Report from the Economic Affairs Department at the Ministry of Finance

The Interaction between the Financial System and the Real Economy

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This report is an English translation of the report “Hur påverkar det finansiella systemet den reala ekonomin?” (Report from the Economic Affairs Department at the Ministry of Finance 2012:1) which was published in November 2012.

Foreword

The Economic Affairs Department at the Ministry of Finance has the task of assessing economic developments and analysing how society's resources are used and distributed. This includes forecasts and analyses of the development of the real economy, financial markets and public finances, as well as analysing the impact various policy proposals may have on economy. These forecasts and analyses are used in government policy. For reasons of space there are, in practice, very limited possibilities of presenting, in government bills, the methods and assumptions that the Economic Affairs Department uses to support different policy decisions. To increase the transparency of its presentations, the Government therefore announced in the Budget Bill for 2009 that in the future it intended to publish separately a more detailed account of the assessments made by the Economic Affairs Department. This is now being done in the report series *Report from the Economic Affairs Department at the Ministry of Finance*.

This report series is aimed at a range of stakeholders. In the first place it meets wishes expressed by the Swedish Fiscal Policy Council and the Swedish National Audit Office for greater transparency in reporting these matters. Other stakeholders can be government agencies, researchers and other organisations working on analyses of economic developments.

The report "*The interaction between the financial system and the real economy*" has been written by Mårten Bjellerup and Hovick Shahnazarian. Both work in the Economic Affairs Department at the Ministry of Finance. The report has been considered at a seminar at the Ministry of Finance by Mats Kinnwall, Peter Englund, Lars Hörngren and Pehr Wissén.

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We are grateful for comments on the report. They can be made direct to Mårten Bjellerup or Hovick Shahnazarian at tel. +46 8 405 1651 and +46 8 405 2779 or by email to marten.bjellerup@finance.ministry.se and hovick.shahnazarian@finance.ministry.se.

Stockholm, January 2013

Fredrik Bystedt
Director-General

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Summary

This report analyses how the financial system affects the real economy. The purpose of the report is to better understand and model how the financial system affects the real economy through various 'transmission channels'. It is not intended to try to explain developments in financial markets as such or why financial crises occur. It is hoped that this report can both contribute to a better understanding of the effects of previous financial crises on the real economy and provide a better tool that can be used to analyse the impact of financial crisis in the future.

The effects of the financial system on the real economy

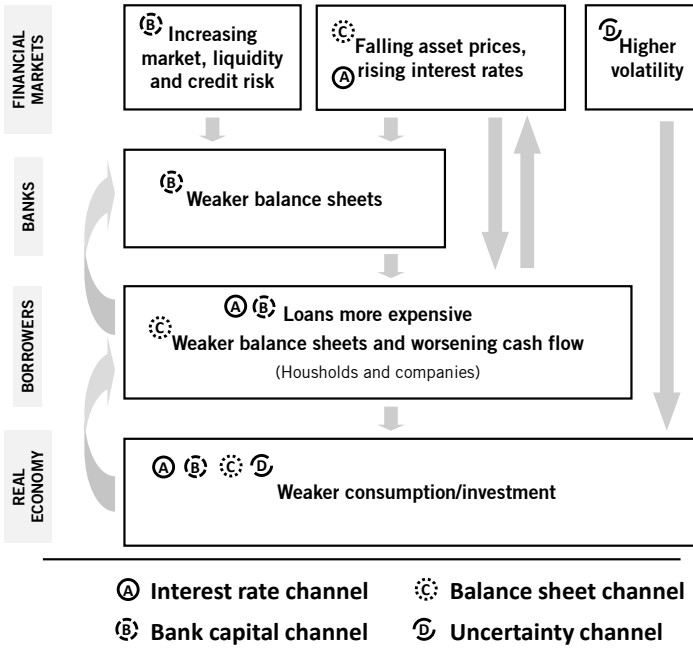
The financial system mainly affects the real economy through the following transmission channels: the interest rate channel, the bank capital channel, the balance sheet channel and the uncertainty channel. Developments in recent years in Sweden and elsewhere underline the importance of understanding these channels and identifying what effect they have on the real economy. The analytical diagram (figure 1) describes how these four channels can affect different parts of the economy.

The *interest rate channel* (channel A) describes how the real economy is affected when market interest rates rise, for example because the central bank increases the repo rate. Rising market interest rates lead, in turn, to higher borrowing costs, which lead to low consumption/investments by households/businesses.

The *bank capital channel* (channel B) describes how different types of risk associated with the operations of banks (e.g. market risk, credit risk and financing risk) worsen bank balance sheets by, for example, reducing the value of the bank's assets and equity. However, banks must meet certain requirements concerning capital adequacy, solvency and liquidity. Banks can choose to either raise

their lending rates (thereby increasing their profit and equity) and/or reduce their lending to be able to fulfil these requirements. Both a higher lending rate and less lending lead to lower consumption and less investment.

Figure 1: Analytical diagram for the effects of the financial system on the real economy



The *balance sheet channel* (channel C) describes how falls in asset prices, e.g. house prices and stock prices, reduce the value of assets held by households and businesses. If the value of assets used as security for loans falls, lenders can tighten security requirements at the same time as the loan terms get worse, e.g. because the lending rate is higher or the borrower is not allowed to borrow as much as they may want to. This then draws down asset prices even more, leading to a financial accelerator effect. Ultimately this leads to lower consumption and less investment.

The *uncertainty channel*s (channel D) describes how more uncertainty in the form of price fluctuations in financial markets, i.e. greater volatility, leads to higher precautionary savings and lower consumption as well as less investment.

The most important financial indicators…

A complete analysis of financial markets, banks and bank borrowers, requires a large number of indicators in each area. But for the sake of ease of comprehension and to be able to quantify the effects on the real economy more easily using econometric methods, there is a need to work with a few summary indicators.
This report identifies and uses three central, summary indicators for an analysis of both the four channels and the three parts of the economy in figure 1.
The indicators are the lending rate, the asset price gap and a financial stress index. These indicators were chosen after statistical tests of a large number of available indicators focusing on their impact on a selection of key real economy variables.

The *lending rate* is the average interest rate that households and companies actually pay. It is influenced both by the interest rate that banks themselves have to pay to borrow funds and the interest rate supplement added by banks when lending on to their customers. The lending interest rate therefore summarises developments for the banks and is also the main indicator for the interest rate and bank capital channels.

The *asset price gap* is a composite of the deviations in house and stock prices from their historical trends and it captures the effect that asset prices have on the consumption and investment decisions of both households and businesses. The asset price gap summarises developments for bank borrowers and is also the main indicator for the balance sheet channel.

The *financial stress index* is a composite of (1) volatility in the stock market, (2) volatility in the currency market, (3) the spread between mortgage and government bonds and (4) the spread between the inter-bank rate and the interest rate on treasury bills. The stress index summarises uncertainty in financial markets and is also the main indicator for the uncertainty channel.

…and their impact on the real economy

In order to capture the link between the financial system and the real economy, historical correlations have been calculated between various real economy variables and the financial indicators. These calculations have been done using an econometric macro model

called MOD-FIN[1], which includes the three main financial indicators given above. The results show that a temporary negative shock to the asset price gap of one index unit, corresponding to a share index fall of about 2.5 per cent and a house price fall of about 1 per cent, results in a negative effect on the level of GDP corresponding to about 0.4 per cent after two years. An isolated, temporary increase in the lending rate corresponding to 1 percentage point results in a negative effect on the level of GDP of about 0.6 per cent after two years. Finally, a temporary increase in the stress index of one unit has a negative effect on the level of GDP corresponding to about 0.4 per cent after two years. Thus each effect has the expected sign and does not seem to be of an unreasonable size.

In addition, MOD-FIN improves the forecasting ability of this model compared to a macro model without these financial variables. MOD-FIN also provides the possibility of examining the impact different types of development of the financial system may have on the real economy compared to a base or main scenario. This is done by either by scenario analysis or by different stress tests. Scenario analysis gives a quantitative indication of how sensitive the development of the real economy can be to disturbances in the financial system. The results of an assumed scenario of distinct financial turbulence, in which developments as of 2012 Q3 resembles those from 2008 Q3 and later, show that the negative effect on the level of GDP would be more than 4 per cent after 2.5 years compared with the forecast in the Government's Budget Bill for 2013. This negative GDP effect comes chiefly from lower share and house prices (more negative asset price gap), but a temporary increase in uncertainty on financial markets (higher financial stress index) also contributes. These negative effects are only countered to a moderate degree by a lower lending rate as a result of a lower repo rate. In this scenario, it is assumed that the lending rates cannot fall as much as it did in 2008–2009 as the initial repo rate is lower and as the banks are expected to secure larger margins, partly on account of the announcement of tougher capital adequacy rules.

[1] The calculation is done using a VAR model which includes the following variables: Global GDP, exchange rate, domestic GDP, inflation and unemployment in addition to the financial indicators.

