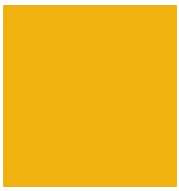
Sveriges Riksbank Economic Review

2015:1

SVERIGES RIKSBANK



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Dear readers,

This issue contains three articles focusing on the central bank's mandate and objectives, the trade-offs that may be required between different targets and the methods that can be used in the work of attaining objectives.

THE CENTRAL BANK'S MANDATE, OBJECTIVES AND DELIBERATIONS

- Magnus Georgsson, Anders Vredin and Per Åsberg Sommar give an overview of the academic debate on the central bank's mandate in a historical perspective which includes the global financial crisis. They summarise the discussion on the responsibility modern central banks may have for price stability and payment systems, as well as supervision of individual financial institutions (microprudential policy) and the financial system as a whole (macroprudential policy). The monetary policy deliberations between the target for inflation and the target for a stable real economy are also discussed, as are various issues concerning the central bank's degree of independence.

  They also describe the role a central bank may have in conjunction with a financial crisis by offering emergency liquidity assistance to financial institutions and how such assistance can be designed so as not to contribute to increased risk-taking in the financial system. The article concludes with a number of questions on the central bank's tasks in the future that have emerged partly as a consequence of the financial crisis.

UNCONVENTIONAL MEASURES IN MONETARY POLICY

- Ferre De Graeve and Jesper Lindé analyse the central bank's possibilities for using unconventional monetary policy measures when inflation is low and the policy rate has approached its lower limit. They study experiences abroad and use a macroeconomic model for various simulations.

  One alternative they study involves the central bank announcing (providing guidance) that the policy rate will remain low for longer than normal. If the decision is deemed credible by households and companies, monetary policy will immediately become more expansionary, contributing to rising inflation. Another alternative involves the central bank purchasing government and/or corporate bonds for longer maturities. This can contribute to lower term and risk premiums, thus making monetary policy more expansionary. In both alternatives, lower interest rates relative to those abroad may also contribute towards weakening the exchange rate, which increase import prices and normally leads to increased inflation. Similar conclusions are obtained from empirical studies, which indicates that unconventional measures can be used as a complement to conventional monetary policy interventions when inflation and the policy rate are very low.

NEW MODELS FOR NOWCASTING

- Michael Andersson and Ard den Reijer describe how a central bank can forecast the current state and immediate future of the economy with the use of what are known as nowcasting models. As outcome data is published with a time lag and the current situation is not yet known, such forecast models need to utilise the large number of indicators available in real time. The article describes two methods for making such forecasts in the short term. The first method estimates many small models and then weighs their forecasts together. The second method weighs together information in several series and then makes a forecast. The new methods also make it possible to understand and interpret the forces that drive economic development and that are reflected by forecasts and forecast revisions.

  The article also describes how the Riksbank's nowcasting system has been expanded with models that take account of the different frequencies at which indicator variables are observed and the different delays in their publication. The authors show how well a dynamic factor model, with the help of a more than 100 indicator variables at a monthly frequency, can forecast quarterly percentage changes in GDP. An application shows how GDP forecasts during the fourth quarter of 2008 were gradually revised downwards because the availability of new indicators changed the assessment of how much the global financial crisis affected the Swedish economy.

Read and enjoy!

Claes Berg, Martin W Johansson, Jesper Lindé, Cecilia Roos-Isaksson and Dilan Ölcer

Contents

Nowcasting refers to methods for forecasting the current state of the economy and developments in the short term. For example, the National Accounts are published with a time lag and consequently no statistics are usually available for GDP growth in the current and preceding quarters when making a forecast. However, more up-to-date indicators are available and can be used in forecasting models to determine the current level of GDP growth.

This article presents two ways of using large amounts of information to make forecasts in the short term, namely by aggregating many models and methods in which the weighting of series takes place prior to modelling. Particular focus is placed on how a dynamic factor model, with the help of more than 100 indicator variables at a monthly frequency can forecast quarterly percentage changes in GDP. The authors show that the model makes accurate forecasts. The factor model is also useful in understanding how the flow of information over time affects the forecasts for a macro variable. An application shows how GDP forecasts during the fourth quarter of 2008 were gradually revised downwards because the availability of new indicators changed the assessment of how the global financial crisis affected the Swedish economy.

The modern central bank's mandate and the discussion following the financial crisis

Magnus Georgsson, Anders Vredin and Per Åsberg Sommar*

Magnus Georgsson works at the Financial Stability Department, Anders Vredin at the General Secretariat and Per Åsberg Sommar at the Markets Department.

Wars and crises have throughout history acted as catalysts for development. This also applies to the mandate of central banks and the most recent financial crisis of 2007-2009 was no exception. In this article we try to provide an overall view of, first and foremost, the academic discussion on the central bank mandate and also other current issues regarding central bank activities now and in the future. As a basis we review the way the central bank's mandate has developed over time, what can be considered the fundamental tasks of the central bank and which trade-offs are required for the central bank's various tasks and objectives.

We can see that there has been a shift in the mandates that different governments have chosen to bestow on their central banks over time, and also in which tasks the legislature and the central bank have chosen to emphasise. On some occasions, the task of funding the government's war has been the most important one, on other occasions the focus has been on price stability to keep inflation in check. Sometimes society has needed a central bank with a broad mandate that can supply most of the services needed in a payment system, while at other times there has rather been a need to provide stability to a payment system with many private actors.

Since the most recent crisis broke out, there has been lively discussion of central bank mandates with several opposing points of view. This has concerned carefully weighing up the central bank's fundamental tasks, such as the need to lend money to payment system participants during a crisis without increasing the risk of moral hazard. There has also been discussion of extending central bank tasks beyond their fundamental activities, and in particular the responsibility for macroprudential policy and supervision of banks and other financial institutions, what is known as microprudential supervision.

The final section of the article presents a number of issues regarding central bank tasks that will probably require more detailed discussion in the coming years.

* The authors would like to thank Jan Qvigstad, Norges Bank, Lars Jonung, Lund University, Juha Tarkka, Finlands Bank and Mikael Apel, Claes Berg, Christina Nordh-Berntsson, Roberto Billi, Joanna Gerwin, Göran Lind, Per Sonnerby and Jonas Söderberg, all at Sveriges Riksbank, for their comments on the article in various parts and stages. Many experts both at the Riksbank and within other organisations such as the IMF and the BIS have contributed useful discussions. The authors would like to thank especially Deputy Governor Cecilia Skingsley and David Archer at the Bank for International Settlements.

1. The history of the central bank mandate

The development into today's modern central banks is often regarded as an evolutionary process when described in the academic literature. This is because central banks mandates in different countries have shifted over time depending on local circumstances and conditions. Central banks are constantly facing new challenges and problems to resolve, and therefore there is no definitive formula as to how they should be shaped over time. On the other hand, historical experiences can provide some guidance as to what have been the central banks' most important tasks.

PRECURSORS TO THE MODERN CENTRAL BANKS

The underlying driving force behind initiating and encouraging the establishment of central banks was essentially the same for all: a wish to introduce a new, reliable means of payment. Both the general public and governments have long needed institutions that take responsibility for certain functions that are currently regarded as defining a modern central bank.[1] The need to make reliable payments with a common means of payment in a joint system was a driving force behind developments. Governments therefore began to either give state-owned or private institutions the privilege of issuing means of payment in the domestic currency and of mediating payments. In this way, they hoped to reduce the disorder that arises when different participants in one country issue means of payment separately in their own units. These institutions were precursors to today's central banks and their objective was largely to maintain the value of the means of payment. The core of modern central banking activities can be traced back to providing stable means of payment, which was first done by state-owned or private banks, something that Ugolini (2011) also emphasises. This concerned both banks which mediated payments and were funded solely through deposits (giro banks) and privately-owned banks which issued banknotes. When they lacked capital, the giro banks were often owned and backed by the state. The privately-owned banks that issued banknotes obtained funding through a combination of equity capital and deposits.

FACT BOX:

The first bank to issue banknotes, Stockholms Banco and how Sveriges Riksbank was established

The first bank in the world to issue banknotes was Stockholms Banco, which was founded when Johan Palmstruch was awarded the privilege of running a bank by King Karl X in the year 1656. Stockholms Banco originally functioned as a deposit bank, where the general public could deposit their means of payment, which included unwieldy copper plates, for a fee. The depositors received

1 See, for example, Ugolini (2011), Capie et al. (2012) and Roberds and Velde (2014a and b).

a receipt of their deposit, which gave them the right to redeem their claim at the bank and receive the funds they had deposited in the form of copper coins. When the bank expanded its balance sheet by beginning to grant credit, it also began to issue banknotes. The banknotes were not linked to any specific deposit amount but instead issued against the bank's entire balance sheet. However, the banknotes gave the bearer the right to redeem them against a certain amount of copper coins. The banknotes became very popular as they were much easier to manage than the unwieldy copper plates. When the government reduced the amount of copper in the coins, the general public began to be suspicious of the banknotes. This suspicion led to people wanting to redeem their banknotes quickly to get back the copper plates they had originally deposited there instead of copper coins with a lower copper content. This led to a bank run, which forced the bank to close in 1664. In 1668, the Riksens ständers bank was established instead (which was later renamed Sveriges Riksbank). This bank was owned by the Riksdag (parliament). However, issuing banknotes had been forbidden in 1664, as this was considered to have caused the fall of Stockholms Banco. The Riksbank did not begin issuing banknotes again until 1745. As the Riksbank was under the control of the Riksdag, it was independent of the king. For instance, the Riksdag opposed the Riksbank taking on loans to finance the state's wars. King Gustav III therefore founded the Swedish National Debt Office in 1789, which was given the task of taking out loans on behalf of the state to finance the national budget, and also to provide loans.[2]

MODERN CENTRAL BANKS

An established view of central banks used as a base by, for instance, Capie et al. (2012) and Green (2003) is that an institution is defined as a modern central bank if it is

- the state bank,
- holder of the monopoly on issuing means of payment in the domestic currency and
- lender of last resort.

Being the state bank usually means that the central bank takes care of the state's transfers, borrows funds for the state budget and administers the national debt. Being lender of last resort means that the central bank should be prepared to lend money to banks and other agents in the payment system to alleviate or avoid a systemic crisis. The basis for this task is the central bank's ability to create means of payment in the form of physical money and holdings in accounts in the domestic currency. Using these criteria, the Bank of England is regarded as the first modern central bank. It had actually been founded back in 1694 with a monopoly on issuing means of payment in England and Wales and with the task of managing the national debt.[3] However, the Bank of England did not take the form of a modern central bank until new legislation in 1844 extended its banknote monopoly to

2 See Wetterberg (2009).
3 See Lees and Footman (2014).

cover the whole of Britain and in 1870 the Bank of England took on responsibility for the stability of the British banking system. The world's oldest still existing central bank, Sveriges Riksbank, would not qualify as a modern central bank according to the criteria above, as it is not the state's bank. While it did have the task of acting as the state's internal bank until 1989, this task was taken over by the Swedish National Debt Office, which has had the task of managing the Swedish national debt since it was established in 1789.

Ugolini (2011) concurs with the view that central banks are defined by the functions they maintain, but notes that modern central banks have two main tasks, namely to ensure financial stability and monetary stability. Financial stability means here supplying stable payment systems, being the ultimate guarantor that the payment system has sufficient means of payment for its function (lender of last resort[4]), and exercising supervision over the banks. Monetary stability means, according to Ugolini, conducting monetary policy and supplying means of payment in the domestic currency. There are clearly some differences between Ugolini's definition of a modern central bank and the one used by Capie et al. In practice, central banks are not necessarily the state's bank and do not necessarily conduct supervision of the banking system.[5] The role of lender of last resort, on the other hand, is essential to the central bank.

But there are also those who say that central banks are not needed, and particularly not in the role as lender of last resort. De Soto (2009) describes the discussion between advocates of central banks and advocates of an entirely free and deregulated banking system that is usually referred to as *free banking*. The free banking advocates say that the actual existence of central banks and their role as ultimate guarantor of the payment system aggravates banking crises and economic downturn. They say that the state has established central banks mainly as a result of pressure from special interests, especially private banks, who have regarded it as necessary for the central bank to go in and guarantee the stability of their operations during crises. According to this point of view, the commercial banks become less responsible and bank customers less inclined to choose stable banks over more risky ones when both the banks and the general public can rely on the central bank intervening and providing support to banks in crisis. The free banking advocates say that private banks can establish their own clearing houses where the banks can oversee one another through a transparent clearing procedure.[6] Historically, commercial banks in many regions have had the aim of managing this on their own. But experiences have shown that the banks found it difficult to maintain sufficient capacity

4 The definition of the concept of lender of last resort differs slightly in the academic literature; see for instance Bordo (2014), Lacker (2014) and Tucker (2014).

5 One example of this is Sveriges Riksbank, which neither conducts supervision of the banks nor acts as the state's bank.

6 Clearing activities here means formally registering and reporting payments between the banks. De Soto (2009) says that the root of the problem is that the banks conduct lending that is only partly backed by reserves in the form of deposits (fractional banking, see the box on commercial bank money in section 3 below). Although he agrees with the view that central banks are not needed, he considers that credit granting by private banks shall be separated from deposits. Deposit operations should be conducted by special deposit banks that receive the deposits and back them with 100 per cent reserves in the form of generally-accepted goods/metals. Credit granting should be conducted by other banks, which are funded in other ways than through deposits.

and to coordinate lending to competing banks. Instead, there was a development towards refining the allocation of roles between commercial banks and central banks. Capie et al. (2012) claims that the commercial banks preferred that the central banks were responsible for supplying payment systems and acting as central counterparty in clearing the banks' payments between one another in exchange for the central banks ceasing activities that competed with the commercial banks, such as supplying credit. The US central bank, or rather the system of twelve federal central banks–the Federal Reserve System–was established in 1913 after the commercial banks had failed to mediate payments between themselves in a stable and reliable manner and to coordinate financial support to banks in crisis. Instead, the central bank was forced to intervene and bring order into the payment system and function as central counterparty in clearing interbank payments in a joint currency at the terms set by the central bank.

Some countries lacked a developed banking sector for a long time. Instead, informal financial sectors supplied financial services and credit. In Sweden, for instance, the informal financial sector consisted of trading firms and wholesalers, in addition to a few banks, up until the 19th century. Establishing a public bank was then a way for the state to establish a financial infrastructure that enabled credit granting to the general public.[7]

FROM THE GOLD STANDARD TO INFLATION TARGETING

During the second half of the 19th century and the start of the 20th century, the gold standard functioned as an international exchange rate regime in most western countries. It established a single, overall objective for the central banks in these countries, namely to maintain the convertibility of the means of payment into gold and its value in relation to other currencies on the foreign exchange market. The system was based on the Bank of England guaranteeing that the British pound could be redeemed for a certain amount of gold and on other central banks pegging their currencies to the British pound. When the First World War broke out, the gold standard ceased to apply, but it was reintroduced in many countries between 1920 and 1930. The losers of the First World War, that is, Austria, Hungary and Germany, were encumbered with large reparation payments that were funded through the banknote printing presses. This resulted in hyperinflation. The hyperinflation only came to an end when the states established independent central banks with legally-sanctioned resilience to refuse the government's demand for credit without collateral and implemented radical changes in fiscal policy.

When economic activity declined and the US stock market crashed in 1929, protectionism ensued and world trade collapsed. This, combined with the large war debts, led to the banking systems in Germany, Austria and Hungary collapsing. High interest

7 In Sweden, the establishment of Sveriges Riksbank in 1668 enabled deposits from and credit granting to the general public, as there was previously no banking sector. This was also the case in Norway, where Norges Bank was established in 1816; see Haldane and Qvigstad (2014). The central banks in the Scandinavian countries supplied financial services in the absence of a fully-fledged banking sector, but also functioned as a foundation for a private banking and financial sector to begin developing.

rates to maintain the currency's convertibility into gold at the same time as unemployment was increasing made it impossible to uphold the fixed exchange rate regime comprised by the gold standard in the long run. The United Kingdom, like Sweden, abandoned the gold standard in September 1931 and let its exchange rate float. The Swedish government instead declared a new monetary policy programme to uphold the value of the Swedish krona. This meant that during the period 1931 to 1937 the Riksbank had the stabilisation of domestic prices as the objective of its monetary policy. In 1937, the Riksbank, in addition to the primary target to preserve a stable price level, was given other goals like aming for full employment.[8] The government also emphasised the importance of the Riksbank choosing monetary policy measures in consultation with the government, that is, coordinating its monetary policy with fiscal policy.[9] Sweden was thus a relative pioneer on the road later followed by most countries after the Second World War, when Keynesianism made an impact. Stabilisation policy and more government regulation of both the real and the financial sectors, including control of international capital flows, meant that the central banks came to be increasingly regarded as public authorities accountable to the governments and having the purpose of attaining the objectives of the general stabilisation policy. In connection with this, many of the central banks that had until then been privately-owned were nationalised.

As a step in restoring confidence in the international financial system, the fixed exchange system known as "Bretton Woods" was established in 1944. At the same time, the International Monetary Fund (IMF) and the World Bank were established. The IMF was given the task of overseeing the new exchange rate cooperation. The Bretton Woods system entailed the member states tying their exchange rates to the US dollar. In return, the United States guaranteed a fixed redemption price for the US dollar in gold. The convertibility of the individual member states' currencies into gold was thus formally maintained until the Bretton Woods system collapsed in 1971. Then, the United States was no longer able to maintain a fixed redemption price for gold. Following this came a period when the currencies of the larger economies floated against one another and the central banks in, for instance, Germany, the United States, Switzerland, Canada and the United Kingdom introduced monetary targeting. Monetary targeting entailed the central banks using targets for growth in the money supply to try to control inflation. However, this policy was abandoned in the mid-1980s after it was proved to be inefficient. Instead, an increasing number of countries returned to stabilising exchange rates. The overall purpose of the exchange rate regime was that the central banks would support the stabilisation policy and at the same time maintain price stability. With mixed experiences from monetary targeting and fixed exchange-rate regimes, some countries with open economies began to introduce inflation targets combined with floating exchange rates. New Zealand was the first to do so in 1990. Canada followed suit in 1991. The United Kingdom and Sweden introduced inflation targets in 1992 and 1993 respectively. Today, the central banks in more than 30 countries use some form of inflation

8 Berg and Jonung (1999) give a detailed description of this monetary policy regime.
9 See Berg and Jonung (1999).

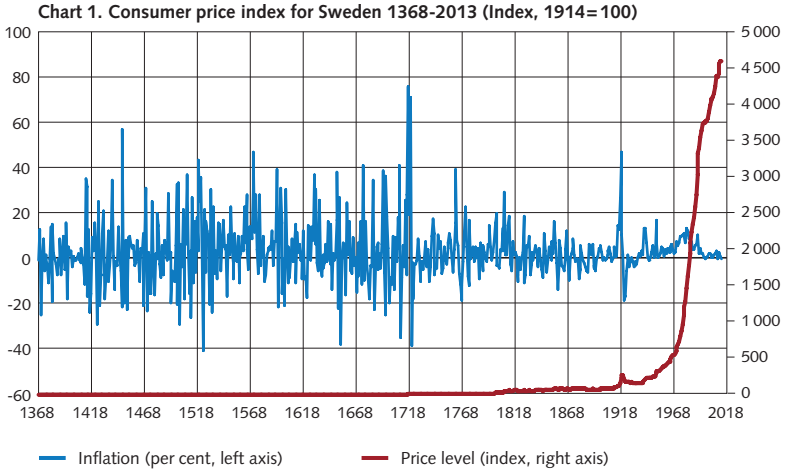
targeting.[10] The independence of the central banks has been reinforced to increase the credibility of the inflation-targeting policy.

