of savings varies over time. An increase in the proportion of elderly in the population is expected to reduce the aggregate savings rate since the retired are assumed to dissave. Similarly, an increase in the proportion of the population at an age too young to work is also expected to reduce the personal savings rate as parents spend their income on taking care of their children. (Berube and Cote, 2000)

Several studies have examined the effects of demographic changes on the savings rate; however, the definitions of dependency are almost as numerous as the studies. Berube and Cote (2000) show that some researchers looked at youth and elderly dependency separately while others have used an aggregate measure of dependency. Further, some researchers categorise the active population as those between 20-64 years of age, see e.g. Berg (1996) while others, see e.g. Agrawal (2001) categorise the working population as those between 15 to 64 years of age. The general conclusion however, is that the dependency ratio is of importance for understanding the level and development of the savings rate.

3.4 LIQUIDITY CONSTRAINTS AND DEREGULATION

Saving is a way to transfer resources over time to smooth consumption. In order to save, the existence of well developed financial markets is integral. The Life Cycle Hypothesis

of Savings rests on the questionable assumption of sufficiently developed capital markets allowing people to borrow against future income. (Deaton, 1999) Jappelli and Pagano (1994) argue that if households cannot borrow to the extent that they want, aggregate savings will be higher than in the case where they can borrow the desired amount. They argue that this may explain the diverging savings rates between countries. Indeed, in many industrialized countries, developments of the financial markets have contributed to less stringent borrowing constraints for consumers. Several empirical studies have attributed the observed decreases in savings rates to the improved access to consumer credit. (Berube and Cote, 2000)

Further, tax system changes may also affect the savings rate. By taxing capital income lightly, savings is encouraged. (Mankiw, 2007) This relationship has been tested by Agrawal (2001), but with the result of no significant effect on the savings rate. It is clear that the Swedish economy went through a significant change in the financial system through the tax reform in 1991. (Daunfeldt, 2002)

3.5 THE REAL INTEREST RATE

A usual presumption is that the total effect of a change in the real interest rate on saving is positive, implying that at a higher real interest rate, people save a larger fraction of their income. (Berube and Cote, 2000) However, the relation between savings and the real interest rate is ambiguous because a change in the real interest rate gives rise to opposing effects, in the form of substitution and income effects. (Metin Ozcan et al., 2003) The direction and size of the net impact of the real interest rate depends on the offsetting forces of the substitution and income effects and also to some extent on an indirect wealth effect. (Serres and Pelegrin, 2003)

The substitution effect implies that an increase in the real interest rate encourages individuals to postpone consumption and increase savings in the present period in order to achieve higher consumption levels later. That is, there is a positive intertemporal substitution effect of an increase in the real rate of interest. The income effect depends on whether the individual is a net lender or borrower. A net lender receives more in capital

income than he must pay to service his debt. In that case a higher interest rate increases net capital income, thus encouraging present consumption and lessening the need to save in order to finance future consumption. If present and future consumption are normal goods, a higher interest rate may thus cause present consumption to rise, while the smaller amount of savings will nevertheless grow to a larger amount of future consumption. (Berube and Cote, 2000) It is also important to consider the wealth effect, whereby an increase in real interest rate reduces the present value of the future labour income, causing a decline in human wealth. (Serres and Pelegrin, 2003)

3.6 VARIATION IN INFLATION

Serres and Pelegrin (2003) argue that inflation can influence savings independently from its influence via the real interest rate. There is often a correlation between the level and the variance of inflation, and the variance of inflation may capture the effect of uncertainty on savings. A rise in inflation would be expected to cause a rise in the variance of inflation, which would raise the savings rate out of precautionary motives. Thus, it is argued that there is a positive relation between variation in inflation and savings where people tend to save more in an unstable environment (Hopf, 2006).

3.7 THE GOVERNMENT FISCAL BALANCE

An observation by Agrawal (2001) is that countries that exhibit high government savings tend to have high total savings rates. The effect of fiscal policy on savings behaviour is an area that has received a lot of attention. The effects differ depending on whether you adopt a Keynesian or Ricardian view. (Metin Ozcan et al., 2003) The Ricardian view holds that individuals are far-sighted and rational and understand that government spending must be paid for now or later. They thus adjust their private savings rate accordingly. The most widely accepted view accepts that Ricardian Equivalence will not hold fully; that an increase in the government deficit will not be fully offset by higher private savings. (Berube and Cote, 2000)

Whether Ricardian Equivalence holds has been examined in several studies. Hopf (2006) goes through a number of studies examining Ricardian Equivalence and shows that the

degree to which Ricardian Equivalence is rejected or supported differs widely in the literature. Loayza et al. (2000) find that fiscal policy is a moderately effective tool in raising national savings, which is taken as evidence against full Ricardian Equivalence.

3.8 THE STOCK MARKET

It has been found that revaluations of equities and housing have contributed to substantial increases in the value of household net worth, reducing the need for saving out of personal income. (Berube and Cote, 2000) Serres and Pelegrin (2003) also argue that in countries where the personal savings rate has decreased, the decline has coincided with a sharp increase in household's financial net assets, indicating a negative correlation between the two time series.

4. METHODOLOGY AND DATA COLLECTION

I will use an econometric regression model to investigate the determinants of the savings rate in Sweden. Below I describe in detail how I have operationalised the variables and collected and prepared the data for the econometric analysis. I have chosen to examine the period 1970-2006 by using annual data and I believe this relatively long period of time offers enough information to draw relevant conclusions.

4.1 THE SAVINGS RATE

In collecting data on the private savings rate I follow the methodology used by Berube and Cote (2001), Marchante et al. (2001) and Metin Ozcan et al. (2003) whereby the savings rate is calculated as household saving through household disposable income. This is the measure provided by the OECD. Household saving is calculated as household disposable income less household consumption expenditure, i.e. households choose to consume or save their disposable income. Household disposable income includes income from employment and from unincorporated enterprises plus receipts for interests, dividends and social benefits minus payments of income tax, interest and social benefit contributions. Household consumption mainly consists of cash outlays for consumer goods and services. The data is collected on an annual basis from 1970 to 2006.

4.2 INCOME GROWTH AND INCOME LEVEL

As described in the theory section, the simplest version of the Life Cycle Hypothesis implies that there should be a positive relation between savings and income growth. This should hold in the long run. However, as mentioned in the theory section, in the short run the level of income may be more helpful in describing the savings rate than the growth in income. Empirical studies have shown that the savings rate is correlated also with the level of income. In this study I will therefore look both at whether the level and the growth in personal disposable income help to understand the development of the savings rate over time. As a measure of the income level I use OECD data on household real disposable income measured in MSEK for the period 1970-2006. To adjust for the increase in population from 1970 to 2007 I collect statistics on the Swedish population

from Statistics Sweden and thereby I calculate household real disposable income per capita. Based on this information I also derive the growth rate in household disposable income.

4.3 DEPENDENCY

As mentioned in the theory chapter several definitions of dependency have been used. In this study I use data from Statistics Sweden on the demographics in Sweden. I follow the setup by e.g. Berg (1996) and Serres and Pelegrin (2003) whereby they categorise the working force as those aged 20-64 years because this is the age group that is most associated with the working age. Those who do not fall into this group are categorised as dependent, i.e. I use an aggregate measure of dependency that aggregates the young and old dependency groups. This should capture the general assumption that both the young and the old dependency groups generally dissave.

