

The Transmission Mechanism and Financial Stability Policy

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Foreword

The Economic Affairs Department at the Ministry of Finance has the task to monitor, analyze and evaluate the development of the Swedish economy and public finances and also analyze how society's resources are used and distributed. An important part of this work is to make forecasts and analyses of the development of the real economy and public finances, as well as analyzing the impact various policy proposals may have on economy. 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.

The report "*The Transmission Mechanism and Financial Stability Policy*" has been written by Hovick Shahnazarian (Ass. Prof. and senior economic advisor) and Mårten Bjellerup (Ph.D. and deputy director at the ministry of finance at the time the report was written). The report has been considered at a seminar at the Ministry of Finance by Professor John Hassler and adjunct Professor Pehr Wissén. The authors would like to thank Mats Kinnwall, Peter Englund, Lars Hörngren, Pehr Wissén, John Hassler and Lars E O Svensson for useful comments and suggestions. We want to pay particular thanks to Sebastian Andersson for excellent research assistance. We would also like to express great thanks to Pål Bergström, Anders Bergvall, Robert Boije, Fredrik Bystedt, Martin Carlens, Sten Hansen, Ylva Hedén Westerdahl, Albin Kainelainen, Henrik Larsson, Håkan Locking, Thomas Nielsen, Henrik Sikström, Pär Stockhammar and the seminar participants at the Ministry of Finance and participants at OECD:s workshop on "New Approaches to Economic

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We are grateful for comments on the report. Authors’ contacts are:

Hovick Shahnazarian, Ministry of Finance, SE-103 33, Stockholm, Sweden. (hovick.shahnazarian@gov.se).

Mårten Bjellerup, National Debt Office, SE-103 74 Stockholm (marten.bjellerup@riksgalden.se).

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Fredrik Bystedt
Director-General

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Summary

This paper identifies negative externalities in the financial system and describes how they affect the real economy through various channels in the transmission mechanism. This serves as the basis for a new broader approach to Financial Stability Policy compared to Macroprudential Policy. Next, a small scale macroeconomic VAR model is developed, including financial indicator variables that allow the separate study of each of the theoretically identified transmission channels. The model is then used for stress tests and also to simulate the effects from financial shocks on the real economy from using two policy instruments: countercyclical capital buffers and loan-to-value ratio.

1 Introduction

In late 2008 during the peak of the financial crisis several markets at the heart of the financial system more or less stopped functioning. Liquidity in the interbank market dried up as banks refrained from lending money, even at short maturities. The price of many assets fell quickly and deeply, central banks cut their policy rates drastically and the situation was characterised by great, perhaps unprecedented, uncertainty. The crisis deepened the incipient recession sharply and most economists and policy makers were, at least at the time, surprised by the dramatic effects on the real economy. But the close link between the financial system and the real economy is not only there in times of crisis; it is also in place under more normal economic circumstances. The effects are just less drastic.

In the wake of the financial crisis, researchers and policy makers have directed much more attention to the linkage between the financial system and the real economy, known as the transmission mechanism.¹ An important part of the increased attention is several governments now considering more far-reaching changes in supervisory and regulatory structures in order to protect the real economy from the recurrent malfunctioning of the financial sector.²

However, if regulation is to be successful, at least two conditions have to be fulfilled. First, policy makers need to have a qualitative knowledge of how the financial markets affect the real economy through the transmission mechanism, in order to choose proper variables that are suited for regulation. In this paper, we describe the interaction between the financial system and the real economy and suggest a formulation of a Financial Stability Policy, including a theoretically based scheme for the potential policy

¹ See Basel Committee on Banking Supervision (2011).

² See Basel Committee on Banking Supervision (2012a).

instruments. Second, policy makers need to have quantitative knowledge of the transmission mechanism in order to make a balanced choice of the magnitude of a specific regulative measure.³ At present, the transmission mechanism cannot be characterized as an integral part of macroeconomic modeling. Early efforts focused largely on modeling individual channels within the transmission mechanism, while later efforts, not least within the dynamic stochastic general equilibrium (DSGE) literature, have a richer modeling of the transmission mechanism.⁴ In this paper, we suggest a description of the transmission mechanism that fits into a small scale VAR model.⁵ Despite being limited in terms of variables, the model offers a number of possibilities in analyzing various developments in financial markets. The reason is that the financial indicators used in the model are composites of several financial variables, which in turn stem from the detailed underlying description of the transmission mechanism.

The report has the following structure. Section II first gives a detailed description of the transmission channels, i.e. the transmission mechanism. Next, the negative externalities in the financial system are identified, including their effect on the real economy. Lastly, these two building blocks are used to define a target for financial stability policy and also to categorize the instruments for this new policy area. In Section III, the framework in the previous section is used to construct four composite financial variables that act as indicators for the transmissions channels, using data from Sweden. In section IV, a small macroeconomic VAR model is complemented with these four financial indicators in order to make an empirical assessment of the

³ It can be argued that there is a natural and important linkage between what is traditionally regarded as monetary policy and financial stability. For example, Svensson (2012) notes that “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 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.”

⁴ See Basel Committee on Banking Supervision (2012b).

⁵ It should be pointed out that there are many studies that examine what effect individual transmission channels have on the real economy. 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.

aggregate effects of the financial system on the real economy. This model is then used to make endogenous forecasts of macroeconomic developments, scenario analysis and stress tests in order to quantify the effect the financial sector may have on the real economy. Finally, the model is used to estimate the effects from financial stability policy, such as capital adequacy requirements and loan-to-value ratio (LTV).

2 Financial stability policy: dealing with various transmission channels

In the wake of the financial crisis, researchers and policy makers have discussed what measures can be taken to counteract the occurrence of financial imbalances, in order to prevent financial crises and to ensure macroeconomic stability. The academic debate and the policy makers' response suggest that a new policy area in its own right is emerging.⁶ A better understanding of the interaction between the financial system and the real economy is important when formulating objectives for this new policy area as well as choosing and applying relevant instruments. Therefore, we start by giving a detailed description of various transmission channels (section 2.1). Equally important is to understand what problems a policy for financial stability should address (section 2.2). These two building blocks give us the tools we need to define an overall target for a financial stability policy (section 2.3) and categorize different instruments (section 2.4).

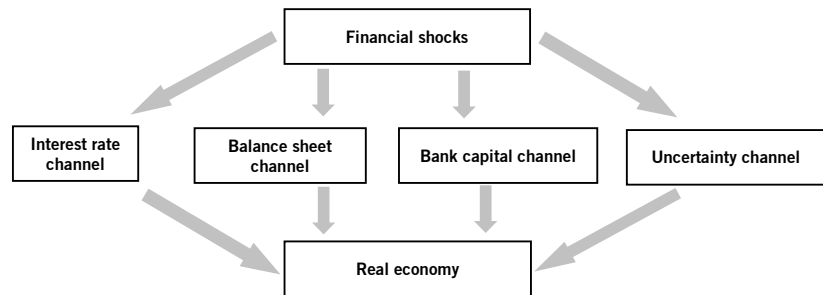
2.1 A description of the transmission mechanism

The transmission mechanism is the process through which central bank interest rate changes and financial shocks affect the real economy by influencing aggregate demand and its components via their effects on financial prices and quantities. The transmission

⁶ A concrete result of the crisis and the ensuing discussion is the development of new international financial regulation framework, Basel 3. This framework has the overall aim of strengthening banks' resilience to losses, in order to reduce the probability of bankruptcy and hence of new financial crises. An important part of the new framework is the introduction of a number of new regulatory instruments, such as the liquidity coverage ratio and countercyclical capital buffers.

mechanism is usually divided into several different channels in order to distinguish between different types of financial shocks and their effects.⁷

Figure 1: The transmission channels.



One way of summarising the transmission mechanism, as described in the academic literature, is to divide it into four different channels (see Figure 1 above). 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 below.

2.1.1 The interest rate channel

The traditional description of the transmission mechanism assumes that contractionary 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 to borrow. Banks increase the lending rates faced by

⁷ 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, including papers initiated by the working group itself in cases where gaps in the literature were identified. The interested reader is referred to Basel Committee on Banking Supervision (2011), (2012a) and (2012b). 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 comparison of a number of dynamic stochastic general equilibrium models that include various financial frictions.

households and businesses by the same amount.⁸ Households increase their savings and reduce their consumption when interest rates rise. Businesses react in a corresponding way, which leads to a fall in investments. Moreover, higher market rates can have a negative effect on the price of financial and real assets because the present value of future returns from these assets decreases. Consumption also decreases as a result of this wealth effect.⁹

2.1.2 The balance sheet channel

The balance sheet channel assumes that a borrower pay an ‘external funding premium’ or a ‘risk premium’, when investments are financed using external funds instead of own funds.¹⁰ The size of the risk premium depends on the creditworthiness of the borrower in the sense that a lower creditworthiness results in a higher premium to borrow. The creditworthiness is linked, in turn, to the borrower’s income, expenditure and balance sheet. Moreover, the borrower’s assets are generally used as collateral when borrowing on the market. Economic shocks can lead to a fall in the value of the borrower’s assets while the value of the loans is left unchanged. In such cases, the borrower’s balance sheet looks worse than expected. As a response, 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 expression ‘financial accelerator effect’. A borrower can choose to amortise part of its debt (balance sheet consolidation) if the funding cost increases more than expected. This means that a larger share of the borrower’s income will go to amortization rather than to consumption and investment for a period to come. Balance sheet consolidation is generally a prolonged process – sometimes averaging several years. Economic

⁸ 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.