Parallel with several countries introducing inflation targeting, the fixed exchange-rate collaboration within the EU developed further. On New Year's Day 1999, eleven EU member states adopted the euro as their joint currency. Today, 19 member states within the EU have the euro as joint currency. The European Central Bank (ECB) also conducts monetary policy with a numerical anchor for inflation in the euro area as a whole.

To summarise, we can conclude that central banks' tasks have varied over time and from one country to another. The common base for most of the tasks allocated to central banks over time is their capacity to act as lender of last resort in their own currency.

Chart 1 shows the development of consumer prices in Sweden for the years 1368 to 2013, both in terms of price level and as an annual inflation rate. The chart shows that the general public experienced major fluctuations over time in the purchasing power of the means of payment. High inflation in one year could become strong deflation in the next. This went on until 1931, when Sweden introduced a price stability target. After that, inflation stabilised and it was possible to avoid periods of strong deflation. However, one period that stands out is the 1970s, when recurring supply shocks and expansionary economic policy led to prices soaring dramatically. It is also worth noting that the development with periods of strong inflation that rapidly changed into strong deflation did not change when the Riksbank was established in 1668.

Chart 1. Consumer price index for Sweden 1368-2013 (Index, 1914=100)



Sources: Edvinsson and Söderberg (2010) and Sveriges Riksbank

10 See Berg (2012) who discusses among other things the development of institutional frameworks for monetary policy and financial crises from a global perspective.

2. The central bank's mandate and tasks

This section moves on from the historical description to discussion of the principles regarding the mandate and tasks that are the most important for a modern central bank, that is, its fundamental tasks. We discuss whether there are any general criteria for what should comprise a central bank task. The purpose is to provide a basic understanding and make it easier to follow the discussion of trade-offs between different tasks in section 3 and the discussion of an extended mandate in section 4.

THE MANDATE AND TASKS OF CENTRAL BANKS ARE DETERMINED BY THE NEEDS OF SOCIETY

One means of approaching the question of what mandate the central bank should have is to begin with society's need for a generally-accepted means of payment, that this means of payment maintains a stable value over time and that there is a stable and efficient infrastructure for payments, that is, the need for a functioning payment system. A system is also needed to transform savings into loans and investment.

The next question is to what extent the state should be responsible for these tasks. Green (2003) suggests that the first question to ask is whether there is a *market failure* that needs to be remedied with regard to payments and loans, that is, a reason why the state should regulate in this area at all. Economists often use a simplified conceptual model, where first and foremost private markets should meet the needs of society. The state should only intervene when the market has failed or is expected to fail in meeting these needs in a satisfactory manner. Such a market failure could be, for instance, that individual market participants do not take into account the risks that their actions cause for the financial market as a whole. In these cases it may be justified to have some form of supervision, regulation or other intervention by the state. The state can then give a central bank the task of managing this. At the same time, it is important that the public authorities' regulation does not become a greater problem for society than the market failure the state is trying to remedy. Trade-offs must thus be made between, for instance, a safe and an efficient payment system, or to put it differently, between a high level of financial stability and a high level of economic growth.[11] One can attain a completely safe and stable payment system through regulation, but then it will be at the cost of low socio-economic efficiency. Several developed countries–including Sweden–underwent a period of extensive regulation of the credit market from the Second World War until the mid-1980s and many say this entailed over-regulation. On the other hand, unregulated financial markets can lead to rapid economic growth at the cost of major risk of financial instability, which could have very negative effects on growth if they were to materialise.

11 Or as British Chancellor of the Exchequer George Osborne put it: "We don't want the stability of the graveyard", see The Telegraph, 15 November 2011.

As we saw in the previous section on the history of the central bank, the functions of a central bank can differ from one society to another, for instance, because of different stages of development and different political environments.

THE INDEPENDENCE OF THE CENTRAL BANK

Central banks have often been established at the initiative of the state.[12] This means that throughout the entire history of central banks there has been an inherent tension between on the one hand the independence of the central bank and its endeavour to maintain the value of the means of payment, and on the other hand the central bank's function as bank to the state. States have often been tempted to use the central bank's monopoly on creating money to fund their activities, which increases the risk of inflation and undermines the value of money. To ensure that the general public has confidence in the central bank's ability to maintain price stability and a payment system that is safe and efficient in other respects, too, it is important that the central bank is not steered by other and more short-term goals, but that it can manage its tasks with a large degree of independence from the state. However, this does not mean that the central bank must be entirely independent. The level of independence depends on how much benefit society wishes to obtain from the advantages of an independent central bank. This must at the same time be weighed against society's need to control the central bank and for accountability to ensure that it really aims to meet the needs of society.

FACT BOX:

Independence of central banks

In a democratic society, sometimes elected representative's powers are restricted in favor of longer term goals. For instance, courts are often given some independence in exchange for providing legal certainty and universities are given autonomy in exchange for independent research. In both cases there are long-term objectives with a balanced development over time. The independence of the central bank has the same foundation. When a society gives a central bank a high degree of independence, the motive has often been the objective of price stability.[13] A central bank shall thus have a sufficient degree of independence to be able to make decisions for long-term monetary policy objectives, even when such decisions have short-term negative effects on the economic conditions for households and companies. If the independence is enshrined in the constitution, it is a further guarantee of decisions on long-term objectives compared with the current government being able to change regulations at relatively short notice.[14] Economic studies of central bank independence focus mostly on the institutional framework for a central bank and they usually divide

12 Capie et al. (2012).
13 See, for instance, Blinder (2010), p.6.
14 Koshie (2013), p. 38.

the regulated independence into four parts: institutional, functional, organisational and financial, see for instance Amtenbrink (1999).

The discussions on the degree of independence often mainly focus on institutional independence and functional independence.[15] **Institutional independence** is often also called goal independence and refers to the central bank's capacity to determine its own objectives without direct influence from the political system. **Functional independence** is often called instrument independence and refers to the central bank's capacity to determine how its tools shall be used to best attain its objectives.

Organisational independence refers both to how the central bank is organised and what conditions exist to appoint and remove the central bank management. This also includes how independent the central bank is of instructions from, primarily, the government. If the central bank governors can be removed on political grounds or because of the work the central bank has done, the central bank cannot be considered to have a high degree of independence. If a central bank is to have a high degree of independence, members of its governing body should only be removed if they are guilty of serious professional misconduct (Amtenbrink, 1999, p. 20) and not due to poor performance. If one could remove the governing body on these grounds, it would open the way for arbitrary political interpretations.[16] The length of the period of office is also important. It should be longer than parliament's period of office and should not expire at the same time as a change in government may occur if the degree of independence is to be regarded as high. In general, the central bank is considered to have a higher degree of independence the longer the term of office for the governing body.

Finally, **financial independence** concerns the role the government or parliament plays with regard to the budget of the central bank. If the government has influence over the central bank's budget, this may make the central bank more vulnerable to influence in its monetary policy decisions. A closely-related question is the central bank's allocation of profits and to what extent and in what way the government or parliament can make demands regarding this. Most central banks regularly pay part of their profits into the state treasury.[17]

THE CENTRAL BANK'S FUNDAMENTAL TASKS

Providing means of payment both in physical form and as holdings in accounts in the country's own currency is the task usually considered fundamental for a central bank.[18] Being responsible for the supply of means of payment in the payment system is a basis for the central bank's other tasks, everything from financial stability and oversight of the payment system to monetary policy. Another important task for the central bank is to maintain the value of money stable over time.

15 Walsh (2005).
16 The Governor of the Reserve Bank of New Zealand can be removed if the inflation target is not attained, but such rules are very unusual, according to the Bank for International Settlement (2009, p.74).
17 Stella and Lönnberg (2008).
18 See, for instance, Goodhart (2010) and Blinder (2010).

Money in its various forms is the most liquid means of payment, that is, the easiest to buy and sell, as it can be used in most transactions.[19]

One type of physical means of payment is banknotes and coins. Central banks usually have the monopoly on producing banknotes and coins and these have a special status, through legislation, as the country's legal tender. This need not mean that banknotes and coins issued by the central bank are the only means of payment that can be used in a country. But the main rule is that the status of *legal tender* means that one can make purchases and pay debts with them.[20] Purchasing power – the real value of money – is governed by inflation, that is, how the prices of goods and services in terms of the means of payment develop. It is usually only physical money that has the status of legal tender. Money that only exists in digital form does not normally receive this. Such money is known as *book-entry money* and can consist, for instance, of money in deposit accounts with banks and be used for payments through various digital forms of payment.

FACT BOX:

Outside money and inside money

According to the standard description of different measures of the money supply in economic textbooks, a distinction is made between central bank money (outside money) and commercial bank money (inside money).

Outside money consists of banknotes and coins and commercial banks' money that is held in accounts with the central banks. The commercial banks have money in accounts with the central bank when they voluntarily or because of mandatory rules are forced to hold reserves to be able to manage changes in the amount of payments made by the general public via the banks. In times of crisis, the central bank may need to increase the amount of outside money in the system more quickly by lending money to the banks against collateral.

Inside money is money that has been deposited with the commercial banks by the general public. However, the deposits from the general public are only covered to a relatively small extent by reserves in the form of cash and deposits with the central bank (that is, claims on the central bank). Instead, the collateral for deposits from the general public is comprised of the claims the commercial banks create by granting credit to the general public. The phenomenon whereby banks only invest a small fraction of their deposits in the form of reserves such as cash or deposits with the central bank is known as *fractional banking*.[21] It is this relationship between short-term debts to depositors and other financiers, and long-term lending to the general public that makes the banks sensitive to potential *bank runs*, that is, if many depositors suddenly wanted to withdraw

19 However, this does not mean it is the only form. Government securities with various maturities can also be a form of collateral much in demand in transactions on the financial markets, particularly in times of crisis.
20 See Verständig (2013).
21 Fractional banking means that the banks hold easily-convertible reserves such as cash and other safe assets comprising only a small part–a fraction–of their liquid deposits and able to be withdrawn immediately by depositors.

their money at the same time. Stabilising a banking system comprised of fractional banking requires that the central bank is prepared to provide emergency liquidity assistance on the basis of its task as lender of last resort. Deposit guarantees for bank customers that protect their deposits if the bank should fail, demands regarding the size of the banks' equity capital and liquid assets and monitoring the banks' risk-taking are other essential elements to gain stability.

Providing means of payment is thus something that can be said to define a central bank. If the central bank has such overall responsibility for society's need of means of payment, which specific tasks should it reasonably have responsibility for? The answer to this question could be that the tasks that can show the strongest link to this responsibility comprise the central bank's fundamental tasks. These include both *financial stability* and *monetary policy*.

FINANCIAL STABILITY

A smoothly-functioning economy requires not only that there is a means of payment, but also that there is a stable and efficient infrastructure to make payments, that is a *payment system*. There is also a need for a credit system that converts savings to investment, and a system for risk management, whereby those who want to can waive risk and pass it on to those who have the capacity and willingness to take on risk. A stable and efficient payment and credit system requires, in brief, that the financial system as a whole has the ability to maintain a number of fundamental functions. Maintaining the fundamental financial functions can be expressed as an objective for *financial stability*.[22]

One main reason for creating a central bank is to ensure there is an efficient payment system.[23] One can regard it as the central bank's responsibility to create means of payment also assumes that these can be put into the financial system. It is then logical to give the central bank the task of also safeguarding the infrastructure for the payment system.

Giving the central bank special responsibility for overseeing at least the central parts of the payment system thus appears natural. This includes a central payment and settlement system, that is, the final regulations of payments between the banks with funds held in accounts. Such a system is aimed at agents who mediate the payments that arise from the

22 See, for instance, Sveriges Riksbank (2013) for a more detailed discussion of the central bank's responsibility for financial stability. The majority of central banks consider that they have responsibility for financial stability. However, far from all of them have descriptions of objectives in their legislation that mention financial stability and of the 146 central banks studied by the Bank for International Settlements (2009, pp. 25 and 30), fewer than one-fifth have an explicit objective of financial stability. Central banks often have other ways of describing their mandate instead of using the concept of financial stability as such, which could be partly because the concept is relatively new. Another reason could be that there has not been any individual, generally-accepted or generally-used definition of financial stability either in academic research, in the factual debate or among legislators. See Issing (2003), Oosterloo and de Haan (2003), Schinasi (2004) and Allen and Wood (2006). Many central banks nevertheless take financial stability into account to some extent in their monetary policy framework; see Billi and Vredin (2014), p. 2.

23 See, for instance, Santomero, Viotti and Vredin (2000), p. 3.

general public's financial transactions. It is thus the banks and not individual people who are members of the central payment and clearing system.

In the event of shocks or crises in the financial system, the task of the central bank to supply means of payment and to support the payment and credit system becomes particularly important. The central bank may be forced to act as lender of last resort to safeguard the stability of the system. On the basis of this responsibility, it is natural that the central bank should also oversee the system. Depending on the implementation of its responsibility as lender of last resort, ensuring that the payment system has means of payment, the central bank may, for instance, also need to counteract the agents in the system taking too many risks when they know they are guaranteed support from the central bank in the event of a crisis (what is known as moral hazard behaviour).

There are other tasks aimed at safeguarding financial stability, but which it is more difficult to determine whether or not should be regarded as part of the central bank's fundamental tasks. For instance, the responsibility for supervision of individual financial institutions – microprudential supervision – and the responsibility for ensuring the financial system as a whole is robust (what is known as macroprudential policy[24]) are in some countries given to central banks and in others to separate financial supervisory authorities. Following the most recent crisis, new tools for macroprudential policy have been proposed, which has also led to a discussion of the advantages and disadvantages of giving responsibility for them to the central bank. We will return to this in section 4.

MONETARY POLICY AND PRICE STABILITY

Maintaining the value of the means of payment is at least as important as ensuring that the infrastructure for the payment and credit system functions. It is important for a society that the means of payment, regardless of whether this is physical or virtual currency, has a lasting value over time. Otherwise, the general public's confidence in the means of payment will be undermined. The principles for stabilising the value of the means of payment have varied over time, as described in the historical account in section 1. In a fixed exchange rate regime it is a case of maintaining the value of the domestic currency in relation to foreign currencies. With a floating exchange rate it is now most common for the central bank to steer the value of the domestic currency on the basis of a particular target regarding changes in value of the domestic currency in relation to price developments on domestically-sold goods and services.

In the latter case, the central bank has the preferential right of interpreting price developments on goods and services sold and on the basis of this determining the interest rate the central bank sets on loans to (or deposits from) the banks. As the central bank has the task of issuing money and overseeing the payment system infrastructure–which

24 The difference between microprudential and macroprudential policy is defined according to Finansinspektionen, the Swedish financial supervisory authority, on the basis of what initiates the supervisory activity – whether it is a company-specific circumstance or a general market/macroeconomic circumstance, see Finansinspektionen (2013).

is a necessary condition for steering the access to means of payment and its value–it is reasonable that the central bank should also be responsible for the country's monetary policy.

Most central bank laws that have been instituted in the past hundred years have price stability as the primary objective of monetary policy.[25] Although not all countries use the same definitions of monetary policy and price stability, there are more similarities than differences. There is almost unanimity on the importance of the central bank having price stability as the objective for its monetary policy.

The monetary policy tool or instrument familiar to most of society is what is known as the policy rate. This is the rate that forms the basis for the interest rates central banks' monetary policy counterparties either pay to borrow money from the central bank or receive when they deposit money with the central bank. Other means of steering access to money and interest rates in the economy can be quantitative instruments such as open market operations, that is, buying or selling various securities. Reserve requirements, that is, when banks are obliged to deposit money with the central bank at zero or very low interest rates, are also a common monetary policy instrument. The central bank's open market operations allow the banks to exchange their collateral, such as government securities or covered bonds, for means of payment in the form of book-entry money. In the event of shocks and financial crises in the payment and credit system, it becomes clear that such measures are also very important for financial stability.[26] This is one of the ways in which monetary policy–or price stability–and financial stability are connected.

CRITERIA FOR THE CENTRAL BANK'S RESPONSIBILITY FOR OTHER TASKS AND INSTRUMENTS

We have now presented what can be regarded as the central banks' fundamental tasks. Now we shall briefly show how this can be used to discuss whether or not further tasks should be given to the central bank. This reasoning, together with the discussion on conflicts of interests and balances between different central bank tasks in the following section, forms the basis for our review of the discussion of an extended central bank mandate in section 4.

One means of determining whether the central bank should have responsibility for other tasks and tools than those included in the fundamental tasks we have already discussed is to analyse what *advantages* it brings to give the central bank responsibility for further tasks. Which arguments indicate that the central bank, rather than any other institution, should be given responsibility for a specific further task? In addition to identifying these advantages, Blinder (2010) suggests that the legislature should assess the possible *conflicts of interest* that might arise between further tasks and the fundamental tasks, and which authority, given such conflicts, would be best suited to taking care of the necessary trade-

25 Bank for International Settlements (2009) p. 7 and Table 2 p. 30.

26 The Federal Reserve made use of several programmes during the most recent crisis in 2007–10 aimed at stabilising the financial markets, for instance the Federal Reserve Systems Term Auction Facility, Term Lending Credit Facility and Primary Dealer Credit Facility. See, for instance, Weinberg (2013).

offs. The larger the number of tasks, the greater the risk of conflict between the tasks.[27] On the other hand, competence becomes narrower and the potential for synergies declines if the mandate is limited. The *way a central bank is governed* may also play a role here. The governance of the central bank is determined on the basis of the bank being able to perform its fundamental tasks and it may either be a help or a hindrance in carrying out further tasks in relation to other institutions. For instance, is the central bank better suited to carrying out a particular task as a result of its large degree of independence? Or, on the contrary, is the task or tool for performing the task closer to fiscal policy or another policy area that is primarily the responsibility of the government? In this case there may be problems of balance in relation to the government tasks, which can in turn affect the independence of the central bank and its credibility. A good example of such an issue is the discussion of whether the tools for macroprudential policy should be given to the central bank or to some other authority.