4.4 LIQUIDITY CONSTRAINTS AND DEREGULATION

One method of capturing the financial deepening is to calculate the ratio of money or quasi-money to disposable income (Hopf, 2006). However, the data on money and quasi money for Sweden contains several omitted values for the period 1970-2006. To capture liquidity constraints I therefore instead follow the method used by Berube and Cote (2000). They use the ratio consumer credit to personal disposable income as an indicator of the liquidity constraint. To capture the liquidity constraint variable for Sweden, I calculate a ratio of consumer credit to personal disposable income based on figures for private sector domestic credit through household disposable income. This shows the average loan each person has in comparison to their income for the same year.

The data has been collected by OECD. However, the OECD changed their way of measuring credit volume in 2001 whereby the measure for credit volume more than doubled. Statistics Sweden have also collected data on credit volume and do not show this jump, whereby I think it is safe to say that the increase can be attributed to the change in measurement methods. However, there is not one time series that covers the whole period 1970-2006 with a consistent way of measuring. To adjust for this problem, I

have taken the growth rate in household debt from Statistics Sweden for 2001 and applied this to the credit volume expressed by OECD for year 2000. For the years following year 2001 I have then applied the growth rate in credit volume by the OECD to the volume of credit I calculated in 2001. This gives a development that is similar to that expressed by Statistics Sweden and gives logically consistent figures on the development of the credit volume in Sweden from 1970 to 2006. As a measure of liquidity constraint I then use the fraction real consumer credit through real disposable income.

To get an understanding of the savings rate in Sweden, it is important to acknowledge the unique characteristics of the Swedish experience. It is clear that Sweden went through a significant change in the tax system in the 1980s and 1990s. Blomquist et al. (1997) describe that there was a series of tax reforms in the 1980s involving the marginal tax rate and deductions that culminated in 1991 with changes in marginal taxes and an introduction of separate taxation of labour and capital income. It may be difficult to capture all the changes in an econometric model, because the effects of tax changes on the savings rate may not be immediate. However, as the largest changes in the tax system took place in 1991, I will include a dummy variable taking the value 0 for the years up to 1990 and taking the value 1 for year 1991 and after whereby I try to capture the possible effect on the savings rate.

4.5 THE REAL INTEREST RATE

As was shown in the theory chapter, there may be opposing forces in the form of substitution and income effects of a change in the real interest rate. The general assumption is that the private savings rate increases as the interest rate increases, which I also assume in this study. I choose to use the real interest rate because this is the interest rate that rational individuals should think about when saving, rather than the nominal interest rate. Berube and Cote (2000) argue that what really matters for the savings decision is the after-tax real rate of return, but also mention that most studies have used pre-tax return. This is because it is not straightforward to measure the tax rate, since the aggregate marginal income tax rate is not easily measurable. Berube and Cote (2000) argue that there is little difference in estimates based on the assumption of a zero

marginal tax rate and a marginal tax rate of 30 per cent adjusted for the proportion of tax-sheltered savings. Thus I do not adjust for the tax effect.

The real interest rate has often been derived indirectly, see e.g. Berube and Cote (2000), Agrawal (2001) and Serres and Pelegrin (2003). As a proxy for the interest rate they use the government bond and deduct inflation from that to get the real interest rate. Berube and Cote argue that the choice of a 3- 5-year maturity of government bonds is a good proxy because the household sector holds interest bearing assets mainly of medium- to long-term fixed instruments. I follow their approach and use the yield on five year government bonds in Sweden as a proxy for the interest rate.

However, not all saving is tied up over a period of time; it may also be correlated with the bank deposit rate for open accounts because. Therefore I also include a variable capturing the real interest on open bank accounts. This interest is the average deposit rate for the biggest commercial banks in Sweden. I include both interest rate variables in real form, because it is the real interest rather than the nominal interest rate that rational investors should care about. To get the real interest rate, I follow the methodology suggested by Agrawal (2001) who calculates the real interest as:

$$R = \left[(1 + I) / (1 + INF^e) \right] - 1$$

where R refers to the real interest and I the nominal interest and INF^e is inflation expectation, measured as inflation the previous year.

4.6 VARIATION IN INFLATION

To capture the fact described in the theory chapter, that people tend to save more when uncertainty is greater, I construct a variable capturing the variance of inflation. To do this requires information about the rate of inflation measured several times per year. Data on inflation for the whole period 1970-2006 is not available at monthly observations. To get a measure of inflation for this period I have received data of CPI from Statistics Sweden and out of this data I compute an annual inflation for each month by comparing CPI for each month by the CPI for the same month one year earlier. Out of the monthly inflation rate observations I then calculate the variance of inflation. I argue that people when

making savings decisions think about the variation in inflation that has prevailed lately, and assume it will be the same in the future, rather than just at the time of the savings decision. Therefore I use variation in inflation for a 24-month period as a proxy for the perceived variation in inflation.

4.7 THE GOVERNMENT FISCAL BALANCE

To capture the potential effect of Ricardian Equivalence on the private savings rate, I have chosen to include a measure of Sweden's government fiscal balance. I include a percentage measure of government savings in Sweden based on figures from Statistics Sweden for the period 1970-2006. Statistics Sweden calculate the government fiscal balance as the difference between public sector income deducted for public sector expenditure. Income mainly consists of taxes and social fees (e.g. income and wealth taxes for the household and corporate sectors) but also interests and dividends. Expenditures mainly consist of transfers to the public and the corporate sector, consumption and investments. Government savings is calculated as percentage of GDP.

4.8 THE STOCK MARKET

Berg (1996) argues that revaluations of equities and housing have contributed to a substantial increase in household net worth during the 1980s and 1990s, which he argues has reduced the need for saving out of personal income. As revaluations are not part of the income concept I use MSCI Sweden as a proxy for the wealth effect on the stock market. MSCI Sweden does not provide a direct measure of wealth, but as I do not have access to information about the wealth of Swedish households I believe that MSCI Sweden provides a good proxy for the wealth effect.

4.9 EXCLUDED VARIABLES

In the model used I have included the variables that I, based on theory and knowledge about the development of the Swedish economy, believe are important for understanding the development of the savings rate. In doing this, I have also chosen to leave out a number of variables used in other studies. I have left out unemployment, which in a study

by Berg (1996) was used as a proxy for income expectations. I left this variable out because there is no clear theoretical link between the unemployment rate and the rate of savings and because the unemployment rate has not been a good measure of the full unemployment. I have also left out a measure of the terms of trade. I have done so because, as Mankiw (2007) writes, the terms of trade and capital flows may be a result of the savings rate in the economy. Following that logic, the terms of trade measure does not help us to understand the savings rate and therefore I have left it out.

4.10 SUMMARY

The variables used in the regression model, their form and their sources are shown summarised below.

Variable	Form	Source
Savings rate	%	OECD
Income	SEK	Statistics Sweden
Growth in Income	%	Statistics Sweden
Dependency rate	%	Statistics Sweden
Liquidity Constraint	%	OECD/Statistics Sweden
Deregulation	Dummy	-
Real Deposit Rate	%	IMF Financial Statistics/Statistics Sweden
Real Yield on Gov Bond	%	OECD/Statistics Sweden
Variation in Inflation	Variance	Statistics Sweden
Government Fiscal Balance	%	Statistics Sweden
MSCI Sweden	Index	-

Table 1: Variables, their forms and sources

The following regression will be run:

$$\begin{aligned} \text{Savings_rate} = & \alpha_1 + \beta_1 \ln_Income + \beta_2 \text{Growth_Income} + \beta_3 \ln_Dependency \\ & + \beta_4 \ln_Liquidity_constraint + \beta_5 \text{Deregulation} + \beta_6 \text{Real_deposit_rate} + \beta_7 \text{Real_yield_gov_bond} \\ & + \beta_8 \ln_Variation_inflation + \beta_9 \text{Gov_fiscal_balance} + \beta_{10} \ln_MSCI_Sweden + u_t \end{aligned}$$

As the period of measurement is close to 40 years and there has been considerable development of the financial markets during this time, there may be structural breaks in the regression coefficients and in the intercept. Therefore I will test for structural stability. I will also test for Granger Causality between income and the savings rate to establish the

direction of the statistical correlation because the theoretical framework is ambiguous about the direction of causality.