The approach in this report has several advantages

One advantage of the approach in this report is that the macroeconomic VAR model includes three financial variables that together capture the transmission mechanism between the financial system and the real economy. This gives the model a better forecasting and explanatory ability than a comparable macro model that does not contain the three financial variables mentioned above. Another advantage is that the VAR models used in the report are not over-complicated, a feature that is often to be preferred in policy contexts. A further advantage is that the financial indicators proposed are composite measures. This makes it possible to set up scenarios for a wide range of different financial variables and then analyse the impact these scenarios may have on the composite measures and on the real economy.

1 Introduction

Financial markets basically stopped functioning all over the world during the financial crisis. The price of many assets fell quickly and deeply, central banks cut their policy rates drastically and the situation was characterised by great uncertainty. The crisis deepened the then incipient recession sharply, which had a particularly severe effect on the export-oriented Swedish economy. Most observers were surprised that a crisis in financial markets had such a deep and long-lasting effect on the real economy.

In the wake of the financial crisis, researchers and economic policy decision-makers have directed much more attention to the linkage between the financial system and the real economy, known as the transmission mechanism. For example, Professor Lars Calmfors notes that:

> "[o]ne systemic fault in economic research was the lack of integration between macro theory (which analyses how the level of economic activity is determined) and financial economics".[1]

But the link between the financial system and the real economy is not something that only exists in times of crisis; it is also in place under more normal economic circumstances. The effects are just less drastic. The description given by Lars E.O. Svensson, Deputy Governor of the Riksbank, is that there is a natural and important linkage between what is traditionally regarded as monetary policy and financial stability.

> Monetary policy affects the real economy and thus profitability, asset prices, balance sheets and loan losses. Thereby it also affects financial stability. Financial-stability policy in the form of requirements for sufficient capital and buffers, directly affects the spread between lending

[1] Calmfors (2012).

> rates and the repo rate, lending and other aspects of financial conditions as well as the transmission mechanism of monetary policy. This means that monetary policy should normally be conducted taking the conduct of financial-stability policy into account, and financial-stability policy should be conducted taking the conduct of monetary policy into account. This is roughly the same as saying that monetary policy should take account of the conduct of fiscal policy, and vice versa."[2]

One illustrative example of this is the commonly used rule of thumb that the lending rate to households and businesses consists of the central bank policy rate plus a fixed supplement, a rule of thumb that often works relatively well. However, an analysis of what the difference between the two rates actually consists of gives information about, for example, the state of financial markets, the future loan losses and the financial health of banks. Developments in recent years also show that it is highly dubious to treat the difference between the repo rate and the lending rate as both small and fixed.

The purpose of this report is to better understand and model the transmission mechanism. The intention is not to try to explain developments on financial markets as such or why financial crises occur, but to try, instead, to explain what effect the financial system has on the real economy. The reasons why financial crises occur vary over time but the channels through which they affect the real economy are more persistent. It is therefore hoped that this report can both contribute to a better understanding of the effects of previous financial crises on the real economy and provide a better tool that can be used to analyse the impact of financial crisis in the future.

The report has the following structure. *Chapter 2* presents the theoretical framework by illustrating and describing the various transmission channels (the interest rate channel, the balance sheet channel, the bank capital channel and the uncertainty channel). These channels, which are highlighted in the academic literature, explain the way in which financial shocks affect aggregate demand and its components via their impact on financial prices and quantities. This framework is then used to construct three composite financial variables that act as indicators for these channels (*Chapter 3*).

[2] Svensson (2012).

In *Chapter 4*, a small macroeconomic VAR model is augmented with these three financial indicators in order to make an empirical assessment of the aggregate effects of the financial system on the real economy. This model is then used to make endogenous forecasts of macroeconomic developments. The model is also used for scenario analysis and stress tests. Finally, the model is evaluated to examine its forecasting properties compared with a model that does not include the three composite financial indicators.

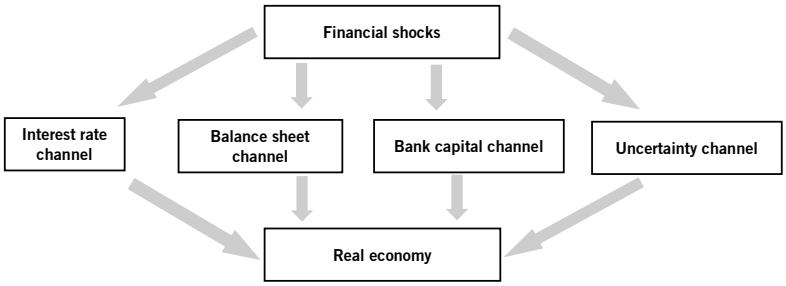
2 Transmission channels

The transmission mechanism is the collective term for how central bank interest rate changes and financial shocks affect aggregate demand and its components via their effects on financial prices and quantities. The transmission mechanism is usually divided into several different channels to distinguish between different types of financial shocks and their effects. The academic literature describing these different channels is very extensive and not always consistent. A working group under the Basel Committee on Banking Supervision has written three survey papers that summarise the latest research in this area.[1] These papers include not only a review of previously published research, but also papers initiated by the working group itself in cases where they have identified gaps in the literature. Antony and Broer (2010) have also written a survey paper on the linkage between the financial sector and the macro economy. Moreover, Gerke et al. (2012) present a good and clear comparison of a number of dynamic stochastic general equilibrium models that include various financial frictions.

One way of summarising the transmission mechanism, as described in the academic literature, is to divide it up into four different channels (see figure 2.1 below). However, there is not full agreement in the literature with regard to the number of channels and exactly how they operate. The figure illustrates how the bulk of this research describes the transmission channels. A more detailed description of how the different channels operate is given in sections 2.1–2.4.

[1] See Basel Committee on Banking Supervision (2011), (2012a) and (2012b). Much of the research referred to in these three reports is currently being refereed in various scientific journals so it should be interpreted with caution for the time being.

Figure 2.1: The transmission channels



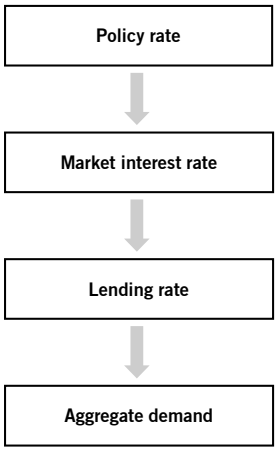
2.1 The interest rate channel

The traditional description of the transmission mechanism assumes that a central bank can influence market interest rates via its policy interest rate and that this, in turn, affects credit costs for households and businesses, which, in turn, affects aggregate demand via effects on consumption and investment (figure 2.2).[2]

A tightening of monetary policy, i.e. an increase in the central bank policy rate, leads to a rise in market interest rates, which makes the financing costs for banks rise, as it becomes more expensive for them to borrow. Banks increase the lending rates faced by households and businesses by the same amount. This means that the differences between lending rates and market rates are unchanged. In principle the policy rate is assumed to have an immediate effect on short-term market rates. It is also assumed that long-term rates are affected, but with a lag. Households increase their savings and reduce their consumption when interest rates rise. Businesses react in a corresponding way, which leads to them reducing their investments. Moreover, higher market rates can have a negative effect on the price of financial and real assets. This is because the present value of future returns from these assets decreases. Consumption also decreases as a result of this wealth effect.

[2] Monetary policy can also affect the economy via the 'exchange rate channel'. An increase in the policy interest rate normally leads to exchange rate appreciation. This happens through a greater inflow of capital because higher interest rates make domestic assets appear more attractive than foreign assets. A stronger exchange rate means lower import prices, with the result that some domestic demand moves from domestic to imported goods. This moderates the inflationary pressure and also leads to a weaker balance of trade. Moreover, monetary policy also affects the economy through other channels via expectations.

Figure 2.2: The interest rate channel



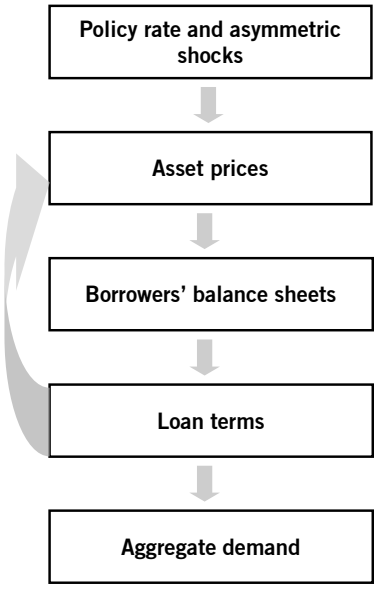
2.2 The balance sheet channel

The balance sheet channel assumes that borrowers pay a an 'external funding premium' or a 'risk premium', if they choose to finance their investments using external funds instead of their own funds.[3] The size of the risk premium depends on the creditworthiness of the borrowers in the sense that when their creditworthiness decreases, they have to pay a higher premium to borrow. The borrowers' creditworthiness is linked, in turn, to the borrowers' income, expenditure and balance sheets. Moreover, the borrowers' assets are generally used as collateral when they borrow on the market. Economic shocks can lead to a fall in the value of the borrowers' assets at the same time as the value of their loans is unchanged. In such cases, the borrowers' balance sheets look much worse than they had expected. Lenders may apply tougher collateral requirements while increasing their lending rates to compensate for the increased risk. This may, in turn, weigh on asset prices even more, hence the 'financial accelerator effect'. Borrowers can choose to amortise part of their debt (consolidate their balance sheets) if their funding costs increase more than they wish. This means that their income will go to amortisation rather

[3] Bernanke and Gertler (1989) and Bernanke, Gertler and Gilchrist (1989) are two of the original papers that describe the mechanisms behind the balance sheet channel and how the funding premium arises. The reader is also referred to Kiyotaki and Moore (1997) and Holmström and Tirole (1997) who also describe this channel.

than to consumption and investment for a period to come (figure 2.3). Such balance sheet consolidation generally takes quite a long time – sometimes several years., Economic development therefore risks being weak during this period. It is only when households and businesses are satisfied with their debt levels that they again begin consuming and investing at a normal rate.