3. Trade-offs between the central bank's objectives, tasks and tools

The broader the mandate a central bank has, the more often it will be forced to find a balance between different objectives, tasks and tools. It is nevertheless common for central banks to have several economic-policy objectives either subordinate to or in addition to the objectives of price stability and financial stability, such as a high level of employment. These objectives can be clearly stated in governing statutes but they are usually kept more general. How the central bank should weigh the different objectives against one another in the event of a conflict between, for instance, the price stability objective and the objective of economic growth and high employment is a question that is constantly being discussed. There is widespread opinion that a central bank is not able to use monetary policy, for instance its policy rate, to influence either growth or employment other than in the short term.

Central banks with inflation targets in practice conduct *flexible* inflation targeting rather than *strict* inflation targeting.[28] Flexible inflation targeting is usually interpreted to mean that monetary policy aims to stabilise both inflation and the real economy, while strict inflation targeting aims only to stabilise inflation without taking into account the stability of the real economy. Stabilising the real economy means stabilising resource utilisation in the economy, even if monetary policy cannot affect the long-term level of production and employment. Temporary deviations from the inflation target can thus be permitted to ensure a stable development in growth and employment. But this is not the same as having,

27 A report by the Bank for International Settlements (2009) concludes that there may be an optimal number of functions per organisation.

28 See, for instance, Rogoff (1985), Fischer (1996), Svensson (1998) and Sveriges Riksbank (2010).

for instance, an own goal for employment. The central bank normally takes into account real economic developments without being tied to attaining any specific goal for them.[29]

Measures to attain financial stability should also be weighed against undesirable effects on other economic-political goals. A more strictly-regulated financial market could, for instance, have fewer opportunities to contribute to national welfare if the regulations limit the banks' opportunities to provide loans to the general public. This is because such regulation limits one of the financial system's most important tasks, namely converting savings into financing consumption and investment in, for instance, housing and production capacity. It may thus be difficult to attain the highest possible level of financial stability and a high level of socioeconomic efficiency at the same time.

There are also risks to the central bank's independence when it has multiple goals. Having several goals increases the risk that some of the goals will be shared with the government and other parts of society, which makes it more difficult to demand accountability from an individual institution. An extended mandate for the central bank with regard to, for instance, macroprudential supervision can open the door to external influence on the central bank when coordinating with other authorities, which can then gain an influence that might come to affect other parts of operations, such as monetary policy. The reason why coordination may be desirable is the strong link between financial stability and monetary policy. Measures to ensure financial stability could have effects on interest rates in general, on economic activity and on inflation, at the same time as the central bank's interest-rate policy affects financial stability.[30] But such coordination could also weaken the central bank's independence and confidence in its monetary policy, see Koshie (2013).

Smets (2013) describes three different views of the relationship between monetary policy and financial stability. He calls them

- "the modified Jackson-Hole consensus",
- "leaning against the wind vindicated" and
- "financial stability is price stability".

The first view was generally prevalent during "The Great Moderation", that is, the period from the mid-1980s until the most recent financial crisis. This period was marked by low inflation and stable growth. The general impression at that time was that the policy rate should be used to attain price stability and to support economic developments, not

29 The Federal Reserve has three targets: maximum employment, price stability and stable long-term interest rates. While the price stability target is set at an inflation rate of 2 per cent, the rate of employment is more difficult to measure against a set target. Instead they publish quarterly reports with forecasts of the levels for growth and unemployment further ahead. They use monetary policy to try to alleviate deviations from the long-term levels of inflation and unemployment. These targets are often complementary, they say. Where this is not the case they apply a balanced strategy to promote both. This balance takes into consideration the scope of the deviation and the forecast for when inflation and/or employment can be expected to return to levels compatible with their mandate. See Federal Reserve (2012).

30 See, for instance, Billi and Vredin (2014), Bryant, Henderson and Becker (2012), Eichengreen et al. (2011), the Swedish Centre for Business and Policy Studies' Economic Policy Group (2012) and the Swedish Fiscal Policy Council's report 2011, chapter 5.

to reduce the risk of an impending financial crisis. If a crisis arose, the central bank and the government could relatively painlessly "mop up" afterwards. This view was based, according to Smets (2013), on the idea that the central bank has a relatively narrow monetary policy mandate with the objectives of price stability and stabilising resource utilisation. According to this view, there are no trade-off problems between monetary policy and financial stability. This is because the central bank's responsibility for financial stability is considered to be limited solely to measures in the event of a crisis, with the possible exception of so-called moral suasion, that is, gentle influence on the financial markets through speeches and documents with no binding requirements. However, "mopping up" after financial crises has proved costly.

Another view of the central bank's responsibility is that monetary policy should "lean against the wind". What this means is that the central bank should in various ways try to dampen or subdue the risk factors it perceives, such as credit bubbles. The argument in favour of leaning against the wind can be partly regarded as a reaction to the central banks' strong focus on the development of inflation prior to the most recent financial crisis. According to the Bank for International Settlements (2009), the central banks were unwilling to use the policy rate when serious market disruptions arose in the build-up to the financial crisis. This unwillingness was due to the central banks' fear of the effects of monetary policy tightening on inflation and inflation expectations. However, the crisis has made clear the close links between monetary policy and financial stability, for instance. A monetary policy that focuses on price stability affects financial stability through the value of assets, commodities, credits, capital flows and exchange rates (see, for instance, Eichengreen et al., 2011). It also becomes very clear during a financial crisis that a stable financial system is a necessary condition for being able to conduct an effective monetary policy. The financial markets and the way they function affect the impact that monetary policy has through the interest rates that households and companies have to pay. Moreover, the economic consequences of a financial crisis have a direct impact on price stability, growth and employment. Price stability contributes to financial stability. For the monetary policy transmission mechanism, that is, the way a change in the repo rate affects inflation and the rest of the economy,[31] to function and be upheld, it is necessary to avoid financial instability (see, for instance, Goodhart and Rochet, 2011). According to, for instance, Eichengreen et al. (2011) the central bank must therefore attain a good balance and optimise the use of various tools with consideration to both price stability and financial stability.

31 The transmission mechanism is in fact not one but several different mechanisms that indicate how changes in the policy rate affect inflation and the rest of the economy. These mechanisms are usually divided into the credit channel, the interest rate channel and the exchange rate channel. The credit channel describes how changes in the policy rate affect demand via banks and other financial institutions. If the policy rate rises, banks choose to reduce their lending and instead invest in other assets, such as bonds. Companies and households find it more difficult to borrow money. Companies reduce their investment and households cut back on their consumption. The stability of the financial system is therefore important for the mechanisms to function and for monetary policy to have an impact. The time aspect is also important: Some of these mechanisms act on inflation fairly quickly, while others take longer to have an effect. It is generally held that a change in the policy rate has its greatest impact on inflation after one to two years.

Something that further complicates the picture is that the time lag between the build-up of systemic risks–for instance, "credit bubbles"–and the development of economic problems is probably longer than the time lag between monetary policy decisions and their effect on inflation.[32] If they only regard inflation over a time horizon of two to three years, central banks may not try to dampen emerging financial imbalances that follow longer financial cycles. As price stability and financial stability are so mutually dependent, it has been claimed that monetary policy could also take the financial cycle into account and act against a credit bubble, for instance, even if this meant that both inflation and growth undershot their targets for a period of time. The framework for flexible inflation targeting should be adapted to take into account the risk of shocks to the financial system of the type that arose during the crisis in 2007-2009, says Woodford (2012). The central banks should in this case take financial stability into account in their monetary policy deliberations by making forecasts, in addition to those for inflation and real economic growth, for whether a financial crisis can occur and reacting to the likelihood of this. According to Woodford, it is only in times of significant financial imbalances that the central bank needs to take into account the risk of a financial crisis arising. In normal times, the central bank can restrict itself to the balance between inflation and real economic stability in its monetary policy decisions.

One counter-argument is that such a multi-faceted use of the policy rate, for instance, could jeopardise the central bank's independence and make its mandate less clear and its independence more difficult to justify. It is difficult to know how great the risk of a future financial crisis is. This means it is also easy to question preventive measures. On the other hand, it has also been claimed that if one limits the central bank's mandate to only defending the independence of the central bank, it may later undermine its legitimacy (see Eichengreen et al., 2011).

Conflicts may arise between price stability targets and resource utilisation in the short term, and the financial stability objective in the longer term. Such trade-offs become particularly difficult if the central bank only has the policy rate at its disposal.[33] However, in addition to the policy rate, there are other tools that may have an impact on both price stability and financial stability. Reserve requirements may limit behaviour in terms of harmful risk-taking, and open market operations can be used to influence interest rates and credit volumes in the economy. Green (2003) says that a central bank's role on the interbank market can also make it possible for the central bank to both predict crises of confidence in the banking system and contribute to stabilising cyclical fluctuations.

Several central banks have now observed the link between financial stability and price stability; see for instance Shakir and Tong (2014) for a description of the Bank of England's views on this, with separate decisions on monetary policy, macroprudential policy and microprudential supervision taken by three separate committees. As Smets' (2013) review

32 See Borio (2014) and Caruana (2014).
33 See, for instance, Ingves (2013) for a discussion of this.

shows, however, opinion is still divided with regard to whether or not monetary policy should "lean against the wind".

The third view presented by Smets (2013) is based on financial stability and price stability being so strongly intertwined that it is impossible to differentiate between monetary policy and measures to attain financial stability. According to this view, both standard monetary policy and extraordinary monetary policy measures are primarily aimed at stabilising the financial system. As shown in Smets' review, however, this view is so far only represented in a small portion of the academic research.[34]

THE IMPORTANCE OF MEASURABILITY

It becomes easier to achieve a balance between different objectives and tasks if the effects of the policies are relatively easy to measure.[35] Measurability also makes it easier to evaluate and to demand accountability, which in turn is important for how far society is prepared to delegate power to such a largely independent institution as a central bank.

When it comes to crisis management tools, it is easy to see a clear link between measure and effect as they are so close to one another in time – a financial institution receives loans from the central bank, can meet its payments and thus continues to be an important part of the payment system. But when it comes to other objectives and means at the disposal of the central bank, where the desired effect lies further ahead in time, it may be difficult to identify afterwards which measures have succeeded or failed. A change in the policy rate, for instance, is considered to have the strongest impact on inflation after one to two years. Long-term macroprudential instruments such as countercyclical capital requirements have similar problems. During good times, when systemic risks normally increase, partly through credit expansion, the banks should build up a capital buffer to be able to withstand potential shocks. The effect is then that they cannot lend as much. The beneficial effect is that the risk of a credit bubble is reduced. Both the policy rate and the capital buffer thus have objectives that lie further ahead in time, namely stable inflation and milder, or no, shocks to the financial system. But there is nevertheless a difference of degree between macroprudential policy tools and the policy rate with regard to the conditions for measurability of the objectives. Monetary policy can have a price stability objective set at a particular inflation rate in the medium term, which is measured as a change in a suitable price index. It is more difficult to construct a similarly quantifiable objective for the macroprudential tools. Part of the problem with regard to the field of financial stability – of which macroprudential policy is a part – is that research on the preventive work is a relatively new phenomenon. Knowledge of how to attain financial stability lags behind the corresponding knowledge of how to attain monetary policy and price stability (see Bank for International Settlements, 2009, p. 27).

34 However, it is close to the views reported in, for instance, Santomero, Viotti and Vredin (2000), chapter 1, and the Swedish Centre for Business and Policy Studies' Economic Policy Group (2012), chapter 5.

35 See, for instance, Reis (2013).

In the absence of an obvious and measurable objective for financial stability, one means of attaining some form of measurability might be to measure several different variables that can lead to disruptions in financial stability. Examples of such variables could be, according to Reis (2013), credit growth, the increase in financial institutions' debts in relation to equity capital, the ratio between bank deposits and lending and the vulnerability of the banks' funding.[36]

To summarise, we can observe that the more tasks and objectives a central bank has in its mandate, the more trade-offs need to be made and the more difficult these trade-offs become. We have also seen that the trade-offs are made easier if the objectives are measurable and that measurability is more important the longer the time lag between the means and objective. On the basis of these insights and the ideas from the previous section on the central bank's fundamental tasks, we will in the following section discuss some, current issues about the central bank's mandate.

4. Current issues in the discussion of the central bank's mandate

The crisis on the financial markets that became acute in autumn 2008 forced many central banks to take unusually forceful measures to maintain the credit supply and dampen the fall in economic activity. Policy rates were cut to just above zero per cent, lending to the banks was extended with regard to maturity, collateral and borrowers and the central banks purchased financial assets directly on the private market.[37] Since the crisis, measures have been taken in several parts of the world to increase regulation, primarily in the macroprudential area.

Many central banks have received a macroprudential policy task linked to their mandate in the wake of the financial crisis. This does not prevent the question of the central bank's responsibility for macroprudential policy being relatively controversial in the academic and political debate. To understand the discussion on the central bank's responsibility for macroprudential policy and microprudential supervision, one can bear in mind the ideas we presented earlier about the fundamental tasks of the central bank, the conditions for attaining a balance between competing objectives and the question of whether the independence of the central bank helps or constitutes an obstacle vis a vis the new tasks.

RESPONSIBILITY FOR MACROPRUDENTIAL POLICY

On the issue of macroprudential policy, one can respond to Green's (2013) question of whether there is a market failure that needs to be remedied with a clear yes. The ability of the banks–and the financial system in general–to withstand shocks was proved to be far too low during the crisis. For instance, the capital buffers in the banks are considered to have been small.

36 See Adrian and Liang (2014) for a more detailed discussion.
37 See, for instance, King (2013) and Haldane (2014a).

One advantage of giving the central bank responsibility for macroprudential policy is that it already has a macroeconomic focus in its mandate and the mandate often already entails the task of analysing the payment system on an overall level. Furthermore, the central bank is responsible for monetary policy operations and its lender of last resort task means it has a good overview of the financial markets. Given this, Eichengreen et al. (2011) consider that the central bank should be well-suited to attaining a necessary balance between the interest-rate tool and various macroprudential policy tools such as countercyclical capital requirements and measures to deal with a credit boom. The central bank should have the responsibility for macroprudential policy as it is so closely tied with the standard objectives of monetary policy, that is, stabilising resource utilisation and inflation, according to Blinder (2010 p. 11). Moreover, the central banks' work on financial stability has traditionally entailed responsibility for the system's access to means of payment by lending both to the market as a whole and to individual institutions, according to Goodhart (2010).

If the central bank does not have responsibility for macroprudential policy, it is nevertheless necessary that the central bank and the authority with responsibility for macroprudential policy can coordinate their decisions to some extent, as the macroprudential tools affect variables that are central to the tasks of the central bank.[38]

The independence of the central bank is a feature that some consider a good reason for giving it responsibility for macroprudential policy tools. Preventive impositions and restrictions, such as forcing the banks to hold larger buffers, are unpopular as they entail a cost for the banks which ultimately their customers are forced to pay. It may be useful to give such long-term measures the same protection from more short-term political deliberations as monetary policy has. In this case, the central bank could be given the task of making decisions with a high degree of independence not just on monetary policy, but also on macroprudential policy tools, see Eichengreen et al. (2011). Such an extension of their independence would entail a need to be able to evaluate the central bank's macroprudential policy measures, which would illustrate the need to be able to measure the objectives for financial stability that we discussed in the previous section. The fact that it is so difficult to make the effects of macroprudential policy tools measurable represents a risk that an extended mandate could damage the legitimacy of the central bank and thus also its independence. If the macroprudential policy tools are used to dampen credit growth and hold back asset prices in an economic upturn, it might be difficult for the general public to understand why. Such measures are politically risky as it may be difficult for a central bank to obtain legitimacy among both the general public and elected political representatives for measures that threaten to reduce growth in the short term, unless it can clearly explain at the same time what the gain will be for the economy. There are

38 Jonsson and Moran (2014) analyse the links between monetary policy and macroprudential policy. Their analysis indicates that the way in which monetary policy should react to the introduction of a capital buffer depends on which disturbances are behind the fluctuations in the economy. According to this analysis, a higher welfare gain is achieved if the authorities responsible for monetary policy and macroprudential policy coordinate their decisions.

arguments that the policy rate also has such effects. Raising the repo rate to attain an effect on inflation at, say, two years ahead will initially increase households' costs. This has been one argument why an independent central bank, which is not influenced by criticism from the general public, is suitable for the task. There are also other ways of controlling, for instance, a credit boom than macroprudential policy measures, as pointed out by Goodhart (2014). Fiscal policy instruments such as taxes can also be used. One argument why responsibility for macroprudential policy tools should lie with the government rather than the central bank is that these measures are very similar to fiscal policy measures, which are normally aimed primarily at governing the allocation of resources in society.[39]

RESPONSIBILITY FOR MICROPRUDENTIAL SUPERVISION

With regard to the question of which institution should have responsibility for microprudential supervision, that is supervision of individual institutions, a review by the European Central Bank (2010) showed that the sector-based supervision divided into banks, insurance and securities under different authorities was in the process of being abandoned, even though the picture prior to the financial crisis was that an overall supervision with all institutions under the same authority prevailed. Several countries were in the process of strengthening the role of the central bank in financial supervision. For the central banks that already had such responsibility, supervision over the banking sector alone was the most common. At the same time, there were different systems within the different EU countries. In several cases, the central bank has received an extended mandate to include microprudential supervision after the crisis.[40] In some cases, the transfer of supervision to the central bank has been a return to an earlier system which in turn may have applied until the central bank was given the blame for the failure of the supervision.[41]

Rosengren (2009) says that a central bank with responsibility for giving support to the banks needs to be able to evaluate the counterpart's–that is, the borrowing bank's–solvency and collateral and that this need is best met by having practised supervisory expertise within the central bank. If a systemically-important institution were to fail, this could in itself be sufficient to start a systemic crisis, which according to Blinder (2010, p. 11) indicates that the authority with responsibility for macroprudential policy should also have responsibility for supervision of at least the systemically-important institutions. It is often the changes in these institutions' balance sheets that can jeopardise financial stability. However, Blinder assumes that the central bank has the responsibility for macroprudential policy. In the cases where this applies, it further increases the central bank's advantages of also being responsible for microprudential supervision.