5. EMPIRICAL RESULTS

5.1 VARIABLE STATISTICS

The variables and their unadjusted means are shown below (For more info see Appendix, part A and B). To simplify and to make easily understandable interpretations, some variables have been transformed into logarithmic form. Further, as some of the time series contain unit roots (See Appendix, part C), all variables are used in their first difference form to allow for generalisations also outside the period of measurement. The final column in the table below shows the form of the variables used throughout this thesis.

Variable	Form	Mean (unadjusted)	Adjustment
Savings rate	%	6.51	Diff
Income	SEK	111862*	Ln, Diff
Growth in Income	%	1.19	Diff
Dependency rate	%	42.04	Ln, Diff
Liquidity Constraint	%	83.14	Ln, Diff
Deregulation	Dummy	-	-
Real Deposit Rate	%	0.74	Diff
Real Yield on Gov Bond	%	2.78	Diff
Variation in Inflation	Variance	2.33	Ln, Diff
Government Fiscal Balance	%	-0.33	Diff
MSCI Sweden	Index	2218.15	Ln, Diff

*Base year 2000

Table 2: Variables, their form, mean and adjustment

As can be seen above, the savings rate has averaged 6.51% over the period 1970-2006. However, as shown in the graph below, the savings rate has varied a lot over time and over the long run no trend can be established by visual examination.

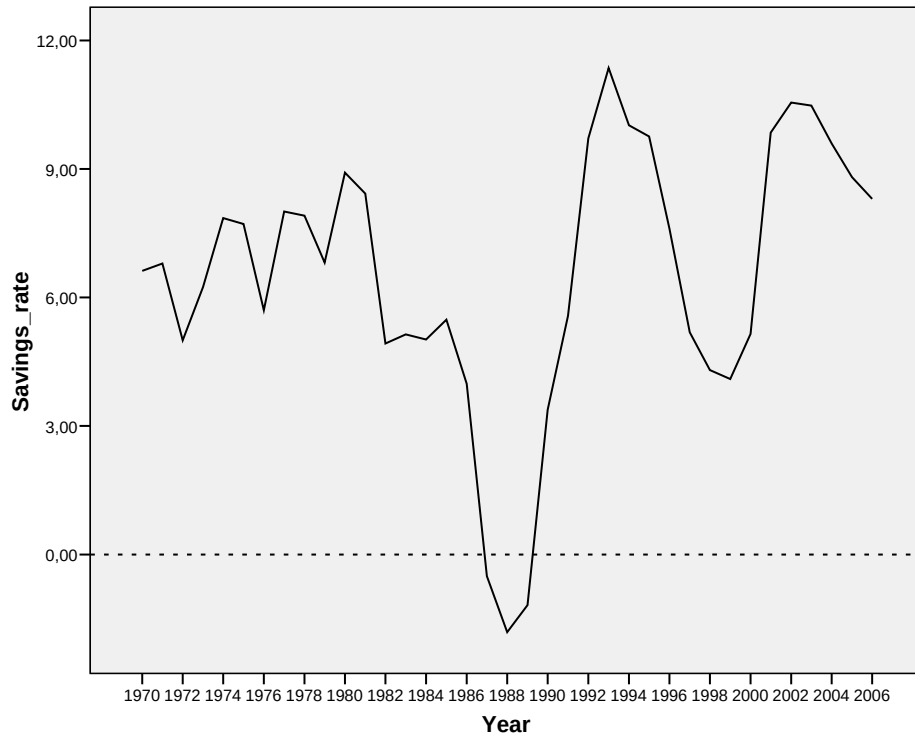


Figure 1: The private savings rate

5.2 THE MODEL

When running the full regression model the results below were obtained and the model had an R-square of 0.696 and an adjusted R-square of 0.570. Three of the variables were found significant at a five percent level and they all carry the expected signs. These are income, liquidity constraint and the government fiscal balance.

Variable	Coefficient	Sig.
Constant	-0.337	0.432
Income	39.085	0.011
Growth Income	0.165	0.246
Dependency	-76.226	0.508
Liquidity Constraint	-12.172	0.003
Deregulation	0.092	0.874
Real Deposit Rate	-0.006	0.976
Real Yield on Gov Bond	-0.022	0.919
Variation Inflation	0.044	0.817
Gov Fiscal Balance	-0.324	0.005
MSCI Sweden	0.149	0.889

R-square 0.696

Adjusted R-square 0.570

Table 3: Variables, their coefficients and level of significance

After removing the least significant variables one by one the result is the model below, which has an R-square of 0.655 and three variables are found to be significant on the five percent level. The variables growth in income, dependency, deregulation, real deposit rate, real yield on government bonds, variation in inflation and MSCI Sweden were all found to be insignificant at a five percent level and they were therefore left out of the final model.

Variable	Coefficient	Sig.
Constant	-0.309	0.202
Income	44.922	0.000
Liquidity Constraint	-11.101	0.002
Gov Fiscal Balance	-0.285	0.004

R-square 0.655

Adjusted R-square 0.623

Table 4: The final model; variables, coefficients and level of significance

As can be seen above, the savings rate is expected to increase with income and fall with liquidity constraint and the government fiscal balance. The interpretation of the regression coefficient for income is that a one percentage higher income is associated

with a 0.45 percentage units higher savings rate. The liquidity constraint variable indicates that as it is easier to borrow, people save less. As the liquidity constraint increases with 1% the savings rate falls with 0.11 percentage units. Finally, the government fiscal balance variable indicates that as government savings increases, people save less. As the government fiscal balance increases by one percentage unit, the savings rate falls with 0.29 percentage units.

This gives the following equation for describing the savings rate:

$$\Delta \text{Savings_rate} = -0.31 + 44.92\Delta \ln_Income - 11.10\Delta \ln_Liquidity_constraint - 0.29\Delta \text{Gov_fiscal_balance}$$

As the reaction to changes in interest rates might carry some lags, I have tested lagged variables with both the real deposit rate and the real yield on government bonds. This gives a model with R-square of 0.722 to be compared with the R-square of 0.696 obtained when the variables were not lagged. Thus, this seems to give a better model for describing the savings rate. However, the lagged variables were still insignificant and thus dropped from the equation. (For more info, see Appendix section D).

5.3 TEST FOR STRUCTURAL STABILITY

The period of measurement is relatively long ranging from 1970 to 2006, which includes 37 years. Therefore I have examined whether the model holds for the whole period or whether there is a structural break in the time series between year 1990 and 1991, the time at which most changes took place. I test both whether the intercept is the same in the two periods as well as whether the regression coefficients are the same. The test for structural stability can not reject the hypothesis that the model holds for the whole period. Thus the model can be considered to be a good model for describing the whole period 1970-2006. (For more info, see Appendix section E).

5.4 TEST FOR GRANGER CAUSALITY

The Life Cycle Hypothesis of Savings holds that a higher growth in income leads to a higher rate of savings. The variable growth in income was insignificant and thus excluded

from the model whereas the level of income was included. I therefore find it interesting to examine what way causality runs between the level of income and the savings rate. (For more info, see Appendix section F).