⁹ 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.

¹⁰ Bernanke and Gertler (1989) and Bernanke, Gertler and Gilchrist (1989) describe the mechanisms behind the balance sheet channel and how the funding premium arises. See also Kiyotaki and Moore (1997) and Holmström and Tirole (1997) who describe this channel.

development therefore risks being weak during periods of large-scale balance sheet consolidation among firms and households. It is only when households and firms are satisfied with their debt levels that they return to consuming and investing at a normal rate.

2.1.3 The bank capital channel

The bank capital channel assumes that banks must fulfil various requirements.¹¹ One such requirement is the capital adequacy requirement which entails that a bank's equity level needs to exceed a certain share of total lending. But the capital adequacy requirement is only one of the requirements applied to bank balance sheets. Other relevant regulation includes bank solvency and liquidity requirements.¹² In addition, 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 invested capital, which is yet another requirement banks must take into account.

Shareholders' equity may decrease due to the outcome of various risks (market risk, liquidity risk, or credit risk, which together can lead to solvency risks for banks). This can result in firms failing to uphold sufficiently high capital adequacy requirements, forcing a bank to raise its lending rate or reduce its lending. 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.¹³

2.1.4 The uncertainty channel

Unlike the balance sheet channel and the bank capital channel, the uncertainty channel means that there is a direct link between uncertainty in the financial market and the real economy that does

¹¹ Stein (1998) och van de Heuvel (2002 och 2004) beskriver mekanismerna bakom bankkapitalkanalerna. Tillsammans med räntekanalerna brukar den också kallas banklånekanalen.

¹² See for example Finansinspektionen (Swedish Financial Supervisory Authority) (2001:1), Finansinspektionen (2002:8), Finansinspektionen (2005:8), Lind (2005), Riksbank (2010a, 2010b and 2011:2) for a more detailed description of the various requirements imposed by Swedish regulators on bank balance sheets.

¹³ However, there is a close link between the balance sheet channel and the bank capital channel in the sense that deterioration of borrowers' balance sheets has a direct effect on bank balance sheets (for example, through greater loan losses for banks and higher capital adequacy requirements)

not operate via prices or quantities in the financial system.¹⁴ Both firms and households are influenced by greater volatility in financial markets. Major fluctuations in asset prices, exchange rates and interest rates are examples of this. In the face of uncertainty, firms scale back their investment plans since higher uncertainty increases the value of waiting. A higher level of uncertainty therefore results in firms postponing some of their investments. Moreover, greater uncertainty is often accompanied by increasing layoffs and unemployment. Households react both to the increased risk of unemployment (more notices of layoffs) and to the greater uncertainty in financial markets. The overall effect is that households increase their precautionary savings, i.e. they reduce their consumption.¹⁵

2.2 A definition of financial stability policy

The description of the linkage between the financial sector and the real economy, as given in the previous section, serves as the backdrop when formulating a new broader approach to financial stability policy. More precisely, it makes it easier to identify the problems that this policy should address and how this influence the formulation of policy objectives and in turn how the policy instruments at hand are classified.

2.2.1 Which problems should the policy address?

The literature discusses what kind of negative external effects cause the accumulation and liquidation of financial imbalances.¹⁶ The

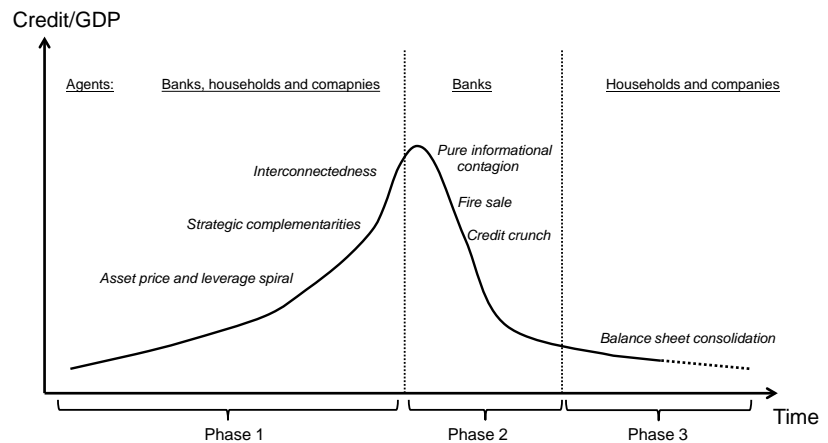
¹⁴ Antony and Broer (2010) highlight this transmission channel as an important channel. In contrast, the Basel Committee on Banking Supervision (2011) contains a discussion as to whether this channel is a channel in its own right or whether, instead, the effect of uncertainty in the financial market always goes via its effects on quantities and prices, i.e. operates through the balance sheet channel and the bank capital channel.

¹⁵ Others think that the uncertainty channel also operates indirectly, e.g. by influencing the discount rate (see, for example, Gerdrup et al., 2006).

¹⁶ Brunnermeier et al. (2009), Shin (2010), and Hanson et al. (2011), among others, argue that financial institutions do not take adequate account of the contagion effects of their behaviour on the financial system and the real economy. Predatory pricing of risk, herd behaviour and the "moral hazard" in combination with the implicit safety net may over time lead to financial imbalances. A correction of these imbalances propagates rapidly through the financial system because of the linkages that exist between the various financial institutions. Fire sale is another negative externality that leads to asset prices fall even more and affect other institutions with similar assets (eg Kashyap, Berner and Goodhart , 2011). In addition, financial institutions have much more difficulties to roll over their short-term interbank funding (Perotti and Suarez, 2009). What matters in the end is perhaps not boom or asset

behaviors that give rise to negative external effects emerge largely when individual agents act rationally, but where the collective action of these agents leads to undesirable economic outcomes. The negative externalities are illustrated below in a stylized credit cycle (Figure 2).

Figure 2: The most important negative external effects in a stylized credit cycle



Source: Own diagram

In phase 1 of the credit cycle, GDP growth is usually high and the situation is characterized by rapidly rising credit volumes and asset prices, both for real and financial assets. The three most important negative external effects contributing to developments in this phase are the asset price and leverage spiral, the strategic complementarities and the interconnectedness between financial institutions. On the whole, phase 1 involves banks, households and firms taking on increasing debt and the risk associated with over-borrowing, and the risk becoming increasingly correlated.

Phase 2 originates when a financial crisis is triggered. On the back of falling asset prices, the banks experience capital adequacy problems, which must be remedied. A possible measure is to sell assets. Firms liquidating assets at prices far below their original market value can lead to fire sales which, in turn, intensify the downward spiral in prices because increased supply drives the

price bubble in itself, but rather whether the boom is financed by credit from leveraged institutions (Crowe et al., 2011). De Nicolò et al. (2012) provides a good review of various externalities.

market. Another possible measure is to curb lending. If banks collectively and simultaneously reduce lending in order to improve capital adequacy, the result will be a credit contraction in the economy at large, which affect banks' borrowers, i.e. households and firms. In addition, there is pure informational contagion about agents' asset holdings. This makes it difficult to assess counterparty risk, which leads to greater caution and lower activity. Phase 2 means that banks liquidate large parts of the financial imbalances that were built up during phase 1.

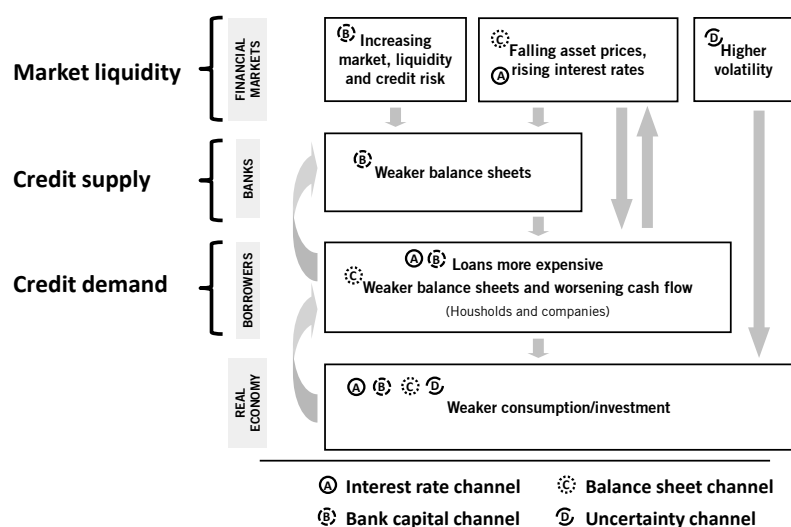
In phase 3, the mechanisms behind the problem are very similar to those driving the banks in phase 2, i.e. balance sheet restructuring by firms and households. Declining asset prices, mainly house prices, lead households to perceive their debt burden as being far too large, and reduce debt ratios and/or increase precautionary savings. Firms behave in a similar manner and postpone investment decisions. Greater savings and lower investments lead to sustained weak demand in the economy. Phase 3 means that households and firms liquidate large parts of the financial imbalances that was built up during phase 1. It ought to be emphasized that the rationale above is schematic. Phase 2 need not be preceded by phase 1, and phase 3 need not be preceded by phases 1–2, which constitute another argument for a broad approach and definition of financial stability policy.