39 These or similar arguments have been put forward by, for instance, King (2013), Goodhart (2014) and Eichengreen et al. (2011).

40 For example: Hungary, the United Kingdom, Belgium and Ireland. See further the European Central Bank (2010).

41 Koetter, Roszbach and Spagnolo (2014) and Cobham (2012).

Experts have pointed to several possible trade-offs that need consideration if the central bank is to have responsibility for the supervision of banks. According to Green (2003), the question is whether one can fear that a central bank with supervisory responsibility will treat the banks more favourably when it supplies emergency liquidity assistance. Blinder (2010) mentions a potential conflict between supervisory responsibility and monetary policy. In a situation where economic development is weak, the supervision might need to limit the credit institutions' lending to reduce the risk of financial instability, at the same time as the economy needs more loans for macro-economic reasons. However, Blinder points out that the trade-off will exist regardless of whether two authorities or one and the same have responsibility for monetary policy and financial supervision. It is then better that one and the same authority takes care of this balance. Blinder also questions whether any other authority can deal with this balance better than the central bank.

The independent position of the central bank is also used as an argument in favour of it having responsibility for at least systemically-important institutions. The fact that these institutions are large and thus have potentially substantial political influence indicates, according to Blinder (2010 p. 12), that the authority responsible for their regulation should be politically independent. Koetter, Roszbach and Spagnolo (2014) and Ingves and Lind (2007) are on the same wavelength here.

Blinder (2010) does not distinguish between banks and other financial institutions: If they are systemically important, they should be under the supervision of the central bank. His analysis focuses on the financial system in the United States. On the other hand, in international terms it is unusual that the overall financial supervision lies with the central bank.[42] In Europe, for instance, the picture is fragmented and subject to change, particularly since the recent financial crisis.

One example of institutions that have long been considered to be of minor interest to the stability of the payment system is insurance companies. However, Carney (2014) says that insurance companies also play an important role in the resilience of the financial system in that they manage and spread risk and have an important role in the effective allocation of capital. These are tasks that they share with the banks. Unlike the banks, the insurance companies have a long-term horizon, which contributes to the resilience of the financial system. Insurance companies may therefore be systemically important. For this reason it is important to understand the insurance companies' activities in fields that entail a link to other parts of the financial system. According to Carney, this justifies the Bank of England having supervisory responsibility over them. It remains to be seen whether these insights will lead to more central banks having responsibility for the supervision of at least systemically-important insurance companies.

42 Bank for International Settlements (2009, p. 10).

Following the most recent financial crisis, and as an effect of the increased regulation of the banking system that ensued, a phenomenon known as shadow banking has attracted increasing attention.[43] The concept refers to institutions with activities similar to those of the traditional banks (for instance, maturity conversions through short-term deposits converted into long-term investments) and which can give rise to systemic risks by, for instance, being on the same markets as traditional banks or supplying products that the banks use, say, to reduce their credit risk. Although shadow banking thus affects the banks in several different ways, these institutions are not regulated in the same way as the banks. Nor are they subject to the same supervision as the banks. This is what makes them increasingly interesting to investors, but at the same time also entails risks to financial stability. The shadow banking sector has grown as a result of increased demands for yield, as well as the flight from an increasingly strictly-regulated and less risky market. An area of shadow banking that is common in the United States, for instance, is money market funds. They contribute to the banks' funding by investing in the banks' bonds and certificates. Additionally, they are active to some extent on the same markets and appeal to the same investors and customers as the banks. The US money market funds also invest in institutions outside the United States and in this way affect banks all over the world. Through the influence on the banks, the shadow banking activities have significance for systemic stability and consequently for the central bank.

At the same time, shadow banking can be a useful complement to traditional banking by giving increased access to loans and supporting the market's need to buy and sell assets (often referred to as liquidity) as well as risk allocation. The challenge is therefore to maximise the advantages of shadow banking at the same time as minimising the risks.[44] Haldane (2014a) says that as activities in the shadow banking sector increase, the central bank will need to grant loans to this sector, too. This is what happened with the money market funds in the United States in autumn 2008. This task will mean that the central bank will see new types of collateral in its operations.

The arguments in favour of the central bank having responsibility for other systemically-important financial institutions than the banks essentially have the same basis as the arguments in favour of the central bank having responsibility for banking supervision.

LENDER OF LAST RESORT AND THE EFFECTS ON FINANCIAL STABILITY

During the financial crisis it became clear to many central banks that what has been their reason for existence for a hundred and fifty years – the ability to create means of payment in their own currency – was no longer sufficient to maintain the functions of the financial system in a crisis situation. Commercial banks that have taken on responsibility for the risk that ensues from cross-border financial operations need foreign currency and in a global

43 The phrase is said to have been coined in a speech by economist Paul McCulley in 2007 at a Kansas City Federal Reserve Bank symposium in Jackson Hole.

44 Read more about shadow banking in IMF (2014) and from a Swedish perspective in Hansson, Oscarius and Söderberg (2014).

financial crisis in a global financial system good access to the large world currencies is required. Building up a foreign currency reserve in the central bank to deal with such a crisis is costly. Central banks therefore need to establish and rely on mutual agreements. This of course involves an element of uncertainty and risk in relation to being responsible for access to one's own currency. The jurisdictions that were systemically important for the United States during the most recent crisis were offered what is known as swap lines. Swap lines in this case are agreements where other central banks are given the opportunity to borrow US dollars from the Federal Reserve. According to Cecchetti (2014), it is likely that such swap lines will also be needed in the future. Most of the swap lines were retained until 2010[45] and a few of them even longer.[46] Cecchetti (2014) says that it is in the United States' interests to once again extend the list of countries that can borrow from the Federal Reserve during a crisis, if the US dollar is to continue to have the status of the world's reserve currency.[47] At the same time, the United States' political preparednes to take on the role as global lender of last resort, and with this possibly some form of supervisory responsibility for other countries' financial systems is most likely uncertain.

At the same time, there are problems in allowing financial institutions around the world to assume good access to large volumes of US dollars. The need to limit the risk of moral hazard – that is the assumption that the risk will be transferred to others – applies of course to all forms of support. To avoid moral hazard, incentives must be created for financial agents to protect themselves against shocks or crises by reducing their risk-taking and investing in assets with lower risk and high liquidity. One possible measure to limit the need for loans from the central bank in foreign currency is to introduce national regulations that limit imbalances between assets and liabilities in foreign currency. Another possible measure is international limitations combined with the Federal Reserve setting a high price on its dollars in the form of a high penalty rate, according to Cecchetti (2014).

The lender of last resort task also entails other moral hazard deliberations. There are those who say that many agents saw the risks in the market prior to the crisis, but despite the risk they speculated and just assumed that they would receive assistance from the government or the central bank. It is a common argument that the conditions for moral hazard behaviour among the banks increase when central banks lend money during crises, which in turn increases the risk of instability in the payment system.[48] If, moreover, the support is provided against collateral with a high risk and low liquidity, this increases moral hazard.

45 The central banks that had swap arrangements with Fed were the Reserve Bank of Australia, the Central Bank of Brazil, the Bank of Canada, Danmarks Nationalbank, the Bank of England, the ECB, the Bank of Japan, the Bank of Korea, the Bank of Mexico, the Reserve Bank of New Zealand, Norges Bank, the Monetary Authority of Singapore, Sveriges Riksbank and the Swiss National Bank.

46 The Bank of Canada, the Bank of England, the ECB, the Bank of Japan and the Swiss National Bank.

47 A reserve currency is a national currency that is also used for international trade and international transactions. Reserve currencies are often included in a country's foreign currency reserve. There are several currencies with the status of reserve currency for other countries – for instance, the euro and the rouble – but the US dollar has been the largest one since the Second World War.

48 See, for instance, Acharya and Tuckman (2013) and Santomero, Viotti and Vredin (2000, p. 6).

With regard to the first phase of the financial crisis of 2007-2009, researchers have concluded with hindsight that traders and brokers retained lucrative, high-risk assets longer than they would have done if they had been convinced that they would ultimately have to bear the risk themselves.[49] There may be some benefit in actually allowing such misconduct to punish itself, even if this entails costs to society in the short term. It need not be the case that the most efficient solution to a stability problem in the short term is also the most suitable one for financial stability in a longer-term perspective. Sometimes, for instance, it may be better for long-term stability to refuse emergency liquidity assistance to prevent harmful risk behaviour in the longer run. Each individual bank failure and each individual fluctuation in asset prices need not be regarded as a sign of financial instability. Following a financial shock, this may rather be a sign that the system is stable and is cleansing itself.[50] If the main rule is instead that the banks' misconduct has tangible effects on the banks and their owners, the owners will be forced to take preventive measures and reduce their risk-taking.

A complementary idea, according to Haltom and Lacker (2013) is to limit the central bank's possibility to provide liquidity assistance. If the central bank can convincingly claim that even systemically-important institutions may be refused assistance, it may create incentives for lower risk-taking on the market. Grung Moe (2012) calls for a resolution that would mean banks could be closed down without consequences for the financial system as a whole. At present, a directive on recovery and resolution of credit institutions is being implemented within the EU.[51] According to this, ownership of an institution that is assessed as being able to partly survive after a reconstruction under certain circumstances will be transferred to its creditors. It remains to be seen whether the threat of such consequences can give the owners sufficient incentive to reduce the risk-taking in their institutions.

Other measures to reduce the expectations of assistance from the central bank during a crisis that Grung Moe mentions include forcing banks to draw up "living wills", that is, reconstruction plans, and separating ("ring-fencing") the banks' trade in securities (investment banking) from their other operations. Grung Moe considers these initiatives to be worthy of praise but that it will take many years before they have been fully implemented and we can see any effect from them.[52]

However, not everyone feels that the most recent crisis was just a question of calculating moral hazard behaviour. Instead, it is said that the banks quite simply did not realise the risks they were taking and that they were not speculating in the hope that they would be saved by tax-payers, or at least not until towards the end of the crisis. Goodhart (2014) says that the banks followed a common pattern that meant they fastened in a property bubble

49 See Acharya and Tuckman (2013) and Grung Moe (2012). Goodfriend (2011) proposes that the Fed should limit its liquidity assistance to "occasionally, temporary, well-collateralized ordinary last resort lending…".

50 See, for instance, Issing (2003) and Schinasi (2004).

51 Directive 2014/59/EU establishing a framework for the recovery and resolution of credit institutions and investment firms.

52 As perhaps first and foremost a theoretically interesting alternative at present, Grung Moe highlights a proposal by James Tobin in 1987 that entails a payment system guaranteed by the government in addition to that of the banks. The effect would be that the banks could never claim systemic importance in a crisis and banks in distress could be closed without any consequences for the payment system.

with an extreme credit expansion and excessive borrowing in relation to their equity capital. When they realised the situation they were in, it was too late to sell the assets without making huge losses.

A summary of this discussion is that central banks should also think about the effects on institutions' risk behaviour when they design their assistance in case of shocks, not least for the sake of long-term financial stability. One hope is that other regulations will comprise an effective complement to the central bank's task as lender of last resort in the case of disruptions to the payment system.

5. Key issues for the future

In the year 2000 a conference was held at the Riksbank on the future mandate of the central bank.[53] The following are some of the questions asked at the conference:[54]

1. Should the central bank conduct a narrow inflation-targeting policy without taking into account the consequences for the macro economy as a whole?
2. Should the central bank be responsible for financial stability, and if so, how should this objective be measured and what should the relationship between financial stability, price stability and macroeconomic stability be in general?
3. How should the regulatory framework be designed; on the one hand sufficiently flexible to follow market developments but on the other hand sufficiently detailed to be useful to the authorities responsible for the stability and efficiency of the financial markets?
4. How should a system that offers systemic loans (so-called lender of last resort) and other forms of guarantees against financial instability be able to withstand the problems of the system agents taking excessive risks in the certainty that they are guaranteed support from the central bank if the risks were to be realised (moral hazard)?

Today, almost fifteen years later and in the wake of a global financial crisis, central banks find themselves in a period marked by increased regulation of the payment system and its participants and extended central bank mandates. There is now a different level of risk awareness than during "The Great Moderation". We now know that risk-taking increased as a result of developments on the financial markets.[55] As a result, authorities around the world are taking action to make the system sufficiently robust to withstand or at least alleviate future shocks.

53 The conference was arranged by Sveriges Riksbank in collaboration with Professor Anthony Santomero, Wharton School, University of Pennsylvania and Professor Torsten Persson, Institute of International Economic Studies, Stockholm University.
54 See Santomero, Viotti and Vredin (2000).
55 See Rajan (2005), who observed at an early stage the risks that were being built up.

On the basis of the academic literature and discussion we have reviewed, we have identified a number of issues we believe will be discussed by central banks, researchers and politicians in the coming years and which may form the basis for a new conference and continued discussions of the central bank's mandate.

THE DECLINING USE OF PHYSICAL MEANS OF PAYMENT

As book-entry money through various forms of digital payment increase in significance, demand from the general public for physical money created by the central bank may decline.[56] What this may entail for society's preparedness to manage the various forms of crisis that can affect the payment system is a future issue that requires further investigation. But one should also investigate how this can affect the central bank, which has a large share of its income from issuing banknotes.

The change is partly a consequence of increased use of digital payment methods and seems to be gaining ground in Scandinavia, in particular. If the central bank is forced to cover its costs through allocations from the government budget, its financial independence could be threatened.

If developments continue along the same path, how will it be possible to finance the central bank's costs and ensure its financial independence in the future?[57]

Is the payment system more vulnerable as a consequence of reduced use of physical means of payment, or is it just an unavoidable step towards a digital payment system that gives rise to other questions, for instance concerning technological security?

What responsibility should the central bank have for safeguarding or promoting the security and efficiency of the payment system when new payment technologies are introduced?

LENDER OF LAST RESORT AND MORAL HAZARD

In recent years a number of initiatives have been taken to reduce risk-taking behaviour that is thought to have been one of the causes of the most recent financial crisis. What effect will these crisis prevention rules for macroprudential policy, resolution, living wills, ring fencing, separation of proprietary trading, stricter capital adequacy rules and so on have on the behaviour of the financial institutions and the need for loans from the central bank?

Are there other, more effective ways of reducing risk-taking?

LENDER OF LAST RESORT IN LIGHT OF INCREASING INTERNATIONALISATION

Being able to supply the domestic currency has always been a central task of the central bank with regard to safeguarding the functions of the payment system. Nowadays we have a constantly growing, globalised financial market that is marked by an increasing degree of

56 There is a discussion of the cashless society originating from Wicksell's lectures, see Wicksell (1935). This is discussed, for instance, in Jonung (1978).
57 See af Jochnick (2015).

cross-border activities. The banks' increased exposure to the large international currencies makes reserve currencies more significant for the stability of the national payment systems. This is particularly true of the US dollar.

How does this development affect the task for other central banks with their own, smaller currencies? Will reserve currencies and swap lines with the larger central banks become even more important in future crises? Could this type of development in practice give the very few large central banks an almost global responsibility for financial stability, and perhaps also for monetary policy?

SUPERVISION OF BANKS AND OTHER FINANCIAL INSTITUTIONS

The supervision of individual, systemically-important financial institutions is important to be able to identify moral hazard and take necessary measures to counteract it. Financial supervision can give central banks access to first-hand information about their presumptive borrowers' creditworthiness. In some countries the central bank already has the responsibility for financial supervision, while other countries have chosen to have separate authorities for this.

What are the advantages and disadvantages of giving the central bank responsibility for microprudential supervision of systemically-important financial institutions?

MACROPRUDENTIAL POLICY

A common argument is that central banks should not be given the responsibility for macroprudential policy tools such as countercyclical capital buffers; as such instruments are similar to fiscal policy tools such as taxes. Decisions on these tools should therefore be made by elected representatives instead of a largely independent authority. Moreover, the effects on households' finances can damage the legitimacy of the central bank. There are also arguments in favour of responsibility for macroprudential policy being with the authority responsible for microprudential supervision. Nevertheless, there are cases where the central bank is given responsibility for these tools, perhaps partly due to the close link to monetary policy with regard to the mechanisms through which the various instruments impact the economy.

What trade-offs need to be made on the question of where the responsibility for macroprudential policy should lie? If the central bank should not have this responsibility, then how can the policies best be coordinated?

STRUCTURAL CHANGES

Bean (2009) is one of many who have pointed out that the most recent financial crisis has led to an interest in Minsky's financial instability hypothesis from 1982.[58] According to this, good times lead to good access to credit, which in turn leads to a credit boom

58 Minsky (1982).

and excessive indebtedness in the private sector. This in turn develops into credit bubbles that trigger a financial crisis when they burst. Falling asset values contribute to the agents with the highest debts defaulting on their payments, which fuels instability in the entire financial system. Companies' and households' access to loans declines significantly, which leads to a downswing in the real economy, which in turn contributes to a continued fall in asset prices. High nominal debts, falling asset prices, lower profits and falling disposable incomes also risk leading to a downward deflation spiral – an argument that has also been put forward by Fisher (1933). Even if successful stability measures lead to a less volatile market, they could force financial agents to take on higher debt in their search for higher yield. The long-term interest rates we have seen for some time now around the world can also contribute to an increase in the search for constantly higher yield, which can result in higher risk-taking. Stricter regulations, more stable markets with less volatility and low interest rates can also lead the financial agents to turn to the shadow banking sector to an increasing extent.

How might such structural changes affect the central bank's objectives and tasks?

THE INTERACTION BETWEEN PRICE STABILITY AND FINANCIAL STABILITY

The most recent crisis has reinforced the impression that financial stability is a necessary condition for price stability, and has also given rise to a discussion on the use of monetary policy tools to attain financial stability. Regardless of whether monetary policy and the instruments for financial stability are managed by one and the same authority or different ones, some form of coordination is needed. All of this raises questions, for instance, on the degree of independence enjoyed by the central bank and on its credibility. Its independence is primarily regarded as intended for monetary policy. But as shown in this article, there are arguments in favour of price stability being only part of the central bank's task in promoting a safe and efficient payment system.

What are the advantages and disadvantages in linking together the tasks regarding price stability and financial stability?