Causality	Lags	F_{OBS}	F_{CRIT}	Decision
Income Causes the Savings Rate	1	1.018	4.12	Do not reject H_0
The Savings Rate Causes Income	1	0.048	4.12	Do not reject H_0
Income Causes the Savings Rate	2	3.85	3.28	Reject H_0
The Savings Rate Causes Income	2	2.65	3.28	Do not reject H_0

Table 5: Test for Granger Causality

The test for Granger Causality with one lag cannot establish any direction of causality between the two variables. With two lags however, there is evidence of unidirectional causality from the level of income to the savings rate, i.e. that income Granger causes the savings rate.

5.5 QUALITY OF THE MODEL

I have made a detailed examination of the regression model estimated to test for its quality on a number of dimensions. There is some but inconclusive evidence of multicollinearity, the Durbin-Watson test shows no problem with autocorrelation in the error term, which according to the Jarque-Bera test is normally distributed. The Goldfeld-Quandt test shows no indication of heteroscedasticity and the RAMSEY Reset test rejects that the model is incorrectly specified. Thus, the general conclusion is that the model is of relatively good quality. (For more info, see Appendix section G).

6. DISCUSSION

As can be seen in Figure 1, the Swedish savings rate has varied greatly over time. Further, studies show that the savings rate also varies greatly between countries. This raises the question of what determines the level and development of the savings rate. When examining similar studies trying to create comprehensive models of the savings rate, see e.g. Agrawal (2001), Japelli and Pagano (1998) and Metin Ozcan et. al (2003), the general insight is that the variables that help to understand the savings rate depend on the country that you examine. The variables that are helpful for understanding the savings rate in one country may not be helpful for understanding the savings rate in another country. By examining a large number of factors I have managed to find a set of variables that are helpful for understanding the Swedish case.

In this thesis I have tested several variables that theoretically can be expected to affect the savings rate and I found that income, liquidity constraint and the government fiscal balance are helpful in creating an understanding of the savings rate. The income variable indicates that an increase in income is related to an increase in the savings rate. This means that the savings rate varies with the business cycle. The liquidity constraint variable shows that the savings pattern is related to the possibility to borrow. As it becomes easier to borrow, people need to save less to invest in e.g. accommodation. The government fiscal balance indicates some degree of Ricardian Equivalence, i.e. that the private savings rate is negatively related to government savings rate. These findings are all in line with theory. The R-square of 0.655 indicates that the model is relatively good considering that it is trend stationary.

In examining the Swedish savings rate I found no significant correlation between the savings rate and the real interest rate even though one measure of the short-term real interest as well as one measure of the long-term real interest was used. According to economic theory, the savings rate should reasonably be related to the real interest rate. That the savings rate was not correlated to the interest rate was also observed by in the study by Agrawal (2001). This finding may be an indication of that people do not follow

the development of the real interest rate or do not act when it is changed somewhat or act with some lag. The interest rate changes continuously over time and people may not be responsive to small changes in the real interest rate.

Because this study failed to establish a relationship between the interest rate and the savings rate, the obvious question is if there is a relationship between the savings rate and the interest rate and if so, what it looks like. The reason no correlation was found might be that people do not think about the real interest but rather about the nominal interest. A more realistic reason may be that people's savings behaviour is responsive to changes in interests with some lag. An indication of that was that when removing the real interest variables and adding lagged real interest variables, the model improved even though the lagged variables were insignificant. This is supported by Loayza et al. (2000) who conclude that the private savings rate shows considerable inertia. As the data used in this study is collected on a yearly basis, this allows only for yearly lags. It is possible that a model with monthly or quarterly collected data would improve the understanding of how people's savings behaviour reacts to changes in interest rates because it allows for a more detailed analysis of the correlation between the savings rate and the interest rate.

Except for the interest variables, also the variables growth in income, dependency, deregulation, variation in inflation and MSCI Sweden were found insignificant. Based on theory, all these variables are expected to affect the savings rate. The variation in inflation and MSCI Sweden are used as proxies for uncertainty and wealth respectively as it is difficult to operationalise uncertainty into a statistical concept and because there is no good measure of the private wealth in Sweden. Finding good proxies is central and the question is whether these proxies capture the underlying concepts. I believe that these proxies provided the best way of capturing the underlying concepts, but it cannot be excluded that these proxies were insignificant just because they did not capture the underlying concepts.

The Life Cycle Hypothesis of saving is based on the idea that people make rational decisions about how much to save at different times in their lives. This requires that

people have good information about the future and that they act on a long-term basis. This study examines savings from a macroeconomic view and considering the variables I found significant it seems likely that the savings rate from this perspective is not a rational long-term decision but largely a consequence of the income you have at disposal and the possibility to borrow. As people's income increases they can save more and as they find it possible to borrow, they need to save less. That would indicate that the private savings rate is determined very much by economic policy and by the possibility to borrow.

As the period of measurement is long the test for structural stability allows us to consider whether the model holds for the whole period 1970-2006. A natural break could be between 1990 and 1991 when major fiscal policy changes took place that could affect the savings rate. However, the test could not establish such a break, instead supporting that the intercept and the regression coefficients hold for the whole period. This is somewhat surprising as tax changes in this period should affect the savings rate, as should the development of the financial markets. However, the liquidity constraint variable may already capture some of this effect, making the dummy redundant.

As mentioned in the theory section, the theoretical models are ambiguous about the correlation between income and the savings rate and whether the savings rate should be correlated with the level or growth in income. I have tested both variables and there is a correlation between the savings rate and the level of income but no significant correlation with the growth in income. At two lags, the Granger Causality test indicates a uni-directional correlation from level of income to the savings rate. This direction of correlation corresponds to the one expected and means that a higher income leads to a higher savings rate but that a higher savings rate does not lead to a higher income. This is as expected, but contradicts the early growth theories of Harrod and Domar and Solow.

7. CONCLUSION

In this thesis I have examined what factors determine the private savings rate in Sweden and whether the determinants have changed over time with the purpose of creating a macroeconomic model that takes into account the characteristics of the Swedish economy. In doing so I examined a number of variables and found that income, liquidity constraint and the government fiscal balance were helpful in creating an understanding of the development of the Swedish savings rate. The interpretation of the results is that an increase in income is related to an increase in the private savings rate and that people save less as it becomes easier to borrow. The government fiscal balance variable shows that as the government saves more, the people save less, an indication of some degree of Ricardian Equivalence. The variables growth in income, dependency, deregulation, real deposit rate, real yield on government bonds, variation in inflation and MSCI Sweden were all found insignificant. This gave a relatively good model with an R-square of 0.655.

I found no evidence of a structural break implying that the model was good at describing the savings rate for the whole period 1970-2006. Further, I also tested for Granger Causality between the savings rate and the level of income and found that the direction of correlation goes from income to the savings rate, as predicted, but contrary to the early growth theories.

Most often the savings rate has been examined using yearly data. A suggestion for further research is to investigate the savings rate based on data collected more often, e.g. quarterly or monthly. This could help to shed light on the responsiveness of people's savings behaviour to e.g. changes in interest rates and other information.