2.2.2 How should a policy objective be formulated?

The negative external effects can also be described in terms of their effect on market liquidity, the supply of credit and demand for credit. Dividing the negative externalities into these three main areas allows us to illustrate how they affect the real economy through various transmission channels (Figure 3). 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 in the figure; (A) the interest rate channel; (B) the bank capital channel; (C) the balance sheet channel; and (D) the uncertainty channel.¹⁷

¹⁷ Figure 3 is schematic and should not be interpreted as saying that the four transmission channels are independent of one another.

Figure 3: Transmission mechanism flow chart, including the three main areas of the credit cycle's negative external effects



Source: Own diagram and the Ministry of Finance (2012)

Information contagion and fire sales are typical externalities affecting market liquidity during phase 2, characterised by major volatility and rapid general declines in financial markets. Heightened volatility leads to increased uncertainty and is followed by greater caution, thus curbing demand in the economy (the uncertainty channel). The effects on the supply of credit occur in both phase 1 and phase 2, and intensify the upturn or downturn. In phase 2, a high degree of interconnectedness between financial institutions intensifies the shocks, which exacerbates the credit contraction or results in higher lending rates. This, in turn, leads to a fall in demand in the real economy (bank capital channel). The effects on the demand of credit occur in both phase 1 and phase 3 but is perhaps most tangible in phase 3 when households and firms react to the decline in asset prices. In order to reduce their debt ratio, households increase their precautionary saving, which reduces aggregated demand in the economy (the balance sheet channel).

In order to formulate an overall target of financial stability policy, it is necessary to consider whether there is a need for a preventive policy with interim targets for the three main areas of market liquidity, credit supply and credit demand. Since there is no

need to counteract overly liquid markets in an upswing phase (phase 1), there is equally no need to develop an interim target for market liquidity. On the other hand, there is a clear need to improve market liquidity in a crisis situation (phase 2).¹⁸ In addition to this, structural measures may also be taken in order to improve market functioning. The target of credit supply should be to prevent build-up of financial imbalances in financial institutions. These can be prevented by ensuring that financial institutions build up capital and liquidity reserves, thereby avoiding undertaking balance sheet consolidation in the event of a crisis. Accordingly, policies targeting credit demand should counter the build-up of financial imbalances among households and firms. Otherwise households and firms run the risk of becoming overly indebted and have to resort to lengthy balance sheet consolidation if economic circumstances change, such as a sudden fall in home prices.

The academic literature usually distinguishes between three objectives of macroprudential policy that vary in their degree of ambition. The least ambitious objective is to protect the banks from the build-up of system-wide vulnerabilities. Another objective is to smooth the financial (credit) cycle. A third and more ambitious objective is to smooth the business cycle through the influence of capital requirements on banks.¹⁹ As mentioned above, the aim should be to prevent build-up of financial imbalances at banks as well as households and firms. If imbalances among the various agents are not countered, they can cause serious problems for credit supply and credit demand.

A narrow target (target 3 in Table 1) fails to counter these imbalances as it disregards the important role of households and firms in a crisis. A broader target (target 1 in Table 1) is not considered appropriate because the business cycle is largely influenced by factors other than those that a financial stability policy should address. Therefore, having an overall target of financial stability policy that stabilizes the credit market (target 2 in Table 1) is advocated in this paper.²⁰

¹⁸ Public debt policy and monetary policy play important roles for market liquidity in a crisis situation.

¹⁹ See for example Galati and Moessner (2010); Drehmann et al. (2011); Longworth (2011); and Houben et al. (2012).

²⁰ Another interesting question is when policy should be used. Financial imbalances can occur for a variety of reasons and affect many different economic actors and are therefore difficult to detect. A broad perspective is therefore necessary in both the analysis and implementation of policy. The broad analytical framework should include indicators providing an assessment of the current status on financial markets (market liquidity), at banks (credit supply) and among households and companies (credit demand). The analysis

Table 1: Alternative policy targets

	Target	Target variable	Term
1	Stabilise the business cycle	Aggregate supply /Aggregate demand	Stabilisation policy*
2	Stabilise the credit market	Supply of credit /Demand for credit	Financial stability policy
3a	Stabilise the banking system	Supply of credit	Macroprudential policy
3b	Improve banks' resilience	Maintain basic functions	Structural macroprudential policy

Note: The first type of target (target 1) means that the instruments are used to stabilize the business cycle, implying that the policy will be a complement to the existing stabilization policy and that it will not be a new policy area of its own. The second type of target (target 2) is to stabilize the credit markets by preventing build-up of financial imbalances that could otherwise have a material adverse impact on credit supply and credit demand, and thus on the real economy. An alternative formulation of the broader target 2 would be to stabilize the financial or credit cycle. The third type of target (target 3) is to stabilize the credit supply by strengthening, protecting and stabilizing the banking system through improved supervision. Target 3a addresses both the structural problems in the financial system through enhanced regulation of financial institutions and the cyclical problems using time-varying buffers to adjust the resilience of the financial institutions during the financial cycle. Objective 3b addresses only the structural problems.

Source: Own illustration

2.2.3 Which instruments can be used?

The instruments which may be used can be divided into two categories. The first dimension relates to their character, i.e. if they are cyclical or structural. The second dimension concerns the way instruments are linked to the three main areas of market liquidity, credit demand and credit supply (see Table 2 below). Counteracting the build-up of financial imbalances is possible through the use of cyclical and structural instruments, addressing both the supply of credit and demand for credit. The cyclical instruments can vary over time while the structural instruments aim to tackle the problems relating to the size and structure of the

should also be supplemented by forecasts and scenario analyses of the financial situation of the various players. On top of that, such a package of indicators should include market-based and forward-looking indicators, and indicators which measure the extent to which various financial institutions increase the risk in the financial system. Finally, the domestic economy is also affected of the accumulation and liquidation of financial imbalances in other countries. Therefore it is very important to also have a good idea of the situation in other countries through the use of indicators capturing the external financial imbalances.

financial system, as well as to structural factors of importance to households and companies, such as allowable debt to value ratio. The majority of instruments can, however, be applied in both cyclical and structural ways, but not at the same time.

Table 2: Examples of potential cyclical and structural instruments for financial stability policy

	Cyclical instruments	Structural instruments
Market liquidity	- Unconventional monetary policy (e.g. purchase of financial assets)	- Assets which can constitute collateral in central bank repos
Credit supply	- Countercyclical capital buffer (CCB)	- Liquidity reserves (LCR and NSFR)
Credit demand	- Loan-to-value ratio (LTV)	- Loan-to-income ratio (LTI)

Note: Loan-to-value ratio (LTV) is currently a structural instrument (mortgage cap). Loan to income (LTI) is currently managed by the banks as part of their credit rating.

Source: Own categorisation.

Most of the instruments that are discussed in the literature aim to influence the negative external effects on the supply of credit by influencing either the equity of banks or liquidity reserves. However, there are also instruments which aim to influence households' and companies' balance sheets and their demand for credit. In terms of liquidity, it is important to differentiate market liquidity from the liquidity of banks. For market liquidity, which concerns the ease with which an asset can be bought or sold, the instruments at the central banks' disposal mainly play an important role in a crisis situation. The liquidity situation of banks instead concerns the banks amount of highly liquid assets needed for daily operations. This should preferably be handled using instruments geared towards preventive policy, for example instruments that affect the banks' liquidity coverage ratio.

In terms of instruments for cyclical use, it is an advantage if they are simple in structure. Countercyclical capital buffer has this advantage and also the best fundamentals to be used as cyclical instruments targeting the supply of credit. For credit demand, a

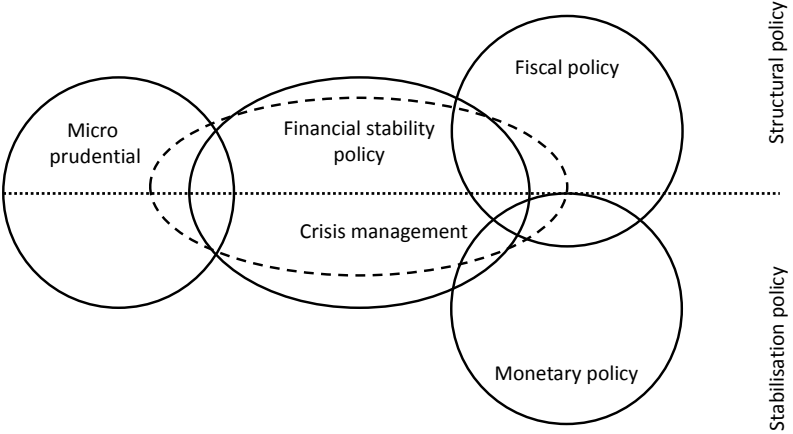
cyclical loan-to-value ratio (LTV) is closest at hand. In terms of structural instruments, liquidity coverage ratio (LCR) and net stable funding ratio (NSFR) have the fundamentals to curb structural risks pertaining to the supply of credit, while the debt to income ratio (LTI) is closest at hand as regards demand for credit.²¹

It is important to identify various causalities and, not least, the interaction between financial stability policy and traditional economic policy. Such an understanding may well limit conflicts between different policy areas on the one hand, and benefit from mutually strengthening effects on the other (see Figure 4). The need for policy interaction is evident in crisis situations, but it is also important for preventive policy.