CHALLENGES FOR CENTRAL BANKS' GOVERNANCE AND STRUCTURE

Governance, transparency and accountability are all important building stones behind the legitimacy of the central bank. The discussions on new, broader mandates will include trade-offs that society will have to make if it wants an independent and credible central bank that is at the same time transparent and subject to effective follow-ups to the extent required by a democratic society. On the basis of the inherent ambivalence in these requirements, the following questions arise:

1. What information should the central bank give to the general public to enable it to demand accountability?

2. How should parliament effectively oversee the central bank's strategy to attain its objectives at the same time as maintaining the independence of the central bank?
3. How should the structure for the central bank's areas of responsibility be designed? Should, for instance, the responsibility for monetary policy and financial stability be managed by special committees, as is the case in the Bank of England?
4. How should the committees in such a case be designed with regard to size, composition (for instance, internal and external members respectively), appointment procedure and the length of the period of office?[59]

CENTRAL BANK INDEPENDENCE IN LIGHT OF A BROADER MANDATE

There is an ongoing discussion on how a central bank's independence is affected by an extended mandate. This question can be divided into three parts:

1. An extended mandate, such as macroprudential policy, often entails further operational tasks within the framework of the responsibility shared with one or more authorities. One effect is thus an increased need for coordination between these authorities.
2. The mandate can also be extended to include further general political objectives for the economy other than the price stability and financial stability objectives, such as one for employment.
3. Historical experience and economic theory shows that there are multiple and strong connections between central banking and fiscal policies. The broader the mandate of the central bank, the stronger the connection. This also means that a broad mandate can be difficult to reconcile with a high degree of central bank independence.

What risks are connected with a broader mandate, partly for central bank independence and partly with regard to delegating tasks that are closely related to fiscal policy to an independent authority?

THE QUESTION OF THE BEST CRITERIA FOR THE CENTRAL BANK MANDATE AND TASKS

Before a decision is to be made to introduce a task or regulation, the question should be asked of what market failure one is trying to remedy. At the same time, public interest should not intervene in a way that makes the actual intervention a greater problem than the market failure. There are examples of a trade-off between a safe and efficient payment system, as between financial stability and economic growth. If the conclusion is that there is justification for an intervention by the authorities, the legislature may proceed to the question of which authority should have responsibility for this intervention.

59 See Haldane (2014b) on the importance of observing the risk of, for instance, consensus thinking in a group that is too homogeneous.

The legislature should make the decision on the basis of three criteria

1. A new task should be a complement to one of the authority's fundamental tasks.
2. There should be benefits from giving the authority the new task with regard to its governance, structure and organisation.
3. The authority should have the best conditions for managing the trade-offs that may arise as a result of conflicts between the objective of the new task and the authority's other tasks.

If the new responsibility is to be assigned to the central bank, what are the central bank's fundamental tasks, and what benefits will arise from giving it further tasks? Which objectives of the central bank's activities are the most important? Are the above criteria of practical use in a discussion on which tasks a central bank or other authority should have?

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Effects of unconventional monetary policy: theory and evidence

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1. Introduction

To counteract a massive fall in economic activity during the financial crisis of 2008-2009, the Federal Reserve reduced the target federal funds rate to a range of 0-¼ per cent by the end of 2008; this range was perceived as the effective lower bound (see e.g. Bernanke, 2013 and 2014). To support the functioning of impaired financial markets around the globe, it also provided short-term liquidity to sound financial institutions, swap lines to foreign central banks, and bought mortgage-backed securities and high-quality commercial paper; see Bernanke (2009) for further details. This round of unsterilized interventions was subsequently referred to as QE1. Despite these actions, output and inflation fell sharply, and amid concerns about the depth and persistence of the recession and a fear for a self-fulfilling deflationary spiral, the Federal Reserve decided to expand its use of alternative tools to provide additional monetary policy accommodation when the federal funds rate had reached its effective lower bound (Bernanke, 2013).

The unconventional monetary policy tools the Fed employed to stem the financial crisis in 2008-09 and to strengthen the recovery during 2010-14 mainly consisted of *forward guidance* about the future path of the federal funds rate and *large scale asset purchases* of private and public longer-term securities. Forward guidance, or expanded guidance about future policy rates, is supposed to support economic activity and boost inflation by putting downward pressure on long-term real yields. The Fed started out by providing *qualitative* guidance ("… federal funds rate to remain near zero for an extended period") in March 2009 , then moved to *date-based* guidance ("… economic conditions would likely warrant keeping the federal funds rate near zero at least through mid-2013") in August 2011, and finally made the guidance *state-dependent* in December 2012 by relating the exit date for the federal funds rate from the effective lower bound directly to thresholds for unemployment and the inflation rate ("… at least as long as the unemployment rate remains above 6-1/2 per cent, inflation between one and two years ahead is projected

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to be no more than half a percentage point above the Committee's 2 per cent longer-run goal").[1]

By linking the exit date directly to its economic objectives, the aim of moving to state-dependent guidance was to ensure that economic agents' expectations of future policy actions were consistent with the intentions of the Fed, and therefore enhance the efficacy of policy. Importantly, it would also make the economy less vulnerable to adverse shocks, as any negative news that worsened the economic outlook would automatically extend the expected duration of how long the Fed would maintain the federal funds rate near zero. In this way, state-dependent forward guidance acts as an automatic economic stabilizer when policy rates have reached their effective lower bound.

Because short-term interest rates in the United States following the crisis were expected to remain close to their effective lower bound for quite some time even without guidance about future rates, forward guidance alone was not thought to provide a sufficient dose of monetary accommodation.[2] In the aftermath of the financial crisis, after QE1, the Fed therefore decided to supplement its interest rate policies and forward guidance with large-scale asset purchases, often referred to as LSAPs. These LSAPs were open market purchases of longer-term U.S. Treasury notes and mortgage-backed securities. The objective was to reduce term premiums and long-term yields, and thus provide further stimulus to investment and consumption. Two rounds of LSAPs were undertaken: QE2 which started in November 2010, and QE3, which was initiated in September 2012.

The Federal Reserve was, however, not the first central bank to use unconventional monetary policies. With its short-term policy rate at the perceived effective lower bound since 1999, the Bank of Japan had already used LSAPs to fight domestic deflation already over the period 2001-2006, and again from 2011 onward. The Bank of England started to use LSAPs in March 2009 to alleviate the macroeconomic consequences of the financial crisis and employed forward guidance in September 2013 to strengthen the recovery. The European Central Bank (ECB) launched its Securities Market Programme (SMP) in May 2010 in an attempt to stem the European debt crisis. The ensuing debt crisis and associated flight-to-safety flows triggered the Swiss National Bank to announce a cap on the Swiss Franc vis-à-vis the euro in September 2011 and to undertake sizable interventions in the currency market to prevent further appreciation of its nominal exchange rate.[3] Similarly, after its policy rate had been cut to the perceived effective lower bound, the Czech

1 It is important to notice that the state-contingent guidance by the Fed was phrased in terms of thresholds, not triggers. Hence, crossing one of the thresholds would not automatically give rise to an increase in the federal funds rate target.

2 An influential paper by Levin, López-Salido, Nelson and Yun (2010) discusses the effectiveness of forward guidance when policy rates are at their effective lower bound. They argue that although forward guidance may be effective in off-setting adverse recessions of moderate size and persistence, it has important limitations to address recessions of the magnitude witnessed during the financial crisis without the support of other policies.

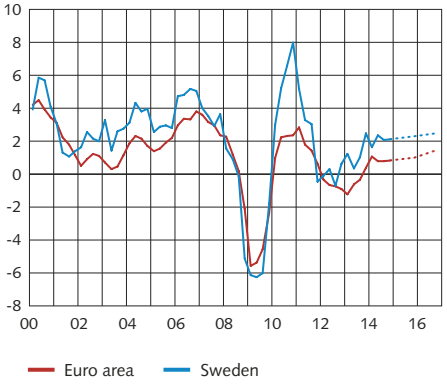
3 The cap was abandoned early 2015, an issue we return to in Section 2.4.

National Bank also intervened in currency markets to keep the koruna cheap relative to the euro.[4]

Today, we are witnessing a solid recovery in the U.S. economy, with very large gains in employment and core inflation running close to the Fed's target inflation rate. The Fed therefore ended QE3 in late October 2014 and in December 2014 the FOMC projections showed that 15 out of 17 FOMC participants anticipated to start raising the federal funds rate target in 2015.

Figure 1. Economic outlook in the euro area and Sweden

GDP growth
Annualized percentage change

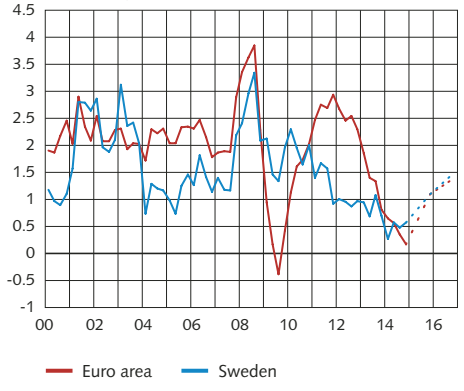


Note. Seasonally adjusted (solid line); consensus forecast for 2015 and 2016 (dotted line) as of January 12, 2015.

Note. Euro area: SPF mean forecast. Sweden: mean of forecasts from Handelsbanken, Nordea, SEB, Swedbank, the Swedish Ministry of Finance, the Swedish National Institute of Economic Research, the Swedish Trade Union Confederation for Sweden.

Sources: Macrobond for euro area; the Riksbank for Sweden

Inflation
Annualized percentage change



Note. CPIF for Sweden; HICP for the euro area (solid line). Consensus forecast for 2015 and 2016 (dotted line) as of January 12, 2015.

Note. Euro area: SPF mean forecast. Sweden: mean of forecasts from Handelsbanken, Nordea, SEB, Swedbank, Swedish Enterprise, the Swedish Ministry of Finance, the Swedish National Institute of Economic Research, the Swedish Trade Union Confederation for Sweden.

Sources: Macrobond for euro area; the Riksbank for Sweden

In Europe, however, against the background of low actual and forecasted rates of inflation and growth prospects among market participants in Sweden and the euro area that are below pre-crisis levels (shown in Figure 1), there have been many calls for the Riksbank and the ECB to follow the Fed and strengthen the recovery by deploying more policy accommodation through unconventional policies.[5] Both central banks have acknowledged the scope for or even implemented such policies, which will be discussed later in this

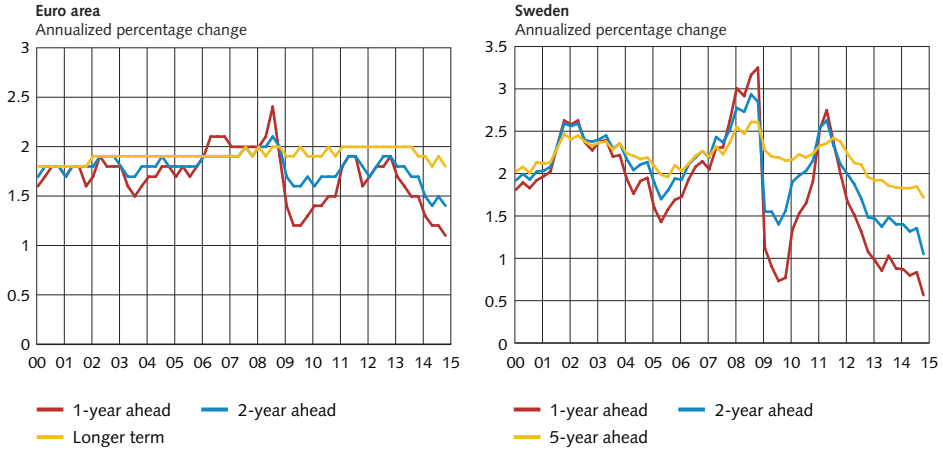
4 Examples of the announcements of the aforementioned unconventional policies can be found at https://www.boj.or.jp/en/announcements/release_2002/mok0210a.htm/, http://www.bankofengland.co.uk/monetarypolicy/Pages/forwardguidance.aspx, http://www.snb.ch/en/mmr/reference/pre_20110906/source/pre_20110906.en.pdf, https://www.cnb.cz/en/monetary_policy/bank_board_minutes/2013/tk_07sz2013_aj.html

5 See e.g. the editorial "Europe's deflation risk leaves no option but quantitative easing" in Financial Times 9 January 2015.

article.[6] A further motivation for a more accommodative policy stance is that this could alleviate the risk of deflation – falling prices for many goods and services. The case of Japan illustrates that once inflation expectations have become rooted at low levels, deflation appears very difficult to escape and standard Keynesian analysis (e.g. downward nominal wage stickiness) suggests that deflation is likely to impede growth and put pressure on public finances. As shown in Figure 2, long-term (5-year) inflation expectations have remained fairly stable in Sweden and the euro area for quite some time, but have recently shown some tendencies towards a decline.

Amid low current and expected rates of inflation and some slack in the economy, policy rates in Sweden and the euro area have been reduced and are now close to their effective lower bounds as shown in Figure 3.[7] Moreover, the dotted lines in the figure indicate that market participants expect the ECB and the Riksbank to retain policy rates at these low levels for an extended period. As a result, any further significant monetary stimulus by the ECB and the Riksbank would have to be through alternative tools, most of them likely very similar in spirit to those employed by the Fed, but tailored to European conditions.

Figure 2. Inflation expectations in the euro area and Sweden



Note. Expectations of HICP inflation from SPF for euro area; Prospera money market measure of CPI inflation expectation for Sweden.

Sources: Macrobond for euro area; TNS-Sifo Prospera and the Riksbank for Sweden

6 See e.g. the Riksbank minutes of December 2014 (http://www.riksbank.se/Documents/Protokoll/Penningpolitiskt/2014/pro_penningpolitiskt_141215_eng.pdf), the press release on the Riksbank policy decision on 12 February 2015 (http://www.riksbank.se/Documents/Pressmeddelanden/2015/prm_150212_eng.pdf) and the ECB's policy decision of January 2015 (http://www.ecb.europa.eu/press/pressconf/2015/html/is150122.en.html).

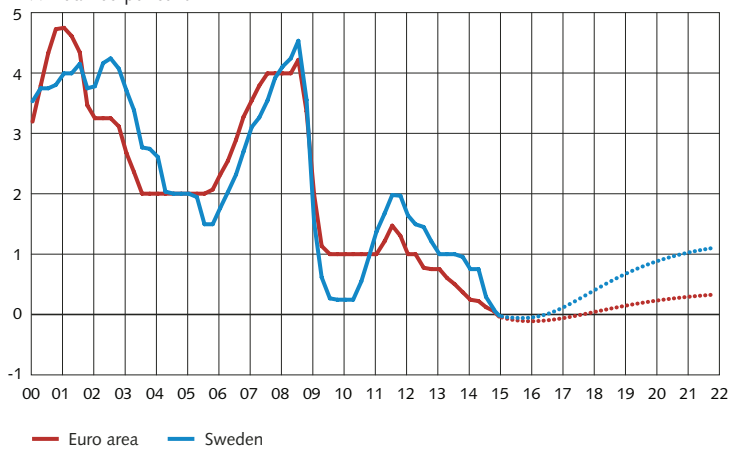
7 A few small central banks have recently cut policy rates below 0 per cent on a sustained basis, notably the Swiss National Bank (-0.75 per cent), Danmarks Nationalbank (the Danish central bank, -0.25 per cent) and most recently the Riksbank (-0.1 per cent). But none of the large central banks (e.g. Bank of Japan, Bank of England and the Federal Reserve) have done so, suggesting that the lower bound is close to, but not necessarily exactly, 0 per cent.

In this context, can forward guidance and LSAPs be vehicles for the ECB and the Riksbank to provide further stimulus? Starting with forward guidance, it is important to note that since February 2007 the Riksbank has published a projected path of its policy rate, along with a number of alternative scenarios following its policy meetings. One could thus entertain the view that the Riksbank normally implements forward guidance. Consistent with this view, Bean (2013) notes that the forward guidance used by the Bank of England was mainly intended to clarify its reaction function and thereby make policy more effective. However, following Woodford (2012) we adopt a more strict definition of forward guidance, which pertains to policy behaviour that is *different* from how the bank would normally act (and communicate) to achieve its objectives. To qualify for strict forward guidance, the central bank thus has to communicate an intention to be more expansionary than it normally would. Even under this more stringent definition, the Riksbank has clearly communicated forward guidance on several occasions. One example of time-dependent guidance by the Riksbank is the July 2009 Monetary Policy Report, in which the Riksbank stated that "The repo rate will not be raised again until the second half of 2010." The second example is the statement following the December 2014 meeting, in which the Riksbank communicated that "The repo rate will remain at zero until inflation is close to 2 per cent." The latter is an example of state-dependent forward guidance, and similar to the language used by the Federal Reserve, but omitting any thresholds pertaining to the unemployment rate.

Even so, there is a risk that the Riksbank's approach to forward guidance and any guidance introduced by the ECB will not provide sufficient stimulus in the current situation, because the financial markets already project that policy rates will be near their effective lower bound for an extended period (see Figure 3). Consequently, it is perhaps not too surprising that the ECB on January 22 announced that it would initiate a programme of large scale asset purchases of government bonds to improve economic activity in the euro area and promote a faster recovery of inflation to its targeted rate. And on 12 February, the Riksbank cut its policy rate from 0 to –0.1 per cent and announced that it would purchase SEK 10 bn of government bonds. The Riksbank also stated that it stands ready to increase these purchases at short notice if necessary.[8]

8 The Executive Board of the Riksbank decided on 18 March 2015 to make monetary policy even more expansionary by cutting the repo rate by 0.15 percentage points to –0.25 per cent. Moreover, the Riksbank will buy nominal government bonds for an additional 30 bn SEK, with maturities of up to 25 years.

Figure 3. Actual and expected policy rates for the euro area and Sweden
Annualized per cent



Note. Quarterly average REPO rate (Sweden) and REFI rate (euro area).

Note. Expected policy rates for Sweden are the instantaneous forward rates and were calculated using the Nelson-Siegel-Svensson parametrization on data from STINA (Tomorrow Next Stibor interest rate swaps) contracts and FRA's (Forward Rate Agreements). For the euro area OIS, FRA and IRS contracts were used in the Nelson-Siegel-Svensson model up to 2014. From there and onwards 1 month futures on Eonia and OIS contracts were used.

Note. Both expected policy rates curves were calculated on data for 12 January 2015.

Source: The Riksbank

We believe it is important to discuss how these policies are intended to work. Accordingly, our aim with this article is to provide an assessment of the basic channels through which unconventional policies used by the Fed and Bank of England – forward guidance and LSAPs – may affect economic activity and inflation, and under what conditions they are likely to be effective.[9] Moreover, since Sweden is an open economy with an export share close to 50 per cent of GDP, we complement the analysis of these policy tools with a discussion of open economy aspects.