Figure 2.3: The balance sheet channel



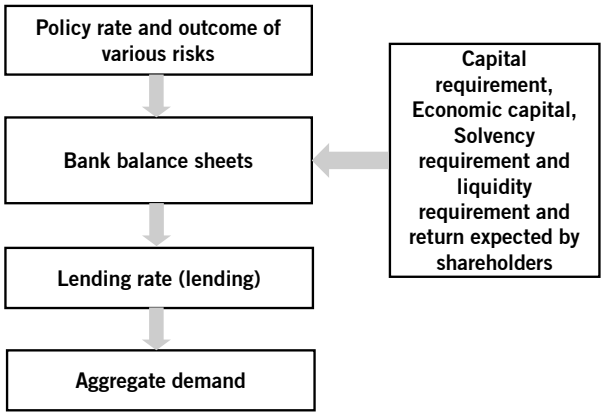
2.3 The bank capital channel

The bank capital channel assumes that banks must fulfil various requirements.[4] One such requirement is the capital adequacy requirement that requires that the equity of banks must exceed a certain share of their total lending. But the capital adequacy requirement is only one of the requirements applied to bank balance sheets. Other important requirements are the requirements concerning bank solvency and liquidity.[5] In addition, the

[4] Stein (1998), van den Heuvel (2002 and 2004) are the original three papers that describe the mechanisms behind the bank capital channel. Along with the interest rate channel it is also called the credit channel.
[5] The reader is referred to Finansinspektionen (Swedish Financial Supervisory Authority) (2001:1), Finansinspektionen (2002:8), Finansinspektionen (2005:8), Lind (2005), Riksbank

requirements set by the credit-rating institutes are generally even higher than the regulatory requirements. On top of this, shareholders expect to receive a return on their capital, which is yet another requirement that banks must take into account.

Figure 2.4: The bank capital channel



If the value of equity (shares) decreases, for example because of monetary policy tightening or because of the outcome of various risks (market risk, liquidity risk, or credit risk, which together can lead to solvency risk for banks), so that the capital adequacy requirement is not upheld to a sufficiently high degree, a bank may be forced to raise its lending rate or to reduce its lending (figure 2.4). A higher lending rate leads, in turn, to lower aggregate demand. This transmission channel thus goes via bank balance sheets unlike the balance sheet channel, which goes via borrowers' balance sheets (figure 2.4).[6]

2.4 The uncertainty channel

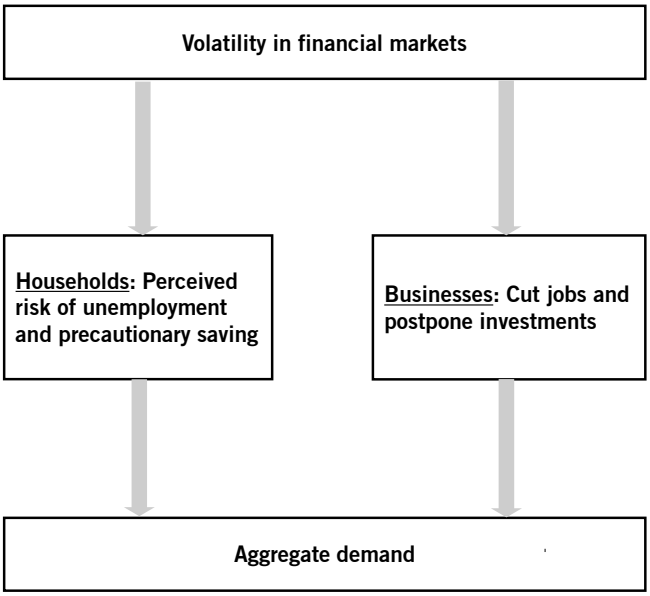
Unlike the balance sheet channel and the bank capital channel the uncertainty channel mans that there is a direct channel between

(2010a, 2010b and 2011:2) for a more detailed description of the various requirements imposed by regulators on bank balance sheets.

[6] However, there is a close link between the balance sheet channel and the bank capital channel in the sense that when borrowers' balance sheets deteriorate this has a direct effect on bank balance sheets (for example, through greater loan losses for banks and higher capital adequacy requirements).

uncertainty in the financial market and the real economy.[7] This direct uncertainty channel goes both via households and via businesses (figure 2.5).

Figure 2.5: The uncertainty channel



Both businesses and households are influenced by greater volatility in financial markets. Major fluctuations in the stock exchange, in the value of the Swedish krona and in bank margins on lending rates are examples of this. Businesses start to review their investment plans when uncertainty increases since greater uncertainty means that the value of waiting to make an investment raises. The effect of greater uncertainty is therefore that businesses postpone some of their investments. Moreover, businesses often react to greater uncertainty by giving notice of layoffs. Households react both to the increased risk of unemployment (more notices of layoffs) and to the greater uncertainty in financial markets. The

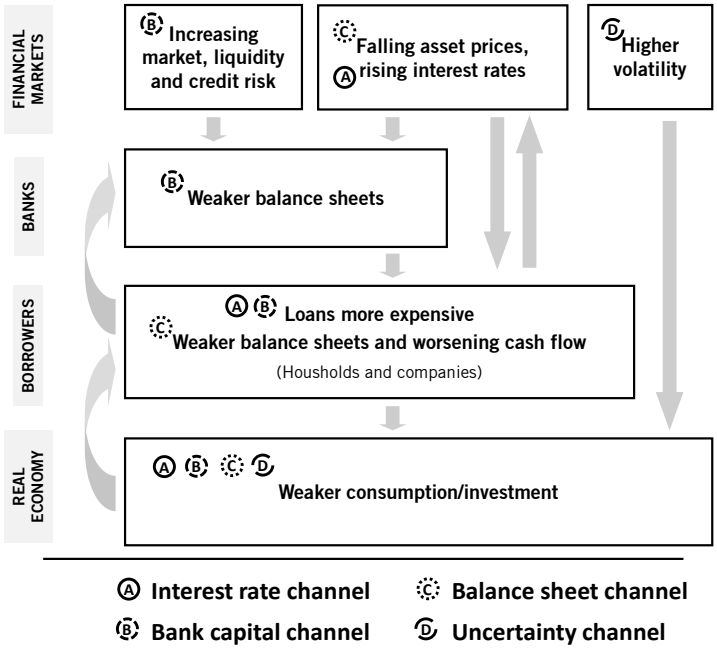
[7] Antony and Broer (2010) highlight this transmission channel as an important channel. In contrast, the Basel Committee on Banking Supervision (2011) contains a discussion as to whether this channel is a channel in its own right or whether, instead, the effect of uncertainty in the financial market always goes via its effects on quantities and prices, i.e. operates through the balance sheet channel and the bank capital channel.

overall effect is that households increase their precautionary savings, i.e. they reduce their consumption.[8]

2.5 An overview of the transmission channels

Figure 2.6 summarises the effects of the various transmission channels on the real economy in an alternative way.

Figure 2.6: The impact of the financial system on the real economy



The purpose of this analytical scheme is to link the transmission channels to different parts of the economy. Depending on the channel, the effects go via the financial market, the banks and/or bank borrowers before finally affecting the real economy. The effect of different transmission channels in the economy has been marked by different letters: The interest rate channel (A), the bank capital channel (B), the balance sheet channel (C) and the uncertainty channel (D).

[8] Others think that the uncertainty channel also operates indirectly, e.g. by influencing the discount rate, see, for example, Gerdrup et al. (2006).

A complete analysis of financial markets, banks and bank borrowers requires a large number of indicators in each area. However, there is a need for a few summary indicators so that the effects on the real economy of all transmissions channels can be quantified using econometric methods. The next chapter therefore presents three indicators that summarise developments in financial markets (the uncertainty channel), in banks (the interest rate and bank capital channel) and among bank borrowers (the balance sheet channel).

3 Choice of financial indicators

This chapter deals with the choice of financial indicators in the light of the theoretical discussion conducted in the previous chapter. In this chapter various indicators are constructed that capture developments on financial markets (section 3.1), among bank borrowers (section 3.2) and among banks (section 3.3).

3.1 Financial markets

Developments in financial markets form the basis for the uncertainty channel, as it was described in section 2.4. Variation in market values, i.e. the volatility increases, creates greater uncertainty, which in turn, has a negative impact on the real economy. The aim of this section is therefore to build an indicator that measures the degree of uncertainty on financial markets, a 'stress index'.