Given the potential impact on real economic fluctuations, cyclical instruments can become an important part of the stabilization policy framework. In the event of a crisis, these instruments should be used in close concert with other economic policies to dampen the impact of the crisis on the economy. This stabilization policy dimension, through its effect on the economy, has a clear link to both monetary policy and fiscal policy. Regarding the structural dimension, microprudential supervision set level requirements on capital and liquidity, which has a direct effect on the robustness of the financial stability policy. Higher requirements on individual institutions bring more capital and liquidity, which reduces the need for a discretionary financial stability policy. If monetary and fiscal policies are effective to dampen the imbalances that arise during the credit cycle then there is less need for an active financial stability policy. The opposite is also true. Financial stability policy cannot replace weak microprudential or weak macroeconomic policies. A strong regulation and effective supervision of individual institutions are prerequisites for effective financial stability policy. The financial stability policy should therefore take account of the other macroeconomic policies, and vice versa. In a crisis situation, the need for coordination is especially important when all economic policies are used to counteract the effect of a crisis.

²¹.It should also be pointed out that the instruments discussed here are selected because they are suitable for financial stability policy. However, there is naturally a series of other instruments with a major potential impact on financial stability, e.g. various fiscal policies. A common factor of these other instruments is, however, that they are taken for the purpose of other objectives, but are nevertheless a key prerequisite for financial stability policy. Some of the instruments can also be considered as crisis management instruments, e.g. stabilization fund levy.

Figure 4: Schematic overview of the link between different policy areas given a target of type 2



Source: Own diagram

3 Choice of summarizing financial indicators

A complete analysis of financial markets, banks and bank borrowers requires a large number of indicators in each area. However, a number of summary indicators are built using the following criteria. First, in empirical models summary indicators are used to quantify and isolate the impact of different transmissions channels on real economy.²² Second, the indicators should preferably comprise the financial variables that are at the centre of the discussion on regulation. In this section various indicators are constructed that capture developments on financial markets (the uncertainty channel), among bank borrowers (the balance sheet channel) and among banks (the interest rate and bank capital channel).

3.1 Financial markets

Developments in financial markets form the basis for the uncertainty channel, as described in section 2. Increased volatility in market values 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’. There are many markets in the financial system performing different functions and of shifting importance. The idea behind the selection of markets made in this paper is to capture the markets that are most important households and firms. In line with the arguments presented in Ministry of Finance (2012), Forss Sandahl et al. (2011) and Sveriges Riksbank (2009), an index is constructed that

²² The empirical models estimated and applied in this paper use Swedish data.

is a composite of developments on the following four markets: the stock market, the currency market, the money market and the bond market.^{23, 24}

3.1.1 Uncertainty in the stock market

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

3.1.2 Uncertainty in the currency market

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

Just as in the case of the stock market, there are several ways of measuring uncertainty 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

²³ Developments on each of these markets are standardised to make it possible to construct a composite indicator. This will be described further down.

²⁴ Johansson and Bonthron (2013) develop a more complex financial stress index and compare the development of this new financial stress index with a simpler. They conclude that the developments of the financial stress indices are quite similar. A strength with the approach chosen in this paper is that it is simple. Osterholm (2010) developed a financial stress index that includes the short real interest rate, the short interbank spread and the return on the stock exchange.

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.

3.1.3 Uncertainty on the money market

The money market is of great importance for both households and firms given its effect on the development of lending rates for short maturities, e.g. floating mortgage rates. On the money market, banks extend loans to one another at short maturities to manage day-to-day liquidity needs. The interest rate on this interbank market is called LIBOR (STIBOR in Sweden) and is often compared with the interest rate on treasury bills with corresponding maturities. 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. In normal cases this interest rate difference, which is called the TED spread, is very small and stable. This is because, in principle, interbank lending 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 extending loans to one another due to perceived increase in counterparty risks. This leads to an increase in the TED spread.²⁵ In view of this, the TED spread is used as a stress indicator for the money market.

3.1.4 Uncertainty in the bond market

The bond market is very important for both households and firms 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 larger companies. 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

²⁵ This effect can also be 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.

these two markets. The mortgage spread is therefore used as a stress indicator for the bond market.

3.1.5 Financial stress index

The four indicators presented above are first standardized so that they can be weighted to a composite financial stress index.²⁶ The weighting is done by giving each indicator the same weight. The new summary index is also standardized which means that the summary financial stress index has a mean of 0 and a standard deviation of 1, which facilitates 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 standardization a value of 1 also means that the level of stress is one standard deviation higher than normal.

Figure 5 shows the stress level on financial markets in Sweden measured by a stress index. There are two clear peaks, one during the crisis in the early 1990s and one at the outbreak of the crisis in 2008. Between the two peaks there is a long period of low stress, especially in the years immediately before 2008.

The level of stress on financial markets in Sweden, measured using a stress index, shows clear covariation with GDP growth (Figure 6). 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.

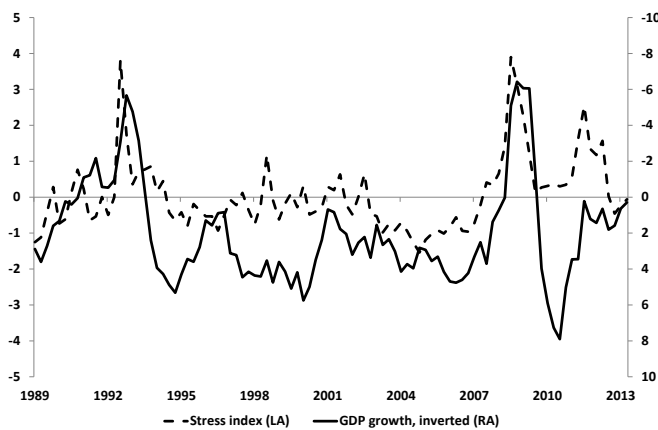
²⁶ This is done by subtracting the mean from each series and then dividing it by its standard deviation. The standardised series then has a mean of zero and a standard deviation of 1.

Figure 5: Financial stress index
Index units



Sources: Ecowin and the Ministry of Finance

Figure 6: Financial stress index and GDP growth
Index units and percentage quarterly change



Sources: Ecowin and the Ministry of Finance

3.2 Bank borrowers

Developments among bank borrowers are the basis for the balance sheet channel described earlier. A fall in solvency, creditworthiness or wealth of households and firms has a negative impact on 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 firms.

There is a whole series of financial measures that can be used to capture the solvency, creditworthiness and wealth of households and firms. One disadvantage of many of these measures is that they are specific in various ways to households or firms so it is not an easy task to combine them. Moreover, several of them are rarely published. However, one common feature of balance sheets and solvency of firms and households is that they are both affected by the price of financial and real assets.

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

3.2.1 Asset price gap

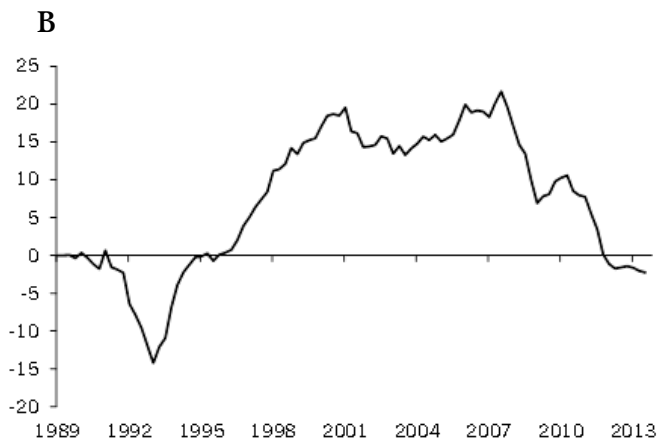
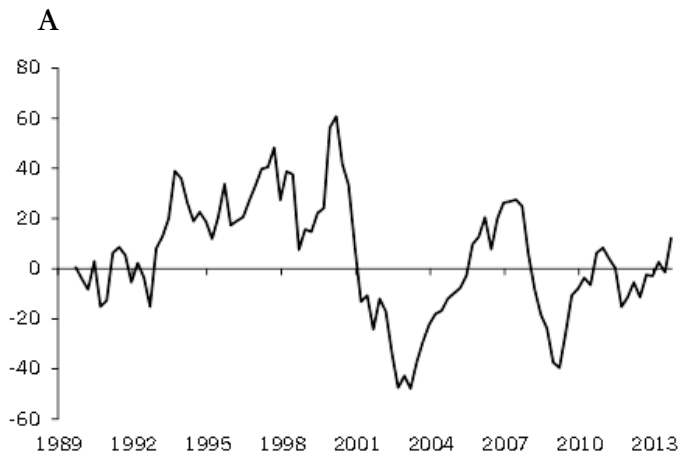
A gap is generated for each of the stock and property markets as a first step towards creating a summary indicator. The stock price gap is defined as the deviation of the OMX index from its trend divided by the trend (see Figure 7:A).²⁷ The real stock price gap captures whether the development of the stock market is following its historical trend. The house price gap is defined in a corresponding way, i.e. as the deviation of the property price index from its trend, divided by that trend (Figure 7:B).