The article is organized as follows. We start by discussing the theoretical effects of unconventional monetary policy in a standard New Keynesian model framework in Section 2. Within this framework, we consider the impact of forward guidance (Section 2.2) and large scale asset purchases (Section 2.3). We comment on the open economy dimensions in Section 2.4. Following the theoretical analysis of the impact of unconventional policies, we provide a brief survey of the empirical evidence on the topic in Section 3. This literature is expanding at a rapid pace as unconventional policies have only been used for a short period, and, since it is a bit immature, the results should be taken with a grain of salt. Nevertheless, we feel it is important to take stock of this literature. Moreover, at the end of this section we also discuss some lessons learned from the empirical and theoretical literature about the scope for LSAPs to work in a low interest

9 Woodford (2012) provides an excellent and extensive overview.

rate environment like Sweden. Finally, in Section 4 we sum up and discuss a number of other policy options to provide stimulus. This is important to the extent that one believes that forward guidance and LSAPs are not effective vehicles to stimulate the economy at the current juncture.

2. Unconventional monetary policy: theory

This section describes the effects of unconventional policies within a standard theoretical framework – a variant of the New Keynesian model of Woodford (2003) and others. We believe the basic New Keynesian model is useful for studying the main channels through which forward guidance affects the economy. For LSAPs, however, this model is not sufficient as it does not allow for the fully articulated financial intermediation channels that are believed to be important for understanding the impact of LSAPs, especially during financial crises. We therefore make some *ad hoc* modifications of the basic model to allow for a pedagogically tractable, yet useful, exposition of the main mechanisms believed to make LSAPs effective.[10] Below, we start by describing this model environment, and then discuss the effects of forward guidance and quantitative easing in detail. We end the section with some open-economy considerations of unconventional monetary policies.

2.1 THE THEORETICAL ENVIRONMENT

The model consists of numerous identical households and firms that interact in markets for goods, capital and labour. As in many other modern New Keynesian general equilibrium models, markets for goods are assumed to be characterised by monopolistic competition. This means that firms, instead of taking prices as given, are aware that they can influence them by their behaviour. However, as prices are sticky, monetary policy is able to affect the real economy (output and labour supply, for example) in the short run because nominal prices do not adjust immediately to a change in the nominal interest rate. The central bank has direct control over the short term nominal interest rate, but cannot cut this rate below an effective lower bound, as outlined in further detail below.[11]

Formally, the key equations of the model are:

(1) $$x_t = x_{t+1|t} - \sigma\left(i_t - \pi_{t+1|t} - r_t^{nat}\right),$$

(2) $$\pi_t = \beta\pi_{t+1|t} + \kappa x_t,$$

Equation (1) expresses the "New Keynesian" aggregate demand equation in terms of the output and real interest rate gaps (i.e. deviations from trend). Thus, the output gap x_t depends inversely on the deviation of the real interest rate $(i_t - \pi_{t+1|t})$ from the natural rate

10 Hence, our model does not provide micro foundations to discuss LSAPs. In the section on LSAPs, we provide references to micro founded models where LSAPs have similar effects.

11 An instructive introduction to a simple model of the real business cycle and how New Keynesian aspects can be incorporated in it is to be found in Goodfriend (2002). Woodford (2003) contains a complete treatment.

r_t^{nat}, as well as on the expected output gap in the following period, $x_{t+1|t}$.[12] The parameter σ determines the sensitivity of the output gap to the real interest rate gap. The price-setting equation (2) specifies current inflation π_t to depend on expected inflation, $\pi_{t+1|t}$, and the output gap x_t, where the sensitivity to the latter is determined by the composite parameter κ.[13]

To understand how monetary policy affects the economy, it is insightful to rewrite the aggregate demand equation. By forward-recursions of equation (1), we can write:

$$x_t = -\sigma \sum_{s=0}^{\infty} \left(i_{t+s|t} - \pi_{t+s+1|t} - r_{t+s|t}^{nat} \right). \tag{3}$$

This equation demonstrates, for a given path of the natural real interest rate (which is independent of the conduct of monetary policy), that economic activity today is affected by the future path of expected short-term real interest rates $r_t = i_t - \pi_{t+1|t}$, or equivalently, the long-term real rate:

$$r_t^T = \frac{1}{T} \sum_{s=0}^{T-1} \left(i_{t+s|t} - \pi_{t+s+1|t} \right) = i_t^T - \frac{1}{T} \left(p_{t+T|t} - p_t \right), \tag{4}$$

where T represents the time to maturity (in quarters, say, so that r_t^{20} represents the real return on a 5-year bond).[14]

To determine how monetary policy affects the macroeconomy, the view one takes on the long-term interest rate i_t^T is key. In particular, one needs to ask: 1) which interest rate matters for aggregate demand, and 2) how does policy affect it?

Our discussion of the effects of forward guidance starts from the view that the simple New Keynesian model takes. In this model, the term structure of interest rates is determined by the expectations hypothesis:

$$i_t^T = \frac{1}{T} \sum_{s=0}^{T-1} i_{t+s|t}. \tag{5}$$

Equation (5) says that long-term interest rates are simply an average of the expected path for the risk-free short-term interest rate i_t controlled by the central bank.

While arguably too simplistic a description of reality, this model does convey a number of essential features for the conduct of monetary policy. First, it shows how *conventional* monetary policy transmission works. That is, a surprise reduction in the central bank interest rate (i_t) lowers the long-term nominal interest rate (i_t^T) on impact, via equation (5). If prices are rigid, this translates into a reduction in the real long-term interest rate (eq. 4), which stimulates economic activity (eq. 3) and inflation (eq. 2).

12 We use the notation $y_{t+j|t}$ to denote the conditional expectation of a variable y at period $t+j$ based on information available at t, i.e., $y_{t+j|t} = \mathrm{E}_t y_{t+j}$.

13 This parameter varies directly with the sensitivity of marginal costs to the output gap, and with the degree of price stickiness. The marginal cost sensitivity, in turn, equals the sum of the absolute value of the slopes of the labour supply and labour demand schedules that would prevail under flexible prices. We provide additional details and the calibration of the model in Appendix A.

14 Strictly speaking, we can only write the aggregate demand equation in equation (9) in terms of the long-term real rate when T approaches infinity. For a finite maturity T, it is only an approximation.

Second, some inflation-targeting central banks, including the Riksbank, publish a projected *path* for the future policy rate in their monetary policy reports. This conveys how monetary policy is expected to evolve conditional on the current outlook of macroeconomic developments. In terms of the model above, publishing paths communicates $i_t, i_{t+1|t}, ..., i_{t+T|t}$ given today's expectations of the output gap $x_t, x_{t+1|t}, ..., x_{t+T|t}$ and inflation $p_t, p_{t+1|t}, ..., p_{t+T|t}$. The path thereby provides information about the policy rule and its arguments.[15]

Thus, key ingredients of conventional monetary policy can be captured within this simple framework and our first unconventional policy tool, forward guidance, can be analysed within that same framework. Section 2.2 does exactly that.

But ample empirical evidence casts considerable doubt on the expectations hypothesis (eq. 5) as a *complete* explanation of long-term interest rates.[16] More realistically, consider equation (6), where the long-term nominal interest rate, i_t^T, is now decomposed into two components:

$$(6) \qquad i_t^T = \frac{1}{T}\sum_{s=0}^{T-1} i_{t+s|t} + tp_t^T.$$

For government yields, the additional component – tp_t^T – is often referred to as the term premium. Our notation reflects that the term premium may vary over time (t) and with the maturity of the bond (T) at each point in time. It is normally assumed to be positive, and represents the extra return that investors require to be willing to hold a longer-term security to maturity relative to the expected return from rolling over short-term securities for the same period.[17] The rationale behind LSAPs is that the central bank can indeed influence term premiums, as we explain in Section 2.3.

An additional consideration is that the relevant long-term interest rate that determines output fluctuations (via eq. 5) is not necessarily the government bond yield, but rather the interest rate that households and firms actually pay. And households and firms do not face the same interest rate as governments, as investors typically require compensation for the additional credit risk associated with extending credit to the private sector, so that

$$(7) \qquad i_t^{T,\,private} = i_t^T + rp_t^T.$$

Thus, even if the central bank can lower the government bond yield, i_t^T, through unconventional policies, private rates ($i_t^{T,\,private}$) may remain elevated due to high risk premiums rp_t^T. As discussed in Section 2.3, LSAPs may therefore sometimes need to be designed to reduce both term and risk premiums.

15 The published path thus describes the usual policy behaviour of the central bank, which we capture with a policy rule in which the actual and expected policy rate is a function of actual and expected inflation and output gaps. In practice, the published path may also involve added judgmental factors.

16 See for instance the seminal paper of Campbell and Shiller (1991).

17 Of course, it is conceivable that government yields also contain a risk premium, reflecting a risk of default for the government at longer horizons. Supported by the current robust fiscal framework in Sweden and the low level of government debt as share of GDP, we assume in this exposition that this risk is negligible in the pricing of government bonds in financial markets. Relatedly, we also assume a negligible role for liquidity.

For expositional purposes, the discussion of forward guidance in Section 2.3 and LSAPs in Section 2.4 abstracts from open economy dimensions. We discuss effects of unconventional tools in an open economy framework in Section 2.4.

2.2 FORWARD GUIDANCE

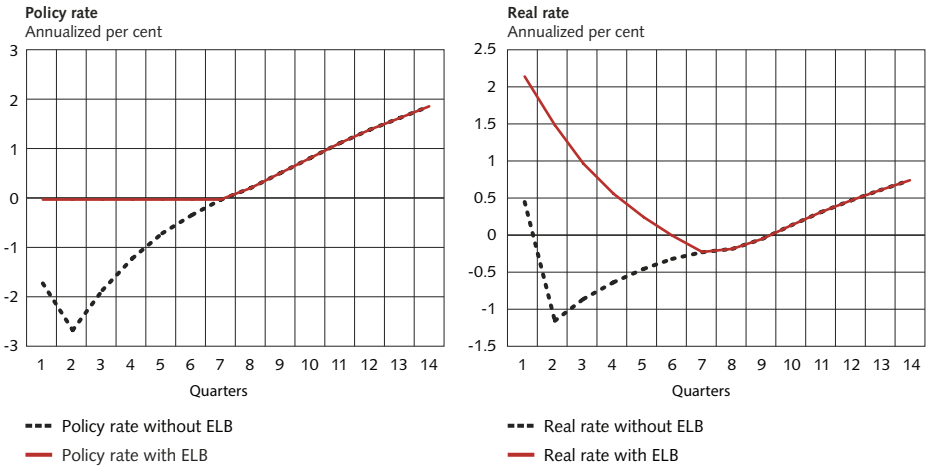
Before discussing forward guidance, we show why conventional policy may not suffice by means of an illustrative example. Suppose the economy is hit by a sequence of adverse shocks, which reduce the natural real rate r_t^{nat} persistently. All else equal, this implies a negative output gap as can be seen from equation (1). The central bank, striving to keep output at its potential and inflation at its targeted rate typically leans against the wind: it reduces its policy rate whenever inflation and the output gap are below target. Such behaviour can be captured by a simple Taylor-type rule:

$$i_t = (1-\rho)(\gamma_\pi \pi_t + \gamma_x x_t) + \rho i_{t-1}. \quad (8)$$

When prices are sticky, the reduction in the nominal policy rate i_t reduces the real interest rate $i_t - \pi_{t+1|t}$ in equation (1) and thus mitigates the fall in output.

If the drop in the natural real rate is very large, the central bank policy rule prescribes a large reduction in the policy rate to stabilize inflation and the output gap, possibly even into negative territory. The dashed black line in the left panel in Figure 4 shows how the policy rate could evolve in such a case. The dashed black line in the right panel shows how that policy would induce a period of protracted negative real short-term interest rates.

Figure 4. The effective lower bound



Source: Authors' own calculations

However, there may be an effective lower bound (ELB, henceforth) on how low the policy rate can be, so that even though the central bank would like to, it cannot reduce the policy

rate below the ELB.[18] In Figure 4, the red solid line in the left panel depicts such a situation. In the panel, the policy rate is at the ELB (which for illustrative purposes is set at 0) for a sustained period and is not raised until after seven quarters when inflation and output have sufficiently recovered. In this first period, the situation is not ideal: the central bank would obviously prefer to set an even lower interest rate but is constrained from doing so by the ELB. In this sense, monetary policy is in fact restrictive today and the central bank would like to be more expansive. We now explain how the central bank may provide more stimulus to the economy through forward guidance. In the next section, we discuss stimulus through LSAPs.[19]

Under forward guidance, the central bank would state today that policy will be more expansive in the future. Specifically, the central bank could communicate that it will keep the policy rate lower for longer than prescribed by its normal behaviour (i.e. the policy rule in equation 10).[20] For example, let us consider what happens if the central bank credibly communicates that it will set its policy rate at the ELB for one additional quarter, although the policy rule (eq. 10) dictates lift-off from the ELB in this quarter. The yellow solid line in panel A in Figure 5 shows this policy, whereas the red solid line simply plots the baseline interest rate path plotted in Figure 4. The red solid line in panels B and C shows the corresponding baseline forecasts for the output gap and the yearly inflation rate, along with their alternative paths under this communication. In panels D-G, the yellow dotted lines show the effect of this policy relative to the baseline forecasts for each of these variables.[21]

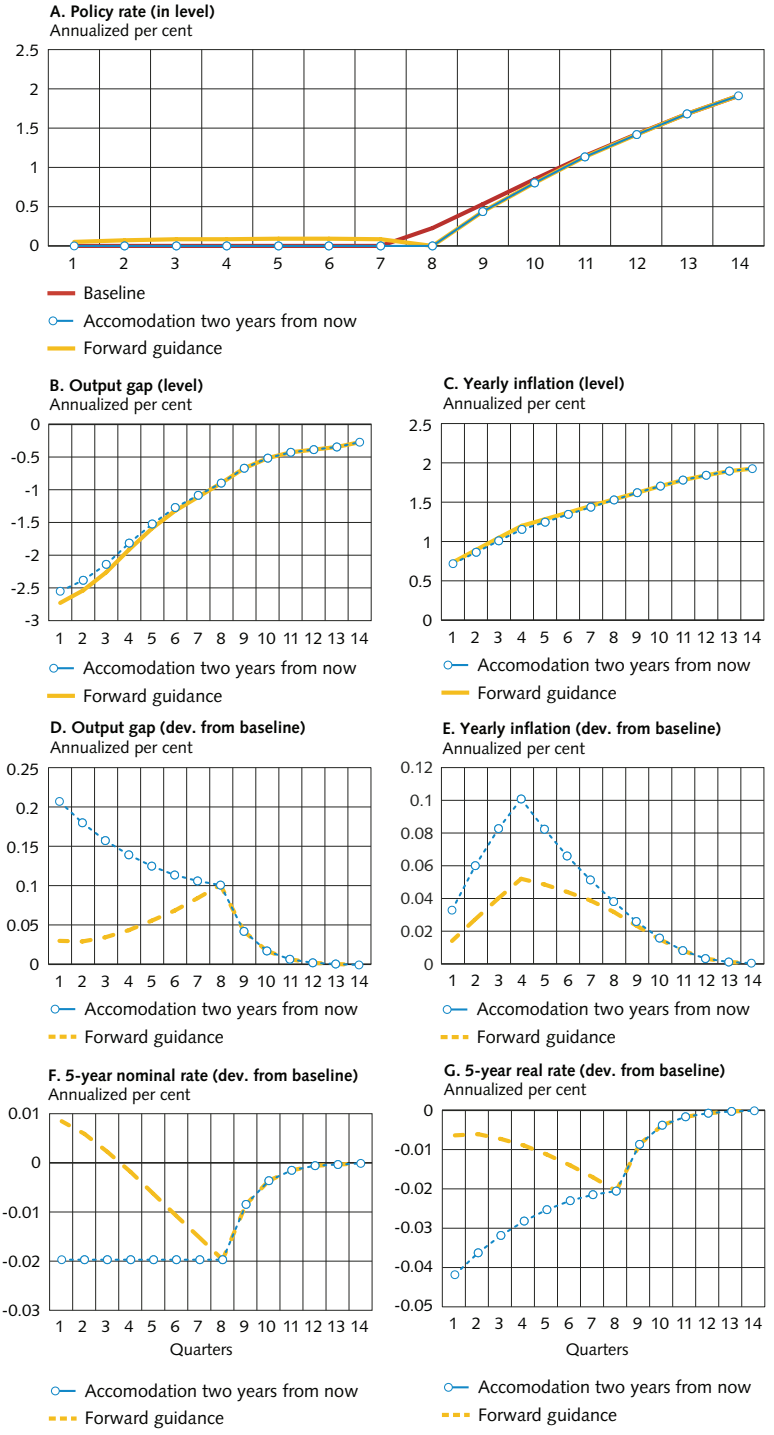
18 For a more detailed description of the policy rule, see Appendix A. Söderström and Westermark (2009) discuss the implications of the effective lower bound for the policy rate in detail.

19 Other insightful discussions of these policies can be found in Bank of England (2013), Söderström and Westermark (2009) and Woodford (2013).

20 Theoretically, promising to be less anti-inflationary in the recovery is often shown to be the optimal policy route out of a liquidity trap (see e.g. Krugman, 1998). Forward guidance is an attempt to do exactly that.

21 Hence, the numbers for the output gap and yearly inflation are computed as the difference between the alternative scenario (with more expansionary monetary policy) and the main scenario (normal policy behaviour). We compute the effects on the long-rates the same way, although we do not show their baseline paths in levels in order to save space.

Figure 5. Alternative policy paths and the effective lower bound



Source: Authors' own calculations

If the announcement by the central bank is credible, households and firms expect that the policy rate will be lower than normal two years from now. Due to nominal price rigidities, the lower-than-normal policy rate will put downward pressure on the real long rate (shown in panel G) two years from now. The lower real long rate boosts investment and consumption, and thus increases output and inflation two years into the future as shown in panels D and E.

But forward-looking households and firms anticipate that all this will happen in the future, and with that understanding, households who value smooth consumption streams will immediately start consuming more. Similarly, firms seeing increased demand will start to increase prices without delay. As a result, output and inflation will increase immediately. Thus, a credible announcement of more future stimulus also improves the outlook in the near term, as can be seen from the instantaneous increases in output and inflation in the figure.