3.1.1 Stress index as a measure of uncertainty

There are many markets in the financial system, with different functions and importance. The idea behind the selection of markets made here is that the markets chosen are intended to capture the main interfaces that households and businesses have with the financial system. In line with the arguments presented in Forss Sandahl et al. (2011) and Riksbank (2009), an index is constructed that is a composite of developments on the following four markets: The stock market, the currency market, the money market and the bond market.[1]

[1] Developments on each of these markets are standardised to make it possible to construct a composite indicator. This is described in a later section.

Uncertainty in the stock market

The stock market is an important source of funding for businesses, either through stock exchange introductions or through new share issues. Moreover, developments in the stock market are important for the growth of wealth held by both households and businesses. Periods of small or large fluctuations in the stock market are something that households and businesses pay attention to.

There are several ways of measuring disturbances and uncertainty in the stock market. One of the most important measures is volatility. There is a group of volatility measures that are forward-looking since they are based on option prices (e.g. VIX in the US). But, from a practical econometric perspective, it is a disadvantage that long time series are not available for these volatility measures. However, long time series are available for stock exchange indices. Therefore, the stress indicator used for the stock market is actual volatility in the OMX index, measured as the standard deviation for the OMX index for the previous 30 days.

Uncertainty in the currency market

The currency market is important for households, but perhaps especially for businesses with exports and/or imports. Periods of small or large fluctuations in the currency market are something that households and businesses pay attention to.

Just as in the case of the stock market, there are several ways of measuring volatility in the currency market, where volatility is the most common measure. And just as in the case of the stock market, there are volatility measures that are based on option pricing, but long time series are not available for the currency market either. Therefore, the actual volatility of the SEK exchange rate against the euro, measured as the standard deviation for the prices noted for the previous 30 days, is used as a stress indicator for the currency market.

Uncertainty on the money market

The money market is of great importance for both households and businesses because it is very important for the development of lending rates for short maturities, e.g. floating mortgage rates . On the money market, banks can, for instance, lend money to one

another at short maturities, even as short as for a day. The interest rate on this interbank market is called STIBOR and is often compared with the interest rate on treasury bills with corresponding maturities.[2] The reason for this comparison is that the difference between these interest rates reflects, in part, the risk that is associated with lending money to the banks, as lending money to the Government at short maturities is (in principle) free from risk.

Normally, this interest rate difference, which is called the TED spread, is very small and very stable. This is because, in principle, lending to banks is regarded as being just as safe as lending to the Government. The occasions on which this spread actually grows tangibly are periods of turbulence in financial markets. In such situations, the banks get more cautious about lending money to one another because they believe that the risk that their counter-party will not be able to repay the loan has increased. This leads to an increase in the TED spread.[3] In view of this, the TED spread, calculated as the difference between the three-month STIBOR and interest rate on three month treasury bills, is used as a stress indicator for the money market.

Uncertainty in the bond market

The bond market is very important for both households and businesses because it is of great importance for the development of the interest rates they face for longer maturities, e.g. fixed mortgage interest rates and the interest rate on bonds issued by companies.

The bond market consists of several parts, with the two most important parts being the government bond market and the mortgage bond market. The government bondholder has a financial claim on the issuer, i.e. the Government. The holder of a mortgage bond also has a financial claim on the issuer (a mortgage institute). In addition to this, there is also security in the form of housing mortgages that the mortgage institute has advanced to its customers. If the mortgage institute has problems paying holders of the mortgage bonds, then it is entitled to the underlying

[2] STIBOR is an abbreviation of Stockholm interbank offered rate.
[3] This effect can also amplified by the fact that in times of uncertainty investors prefer to buy securities with as little risk as possible, e.g. treasury bills, which means that the interest rate on treasury bills can become unusually low.

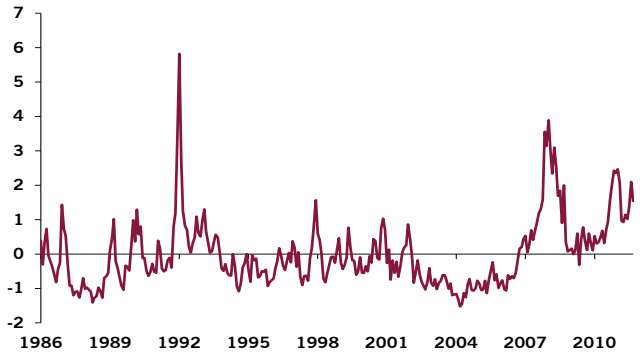
security.[4] The spread in interest rates between mortgage- and government bonds, which is called the mortgage spread, says something about how sellers assess the risks associated with each bond. This makes this spread a good indicator of developments on these two markets. The mortgage spread is therefore used as a stress indicator for the bond market.

3.1.2 Financial stress index

The four indicators presented above are first standardised so that they can be weighted to a composite financial stress index.[5] The weighting is done by giving each indicator the same weight. Finally the new summary index is also standardised. This means that the summary financial stress index has a mean of 0 and a standard deviation of 1, which facilities interpretation of the index. When the series has the value of zero it is equal to its historical mean and the stress level should therefore be considered normal. With this standardisation a value of one also means that the level of stress is one standard deviation higher than normal.

Figure 3.1: Financial stress index

Index units



Sources: Datastream and the Ministry of Finance

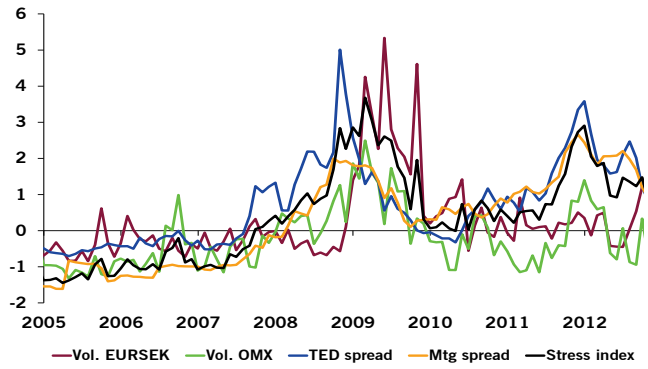
Figure 3.1 shows the stress level on financial markets in Sweden measured by a stress index. There are two clear peaks, one during

[4] This type of design is called a covered bond and is intended to reduce the buyer's risk, which means that the issuer can borrow money to a lower cost.
[5] This is done by subtracting the mean from each series and then dividing it by its standard deviation. The standardised series then has a mean of zero and a standard deviation of 1.

the crisis in the early 1990s and one at the outbreak of the crisis in 2008. Between them there is a long period of low stress, especially in the years immediately before 2008. However, a composite stress index can be the sum of very different types of developments in the markets included. For a deeper analysis and understanding of developments, it is important to also study the components of the index so as to form a clearer picture of how the different parts contribute to the whole (see figure 3.2 for developments of late).

Figure 3.2: Financial stress index and its components

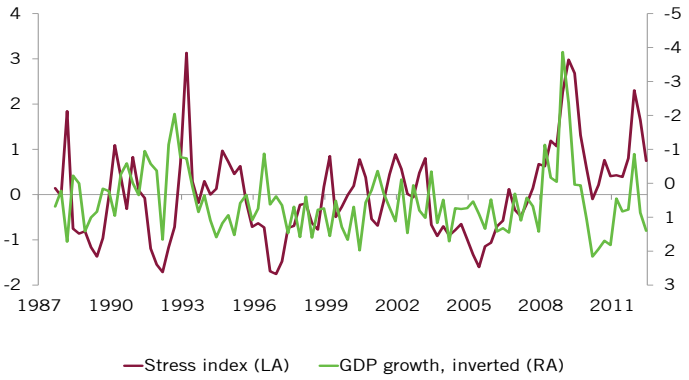
Index units



Note: All series have been normalised around their historical average.
Sources: Datastream and the Ministry of Finance

Figure 3.3: Stress index and GDP growth

Index units Percentage quarterly change



Sources: Datastream and the Ministry of Finance

The level of stress on financial markets in Sweden, measured using a stress index, shows clear covariation with GDP growth (figure 3.3). Periods of lower than normal stress coincide approximately with the periods of high and stable GDP growth and the two periods of very high stress coincide approximately with the two major economic crises that Sweden has experienced in recent decades.

3.2 Bank borrowers

Developments among bank borrowers are the basis for the balance sheet channel described in section 2.2. If the solvency, creditworthiness or wealth of households and businesses decreases, this is negative for the development of the real economy. The aim of this section is thus to produce an indicator that is a measure of the financial health of households and businesses.

There is a whole series of financial measures that can be used to capture the solvency, etc. of households and businesses. One disadvantage of many of these measures is that they are specific in various ways to households or businesses so that it is not easy to combine them. Moreover, several of them are published relatively seldom. However, one thing that the balance sheets and solvency of businesses and households have in common is that they are both affected by the price of both financial and real assets.