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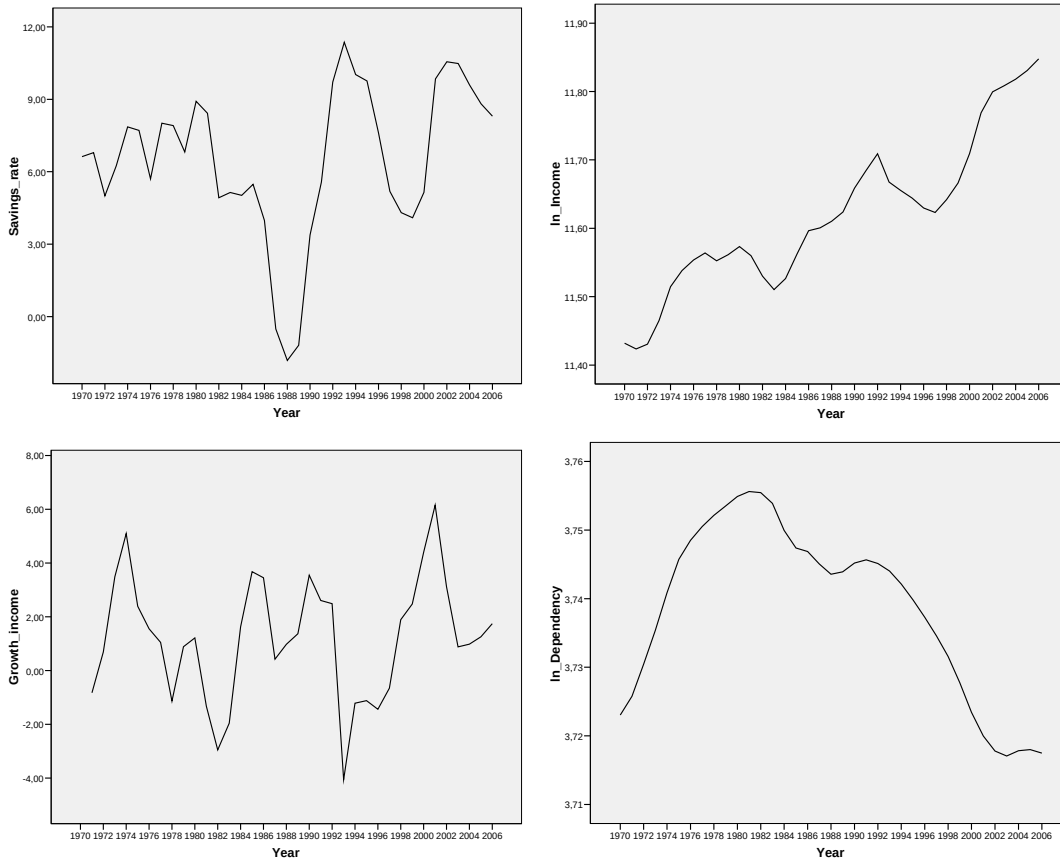
APPENDIX

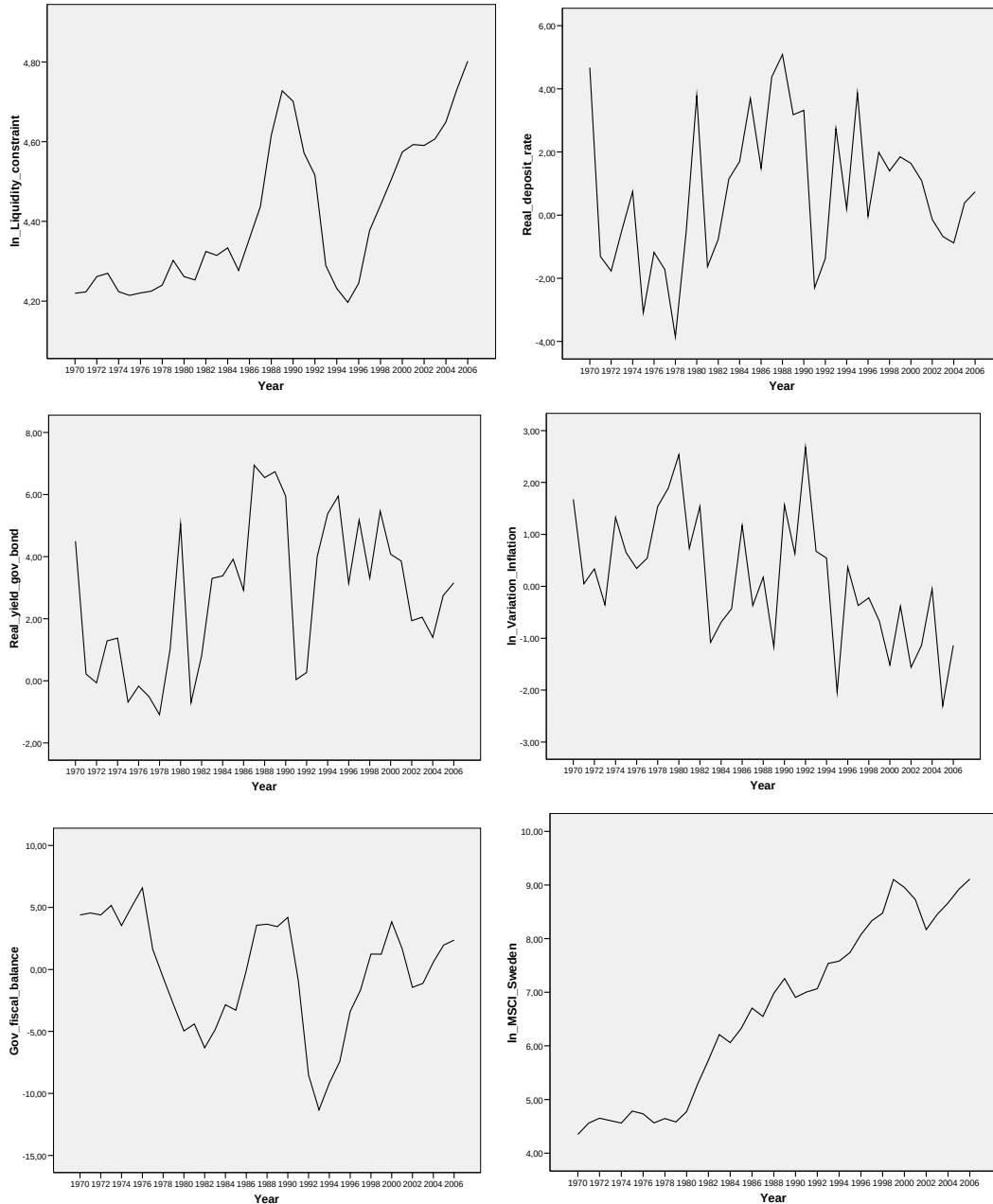
A. Descriptive statistics

Descriptive Statistics

	N	Mean	Std. Deviation
Savings_rate	37	6,5075	3,14435
Income	37	111862,4	12901,44437
Growth_income	36	1,1863	2,24878
Dependency	37	42,0414	,53064
Liquidity_constraint	37	83,1384	16,17703
Deregulation	37	,4324	,50225
Real_deposit_rate	37	,7400	2,26645
Real_yield_gov_bond	37	2,7770	2,37705
Variation_inflation	37	2,3273	3,19809
Gov_fiscal_balance	37	-,3259	4,55198
MSCI_Sweden	37	2218,1457	2759,65368
Valid N (listwise)	36		

B. Sequence Charts of unadjusted variables





C. Unit root test

To test for a unit roots the following regressions have been run:

$$\Delta Y_t = \beta_1 + \beta_2 T + \delta Y_{t-1} + u_t$$

The following hypotheses are to be tested:

$$H_0 : \delta = 0$$

$$H_1 : \delta \neq 0$$

Where H_0 implies existence of unit root. The Dickey-Fuller critical value for 35 observations with a 95% confidence interval is -3.543.