In the second step the share price gap (20 per cent) and the property price gap (80 per cent) are combined in an asset price gap that summarizes the development of house and stock prices (Figure 8). This measure is used as an indicator in order to analyze what effect the balance sheet channel has on the real economy.

²⁷ 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 which is a key indicator for decision to activate the countercyclical capital buffer and also to decide the level of this buffer.

Figure 7: A is real stock price gap (per cent) and B is real house price gap

Per cent



Sources: Ecwin, Statistics Sweden and the Ministry of Finance.

Figure 8: Real asset price gap

Per cent



Source: 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 worse than they had expected, with the result that they amortise part of their liabilities (consolidate their balance sheets). One way of illustrating this linkage is to compare the historical development of asset prices (the asset price gap) and liabilities (credit growth and the credit gap).²⁸ As is seen in Figure 9, changes in asset prices precede changes in credit growth and credit gap 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. However asset prices and credit can reinforce each other through the 'financial accelerator effect'.²⁹

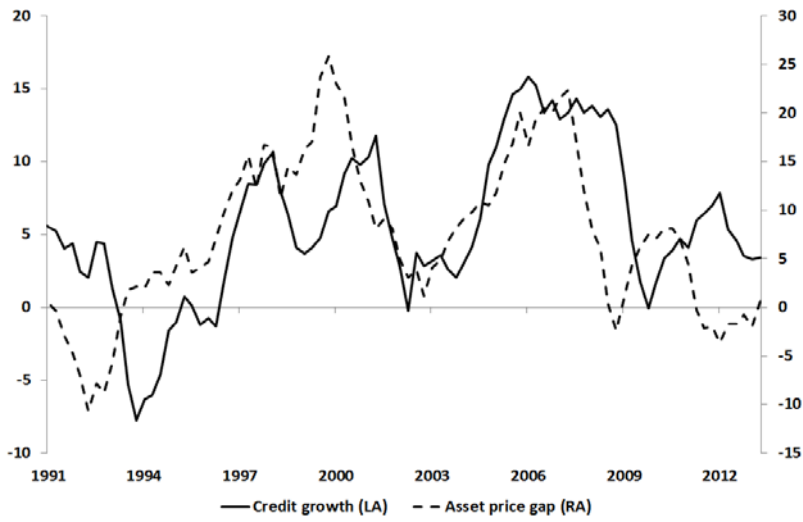
²⁸ In technical terms the credit gap has been designed in the same way as the asset price gaps.

²⁹ In the next section, we will explain the way the 'financial accelerator effect' is handled in the empirical model.

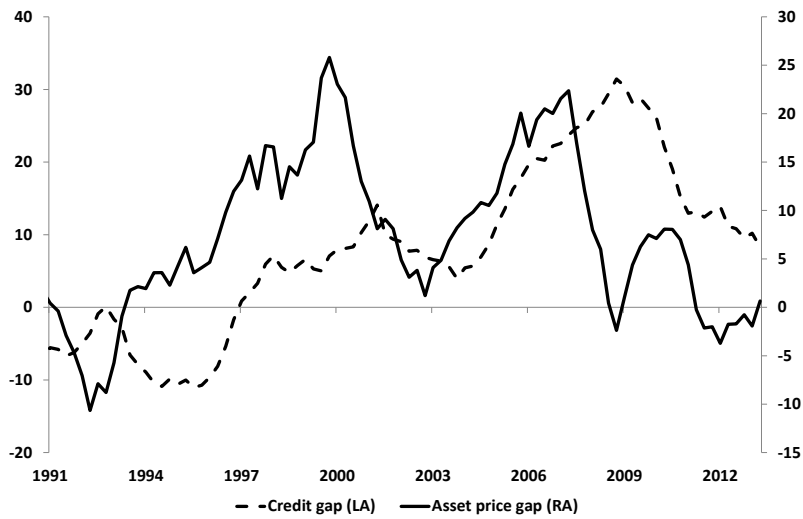
Figure 9: A shows the relationship between asset price gap and total credit growth. B shows the relationship between asset price gap and total credit gap

Per cent and annual percentage change

A



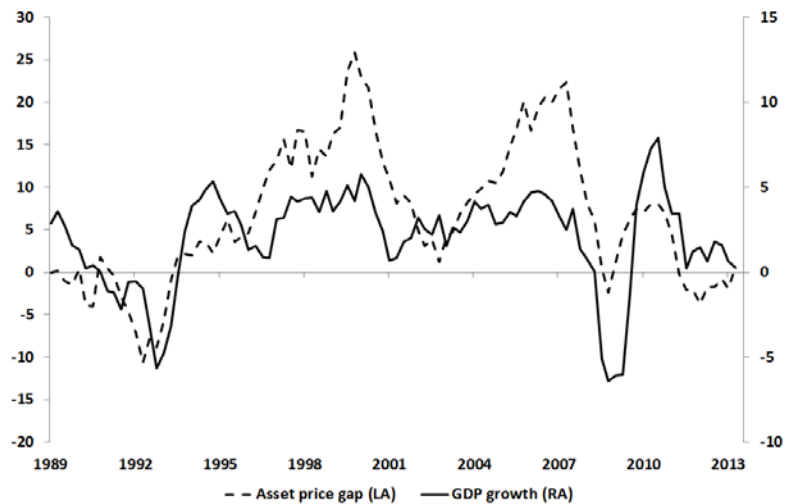
B



Sources: Ecwin and the Ministry of Finance

Figure 10 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..

Figure 10: Asset price gap GDP growth
Per cent and annual percentage change



Sources: Ecowin and the Ministry of Finance

3.3 Banks

As pointed out earlier, 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 behavior 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 characterized 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 II, i.e. the lending rate. One advantage of this approach is that the lending rate can be decomposed, which makes it possible to derive 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 11).³⁰

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 10, the internal interest rate contributes 1.74 percentage points to the interest rate on new lending which, in turn, can be divided 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 11.

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 11, this contribution amounts to 0.12 percentage points.

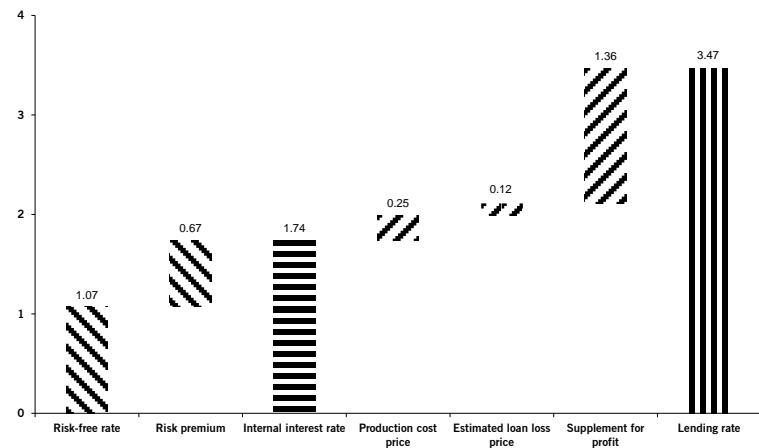
The banks' capital base costs are another important factor.³¹ Put simply, this is a cost that arises because banks cannot use this capital in their operations. Internally, banks usually call the contribution of capital base costs to the interest rate on new lending the capital base cost price.

³⁰ For a more detailed description of the market structure and loan pricing equation, see Arrgui et. al. (2013), Box 2. The development of various components of the lending rate in Sweden is described in Ministry of Finance (2012).

³¹ 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.

Finally the banks usually add a supplement for profit. In Figure 11 this supplement has been lumped together with the capital base cost since the profit made by a bank can either be distributed to 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 11 the capital base cost price along with the supplement for profit amount to 1.36 percentage points of the interest rate on new lending.³²

Figure 11: Contributions to the average interest rate for new lending in the four big banks in Sweden, June 2012
Percentage points and per cent



Source: Ministry of Finance

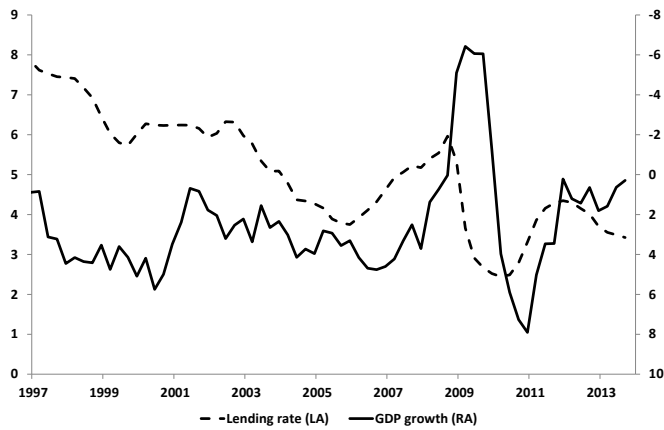
The above discussion indicates that what the macroeconomic literature calls credit spread contains many different components that are affected in one way or another by various risks associated with bank operations. Using lending rates, instead of policy rates in macroeconomic models makes it possible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

The lending rate that is used as an indicator is a combination of the interest rate that households and firms actually pay on their

³² This margin means that lending operations give a return on equity corresponding to 18 per cent.

existing loans.³³ This interest rate affects GDP growth, even though the effect of an interest rate change on GDP takes 1 to 2 years (Figure 12). Thus, the actual lending rate is used to analyse the effect of the bank capital channel on the real economy.