Therefore in order to capture the variations in both financial and real asset prices a summary index is created that is based on how the share and property prices change in relation to their historical trends.

3.2.1 Asset price gap

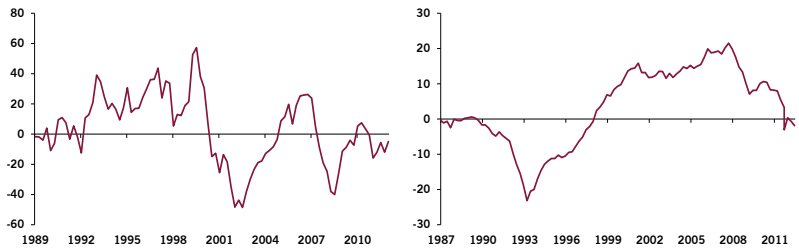
A gap is generated for each of the stock and property markets as a first step towards creating such a summary indicator. The stock price gap is defined as the deviation of the OMX index from its trend divided by the trend (see figure 3.4).[6] The real stock price gap captures whether the development of the stock market is following its historical trend. The house price gap is defined in a

[6] The trend is calculated through a one-sided HP filter using a lambda equal to 400 000. The reader is referred to Drehmann et al. (2010) for a more detailed description of this method. The Basel Committee suggests using this method to calculate the credit gap and the countercyclical capital buffer.

corresponding way, i.e. as the deviation of the property price index from its trend, divided by that trend (figure 3.4). In the second step the share price gap (20 per cent) and the property price gap (80 per cent) are combined in a asset price gap that therefore summarises the development of house and stock prices (figure 3.5).[7] This summary measure is used as an indicator in order to analyse what effect the balance sheet channel has on the real economy.

Figure 3.4: Real stock price gap and real house price gap

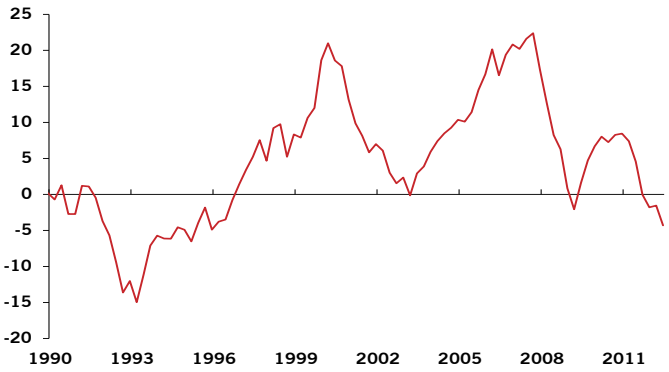
Per cent



Sources: Datastream and the Ministry of Finance

Figure 3.5: Real asset price gap

Per cent



Sources: Datastream and the Ministry of Finance

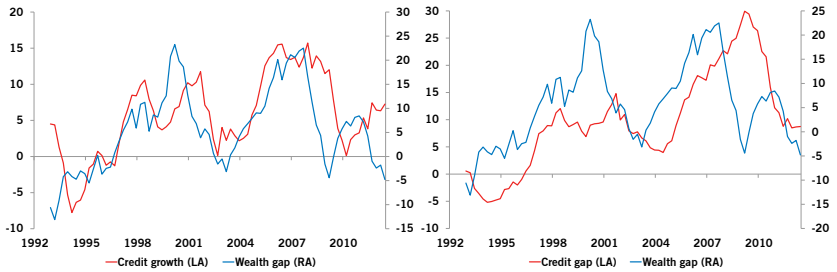
As previously noted, economic shocks lead to a fall in the value of borrowers' assets at the same time as the value of their loans is unchanged. In such cases the borrowers' balance sheets look much

[7] This weighting has been carried out after studies of the asset price gap so as to make it a composite measure of the financial health of households and businesses ..

worse that they had expected, with the result that they amortise part of their liabilities (consolidate their balance sheets). One way of illustrating what this linkage looks like in practice is to compare the historical development of asset prices (the asset price gap) and liabilities (credit growth and the credit gap).[8] As is seen in figure 3.6, changes in asset prices precede changes in credit growth by a number of quarters. So, there are both theoretical and empirical reasons for choosing asset prices – and not liabilities – as an indicator for the balance sheet channel.[9]

Figure 3.6: Asset price gap and total credit growth and total credit gap respectively

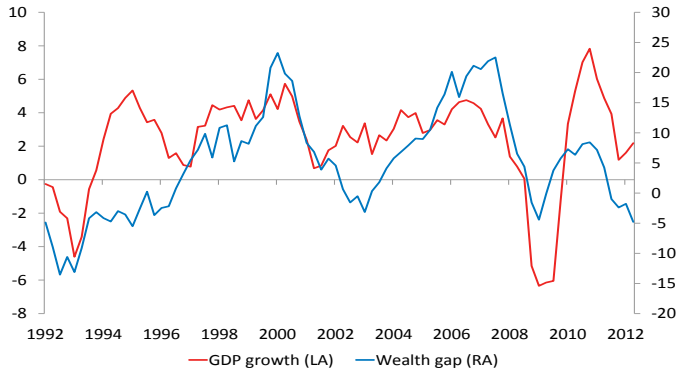
Annual percentage change and per cent



Sources: Datastream and the Ministry of Finance

Figure 3.7: Wealth gap and GDP growth

Annual percentage change Per cent



Sources: Datastream and the Ministry of Finance

[8] In technical terms the credit gap has bee designed in the same way as the wealth gap.
[9] Moreover, the quarterly statistics for liabilities do not go as far back as those for asset prices. These statistics do not have information about the development of liabilities during the first half of the 1990s.

Figure 3.7 shows that the asset price gap covaries with GDP growth. The peaks and troughs of the asset price gap coincide roughly with the peaks (2000, 2007) and troughs (1993, 2009) identified in the economic cycle.

3.3 Banks

As pointed put in section 2.3 banks are regulated so that various risks in bank operations do not have too much effect on bank balance sheets. These risks can be followed using a number of different indicators, for example various key ratios based on bank balance sheets and income statements. But, the central issue is what effect these risks have on bank balance sheets and income statements and ultimately on the pricing behaviour of banks and their lending to the public.

As in Karlsson, Shahnazarian and Walentin (2009) it is assumed that banks in Sweden operate on a market characterised by monopolistic competition. This means that the lending rate is more suitable as a summary indicator for the banks and the interest rate and bank capital channel. Thus, the bank capital channel affects the real economy via the same financial variable as the interest rate channel described in section 2.1, i.e. the lending rate. One advantage of this approach is that the lending rate can be decomposed, which makes it possible to get an idea of how much of the changes are due to monetary policy and how much depend on other factors.

3.3.1 Bank lending rates

In a market with monopolistic competition the banks' lending rate is set as a mark-up on their marginal costs and the interest rate can be divided up into several parts (figure 3.8).

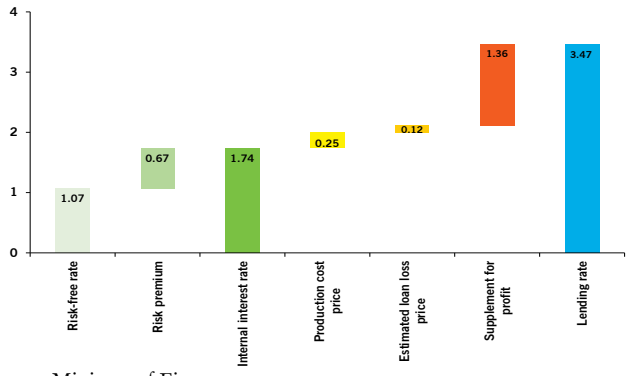
The banks usually call their funding cost the internal interest rate and this is normally the largest part of the lending rate. The internal interest rate is dependent of what the bank has to pay for its own borrowing. In figure 3.8, the internal interest rate contributes 1.74 percentage points to the interest rate on new lending. It can, in turn, be divided up into two parts. Risk-free interest rates contribute 1.07 percentage points and the risk

premiums, i.e. what the bank charges over and above what the Government has to pay, contribute 0.67 percentage points to the internal interest rate.

Other production costs are another factor that contributes to the interest rate on new lending and internally the banks usually call this the product cost price. These production cost prices, which consist of personnel costs, tax and other overheads, amount to 0.25 percentage points in figure 3.8.

Figure 3.8: Contributions to the average interest rate for new lending in the four big banks, June 2012

Percentage points



Source: Ministry of Finance

In addition, the banks add a supplement for their expected loan losses. This is a measure of their expected losses which states how much the bank expects to lose on its present loan portfolio. The contribution of these costs to the interest rate for new lending is usually called the price of estimated loan losses. In figure 3.8, this contribution amounts to 0.12 percentage points.

The banks' capital base costs are another important factor.[10] Put simply, this is a cost that arises because banks cannot use this capital in their operations. Internally, banks usually call the contribution of capital base costs to the interest rate on new lending the capital base cost price.