Decision rule: Do not reject H_0 of unit root if the observed value is greater than -3.543.

The result of unit root test:

Variable	t-value	Decision
Savings rate	-1.981	Unit root
Income	-1.314	Unit root
Growth in income	-3.051	Unit root
Dependency rate	-4.324	No Unit root
Liquidity constraint	-1.400	Unit root
Real deposit rate	-4.700	No Unit root
Real yield on gov bond	-3.778	No Unit root
Variation in inflation	-5.116	No Unit root
Government fiscal balance	-1.637	Unit root
MSCI Sweden	-2.271	Unit root

Conclusion: As there are unit roots in several time series, all time series will onwards be expressed in first differences.

D. Model Estimations

Results from model estimation including all variables:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,834 ^a	,696	,570	1,34808

a. Predictors: (Constant), DIFF(ln_MSCI_Sweden), Deregulation, DIFF(Real_deposit_rate), DIFF(ln_Liquidity_constraint), DIFF(ln_Variation_Inflation), DIFF(Growth_income), DIFF(Gov_fiscal_balance), DIFF(ln_Dependency), DIFF(ln_Income), DIFF(Real_yield_gov_bond)

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,337	,422		-,799	,432
	DIFF(ln_Income)	39,085	14,215	,425	2,750	,011
	DIFF(Growth_income)	,165	,139	,169	1,188	,246
	DIFF(ln_Dependency)	-76,226	113,372	-,097	-,672	,508
	DIFF(ln_Liquidity_constraint)	-12,172	3,724	-,442	-3,268	,003
	Deregulation	,092	,573	,023	,160	,874
	DIFF(Real_deposit_rate)	-,006	,190	-,007	-,030	,976
	DIFF(Real_yield_gov_bond)	-,022	,211	-,024	-,103	,919
	DIFF(ln_Variation_Inflation)	,044	,190	,030	,234	,817
	DIFF(Gov_fiscal_balance)	-,324	,106	-,414	-3,059	,005
	DIFF(ln_MSCI_Sweden)	,149	1,052	,019	,141	,889

a. Dependent Variable: DIFF(Savings_rate)

Model with lagged interest rates:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,850 ^a	,722	,607	1,28883

a. Predictors: (Constant), DIFF(ln_MSCI_Sweden), LAGS(Diff_Real_yield_gov_bond), Deregulation, DIFF(ln_Liquidity_constraint), DIFF(ln_Variation_Inflation), DIFF(Growth_income), DIFF(Gov_fiscal_balance), DIFF(ln_Dependency), DIFF(ln_Income), LAGS(Diff_Real_deposit_rate)

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,445	,421		-1,057	,301
	DIFF(ln_Income)	38,790	13,737	,421	2,824	,009
	DIFF(Growth_income)	,127	,138	,131	,925	,364
	DIFF(ln_Dependency)	-40,969	109,869	-,052	-,373	,713
	DIFF(ln_Liquidity_constraint)	-10,450	3,734	-,380	-2,799	,010
	Deregulation	,293	,555	,072	,528	,603
	LAGS(Diff_Real_deposit_rate)	-,012	,208	-,016	-,058	,954
	LAGS(Diff_Real_yield_gov_bond)	,183	,251	,208	,732	,471
	DIFF(ln_Variation_Inflation)	,093	,193	,063	,483	,634
	DIFF(Gov_fiscal_balance)	-,387	,110	-,496	-3,518	,002
	DIFF(ln_MSCI_Sweden)	,191	1,125	,024	,170	,867

a. Dependent Variable: DIFF(Savings_rate)

Model when excluding insignificant variables one by one:

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,810 ^a	,655	,623	1,24358	2,177

a. Predictors: (Constant), DIFF(Gov_fiscal_balance), DIFF(ln_Income), DIFF(ln_Liquidity_constraint)

b. Dependent Variable: DIFF(Savings_rate)

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	94,075	3	31,358	20,277	,000 ^a
	Residual	49,487	32	1,546		
	Total	143,563	35			

a. Predictors: (Constant), DIFF(Gov_fiscal_balance), DIFF(ln_Income), DIFF(ln_Liquidity_constraint)

b. Dependent Variable: DIFF(Savings_rate)

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-,309	,237		-1,303	,202		
	DIFF(ln_Income)	44,922	9,643	,494	4,659	,000	,958	1,043
	DIFF(ln_Liquidity_constraint)	-11,101	3,231	-,404	-3,436	,002	,781	1,281
	DIFF(Gov_fiscal_balance)	-,285	,092	-,365	-3,114	,004	,785	1,274

a. Dependent Variable: DIFF(Savings_rate)

Collinearity Diagnostics^a

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	DIFF(ln_Income)	DIFF(ln_Liquidity_constraint)	DIFF(Gov_fiscal_balance)
1	1	1,642	1,000	,16	,14	,13	,03
	2	1,327	1,112	,07	,10	,11	,31
	3	,547	1,733	,73	,36	,19	,11
	4	,484	1,841	,05	,40	,56	,55

a. Dependent Variable: DIFF(Savings_rate)

Outliers lying two or more standard deviations away:

Casewise Diagnostics^a

Case Number	Std. Residual	DIFF(Savings_rate)	Predicted Value	Residual
21	2,588	4,56	1,3421	3,21888

a. Dependent Variable: DIFF(Savings_rate)

E. Test for structural stability

D=Dummy. The Dummy takes value 1 for 1991 and later, zero otherwise. To test for structural stability I estimate the following model:

$$\Delta \text{Savings_rate} = \alpha + \beta_1 \text{Dummy} + \beta_2 \Delta \ln_Income + \beta_3 \Delta \ln_Liquidity_constraint + \beta_4 \Delta \text{Gov_fiscal_balance} + \beta_5 \text{Dummy} _ \Delta \ln_Income + \beta_6 \text{Dummy} _ \Delta \ln_Liquidity_constraint + \beta_7 \text{Dummy} _ \Delta \text{Gov_fiscal_balance} + u_t$$

Hypotheses:

$$H_0 : \beta_1 = \beta_5 = \beta_6 = \beta_7 = 0$$

$$H_1 : \text{any of } \beta_1, \beta_5, \beta_6, \beta_7 \neq 0$$

Where H_0 implies that the estimated model holds for the whole period 1970-2006.

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	96,299	7	13,757	8,150	,000 ^a
	Residual	47,263	28	1,688		
	Total	143,563	35			

a. Predictors: (Constant), D_Diff_In_Gov_fiscal_balance, D, DIFF(ln_Income), DIFF(ln_Liquidity_constraint), DIFF(Gov_fiscal_balance), D_Diff_In_Income, D_Diff_In_Liquidity_constraint

b. Dependent Variable: DIFF(Savings_rate)

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,291	,379		-,767	,449
	D	,035	,534	,009	,066	,948
	DIFF(ln_Income)	39,980	15,160	,440	2,637	,013
	DIFF(ln_Liquidity_constraint)	-13,630	5,397	-,495	-2,525	,018
	DIFF(Gov_fiscal_balance)	-,356	,149	-,456	-2,386	,024
	D_Diff_In_Income	11,914	24,280	,102	,491	,627
	D_Diff_In_Liquidity_constraint	1,927	8,199	,056	,235	,816
	D_Diff_In_Gov_fiscal_balance	,145	,224	,150	,646	,524

a. Dependent Variable: DIFF(Savings_rate)

$$F_{obs} = \frac{49.487 - 47.263 / 4}{47.263 / (36 - 8)} = 0.329$$

F_{crit} for 4 and 28 degrees of freedom is 2.71. Thus $F_{crit} > F_{obs}$ whereby H_0 can not be rejected. Thus the estimated model is a good estimation for the whole period. When dividing into two periods, the results reject that there are differences in the intercepts and slope coefficients between of two observation periods.