Figure 12: Lending rate and GDP growth
Per cent and annual percentage change



Sources: Ecwin and the Ministry of finance

³³ The lending rate is the weighted average of the interest rates for households (2/3) and the interest rate for firms (1/3).

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 analyzed (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 models' endogenous GDP forecasts are compared and evaluated. In Section 4.4, one of the models is used for stress test to illustrate how the economy may develop in the event of a sharp deterioration of the situation on financial markets. Finally, the same model is used to estimate the impact of financial stability policy on the real economy.

4.1 The empirical models

This section supplements a VAR model of the macro economy with four summary financial indicators: the financial stress index, the credit gap, the asset price gap and the lending rate.³⁴ The variables used in the models can be divided into two categories (Table 3). The first category consists of variables frequently used in macroeconomic models, most relate to the real economy and some are financial (Figure 13). The second category consists of the

³⁴ 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 a small, open economy, the currency rate and foreign GDP is also included in the set of variables. The inclusion of the exchange rate therefore also handles the exchange rate channel.

financial variables introduced in this paper, which are assumed to represent the different transmission channels (Figure 14).

Table 3: The endogenous variables in the models

Variable name	Variable designation	Transformation
Unemployment	U	First difference
Swedish GDP	GDP	Log difference
Foreign GDP1	GDPTCW	Log difference
Core inflation	CPI	Log difference
National Institute of Economic Research exchange rate index for the Swedish krona	ER	Log difference
Interest on three-month treasury bills	ITB	Log difference
Asset price gap	AGAP	First difference
Credit gap	CGAP	First difference
Stress index	SI	First difference
Actual lending rate	IL	Log difference

NOTE: GDPTCW is defined as a weighted GDP in the US and the Euro area.

In addition to the macroeconomic and financial variables the models use a dummy variable for the period 1989 Q2–1992 Q4 to control for the shift in the Swedish exchange rate regime. The foreign GDP variable is exogenous, while the other variables are endogenous.

Three VAR models are used; i) a macro model without the financial indicators (MOD-MAK); ii) a macro model with three financial indicators (MOD-FIN); and iii) a macro model with four financial indicators (MOD-FIN-ALT).³⁵ Table 4 presents the models 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, IRL, and AGAP in MOD-FIN. In the same way, no lagged values of AGAP or IL are permitted in the equations for SI in MOD-FIN. Thus, in MOD-FIN, which includes these

³⁵ Osterholm (2010) used a Bayesian VAR model with both US and Swedish variables to assess the quantitative effects of the financial crisis on Swedish real GDP growth.

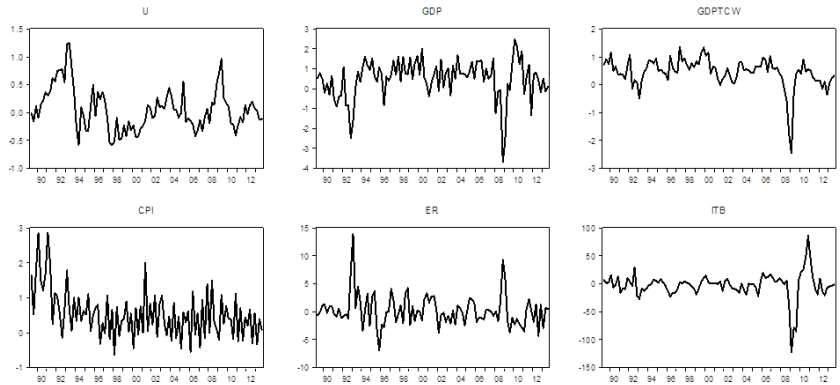
restrictions, the stress index only affects the macroeconomic variables.³⁶ It is also important to notice that the impact of the balance sheet channel is analysed by the inclusion of AGAP in MOD-FIN.

The impact of the balance sheet channel and the occurrence of a ‘financial accelerator effect’ is analysed differently in MOD-FIN-ALT. This is done by including an additional endogenous variable in the model, namely the credit gap (see Table 5). Restrictions are also introduced on CGAP, which means that CGAP is not allowed to have a direct impact on, or be affected by, the macro variables (CPI, U, GDP, ITB, KIX). This means that CGAP is only affected by AGAP, SI and IL. However, CGAP is allowed to affect AGAP to be able to capture the financial accelerator effect.³⁷

³⁶ The results of the statistical tests show that there are no problems with autocorrelation or heteroscedasticity.

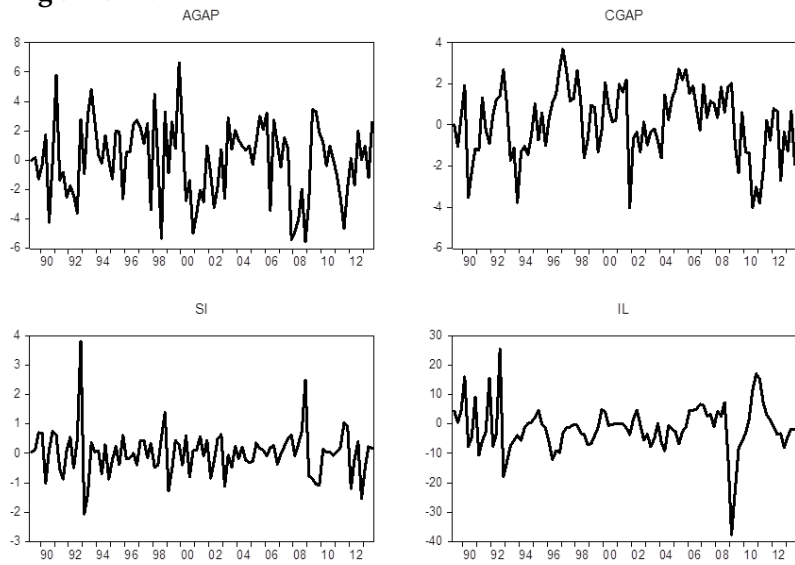
³⁷ An alternative way of estimating the VAR-models without imposing restrictions on coefficients is to estimate VAR-models using Bayesian estimation methods and using priors on coefficients. In a VAR-model, the number of parameters grows quickly and for a medium-sized quarterly VAR this number exceeds 400. Inevitably, this leads to a great deal of uncertainty. Especially considering that relative to the number of parameters, the number of observations is usually quite small. In the forecasting literature, reduction of the number of parameters most commonly boils down to utilizing some sort of prior restrictions. For example, one might impose so-called zero restrictions on some coefficients to eliminate them altogether from the model. If there is no expected direct connection between GDP and the interest rate, this strategy would amount to setting the coefficients corresponding to the lagged values of GDP to 0 in the equation for the interest rate and vice versa. Effects between the variables may still exist in the model, but they are restricted to go through other variables (such as inflation and exchange rates, to complete the example). An alternative countermeasure to overfitting is to ‘shrink’ the parameters. This can be thought of as an inexact zero restriction, as opposed to the previously discussed exact zero restriction. Essentially, this means that parameter estimates are pulled towards zero in order to reduce the consequences of overfitting. Instead of imposing an exact restriction saying that a certain parameter is zero with complete certainty, a distribution centered on zero is assigned to the parameter. A set of hyperparameters, chosen by the researcher, controls the tightness of the prior. This is, however, beyond the scope of this paper and left as a suggestion for further development of the empirical model.

Figure 13: The traditional macroeconomic variables after suitable transformations



Sources: Statistics Sweden, Ecwin and the Ministry of Finance.

Figure 14: The financial indicators



Sources: Statistics Sweden, Ecwin and the Ministry of Finance.

Table 4: The endogenous variables in the models

Model	Endogenous variables
MOD-MAK	CPI U GDP IRB ER
MOD-FIN	CPI U GDP AGAP IL ER SI
MOD-FIN-ALT	CPI U GDP AGAP IL ER SI CGAP ITB

A third restriction is placed on the interest rate on the three-month treasury bill. As mentioned earlier, the effect of monetary policy is captured by the lending rate in MOD-FIN because this is assumed to capture both the interest rate channel and the bank capital channel. In MOD-FIN-ALT, we also include an additional endogenous variable, namely, ITB, to distinguish the interest rate channel from the bank capital channel. It is assumed, however, that the effect on the economy of a change in interest rates always goes through the lending rate, but that monetary policy is able to influence the lending rate through ITB. Therefore, restrictions are introduced on ITB, which means that ITB is not permitted to have a direct impact on CPI, U, GDP, ER, AGAP and CGAP. By contrast, the ITB have a direct impact on IL. ITB is itself explained by CPI, U, GDP and SI.

Table 5: Model structure

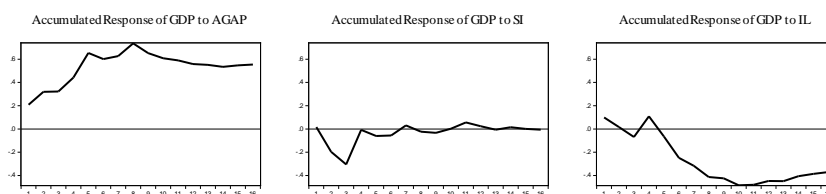
	GDP	U	CPI	ER	IL	SI	AGAP	CGAP	ITB
GDP	x	x	x	x	x	x	x	0	0
U	x	x	x	x	x	x	x	0	0
CPI	x	x	x	x	x	x	x	0	0
ER	x	x	x	x	x	x	x	0	0
IL	x	x	x	x	x	0	x	0	x
SI	x	x	x	x	0	x	0	0	x
AGAP	x	x	x	x	x	0	x	x	0
CGAP	0	0	0	0	x	x	x	x	0
ITB	x	0	x	0	0	0	0	0	x

NOTE:- x are the coefficients that are estimated. 0 indicates that the coefficients for all lagged variables are assumed to be equal to zero.