Now, typical central bank behaviour (e.g. the rule in eq. 10) implies leaning against gains in inflation and the output gap in order to stabilize inflation around the target and output around its natural level. The central bank will thus tend to increase the interest rate amid the improved outlook. In panel A, this is illustrated by the fact that the policy rate is now higher than the baseline path in the periods leading up to the policy expansion.

However, to the extent that monetary policy absent the announcement (red line in Figure 5) was restrictive, it is unreasonable to assume that the central bank would hike the rate prior to the eighth quarter. If anything, the central bank would opt for a policy rate below the ELB if it could choose freely as shown in Figure 4. To provide maximum stimulus, the central bank will therefore not increase the policy rate in the near-term; instead, the central bank announces it will keep rates unchanged at the ELB from now until the exit date ($t=8$), as shown by the blue circled line in panel A of Figure 5.

The fact that the central bank keeps the interest rate unchanged, even though the outlook has improved somewhat, implies that forward guidance has an additional positive *indirect* stimulative effect on the economy, because this effectively implies that the policy rate is lower at every point in time compared to the baseline path (red solid line). In Figure 5, the macroeconomic implications of not changing the interest rate prior to the exit date can be seen by the difference between the blue circled lines and the yellow lines. Specifically, this path of the policy rate implies an immediate and persistent drop in the nominal long-term interest rate (panel F), and the real rate consequently drops significantly on impact (panel G). As a result, output and inflation rise even more, as is apparent from a comparison of the blue and yellow lines in panels D and E. This shows that announcing to stay at the ELB one quarter longer improves the output and inflation outlook compared to the baseline scenario. However, this does not make forward guidance a panacea as is evident from panels B and C, which show the level of output and inflation under the different policy scenarios. While forward guidance helps, it may not alone provide the entire stimulus required for a quick recovery to target levels for inflation and resource utilization.

Although our model is heavily stylized and the numbers in the figure should be interpreted with due caution, it suggests that forward guidance can be quite effective. Importantly, it does so not only because the announcement of lower rates in the future boosts activity directly, but also because by doing so, it relieves the extent to which the ELB is a constraint on policy today. For the more technically oriented reader, Appendix A provides additional details on the different transmission channels highlighted here.

Exactly how potent forward guidance is depends critically on the credibility with which the central bank succeeds in convincing the public it will in fact keep the rate at the ELB for longer than it normally would (given the outlook). Throughout our exposition above, we have assumed that the central bank is able to pledge a credible commitment, but in practice this cannot be taken for granted. Figure 4 illustrated how the central bank would – according to its policy rule – like today's policy rate to be very negative. Because it is constrained by the lower bound (red line in Figure 4 and 5A), an alternative way of providing that stimulus is to promise future deviations from its rule (blue circled line in Figure 5A). Thus, today it is optimal to promise such a future deviation from its own policy rule. This creates a conflict between what the central bank (optimally) announces today about its future behaviour (policy rate lower than policy rule), and its actual behaviour in the future (policy rate according to the rule, higher than what is announced today under forward guidance). This is commonly known as a time-inconsistent policy. If the public doubts the central bank's willingness to follow through on its announced policy intention, the gains of forward guidance may be significantly reduced. We elaborate further on this issue below.

2.3 LARGE SCALE ASSET PURCHASES (LSAPS)

LSAPs are open market purchases of longer-term government and corporate bonds, and mortgage-backed securities. By purchasing these financial assets from commercial banks and other private institutions, the central bank raises their prices and lowers their yields, while simultaneously expanding the monetary base (unless the purchases are sterilized). This differs from the conventional policy of buying very short-term government bills to keep the short-term policy rate at its target. LSAPs are often referred to as quantitative easing.[22]

While both forward guidance of short-term rates and LSAPs strengthen economic activity by putting downward pressure on long-term real yields, they affect these yields differently. LSAPs differ from forward guidance as they are directly aimed at reducing term premiums, tp_t^T in equation (6).[23]

22 See for instance the editorial "Europe's deflation risk leaves no option but quantitative easing" in Financial Times 9 January 2015. We use the term LSAP, as it embodies purchases of both private and government assets. Bernanke (2009) makes a compelling distinction between quantitative easing (which focuses on expanding bank reserves) and credit easing (which focuses on the way the composition of assets the central bank buys affects credit conditions for households and firms).

23 Akkaya (2014) shows that forward guidance may also have a negative impact on the term premium by reducing the uncertainty about the future policy rate. In our exposition here, we assume such effects are negligible.

When the central bank buys a sizable amount of the outstanding stock of longer-term securities, the quantity of these securities shrinks and their price rises. As a result, the yields on these assets should fall as the term premium investors obtain for holding them shrinks.[24] For a given path of short-term rates, a lower term premium tp_t^T will reduce long-term yields i_t^T on different maturities T according to equation (6) and thus stimulate economic activity and inflation according to equations (3) and (2). Under standard assumptions about demand and supply elasticities, the purchases have to be fairly large in scale to affect prices materially. But which securities should the central bank acquire? In the presence of imperfect substitutability between various maturities, LSAPs need to be carried out for many different maturities. Thus, with limited portfolio re-balancing among financial market investors, it is not sufficient to buy bonds with a certain maturity only.

By reducing the term premium, the central bank may hope to also lower interest rates for firms and households. That is, by reducing i_t^T the central bank may well reduce the interest rates the private sector needs to pay for its longer term funding, $i_t^{T,\,private}$, as suggested by equation (7).

In addition, if the central bank is willing to take on securities from asset classes beyond government bonds, LSAPs can also reduce private interest rates more directly by reducing rp_t^T in equation (7).

Hence, by including both government and private assets in the LSAPs, the central bank can reduce both the term and risk premiums, and therefore provide maximum stimulus to economic activity. At the same time, equations (6)-(7) make clear that the effectiveness of LSAPs can be limited if the central bank can only influence the term premium by purchasing government yields, and not lower elevated risk premiums.

Another potential advantage with LSAPs is they may mitigate possible credibility problems associated with providing forward guidance. When financial markets already project that the policy rate will be near its effective lower bound for an extended period (see Figure 3), forward guidance needs to be credible far along the yield curve to be effective. Since a current board of governors cannot easily constrain the voting of a future one, such a high degree of credibility may be hard to establish in modern central banking institutions where the tenure of a voting committee is fairly short. This makes LSAPs interesting in the current European situation as LSAPs would likely alleviate potential commitment problems associated with forward guidance. To the extent that LSAPs extend the duration and size of the central bank's portfolio, starting to raise the policy rate early may result in significant capital losses (at least mark-to-market), and they could hence strengthen the credibility of announced guidance about low future rates.

As a practical matter, the number of assets the central bank can buy is far fewer in Europe, where loans to corporates and households are generally extended via banks, compared to the United States, where there is an ample supply of private assets (e.g. corporate bonds and mortgage-backed securities). This need not necessarily impair the

24 A theoretical framework consistent with the idea that LSAPs reduce term premiums for different maturities is the theory of preferred habitat, see e.g. Andres et al. (2004) and Vayanos and Vila (2009).

efficacy of LSAPs, but it does imply that policymakers in Europe may need to devise creative ways to reduce risk premiums and stimulate the economy. The ECB's targeted longer-term refinancing operations (TLTROs) and the Bank of England's "funding for lending"-programme provide recent examples of such attempts.

Finally, we note that the policies characterized above fall in the realm of general policy accommodation in the absence of significant turmoil in financial markets. There may of course be other reasons for engaging in buying securities across different asset classes. An important rationale may lie in the resolution of financial distress. For instance, in the U.S. the Fed initiated QE1 largely in response to the financial market turmoil. It stepped in in markets where there was little or no trade, in view of making markets more liquid as well as aiding banks by maintaining collateral values at a less depressed value. Such policies can be rationalized in models with explicit credit frictions (see e.g. Gertler and Karadi, 2013).

2.4 OPEN ECONOMY CONSIDERATIONS

So far, the discussion has not explicitly touched on open economy implications of unconventional policies. In this section, we briefly discuss the open economy dimensions of forward guidance and LSAPs in relation to the simple model outlined above.

As shown by e.g. Adolfson (2002) and Lindé et al. (2009), moving to an open economy framework involves additional terms-of-trade terms in the aggregate demand equation (1) and the Phillips curve (2). Additionally, it adds the well-known uncovered interest parity (UIP) relationship to the model, which relates the interest differential between the domestic and foreign policy rates to the expected depreciation rate of the nominal exchange rate s_t:

$$(9) \qquad i_t - i_t^* = s_{t+1|t} - s_t + ep_t,$$

where i_t^* is the foreign interest rate and ep_t is the exchange rate risk premium.

Analysing the open economy implications of forward guidance is straightforward: a credible commitment to keep policy rates lower for longer should tend to depreciate the nominal exchange value of the currency provided that the path of the foreign nominal rate is not adjusted to the same extent. Given that prices are sticky domestically and abroad, this policy should be associated with a depreciation of the real exchange rate, and hence trigger, ceteris paribus, some boost to net exports under regular assumptions about import and export demand elasticities. Higher economic activity (eq. 1) will indirectly put upward pressure on inflation according to equation (2). Moreover, there is also a direct positive effect on inflation of a weaker currency through higher prices for imported goods and services.

The effects of LSAPs on the nominal exchange rate are somewhat less straightforward to trace out and should in principle depend on which interest rate matters most for currency flows. However, under the presumption that the relevant interest rates for currency flows are government bond yields (or the interest rates faced by households and firms) and

LSAPs cause those yields to fall, then the currency should depreciate.[25] Hence, as was the case with forward guidance (FG), LSAPs are likely to further boost economic activity and inflation through the exchange rate channel.

The ability of the central bank to affect its exchange rate through open market operations gives it another instrument in addition to FG and LSAPs. In terms of the simple UIP condition in equation (9), the central bank can through interventions in foreign exchange markets affect the exchange rate risk premium ep_t and thereby affect the path of the nominal exchange rate given an expected path of the interest rate differential. Specifically, following the "foolproof way" discussed in Svensson (2001), the central bank can announce a (crawling) peg for the exchange rate and support a depreciated value of the currency by issuing money to buy foreign currency. This commits the central bank to defending the peg, as a failure to do so will imply capital losses. The threat of such capital losses may increase the credibility of the central bank in delivering higher inflation, beyond what forward guidance and LSAPs can provide. In addition, weakening the currency also has more direct effects on inflation and output. The recent experience of the Swiss National Bank (SNB), however, casts some doubts on the sustainability of such a strategy: from September 2011 until January 2015 the SNB maintained a floor for the Swiss franc against the euro (thereby vastly expanding its balance sheet), and its decision to abandon the peg earlier this year is likely to have caused substantial capital losses.[26] Therefore, while direct interventions to depreciate the currency may be a risky endeavour, there is possibly an argument to be made following the "foolproof way" that the central bank communicates that it will intervene to depreciate its currency in case FG and LSAPs are not sufficient to boost inflation and inflation expectations towards target levels. A credible communication of this intention may avoid the need to carry out any larger sustained interventions in practice.

25 From equation (9) above, we see that if the relevant interest rate is in fact the policy rate, then LSAPs may in fact trigger an appreciation of the exchange rate. To see this, note that to the extent LSAPs stimulate economic activity and inflation, it will put upward pressure on the policy rate. The higher policy rate path relative to foreign rates, in turn, attracts capital from foreign investors, which leads to an appreciation of the exchange rate.

26 The Swiss National Bank abandoned its peg of the Swiss Franc to the euro (which set a floor of 1.20 euros per franc) on 15 January, and lowered the mid-point of the target range for the three month Libor rate by 50 basis points to -0.75 per cent. Despite the reduction of the Libor to unprecedented negative levels, the franc appreciated roughly 15 per cent. The Czech National Bank is still committed to intervene on the foreign exchange market so that the exchange rate of the koruna is kept close to CZK 27 to the euro.

3. Unconventional monetary policy: empirical evidence

In this section, we review the international literature about the evidence of the effects of unconventional policies. In addition, we briefly discuss the Swedish situation and what theory and evidence suggest about the scope of LSAPs to lower term and risk premiums and thus provide stimulus to the economy.

3.1 INTERNATIONAL EVIDENCE

Because the policies described do not have a particularly long history, data to evaluate them is relatively scarce. In addition, the nature of the policies poses novel empirical and interpretational challenges. That said, numerous recent studies aim to measure the effects of the recently installed policies and we here give a brief overview of some of their findings.

The literature can, by and large, be seen as trying to address two distinct questions. First, to what extent do these policies affect long-term interest rates and other asset prices? Second, given a change in policy, how is the macroeconomy affected? These questions are longstanding ones in monetary economics and are largely addressed for regular policy interventions. However, there is a widespread belief that the central bank's ability to influence rates other than the policy rate, as well as the policy transmission channels, may be different when the policy rate is at its lower bound.

Let us start with the effect of FG and LSAPs on asset prices. A vast collection of event studies shows that around the time of policy announcements, nominal long-term government bond yields fall.[27] As discussed in the previous section, the reduction in these yields can be attributed to two main channels: a lower path of expected policy rates and a reduction in the term premium. While the extent to which each channel is important is perhaps a bit contentious, the reduction in the nominal interest rate at various maturities along the yield curve appears robust. Chung et al. (2012) provide an extensive review of the evidence for the U.S. which, as a general guide, suggests that LSAPs of 1 per cent of GDP reduce 10-year yields by roughly 7 basis points. They also argue that a given reduction of the long yield is equivalent to a much larger cut in the short-term interest rate. Specifically, they suggest that a 50 basis point reduction in 10-year yields corresponds to a sustained 200 basis point cut in the federal funds rate.[28]

Moreover, yields of other asset classes not necessarily acquired by the central bank (e.g. corporate bonds during QE2 and QE3) also tend to fall following policy announcements, albeit seemingly to a somewhat lesser extent than the reduction in the purchased assets. The nominal exchange rate tends to depreciate for the country announcing unconventional policies, but not always. Effects on stock markets vary across countries.

27 See, e.g., Rogers et al. (2014) and the references therein.

28 Relatedly, Figure A.3 in Appendix A shows how a reduction in the path of the short-term rate through forward guidance results in a much more persistent decline in long-term yields compared to an equal reduction of the short-term rate today.

While a reduction in nominal long-term interest rates may appear robust, this does not necessarily mean the policies are actually effective. In fact, to the extent that policy boosts economic activity, it may even be expected to raise nominal long-term rates rather than reduce them, as discussed earlier.[29] More relevant than the nominal yield response is how policy affects *real* yields. What matters for consumption and investment decisions is, arguably, the long-term real interest rate (recalling equation 3). While there is some evidence that FG and QE indeed reduce real rates (e.g. Gilchrist et al., 2013), a consensus view is yet to emerge.

We now turn to the second question of how FG and LSAPs affect macroeconomic outcomes. In this regard, the bulk of evidence we have comes from structural vector autoregressions (SVARs henceforth) and dynamic stochastic general equilibrium (DSGE henceforth) models. On the one hand, SVAR studies tend to find that shocks that reduce yield spreads during the crisis exert a positive influence on inflation and GDP (e.g. Baumeister and Benati 2013, and Kapetanios et al., 2012). Evidence by e.g. Gambacorta et al. (2014) and Weale and Wieladek (2014), suggests that surprise expansions in central bank balance sheets have similar effects. On the other hand, DSGE models suggest that LSAPs have more limited effects (see e.g. Chen et al., 2012), while credible announcements of forward guidance are rather effective (see e.g. Milani and Treadwell, 2012).

Our view is that the empirical results regarding how FG and LSAPs affect the macroeconomy are less certain compared to the impact these tools have had on various asset prices. The short history of these tools poses considerable limitations, as much longer samples are needed for reliable estimation and some of the identification issues involved in assessing the macroeconomic effects are non-trivial and only partially addressed thus far in the literature. Overall, however, there is little or no evidence suggesting adverse macro effects of unconventional monetary policies.

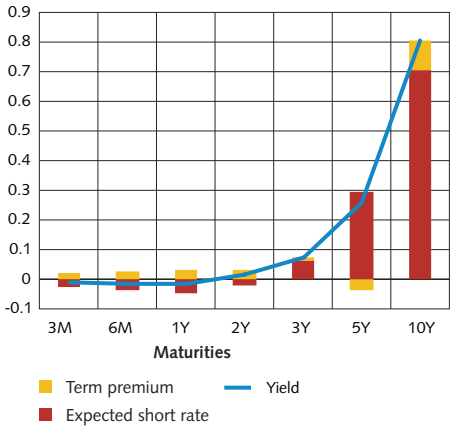
3.2 CONSIDERATIONS FOR SWEDEN

With the theoretical mechanisms and empirical review in mind, we briefly comment on the scope for LSAPs to materially lower term and risk premiums in Sweden. The left panel of Figure 6 decomposes the yields on government bonds into an expected short rate component and a term premium component per 12 January 2015. As can be seen from the graph, the term premium appears quite compressed currently, even at longer horizons. The 10-year yield is 0.8 per cent, of which 0.65 percentage points are due to expectations of short rates, and only 0.15 percentage points are due to the term premium. However, as discussed in Swanson (2007), there is nothing which stipulates *a priori* that the term premium has to be positive, so it can be reduced more than the 15 basis points the figure reports for the 10 year government yield. However, even if the term premium were to be sizably reduced through LSAPs, it is uncertain how much of the lower yields would be

29 The intricacies of the long-term interest rate effects of forward guidance are discussed in De Graeve et al. (2014).

transmitted to household and firms, and whether banks would be willing to extend new loans to corporates when yields are as compressed as they currently are.[30]

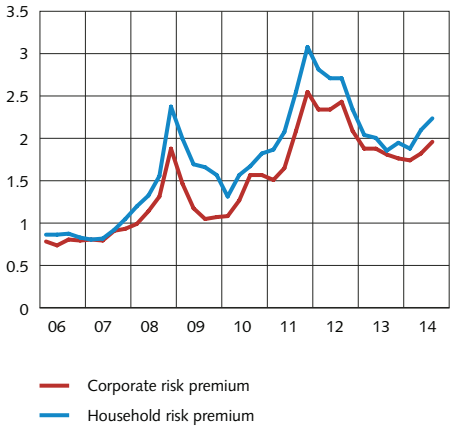
Figure 6. Yields for government, firms and households in Sweden



Note. Yields were calculated using Nelson-Siegel-Svensson parametrization on Riba and FRA contracts. Expected short rates were calculated by averaging the instantaneous forward rates in Figure 3 up to the given maturity. The term premium is the difference between the yield and the expected short rate

Note. The yield curve is decomposed as of January 12, 2015.