F. Test for Granger Causality:

When testing for Granger Causality between income and the savings rate with one and two lags the following set of regressions are used:

$$\Delta Savings_rate_t = \sum_{i=1}^n \alpha_i \Delta \ln_Income_{t-1} + \sum_{j=1}^n \beta_j \Delta Savings_rate_{t-1} + u_{1t}$$

$$\Delta \ln_Income_t = \sum_{i=1}^n \alpha_i \Delta Savings_rate_{t-1} + \sum_{j=1}^n \beta_j \Delta \ln_Income_{t-1} + u_{2t}$$

$$F = \frac{(RSS_R - RSS_{ur}) / m}{RSS_{UR} / (n - k)}$$

Decision rule: If $F_{OBS} > F_{CRIT}$ then H_0 is rejected (meaning that the lagged terms are to be included in the model, which means that income Granger causes the savings rate). F_{CRIT} for 1 and 35 degrees of freedom is 4.12 while F_{CRIT} for 34 and 2 degrees of freedom is 3.28.

The tests of Granger Causality are summarized as:

Causality	Lags	F_{OBS}	F_{CRIT}	Decision
Income Causes Savings Rate	1	1.018	4.12	Do not reject H_0
The Savings rate Causes Income	1	0.048	4.12	Do not reject H_0
Income Causes the Savings Rate	2	3.85	3.28	Reject H_0
The Savings Rate Causes Income	2	2.65	3.28	Do not reject H_0

Test of Granger Causality with one lag:

Test of whether income Granger causes the savings rate (one lag):

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	30,374	3	10,125	2,773	,058 ^a
	Residual	113,173	31	3,651		
	Total	143,547	34			

a. Predictors: (Constant), LAGS(Diff_Savings_rate), LAGS(Diff_In_Liquidity_constraint), LAGS(DiffGov_fiscal_balance)

b. Dependent Variable: DIFF(Savings_rate)

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33,973	4	8,493	2,325	,079 ^a
	Residual	109,574	30	3,652		
	Total	143,547	34			

a. Predictors: (Constant), LAGS(Diff_In_Income), LAGS(DiffGov_fiscal_balance), LAGS(Diff_In_Liquidity_constraint), LAGS(Diff_Savings_rate)

b. Dependent Variable: DIFF(Savings_rate)

$$F = \frac{(RSS_R - RSS_{ur})/m}{RSS_{UR}/(n-k)} = \frac{(113.173 - 109.574)/1}{109.574/(35-4)} = 1.018$$

Test of whether the savings rate Granger causes income (one lag):

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,008	3	,003	8,767	,000 ^a
	Residual	,0091681	31	,000		
	Total	,017	34			

a. Predictors: (Constant), LAGS(Diff_In_Income), LAGS(DiffGov_fiscal_balance), LAGS(Diff_In_Liquidity_constraint)

b. Dependent Variable: DIFF(ln_Income)

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,008	4	,002	6,384	,001 ^a
	Residual	,0091541	30	,000		
	Total	,017	34			

a. Predictors: (Constant), LAGS(Diff_Savings_rate), LAGS(Diff_In_Income), LAGS(DiffGov_fiscal_balance), LAGS(Diff_In_Liquidity_constraint)

b. Dependent Variable: DIFF(ln_Income)

$$F = \frac{(RSS_R - RSS_{ur})/m}{RSS_{ur}/(n-k)} = \frac{(0.0091681 - 0.0091541)/1}{0.009154/(35-4)} = 0.0477$$

Conclusion: The direction of causality between income and the savings rate cannot be established with one lag.

Testing for Granger Causality with two lags:

Testing whether income Granger causes savings (two lags):

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	40,412	6	6,735	1,825	,132 ^a
	Residual	99,668	27	3,691		
	Total	140,080	33			

a. Predictors: (Constant), LAGS(Lag2_Diff_Savings_rate), LAGS(Diff_Savings_rate), LAGS(Lag2_Diff_In_Liquidity_constraint), LAGS(Lag2_Diff_Gov_fiscal_balance), LAGS(DiffGov_fiscal_balance), LAGS(Diff_In_Liquidity_constraint)

b. Dependent Variable: DIFF(Savings_rate)

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	63,164	8	7,896	2,566	,034 ^a
	Residual	76,916	25	3,077		
	Total	140,080	33			

a. Predictors: (Constant), LAGS(Lag2_Diff_In_Income), LAGS(Lag2_Diff_Gov_fiscal_balance), LAGS(Diff_Savings_rate), LAGS(Lag2_Diff_In_Liquidity_constraint), LAGS(DiffGov_fiscal_balance), LAGS(Diff_In_Liquidity_constraint), LAGS(Lag2_Diff_Savings_rate), LAGS(Diff_In_Income)

b. Dependent Variable: DIFF(Savings_rate)

$$F = \frac{(RSS_R - RSS_{ur})/m}{RSS_{UR}/(n-k)} = \frac{(99.668 - 76.916)/2}{76.916/(34-8)} = 3.85$$

Testing whether the savings rate Granger causes income with two lags:

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,011	6	,002	7,803	,000 ^a
	Residual	,006188	27	,000		
	Total	,017	33			

a. Predictors: (Constant), LAGS(Lag2_Diff_In_Income), LAGS(Lag2_Diff_Gov_fiscal_balance), LAGS(Lag2_Diff_In_Liquidity_constraint), LAGS(DiffGov_fiscal_balance), LAGS(Diff_In_Income), LAGS(Diff_In_Liquidity_constraint)

b. Dependent Variable: DIFF(ln_Income)

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,012	8	,001	7,163	,000 ^a
	Residual	,005139	25	,000		
	Total	,017	33			

a. Predictors: (Constant), LAGS(Lag2_Diff_Savings_rate), LAGS(Diff_In_Income), LAGS(DiffGov_fiscal_balance), LAGS(Lag2_Diff_In_Liquidity_constraint), LAGS(Lag2_Diff_Gov_fiscal_balance), LAGS(Diff_In_Liquidity_constraint), LAGS(Lag2_Diff_In_Income), LAGS(Diff_Savings_rate)

b. Dependent Variable: DIFF(ln_Income)

$$F = \frac{(RSS_R - RSS_{ur})/m}{RSS_{UR}/(n-k)} = \frac{(0.006188 - 0.005139)/2}{0.005139/(34-8)} = 2.65$$

F_{CRIT} for 34 and 2 degrees of freedom is 3.28.

Decision rule: if $F_{OBS} > F_{CRIT}$ then H_0 is rejected (meaning that the lagged terms are to be included in the model, which means that income Granger causes the savings rate).

Conclusion: With two lags, I conclude that income Granger causes the savings rate. But with two lags, I conclude that the savings rate does not Granger cause the income because $F_{OBS} (2.65) < F_{CRIT} (3.37)$.