4.2 Quantifying the effects on the real economy

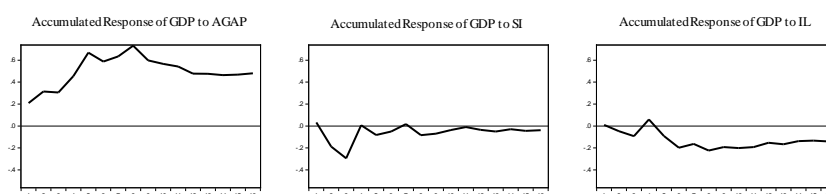
The effect of the different transmission channels on the real economy is examined in MOD-FIN and MOD-FIN-ALT using impulse-response analysis (Figures 15 and 16).³⁸

Figure 15: Effects on GDP shocks to the financial indicators in MOD-FIN.



Source: Own calculations.

Figure 16: Effects on GDP shocks to the financial indicators in MOD-FIN-ALT.



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. Also, the stress index is the only one with a temporary effect, as could be expected from the reasoning in section IIA. Increased uncertainty leads to postponement of investments (temporary effect), and not to abandonment of investments (permanent

³⁸ 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. The variance decomposition is made using Cholesky decomposition of the residual covariace matrix. This imposes an ordering of the variables in the VAR and attributes all of the effects of any common component to the variable that comes first in the VAR system. Note that responses can change dramatically if the ordering of the variables is changed. However, the ordering of the variable does has a minor impact on the responses in FIN-MOD and FIN-MOD-ALT. The ordering of the variables in FIN-MOD is: AGAP, SI, IL, ER, CPI, U and GDP. The ordering of the variables in FIN-MOD-ALT is: ITB, CGAP, AGAP, SI, IL, ER, CPI, U and GDP.

effect). However, common for all three cases is that the full effect works through after approximately two years

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 0.7 per cent after two years in MOD-FIN (and 0.7 per cent in MOD-FIN-ALT). 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 0.4 per cent after two years in MOD-FIN (and 0.2 per cent in MOD-FIN-ALT). Finally, a temporary increase in the stress index of one unit has not an impact on the level of GDP after two years (and -0.1 per cent in MOD-FIN-ALT).³⁹ However, the maximum temporary effect after three quarters is approximately -0.3 per cent. So the impulse response tests indicate that the macroeconomic impact of various financial shocks is not negligible.

Furthermore, the results mean that it is possible to quantify the effect from several variables that were frequently discussed during the crisis. Obviously, it is not an aim in itself to model the variables that make the headlines in the financial newspapers. However, not least from a policy perspective, it is desirable to have an informed opinion of how, say, financial stress, bank's profit margins or fire sales in the stock market affect the real economy. Although the accuracy of the model should not be exaggerated, such modelling is possible, given that the financial indicators used in the model are composites of several financial variables, including the above-mentioned ones.

Another way of getting an indication of the amount of information each variable contributes to the other variables in the autoregression is to use variance decomposition. It determines how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables. The results of this decomposition indicate that AGAP accounts for 13.0 per cent, SI for 15.3 per cent, IL for 13.0 per cent, ER for 9.9 per cent, CPI for 3.6 per cent, U for 3.4 per cent and GDP for 41.8 per cent of forecast error variance of GDP in MOD-FIN. A variance decomposition of forecast errors in MOD-FIN-ALT indicate that ITB accounts for 8.8 percent, CGAP for 3.0 per cent, AGAP for 13.1 per cent, SI for 14.2 per cent, IL for 5.7 per cent, ER for 10.1

³⁹ 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.

per cent, CPI for 3.1 per cent, U for 2.8 per cent and GDP for 39.3 per cent of forecast error variance of GDP in MOD-FIN. Variance decompositions analysis of GDP reveals that financial indicators accounts for a substantial amount for quarterly forecast error variance of GDP.

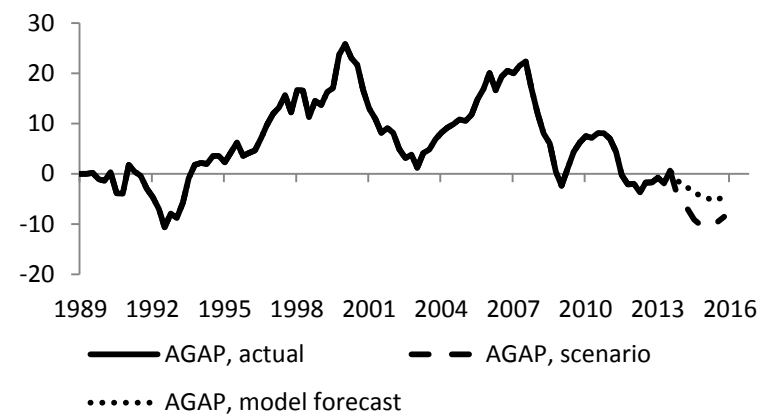
Yet another way of describing the model is to shock all the financial variables at the same time, in order to mimic a crisis, i.e. a stress test. The chosen scenario starts in the fourth quarter of 2013. This scenario assumes that the asset price gap will follow a pattern that is reminiscent of the development 1991-1993 (see Figure 17).

At the same time, it is assumed that the lending rate will be lower throughout the period (see Figure 18). It is also assumed that financial stress will be much higher in 2014, after which it will decrease gradually (see Figure 19). Finally it is assumed that foreign GDP growth will be in line with growth in 2008–2009.

The model simulation (see Table 6), using MOD-FIN-ALT indicates that the level of GDP will be more than 3.3 per cent lower than the model's endogenous forecast for 2015. 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, because banks are expected to secure larger margins, partly due to the announced tougher capital adequacy rules.

Figure17: Asset price gap

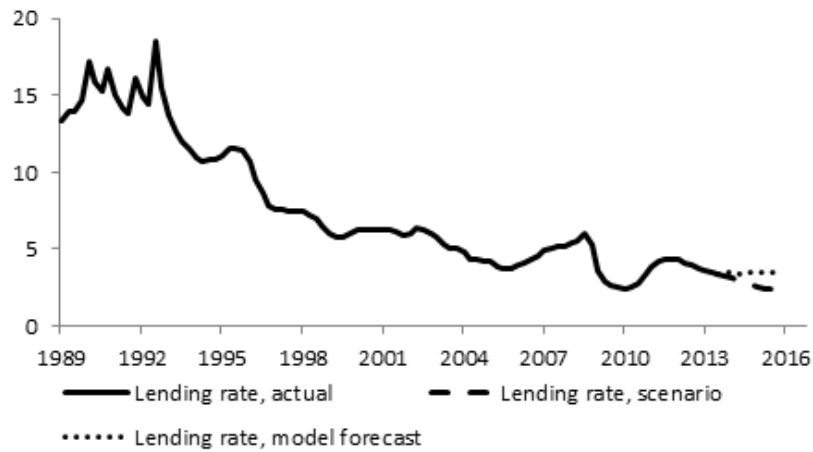
Per cent



Sources: Ecwin and own calculations.

Figure 18: Lending rate

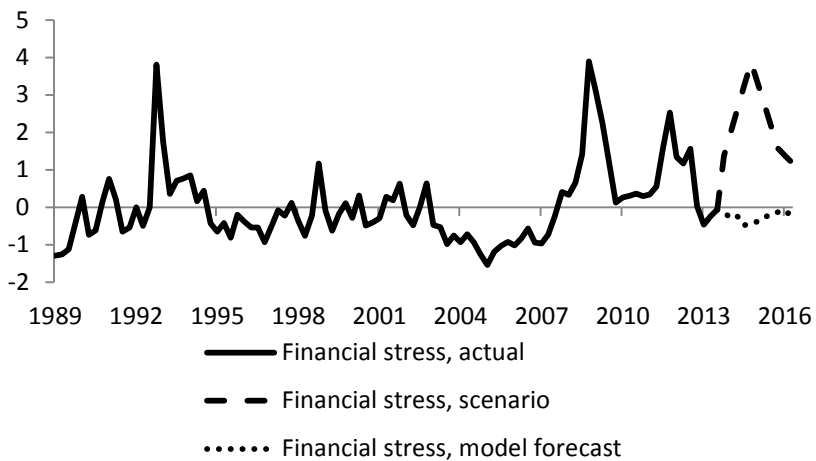
Per cent



Sources: Ecwin and own calculations.

Figure 19: Financial stress index

Index units



Sources: Ecwin and own calculations.

Table 6: Simulation of effects on Swedish GDP growth of a severe disturbance on financial markets, deviation from the models endogenous forecast

	2013	2014	2015
GDP growth	0.0	-1.5	-3.3

NOTE: GDP growth is given as deviation in percentage points

Source: Own calculations.

4.3 Forecasts and evaluation

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 2.9 per cent in 2014 and 3.0 per cent in 2015 (table 7). MOD-FIN-ALT forecast for 2014 is 2.7 per cent and for 2015 2.7 per cent.