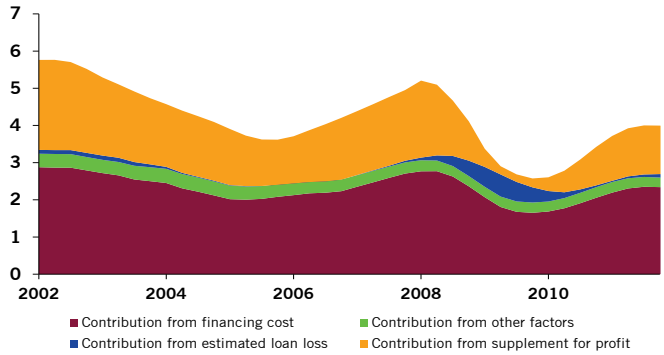
Finally the banks usually add a supplement for profit. In figure 3.8 this supplement has been lumped together with the capital base cost since the profit made by a bank can either be distributed to

[10] This follows from the statutory capital adequacy requirement and requirements from credit-rating institutes that banks must have sufficient equity at any point in time.

shareholders or used to strengthen the bank's equity. The capital base cost is actually a calculated return on equity that corresponds to the return expected by shareholders. In figure 3.8 the capital base cost price along with the supplement for profit amount to 1.36 percentage points of the interest rate on new lending.[11]

Figure 3.9: Lending rate on loan stock and its various components from 2002

Percentage points



Sources: Bank reports, Riksbank and the Ministry of Finance.

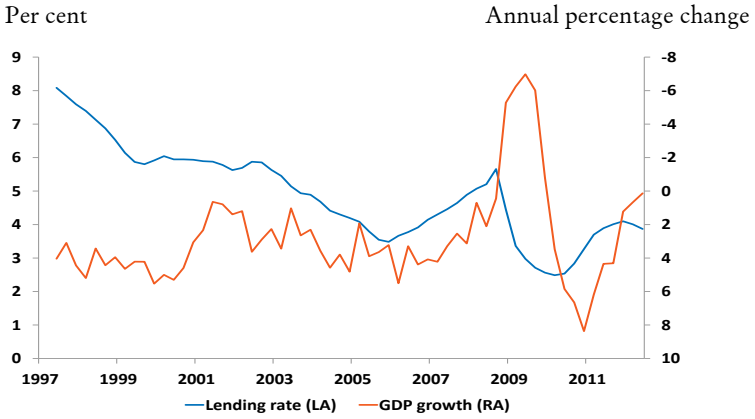
It is also important to follow the development of the factors that influence the lending rate on the loan stock over time (figure 3.9). Up until the beginning of the global financial crisis the internal interest rate rose as the monetary policy was tightened while the contribution from the other factors was approximately unchanged. During the crisis internal interest rates fell as the Riksbank reduced its policy rate in order to counter the higher risk premiums. In addition, the banks' loan losses began to rise. Moreover, the banks reduced their profit margins. In the past two years, the banks have again begun to increase their profit margins.

The above discussion indicates that what the macroeconomic literature calls credit spread contains many different components that are affected in one way or another by various risks associated with bank operations. Using lending rates, instead of policy rates in macroeconomic models makes it possible to analyse the effects these risks, along with the monetary policy being pursed, have on the macro economy.

[11] This margin means that lending operations give a return on equity corresponding to 18 per cent.

The lending rate that is used as an indicator is a combination of the interest rate that households and businesses actually pay on their existing loans.[12] This interest rate affects GDP growth, even though the effect of an interest rate change on GDP takes 1 to 2 years (figure 3.10). Thus, the actual lending rate is used to analyse the effect of the bank capital channel on the real economy,

Figure 3.10: Lending rate and GDP growth



Sources: Datastream and the Ministry of Finance

[12] The combination of interest rates for households (2/3) and businesses (1/3) has been made so as to get an aggregated series with fixed weights that describes the historical development of the total lending rate as well as possible.

4 Modelling the effects on the real economy

This chapter quantifies how the financial system affects the real economy. This is done as follows: First, the empirical models are presented (section 4.1). Second, the overall effect of different transmission channels is analysed (section 4.2) This is done by studying how different types of shocks to financial markets affect the development of the real economy. In the following section (section 4.3), the forecasting ability of the models is evaluated using several alternative methods, after which the models' endogenous GDP forecasts are compared (section 4.4). The chapter ends with a stress test that illustrates how the economy may develop in the event of a sharp deterioration of the situation on financial markets (section 4.5).

4.1 The empirical models

This section supplements a VAR model of the macro economy with three summary financial indicators: the financial stress index, the asset price gap and the lending rate.[1] The variables used in the models can be divided up into two categories (table 4.1). The first category consists of variables frequently used in macroeconomic models, most relate to the real economy and a couple are financial (figure 4.2). The second category consists of the financial variables

[1] This type of model is commonly used to analyse different types of shocks, and especially to examine the effects of monetary policy. See, e.g., Sims (1992) and Gerlach and Smets (1995), for early contributions. The original models typically included three variables: a short term interest rate, the inflation rate and GDP growth or some similar production measure. This report expands the model by including unemployment so as to be able to take account of developments on the labour market. Since Sweden is s small, open economy, the currency rate and foreign GDP is included in the set of variables. The inclusion of the currency rate therefore also handles the exchange rate channel.

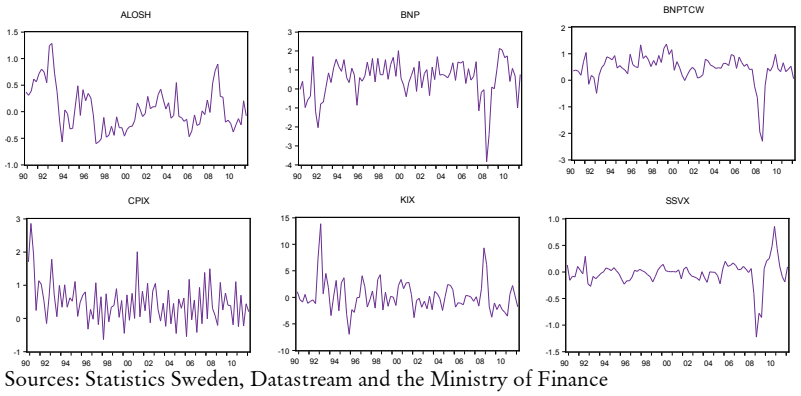
introduced in this paper and which are assumed to represent the different transmission channels (figure 4.2).

Table 4.1: The endogenous variables in the models

Variable name	*Variable designation*	*Transformation*
Unemployment	ALOSH	First difference
Swedish GDP	GDP	Log difference
Foreign GDP[1]	BNPTCW	Log difference
Core inflation	CPIX	Log difference
National Institute of Economic Research exchange rate index for the Swedish krona	KIX	Log difference
Interest on three-month treasury bills	SSVX	Log difference
Assets price gap	FGAP	First difference
Stress index	SI	First difference
Actual lending rate	UTLANR	Log difference

[1] Defined as a weighted GDP in the US and the Euro area

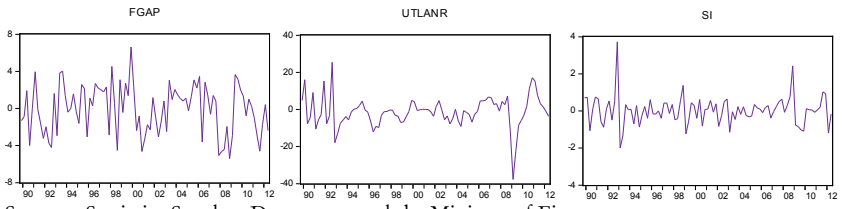
Figure 4.1: The traditional macroeconomic variables



Sources: Statistics Sweden, Datastream and the Ministry of Finance

In addition to the macroeconomic and financial variables the models use a dummy variable for the period 1991 Q4–1992 Q3 to control for the Swedish 1990s crisis. The foreign GDP variable is exogenous, while the other variables are endogenous.

Figure 4.2: The financial indicators



Sources: Statistics Sweden, Datastream and the Ministry of Finance

Two VAR models are used, a macro model without the financial indicators (MOD-MAK) and a macro model with the financial indicators (MOD-FIN).[2] Table 4.2 presents the models, giving their names and the associated endogenous variables. According to the theoretical review of the uncertainty channel, this channel has a direct linkage to the real economy that does not go via the balance sheet and bank capital channels. To test this hypothesis, restrictions are introduced on the stress index. The stress index is not allowed to have a direct effect on, or be affected by, UTLANR and FGAP in MOD-FIN. In the same way, no lagged values of FGAP or UTLANR are permitted in the equations for SI in the model. Thus, in MOD-FIN, which includes these restrictions, the stress index only affects the macroeconomic variables.[3]

Table 4.2 The endogenous variables in the models

Model	*Endogenous variables*
MOD-MAK	CPIX ALOSH BNP SSVX KIX
MOD-FIN	CPIX ALOSH BNP FGAP UTLANR KIX SI

In a VAR model the relationships between the variables are estimated simultaneously. This makes it possible to capture the influences of the variables on one another in a more interactive way than in a conventional linear regression. Another advantage of VAR models is that they are relatively easy to interpret because they are estimated as OLS regressions. A further advantage of VAR models is that the model can be used to analyse how a shock to one of the variables in the model affects the other variables, e.g. what happens to GDP growth if the lending rate is increased by one

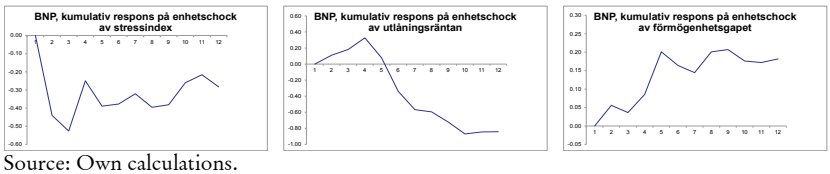
[2] A VAR model is autoregressive, which means that every variable in the model in period *t* is affected by the value of the other variables in a set number *(n)* of previous periods (*t-1* to *t-n*).
[3] The results of the statistical tests show that there are no problems with autocorrelation or heteroscedasticity. However, the residuals are not normally distributed.

percentage point. In addition, VAR models can be used to make both endogenous and conditional forecasts.[4]

4.2 How do the transmission channels affect the real economy?

The effect of the different transmission channels on the real economy is examined in MOD-FIN using 'impulse-response analysis' (figure 4.3).[5]

Figure 4.3: Effects on GDP shocks to the financial indicators in MOD-FIN



Source: Own calculations.