G. Quality of the model

Multicollinearity:

Correlations

		DIFF(Savings_rate)	DIFF(ln_Income)	DIFF(ln_Liquidity_constraint)	DIFF(Gov_fiscal_balance)
DIFF(Savings_rate)	Pearson Correlation	1	,480**	-,504**	-,589**
	Sig. (2-tailed)		,003	,002	,000
	N	36	36	36	36
DIFF(ln_Income)	Pearson Correlation	,480**	1	,120	-,095
	Sig. (2-tailed)	,003		,484	,581
	N	36	36	36	36
DIFF(ln_Liquidity_constraint)	Pearson Correlation	-,504**	,120	1	,439**
	Sig. (2-tailed)	,002	,484		,007
	N	36	36	36	36
DIFF(Gov_fiscal_balance)	Pearson Correlation	-,589**	-,095	,439**	1
	Sig. (2-tailed)	,000	,581	,007	
	N	36	36	36	36

** . Correlation is significant at the 0.01 level (2-tailed).

Indications of multicollinearity:

- High R-square, but few significant t-ratios; R-square is relatively high (0.655) and there are 3 significant t-ratios. No indication of multicollinearity.
- High pairwise correlations; the pairwise correlations indicate multicollinearity if the correlation is higher than 0.8. Thus, when looking at the pairwise correlations, there is indication of multicollinearity between the liquidity constraint and the government fiscal balance.
- Eigenvalues and Condition Index; Indication of multicollinearity if Condition Index > 10. Since highest value is 1.8 the Condition Index values indicate no multicollinearity.

To summarise, there is some but inconclusive evidence of multicollinearity. Dropping any of the collinear variables leads to a model with R-square of approximately 0,5 with all variables still significant. Since the evidence is inconclusive, I keep all three explanatory variables to avoid specification bias.

Autocorrelation:

Durbin Watson d-test for Autocorrelation:

The observed Durbin-Watson value is 2.177. A Durbin-Watson value greater than 2 indicates negative autocorrelation, thus I will test for negative autocorrelation. Critical limits for the Durbin-Watson test (with 3 regressors and 36 observations is):

$(4-du)=4-1.654=2.346$ and $(4-dl)=4-1.295=2.705$

H_0 : No negative autocorrelation

H_1 : Negative autocorrelation

Decision: Do not reject H_0 of no negative autocorrelation, i.e. the Durbin Watson test indicates no problem with autocorrelation.

Jarque-Bera test of Normality:

H_0 : S=K=0

H_1 : S and/or K $\neq$ 0

$$JB = N \left[\frac{S^2}{6} + \frac{K^2}{24} \right]$$

Asymptotically, the Jarque-Bera statistics as written above follows the chi-square distribution with 2 degrees of freedom. Thus, the critical value is 5.9915.

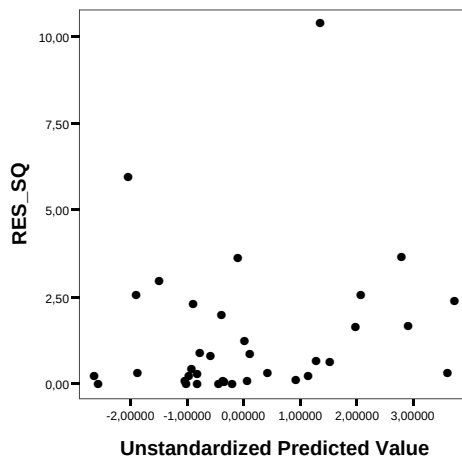
$$JB = 36 \left[\frac{0.176^2}{6} + \frac{0.401^2}{24} \right] = 0.427$$

Descriptive Statistics

	N	Mean	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Unstandardized Residual	36	,0000000	,176	,393	,401	,768
Valid N (listwise)	36					

Conclusion: According to the Jarque-Bera test of normality, H_0 of a normally distributed error term cannot be rejected.

Test for Heteroscedasticity



A visual examination of the residuals compared with the predicted values shows no indication of heteroscedasticity. A statistical examination gives a regression with 36 observations. I have ranked the observations and divided them into three groups. The middle group consists of 10 observations and the higher and lower groups consist of 13

observations each. This follows the advice by Gujarati, who argues that for 30 observations, approximately 8 observations should be in the middle group.

ANOVA^{c,d}

Group	Model		Sum of Squares	df	Mean Square	F	Sig.
.	1	Regression	4,564	3	1,521	,658	,607 ^a
		Residual	13,874	6	2,312		
		Total	18,438	9			
1	1	Regression	20,143	3	6,714	4,158	,042 ^a
		Residual	14,532	9	1,615		
		Total	34,675	12			
2	1	Regression	26,999	3	9,000	3,658	,057 ^b
		Residual	22,140	9	2,460		
		Total	49,139	12			

a. Predictors: (Constant), DIFF(ln_Variation_Inflation), DIFF(ln_Income), DIFF(ln_Liquidity_constraint)

b. Predictors: (Constant), DIFF(ln_Variation_Inflation), DIFF(ln_Liquidity_constraint), DIFF(ln_Income)

c. There are no valid cases in one or more split files. Statistics cannot be computed.

d. Dependent Variable: DIFF(Savings_rate)

Each of the RSS have $\frac{(n-c)}{2} - k$ or $\frac{(n-c-2k)}{2} df$

$$\lambda = \frac{RSS_2 / df}{RSS_1 / df} = \frac{22.140 / 9}{14.532 / 9} = 1.5235$$

Critical F-value at the five percent level is 3.1789. The critical F-value exceeds the observed F value and thus we can conclude that there is no evidence of heteroscedasticity in the error term.

RAMSEY RESET Test testing model specification

$$\Delta Savings_rate = \alpha_1 + \alpha_2 \Delta \ln_Income + \alpha_3 \Delta \ln_Liquidity_constraint + \alpha_4 \Delta Gov_fiscal_balance + \alpha_5 PRE_SQ_t + \alpha_6 PRE_CUBE_t + u_t$$

Hypotheses: $H_0 : \alpha_5 = \alpha_6 = 0$
 $H_1 : \alpha_5$ and/or $\alpha_6 \neq 0$

The null hypothesis implies that the model is correctly specified, whereas the alternative hypothesis implies that the model is incorrectly specified.

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,816 ^a	,665	,610	1,26538

a. Predictors: (Constant), PRE_CUBE, DIFF(ln_Income), DIFF(ln_Liquidity_constraint), PRE_SQ, DIFF(Gov_fiscal_balance)

b. Dependent Variable: DIFF(Savings_rate)

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	95,527	5	19,105	11,932	,000 ^a
	Residual	48,036	30	1,601		
	Total	143,563	35			

a. Predictors: (Constant), PRE_CUBE, DIFF(ln_Income), DIFF(ln_Liquidity_constraint), PRE_SQ, DIFF(Gov_fiscal_balance)

b. Dependent Variable: DIFF(Savings_rate)

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,254	,307		-,826	,415
	DIFF(ln_Income)	52,558	13,889	,578	3,784	,001
	DIFF(ln_Liquidity_constraint)	-12,787	4,063	-,465	-3,147	,004
	DIFF(Gov_fiscal_balance)	-,365	,128	-,467	-2,848	,008
	PRE_SQ	-,018	,088	-,032	-,207	,837
	PRE_CUBE	-,025	,039	-,170	-,638	,528

a. Dependent Variable: DIFF(Savings_rate)

$$F = \frac{(RSS_R - RSS_{ur})/m}{RSS_{UR}/(n-k)} = \frac{(49.487 - 48.036)/2}{48.036/(36-6)} = 0.453$$

F_{CRIT} for the five percent level with two and 30 degrees of freedom is 3.3158. H_0 of a correctly specified model is not rejected if the $F_{OBS} < F_{CRIT}$. In this case, the critical value (3.3158) is greater than the observed value (0.453) and thus the hypothesis of a correctly specified model is not rejected.