According to the more traditional VAR model (MOD-MAK) GDP growth will be 2.1 per cent in 2014 and 3.0 per cent in 2015. The difference between these forecasts is due to the inclusion of three different financial indicators in MOD-FIN and MOD-FIN-ALT that are expected to have a stimulating effect on GDP growth in the next 2 years. The endogenous forecasts made by the models therefore give a picture of how much the financial sector affects growth in the economy. This could also be seen when the model was used for scenario analyses in the previous section.

Table 7: Forecasts of GDP growth

	2013	2014	2015
MOD-MAK	0.9	2.1	3.0
MOD-FIN	1.1	2.9	3.0
MOD-FIN-ALT	1.1	2.7	2.7

NOTE: GDP growth is in annual percentage units. The model forecasts have used information up to and including Q1 of 2013.

MOD-MAK: VAR with GDPTCW, ER, CPI, U, GDP and ITB.

MOD-FIN: VAR with MAK + AGAP, IL instead of ITB and SI (with restrictions on SI).

MOD-FIN-ALT: VAR with MAK (with restrictions on ITB)+ AGAP, IL, SI (with restrictions on SI) and CGAP (with restrictions on CGAP).

Source: Own calculations.

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.

The out of sample forecast evaluation is carried out in the following way. The period 2006 Q1 to 2013 Q3 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 1990 Q2 to 2005 Q4, after which forecasts are made for one to five quarters to come. In a second step, the models are estimated using data from 1990 Q2 to 2006 Q1 and the forecasts are then redone with the same time horizons as before.⁴⁰ This then continues in the same way moving one quarter ahead in each stage. With this procedure each model has at most 31 forecasts (one quarter horizon) down to 29 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 summarised by the root mean square error (RMSE).⁴¹ Table 8 presents the RMSE values for the models, with a lower value meaning better forecasting ability. MOD-FIN and MOD-FIN-ALT have better forecasting ability than both MOD-MAK and the naive AR(1) model up to four quarters.⁴²

⁴⁰ 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 2013 Q3. 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.

⁴¹ Bjellerup and Shahnazarian (2012) summarize the forecasting abilities also by mean absolute error and bias. The results show 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. However, there seems to be a positive bias in all the models, which means that the forecasts are on average higher than the actual outcomes.

⁴² The GDP series has a standard deviation of 1.31 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 8 shows that MOD-FIN, MOD-FIN-ALT and MOD-MAK are clearly better than AR(1) in this respect.

Table 8: Root mean square error (RMSE) for GDP forecasts 2006 Q1-2013 Q1

Period	MOD-MAK	MOD-FIN	MOD-FIN-ALT	AR(1)
1	1.30	1.12	1.12	1.17
2	1.29	1.09	1.15	1.28
3	1.27	1.13	1.19	1.30
4	1.19	1.21	1.32	1.36
5	1.24	1.39	1.43	1.37

Source: Own calculations.

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.⁴³ This is yet another way of shedding light on the added value of the expanded modelling of the transmission mechanism.

4.4 The impact of financial stability policy

It is also interesting to analyze whether financial stability policy has an impact on GDP growth. This is done by quantifying the effect of two key financial stability policy instruments, countercyclical capital buffers and loan-to-value ratio. This is done in four steps.

In a first step, we need to quantify the impact the instruments have on different financial indicators. The financial stability policy is a new policy area and it is therefore not possible to draw empirical lessons from policy experience in Sweden. However, such policy has been used in developing countries as well as emerging countries. Using panel-studies it is possible to draw conclusions regarding the impact of financial policy on house prices, credit

⁴³ Another way of assessing the value of an 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. Such an assessment is presented in a report by Bjellerup and Shahnazarian (2012). 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 compared to MOD-MAK. 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.

growth and GDP. This has been done in newly published work by IMF (2013a and b). The results indicate that a unit increase in an index constructed for capital ratio/LTV produces a negative effect on house price growth corresponding to 0.57/0.34 percentage points each quarter.

In a second step, we need to quantify the impact capital ratio has on lending rates. The decomposition of the lending rate in Ministry of Finance (2012) indicates that banks' lending operations in Sweden provide a return on equity of 18 per cent. This means that an increase of the countercyclical capital buffers by 1 percentage point, given a return of 18 per cent, increases the funding cost for banks by about 0.18 percentage point, which is assumed to be fully passed on to borrowers' lending rates.

In a third step, the calculated effects of different instruments from step one and step two are used to construct scenarios for AGAP and IL. The scenario analysis is used to examine how the real economy is affected in periods when the countercyclical instruments and/or LTV are activated. Scenario analysis thus gives an idea of how powerful these instruments are in terms of their effect on GDP growth.

Finally, MOD-FIN-ALT is used to make two conditional forecasts. The first forecast gives the development without an activation of the instruments (main scenario) and the second forecast gives the development where the asset price gap and the lending rate is influenced by the respective instruments in line with the effects described in step one and step two (alternative scenario).⁴⁴

The simulations indicate that the GDP level becomes 0.35/0.12 percentage points lower in the alternative scenario compared with the main scenario after two years.⁴⁵ The combined GDP effect of activating both instruments at the same time (assuming independency between the instruments) is 0.47 per cent, equivalent to about 17 billion SEK. The GDP impact depends largely on the negative changes in assets prices which has large and persistent effects on GDP enhanced by a higher lending rate. A decrease in GDP by 0.47 per cent reduces government revenue and transfers

⁴⁴ In the main scenario, AGAP and IL are assumed to follow a pattern that is reminiscent of the development before the financial crisis.

⁴⁵ The IMF (2013a and b) study indicate that GDP level become 0.1-0.15 percentage points lower when the capital ratio or LTV are introduced or increased. This panel study lacks many of the interactions identified and quantified in this paper. However, the GDP-impact isolated in this paper is highly dependent of the house price impact that IMF (2013a and b) found in their panel study.

and thus implies that public finances weaken by around 4 billion. These fiscal consequences, however, presupposes that the public sector does not adjust their consumption and investment to the lower level of GDP. The impact on the public finances depends largely also on the ability of banks to pass on the increased capital costs on their lending rates in the short and long term. The results thus indicate that financial stability instruments could have a significant impact on the economy and on public finances, and that the instruments are therefore to be seen as powerful economic policy instruments.⁴⁶

In light of the results in previous studies (especially those using DSGE-models for quantifying the impacts), the size of the here estimated effects are relatively large. The problems that this new policy area is supposed to address are the ones that, among other things, led to inflated asset values and unsustainable rates of growth (during the build-up phase, phase 1). A policy that aims to mitigate those processes must reasonably have a reverse effect on growth. Using the four transmission channels as a starting point for analyzing the results, we see that a significant share of the effect comes from the balance sheet channel while the interest rate and bank capital channels are less important. Although the estimated effects are relatively large, the composition of the effects in this paper seems to correspond to the structure of results in previous papers. In general, studies using structural models without an asset price effect (balance sheet channel) typically find smaller effects, while studies using an empirical approach that include an asset price effect typically find larger effects. In that sense, we view the results in this paper to be in line with previous results. However, given that there seem to be a systematic difference, based on the choice of method, we consider it a very important area for further research.

⁴⁶ Also, a limited sensitivity analysis shows that the effect of an instrument can be affected by timing, although the main conclusions remain intact, which means that timing is an important part of the policy decision. This means that the estimates of the effect of an instrument may be different depending on when action is taken to improve financial stability. Preferably, preventive measures should be taken when the asset price gap is closed or positive, when interest rates are relatively low and the level of stress in the financial markets is low. However, these estimates are uncertain and should therefore not be regarded as the expected size of the impact. In future, it will be possible to undertake better and more accurate empirical investigations.

5 Conclusions and comments

The main contribution of the paper is twofold. First, it ties the description of the transmission mechanism to the definition of a new policy area, financial stability policy. Through this, the arguments and need for a broad definition of the policy area, including the well-being of banks as well as households and companies, become clear. Second, the theoretical framework is then tested and quantified using a small scale VAR model, in turn enabling an assessment of possible effects from financial regulation. A main result of the empirical investigation is that the financial system is important for the real economy. The paper not only acknowledges that there is an effect but quantifies this effect for each of the theoretically identified transmission channels. Given the on-going debate on the need for increased regulation, the result that financial regulations can have short-run negative effects on GDP growth should not be neglected.

A couple of other aspects of the suggested approach and the results in the paper deserve to be highlighted. First, the chosen approach is important because it makes clear that the most important reason for an active financial stability policy is because of the financial systems possibly negative impact on the real economy, not because the stability of the financial system is an aim of its own. Second, the mapping of the transmission mechanism into the empirical model is simple and pedagogical. Four financial variables 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 asset price gap and credit gap (the balance sheet channel). Furthermore, and critical, the empirical properties of the model are in line with the theoretical conclusions and the effects are of reasonable size. Third, although the suggested small scale VAR(4) model is relatively small, the modelling of the transmission mechanism is

relatively rich. This is because the four financial indicators that represent the transmission channels are composites made up of several financial variables, thus allowing for a multitude of scenario testing.

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 not 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 assuming non-linearity in the parameters. Second, the macroeconomic VAR model in this report covers two of the three main areas of economic policy, 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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