GDP is affected as predicted by theory. The stress index and the lending rate have a negative effect on GDP while the asset price gap has a positive effect. However, the effects work through at different rates. As expected, the stress index has the fastest impact. The full effect works through after only two years in all three cases.

A shock to the asset price gap of 1 index unit, corresponding to a share index fall of about 2.5 per cent and a house price fall of about 1 per cent, results in a negative effect on the level of GDP corresponding to about 0.4 per cent after two years. An isolated, temporary increase in the lending rate corresponding to 1 percentage point results in an aggregate negative effect on the level of GDP of about 0.6 per cent after two years. Finally, a temporary increase in the stress index of one unit has an aggregate negative effect on the level of GDP corresponding to about 0.4 per cent after two years.[6] So the impulse response tests indicate that the

[4] Endogenous forecasts are made by the model using existing observations to make a projection of the development of all variables. Conditional forecasts mean that the value of one or more of the variables in one or more observations during the forecast period are taken as given. This can, for example, be the case when statistics for financial markets are published much earlier than GDP statistics.

[5] Impulse-response analysis means that a variable is shocked by a certain value, e.g. an increase in the asset price gap of five percentage points, after which the effect on GDP growth in coming periods is quantified.

[6] It may be the case that the direct effect of different channels is underestimated in a linear model.One alternative to test whether this is the case can be to examine the direct effect in a non-linear model.

macroeconomic impacts of various financial shocks are not negligible.

4.3 Evaluation

Even though MOD-FIN has a clear value on its own, given its structure and properties as presented in the previous section, it is interesting to see to what extent it also improves the possibilities of explaining GDP growth compared with MOD-MAK. This is another way of shedding light on the added value of the expanded modelling of the transmission mechanism. A first natural step is to test the forecasting ability of the models out of sample (section 4.3.1). But, considering that only two crises are included in the current sample, it is also of interest to let the models learn from both these crisis so as to see whether MOD-FIN is better able to explain GDP growth during a period of financial crisis (4.3.2).

4.3.1 The general forecasting ability of the models

The out of sample forecast evaluation is carried out in the following way. The period 2006 Q1 to 2012 Q2 is used as the evaluation period and the models make recursive forecasts for these periods. This means that in a first step the models are estimated using data from 1989 Q4 to 2005 Q4, after which forecasts are made for one to five quarters to come. In a second step, the model are estimated using data from 1989 Q4 to 2006 Q1 and the forecasts are then redone with the same time horizons as before.[7] This then continues in the same way moving one quarter ahead in each stage. With this procedure each model has at most 26 forecasts (one quarter horizon) down to 21 forecasts (five quarter horizon), which make up the forecast series that are evaluated. Each model's forecast series are then compared with the actual outcome series and the forecasting abilities of the two models are

[7] In the evaluation the latest regular outcome figures for the national accounts have been used as an outcome series for GDP, i.e. up to and including 2012 Q2. One reason why a real time series has not been used for GDP is that the evaluation is not primarily intended to evaluate the absolute forecasting ability of MOD-FIN but its forecasting ability relative to MOD-MAK, in order to use this as a test of the added value of including the financial variables. However, the forecasting ability of these models is evaluated relative to the forecasts of a simple AR model so as to obtain an indication in that way of whether the model has added value in forecasting ability.

summarised in three different evaluation measures: Root mean square error (RMSE), mean absolute error (MAE) and bias.

The root mean square error is calculated as

$$RMSE = \sqrt{\frac{\sum_{s=1}^{N}(\hat{y}_s - y_s)^2}{N}}$$

where N is the number of estimates, $\hat{y}$ is the forecast and y is the outcome. Because the forecast errors are squared, RMSE gives greater weight to large forecast errors. Another consequence of the squaring is that no distinction is made between positive and negative forecast errors.

MAE is calculated as

$$MAE = \frac{\sum_{s=1}^{N}|\hat{y}_s - y_s|}{N}$$

MAE does not make any distinction between positive and negative forecast errors because it calculates the mean value of the absolute errors. This measure shows how big the forecasting error is on average, not taking account of whether there are over- or under-estimates. MAE is always smaller than or equal to RMSE and the bigger the difference between the two measures, the bigger is the variation in the forecasting errors.

Bias is calculated as

$$Bias = \frac{\sum_{s=1}^{N}\hat{y}_s - y_s}{N}$$

In contrast to RMSE and MAE, bias distinguishes between negative and positive forecasting errors. It is a mean of the forecasting errors, which shows whether the forecasts are, on average, above or below the actual outcomes.

The evaluation is carried out for the ability of the models to forecast GDP, and for the sake of comparison a simple AR(1) model is also used to forecast GDP growth. A model that generates more accurate forecasts than AR(1) is deemed to provide added value.

Table 4.3 presents the RMSE values for the models, with a lower value meaning better forecasting ability. MOD-FIN has better

forecasting ability than both MOD-MAK and the naive AR(1) model up to four quarters.[8]

Table 4.3: Root mean square error (RMSE) for GDP forecasts 2006 Q1-2012 Q2

Period	*MOD-MAK*	*MOD-FIN*	*AR(1)*
1	1.28	1.16	1.23
2	1.22	1.10	1.37
3	1.33	1.19	1.41
4	1.37	1.27	1.46
5	1.37	1.53	1.48

Source: Own calculations.

Table 4.4 shows that MOD-FIN has better forecasting ability than both MOD-MAK and AR(1), even when mean absolute error is used as an evaluation measure. MOD-FIN is still best up to four quarters, but AR(1) is now better than MOD-MAK.

Table 4.4: Mean absolute error (MAE) for GDP forecasts 2006 Q1-2012 Q2

Period	*MOD-MAK*	*MOD-FIN*	*AR(1)*
1	0.99	0.88	0.88
2	0.95	0.84	0.92
3	1.05	0.83	0.97
4	1.10	0.96	1.00
5	1.06	1.04	1.02

Source: Own calculations.

Table 4.5 shows that there is positive bias in all the models, which means that the forecasts in 2006 Q1 to 2012Q2 were on average higher than the actual outcomes and that the models thus over-estimated GDP growth in this period.[9]

Thus the evaluation shows that the out of sample forecasting ability for GDP growth is improved for a range of up to one year when a traditional macroeconomic model is expanded with more detailed modelling of the transmission mechanism.

[8] The GDP series has a standard deviation of 1.38 during the forecast period. This is usually used as a guide value for whether or not models have forecasting ability. The models should have a lower RMSE than the series' standard deviation. Table 3 shows that MOD-FIN and MOD-MAK are clearly better than AR(1) in this respect.

[9] However, it should be noted that the evaluation period is relatively short, which means that the models' relatively large forecasting mistakes in the two quarters that had strong negative GDP growth (2008 Q4 and 2009 Q1) have a considerable effect on the final result. These two forecasting mistakes account for more or less all the bias reported in table 4.5.

Table 4.5: Bias for GDP forecasts 2006 Q1-2012 Q2

	MOD-MAK	*MOD-FIN*	*AR(1)*
1	0,07	0,14	0,08
2	0,06	0,15	0,14
3	0,20	0,19	0,19
4	0,27	0,09	0,23
5	0,20	0,05	0,23

Source: Own calculations.

4.3.2 The models' forecasting ability in crisis periods

Another way of assessing the value of a augmented model of the transmission mechanism is to examine whether the models can explain the development of the real economy in the period immediately after the outbreak of each crisis, i.e. after autumn 1990 and after autumn 2008. This is done in the following way. First, the models are estimated for the period 1990 Q4-2012 Q2. Then, the models are used to make conditional forecasts of GDP growth in 1991 Q1–1993 Q4 and 2008 Q3–2011 Q4.[10] Finally, the conditional forecasts from both models are compared with the outcome for GDP growth. Tables 4.6 and 4.7 summarise the results of this study. These tables show that MOD-FIN captures GDP growth better than MOD-MAK.

A comparison of the total mean absolute error for the forecasts shows that MOD-FIN improves the forecasts for 2008–2011 by an average of 25 per cent and the forecasts for 1991–1993 by an average of 62 per cent.

The reason that MOD-FIN captures GDP growth during the two crises better than the traditional macro model MOD-MAK is that this model includes financial indicators that were of unusual importance during these two specific periods.[11]

[10] MOD-MAK-s forecasts are conditional on the actual development of SSVX and KIX, while MOD-FIN's forecasts are conditional on the actual development of UTLANR, FGAP, SI and KIX.

[11] This result remains even if the corresponding test is carried out without interaction, i.e. MOD-MAK and MOD-FIN estimated up to and including 2008 Q2 and then endogenous forecasts are made.

Table 4.6: Within sample forecasts for GDP 2008 Q3-2011 Q4, conditioned by the development of the financial variables

Annual percentage change, percentage points and percent

	GDP forecasts			Difference from outcome	
Period	Outcome	MOD-MAK	MOD-FIN	MOD-MAK	MOD-FIN
2008	-0.77	-0.18	-0.36	*0.58*	*0.41*
2009	-4.98	-2.72	-3.76	*2.25*	*1.21*
2010	6.27	6.49	5.75	*-0.22*	*-0.52*
2011	3.94	3.24	3.26	*-0.70*	*-0.68*

Source: Own calculations.

Table 4.7: Within sample forecasts for GDP 1991 Q1-1993 Q4, conditional on the development of the financial variables

Annual percentage change, percentage points and percent

	GDP forecasts			Difference from outcome	
Period	Outcome	MOD-MAK	MOD-FIN	MOD-MAK	MOD-FIN
1991	-1.11	-1.07	-0.72	*0.04*	*0.39*
1992	-1.23	-1.77	-1.35	*-0.54*	*-0.12*
1993	-2.04	-1.17	-2.08	*-0.87*	*0.04*

Source: Own calculations.

4.4 Endogenous forecasts

This section is intended to provide a brief, general description of the models by comparing the models forecasts for coming years. MOD-FIN-s endogenous forecast for GDP growth are 1.0 per cent in 2012 and 2.3 per cent in 2013 (table 4.8).

According to the more traditional VAR model (MOD-MAK) GDP growth will be 1.0 per cent in 2012 and 2.6 per cent in 2013. The difference between these forecasts is due to the inclusion of three different financial indicators in MOD-FIN that are expected to have a dampening effect on GDP growth in the next 1.5 years.

Table 4.8: Forecasts of GDP growth

Annual percentage change

	2012	2013	2014
MOD-MAK	1.0	2.6	3.5
MOD-FIN	1.0	2.3	3.5

Note: The model forecasts have used information up to and including Q2 of 2012.
MAK: VAR with TCWBNP, KIX, CPIX, unemployment, GDP and 3 month STIBOR
FIN: VAR with MAK + asset price gap, lending rate instead of 3 month STIBOR and stress index (with restrictions on SI)
Source: Own calculations.

The endogenous forecasts made by the models therefore give a picture of how much the financial sector affects growth in the economy. This is also seen when the model is used for scenario analyses (see section 4.5).

4.5 Stress tests

One advantage of using models that include financial indicators is that they can be used for stress tests and scenario analyses. By carrying out scenario analyses it is, for example, possible to examine to what extent the development of the real economy is weakened in periods of negative developments in financial markets. In this way scenario analyses give a picture of how sensitive the development of the real economy can be to disturbances in the financial system. The scenario, that starts in the third quarter of 2012 (see table 4.9), is similar to what happened in 2008–2010.[12]

This scenario assumes that property and stock prices will be lower in the first two years than is assumed in the Budget Bill for 2013.

[12] The scenario has not been designed with the intention of copying the events in and after 2008. There is also an important difference between the developments up to 2008 Q3 and 2012 Q3. This difference has a great impact on developments after 2008 Q3 and 2012 Q3. See section 4.1 for a description of how VAR models operate.

Table 4.9: A scenario for developments on financial markets, deviation from the forecast in the Budget Bill for 2013

Percentage points and index points

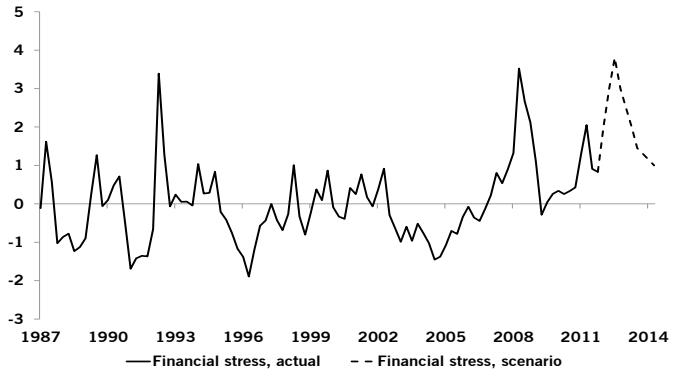
	2012	2013	2014
Lending rate[1]	-0.8	-0.8	-1.5
House prices[2]	-1	-7	2
Stock prices[2]	-31	-11	8
Stress index[3]	2.5	1.5	0.5

[1] *Deviation in percentage points at year end*
[2] *Deviation in percentage points of annual growth*
[3] *Deviation in index points at year end*
Source: Own calculations.

At the same time, it is assumed that the lending rate will be lower throughout the period. It is also assumed that financial stress will be much higher in 2012, after which it will decrease gradually (see figure 4.4). Finally it is assumed that foreign GDP growth will be in line with growth in 2008–2009.

Figure 4.4: Financial stress index

Index unit, corresponds to one standard deviation.



Sources: Datastream and own calculations.

The model simulation (see table 4.10) indicates in this case that the level of GDP will be more than 4 per cent lower than in the forecast in the Budget Bill for 2013.[13]

[13] A similar scenario was analysed in Swedish Government (2011), pages 224 and 225. Even though the alternative scenario in this report does not presuppose the same negative developments, the model-based simulation shows that the results are in line with the assessments made then.

Table 4.10: Simulation of effects on Swedish GDP growth of a severe disturbance on financial markets, deviation from the forecast in the Budget Bill for 2013.

Percentage points

	2012	2013	2014
GDP growth	-0.2	-3.9	-0.2

Source: Own calculations.

The effect is largely due to negative asset price development having major and lasting effects that are not counteracted fully by a lower lending rate. The lending rate does not fall as much as in 2008 and 2009, and this is because the repo rate is already relatively low and because banks are expected to secure larger margins, partly due to the tougher capital adequacy rules announced.

5 Conclusion and comments

This report provides an analysis, in both theoretical and empirical terms, of how the financial system affects the real economy thorough various channels, the 'transmission mechanism'. The analysis is based on the research literature of recent years. The results suggest that GDP growth can be better understood if the modelling of the transmission mechanism is expanded by adding more financial variables. Three summary financial variables is used to capture the four channels of the transmission mechanism: a financial stress index (the uncertainty channel), the actual lending rate (the interest and bank capital channels) and a asset price gap (the balance sheet channel).

The reports main contribution is twofold. *First*, it designs a macroeconomic VAR model including three financial variables, which are assumed to represent the transmission mechanism between the financial system and the real economy. The empirical properties of the model are in line with the theoretical conclusions and the effects are of a reasonable size.[14] *Second*, the model has a better forecasting and explanatory accuracy than a comparable macro model that does not contain the three financial variables mentioned above.

The approach in the report also has two other advantages: The first is that it is often an advantage that the analytical models used in policy contexts are not over-complicated. The VAR models used in the report is easier to work with than a general equilibrium model. This facilitates the interpretation and understanding of the results. A further advantage is that the financial indicators

[14] It should be pointed out that there are many studies that examine what effect *individual* transmission channels have on the real economy. As far as is known, the empirical literature does not contain studies using the same approach as this report, i.e. modelling the *complete* transmission mechanism in a VAR model. However, there are general equilibrium models with a much more detailed modelling of the economy that take account of several transmission channels at the same time.

proposed are composite measures. This makes it possible to set up scenarios for a large number of financial variables, e.g. TED spreads, VIX (volatility) indices, bank mortgage margins, stock prices and house prices, and then analyse the impact these scenarios may have on the composite measures and on the real economy.

There are, of course, possibilities for further development of the models introduced in this paper. *First,* one common argument is that the usual economic relationships are different during a crisis. Financial markets that are exposed to sufficient stress suddenly function much worse or nor at all. Government and central banks often react by pursuing a significantly more expansive policy because of the weak economic development during a financial crisis. These two examples might suggest that there are non linear relationships between the variables in a model. It can therefore be of interest to examine whether the results in this report are altered if the models are estimated using non-linear estimation methods. *Second,* the macroeconomic VAR model in this report covers two of the three main areas of economic policy identified by, for example, Svensson (2012), namely financial stability and monetary policy. If the model was expanded to cover the third area of economic policy, fiscal policy, then such a model could also act as a complete policy model.

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