Source: The Riksbank



Note. The spread for households was calculated by taking a weighted average (weights with respect to their maturities in the CPI) of mortgage rates for different maturities (3 months, 1 year, 2 years and 5 years) and subtracting the weighted average of government bond yields (using the same weights). The same was done for the corporate spread, but using weights for the corporate sector instead.

Source: Statistics Sweden and the Riksbank

To assess the scope for LSAPs to affect the situation for Swedish households and firms, the right panel in the figure reports a measure of the risk premium on newly issued mortgage loans and loans to non-financial corporates.[31] As can be seen from this graph, there appears to be some scope to reduce these risk premiums back to the levels prevailing before the financial crisis.

Although there is possibly some scope to reduce term and risk premiums, it is a fact that both nominal short- and long-term yields are at extremely low levels currently in both the euro area and in Sweden. And because of this, it is tempting to draw the conclusion that LSAPs have little scope to provide significant stimulus in core euro area economies

30 The view that banks demand too high returns to increase the amount of extended loans (and that firms require too high returns to find it worthwhile to invest) at the low yields prevailing in today's capital markets has been voiced by some market followers, notably the former deputy governor of the Riksbank Thomas Franzén (see e.g. the interview with him by Andreas Cervenka in Svenska Dagbladet on 22 January 2015). While this is an intriguing hypothesis which would suggest that LSAPs will be less potent, solid evidence is needed to substantiate it.

31 The risk premiums are constructed as size-weighted averages of interest rates on different maturities (3 months-5 years) on new loans minus the compounded government yield using the same weights. The weights are changed each month, reflecting the composition of maturity structure of newly issued loans at the time.

and Sweden. Our view, however, is that such a conclusion may be unwarranted for the following three reasons. First, the analysis with the simple model in Section 2.2 suggests that seemingly small movements in long-term interest rates can have a substantial effect. By that token, reducing the term premium by, say, 10 and 20 basis points at the 5- and 10-year horizons could have a material impact on the outlook for the economy, provided that the lower yields are transmitted to firms and households.

Second, the fact that long-term nominal yields are low does not mean that LSAPs are necessarily ineffective. LSAPs may be effective even if longer-term nominal yields have limited scope to fall further when the term premium is reduced. To see this, it is useful to consider equation (6) which says that the nominal yield equals the expected path of short-term rates plus the term premium. When the central bank intervenes in bond markets and succeeds in shrinking the term premium on various maturities, it puts downward pressure on various long-term nominal yields i_t^T. Given that prices are rigid in the short-term, this reduces the real long-term yields r_t^T according to equation (4), and therefore stimulates demand according to equation (3) which puts upward pressure on the prices according to the New-Keynesian Phillips curve (eq. 2). Importantly, the gains in economic activity and higher inflation imply that the path of the short-term policy rate is shifted up according to equation (8), at least upon exit from the effective lower bound. In turn, this means that the expected interest rate component in equation (6) shifts up, and thereby counters some of the downward pressure on long-term nominal yields stemming from the lower term premium.[32] Even so, the key is that real long-term yields should unambiguously fall as a result of the reduction in term premiums and higher inflationary pressure. Thus, the effectiveness of LSAPs should not primarily be evaluated in terms of their effects on nominal yields: it is their effect on real yields that matters the most.

The third reason is related to what we just discussed. If the LSAPs reduce term and risk premiums and put some upward pressure on the expected path of short-term policy rates by stimulating economic activity, the central bank can use forward guidance to magnify the stimulus by committing not to exit earlier from the effective lower bound.

4. Concluding remarks

In January this year, the ECB decided to initiate an extensive LSAP program with purchases starting in March. And in February, the Riksbank cut the repo rate from 0 per cent to –0.1 per cent, and announced its intention to buy long-term government bonds for SEK 10 bn. The unconventional actions by the Riksbank were further bolstered at an extra policy meeting on March 18, in which the Riksbank cut the rate to -0.25 per cent and decided to expand its asset purchases with SEK 30 bn. Given the current outlook for inflation and

32 In fact, if the interest sensitivity of demand (σ in eq. 1) and the slope of the Phillips curve (κ in eq. 2) are sufficiently high, then it is conceivable that the increase for the expected policy rates will outweigh the fall in the term premium, so that the nominal long-term yields may increase. The notion that LSAPs may not reduce nominal yields to the same extent as real yields is supported by Charts 1 and 2 in Bernanke (2013, 1 March). Chart 1 shows that 10-year nominal yields in the U.S. have closely tracked some key foreign counterparts, some of which did not undertake LSAPs.

inflation expectations in the euro area and Sweden, and the risks of a prolonged period with inflation significantly below target, there was a case to be made to employ these unconventional monetary policies. Arguably, a central bank sensitive to downward risks need not wait for further data releases to disappoint: the mere possibility of a deflationary trap may call for sizeable pre-emptive measures.

When using these unconventional measures in policy, it is important to understand how they work. In this review article, we therefore discuss theory and evidence concerning the effects of two unconventional polices: forward guidance (FG) and large scale asset purchases (LSAPs). We focus on these policies as they have been widely used by leading central banks since the outset of the financial crisis.

In the face of a lower bound on nominal interest rates, both FG and LSAPs aim to work on the longer end of the yield curve, because the short end of the yield curve is at its minimum already. By promising to be more expansive upon exit from the lower bound, the central bank can use FG to communicate that it will temporarily allow the economy to expand more than it normally would (if it adhered to its usual policy behaviour). The hope is that the commitment to a more accommodative policy stance in the future will lower real long-term yields today and provide additional stimulus, even though the policy rate is at its effective minimum.

In practice, state-dependent forward guidance which ties future interest rate hikes to e.g. future inflation thresholds offers a good route to offset expectations of an earlier interest rate hike, as the degree of accommodation it provides naturally adjusts to new economic developments. Importantly, state-dependent guidance supposedly reduces such uncertainty by providing very tangible conditions when lift-off from the ELB will not occur. In that way, it ties central bank behaviour closer to economic outcomes than is currently the case for many central banks.

Regardless of the precise implementation of FG, there may be limitations to how long into the future a central bank can credibly commit. For instance, a current central bank board cannot constrain the voting behaviour of a future one. This issue is likely highly relevant today, given that policy rates in many countries are already expected to be exceptionally low for an extended period of time. Potentially, LSAPs can remedy some of the problems with commitment. The composition of the central bank balance sheet is likely to form a constraint on the future conduct of policy, as, depending on how the bank decides to retire assets from its balance sheets, it will entail capital gains or losses. For instance, if the central bank portfolio of bonds has a very long duration, then starting to raise the policy rate early may result in significant capital losses on its portfolio.[33]

Even so, although our review of the literature suggests that forward guidance and LSAPs – if properly designed – could be effective tools to provide further stimulus to the economy and improve the inflation outlook, there are of course additional considerations. First,

33 Note that we have refrained from discussing changes in long-term central bank strategies. These are an alternative form of stimulus out of the crisis, and may imply permanent changes in the size of the central bank balance sheet. Changing the central bank's long-term objectives may be effective even in the absence of the portfolio balance effects described in Section 2.3. See Eggertsson and Woodford (2003) for a discussion.

given that the European financial system is heavily bank-based, and that banks are not as willing to extend credit to firms when yields are low, it could very well be that the interest sensitivity of aggregate demand is substantially lower in the current low-yield environment than is normally the case. This would seriously hamper the efficacy of these tools. Second, a central bank attuned to risks building up in the financial system by reducing both short and long yields for an extended period, and to an adverse impact on its balance sheet and ultimately on its political independence, may also be rightfully reluctant to employ these tools when there is ample liquidity in the financial system already.

Finally, in case the potency of FG and LSAPs turns out to be significantly more modest in Europe relative to the United States (e.g. because lower government yields may not be transmitted to households and firms to the same extent) and direct exchange rate interventions are infeasible as a means to boost inflation, a viable alternative way to stimulate the economy is through fiscal expenditures aimed at increasing aggregate demand. As real and nominal interest rates are exceptionally low, the costs of borrowing for the government to finance such expenses would be minuscule. Galí (2014) provides evidence that fiscal policy can be very effective when financed by the central bank instead of through higher taxes. Furthermore, recent research (see for example, Erceg and Lindé, 2014) has pointed out that the budgetary cost of a fiscal expansion is likely small or even negative in a long-lived liquidity trap.

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Appendix A: Additional model details and forward guidance results

This appendix provides a more detailed description of the model and more extensive analysis of the mechanisms through which forward guidance may impact the economy. In Appendix A.1, we provide additional model details of the complete model and how it is calibrated. In Appendix A.2, we provide a more elaborate write-up of how forward guidance affects the economy according to the model, and why forward guidance is more potent than traditional monetary policy interventions.

A.1 ADDITIONAL MODEL DETAILS

In the model equations, all variables are measured as per cent or percentage point deviations from their steady state level. Central bank behaviour is governed by:

$$i_t^{unc} = (1-\rho)(\gamma_\pi \pi_t + \gamma_x x_t) + \rho i_{t-1} + \varepsilon_t, \tag{10}$$

$$i_t = \max\{-i,\ i_t^{unc}\}. \tag{11}$$

The unconstrained policy rate i_t^{unc} follows a Taylor rule with smoothing according to equation (10). But since the policy rate is assumed to be subject to the effective lower bound (equation 11), the actual policy rate i_t will differ from i_t^{unc} when the ELB binds. To simplify the exposition, we assume the ELB to be 0, which implies that the first argument of the max operator is $-i$ rather than 0 (i.e. the ELB) because the model is written in terms of deviations from the steady state.

The model is completed by the following set of equations:

$$r_t^{nat} = \delta(\Omega_t - \Omega_{t+1|t}), \tag{12}$$

$$y_t^{pot} = \alpha \Omega_t, \tag{13}$$

$$y_t = x_t + y_t^{pot}, \tag{14}$$

$$p_t = \pi_t + p_{t-1}. \tag{15}$$

Ω_t is a vector which collects all fundamental shocks hitting the economy, which can include but is not limited to technology shocks, consumption demand shocks, foreign shocks, and so forth. As indicated by equation (12), the potential real rate is determined by the expected change of the fundamental shocks in the economy. Potential output in eq. (13), however, is determined by the level of these shocks. The vectors δ and α measure the extent to which the fundamental shocks affect the potential real rate and the level of potential output respectively. Finally, equations (14) and (15) are accounting identities for output and prices (in log-levels).

In Table A.1, we provide the parameters used to generate results in Figure 4 and 5.

Table A.1. Calibration of simple model

PARAMETER	VALUE
σ	1
β	0.99
κ	0.028
ρ	0.5
γ_π	1.5
γ_χ	0.125

A.2 ADDITIONAL DETAILS ON THE TRANSMISSION OF FORWARD GUIDANCE

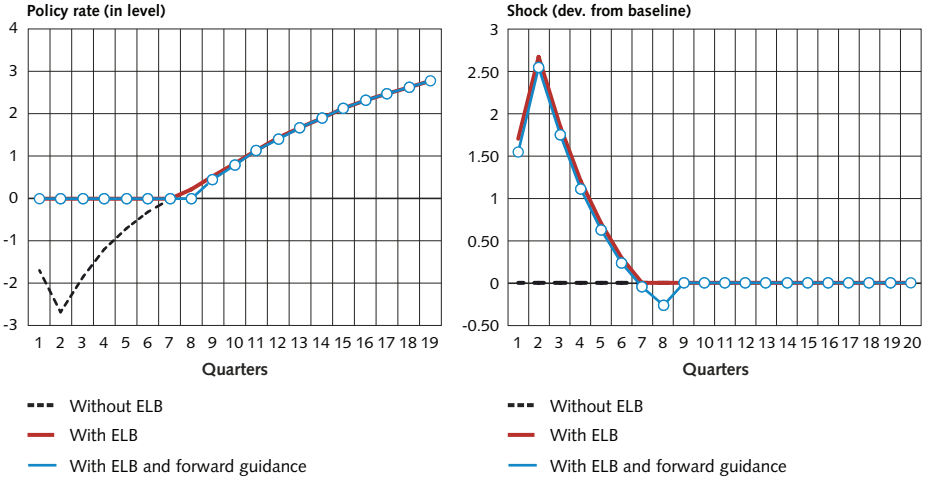
We here provide substantially more details on the mechanism behind the results documented in Section 2.2.

The policy rate that the central bank would like to implement is negative for a number of quarters. This is documented in the left panel of Figure A.1 by the dashed line which shows the unconstrained policy rate i_t^{unc} given the current projections of the output gap and the inflation rate (not shown). The fact that the actual policy rate of zero is higher than the unconstrained policy rate in equation (10) means that policy is restrictive: the difference between the two rates can be captured by a sequence of deviations from the policy rule.[34] These shocks are shown in the right panel of Figure A.1 by the solid red line. They are all positive because the actual policy rate is higher than the unconstrained one. The shocks are also known at date $t=1$ as agents understand that the interest rate cannot fall further. The unconditional interest rate i_t^{unc} is negative or zero for the first seven quarters, during which period the ELB binds: $i_1 = ... = i_7 = 0$. Given this outlook, lift-off from the ELB according to the rule in eq. (3) is expected in the eighth quarter, in which $i_8 = i_8^{unc} > 0$.

The alternative path of interest rates, with FG, is depicted by the blue circled line in the left panel of Figure A.1. Here the policy rate is kept at zero for one additional quarter (i.e. the eighth quarter), although the unconstrained policy rule prescribes a positive interest rate in this period.

34 This is shown in Laséen and Svensson (2011) and Hebden et al. (2010).

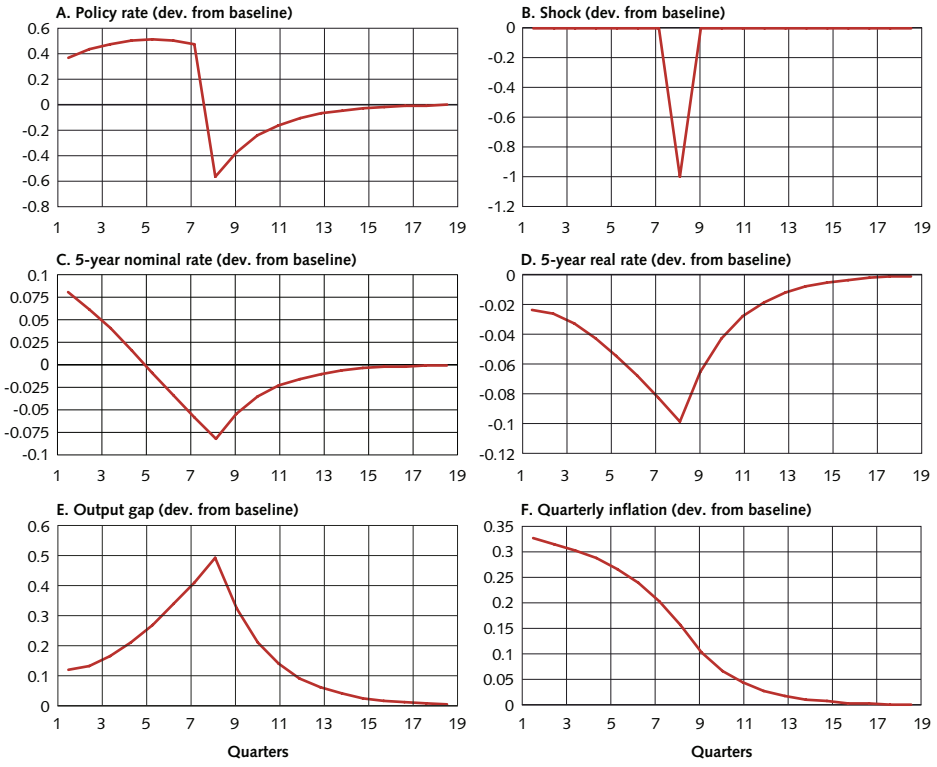
Figure A.1. Alternative policy interest rate paths and the effective lower bound



Source: Authors' own calculations

Why would this alternative policy rate path stimulate the economy? In essence, the policy works through two mechanisms. First, similarly to an unanticipated contemporaneous reduction in the interest rate, the announcement of a future policy rate reduction provides some immediate stimulus to the economy by putting downward pressure on long-term interest rates. Second, recall that policy is in fact presently constrained – the ideal policy rate is below the actual one: given the current economic outlook, the central bank would like to further decrease the interest rate. Now, because the future policy expansion is already boosting the economy, it relieves a bit of that constraint. Let us explain each transmission mechanism in turn.

Figure A.2. Impulse responses to an anticipated policy shock eight periods ahead



Note. Inflation and interest rates in annualized terms.

Source: Authors' own calculations

Figure A.2 shows what happens when the central bank credibly announces that it will reduce the policy rate two years from now. In model terms, the agents' current expectation is that the residual e_t in equation (10) will take the value -0.25 per cent two years from now (see panel B in the figure). Let us first inspect what happens at that particular date $t=8$, ignoring all other periods for the time being. The exogenous reduction in the short rate reduces the nominal long-term interest rate as shown in panel C, via equation (5). In the presence of price rigidities, this reduces the real long-term interest rate, thus increasing output and inflation according to equations (1) and (2) because the natural real rate r_t^{nat} is unaffected. This is reminiscent of the typical transmission of unanticipated monetary policy shocks. The added feature here is that this shock is announced to take place in the future. What distinguishes this anticipation from an unanticipated shock is that forward-looking households and firms (i.e. the basis for the behavioural equations) will not wait for the actual cuts of the policy rate: if the FG announcement is credible, they will incorporate that information into their decisions today. They understand that the real long-term interest rate (shown in panel D), which is what matters for their decisions, is unusually low at present. Thus, consumers – who value a smooth consumption path – will already start consuming

more today, in anticipation of future lax monetary policy. Similarly, forward-looking producers – who may not be able to reset their prices every period – will adjust their prices today. Therefore, as a result of the announcement of a low policy rate in the future, output and inflation increase on impact as shown in panels E and F. As usual, the policy rule (10) dictates that the central bank will (endogenously) lean against the wind: the policy rate will therefore be higher in the periods leading up to the expansion as shown by panel A in the figure.

However, in a situation where the ELB binds, the central bank will not carry out any interest rate hikes in the near term; consistent with its guidance it will keep the policy rate at its minimum until the two years have passed. To examine the implications of this behaviour, let us turn back to Figure A.1. Recall that given the current outlook, the central bank is constrained: it would like the policy rate to be lower (the black dashed line) than it can implement (the red solid line, which is drawn for an effective lower bound of 0 per cent). Announcing the future policy stimulus boosts the economy on impact, as we just saw in Figure A.2. Therefore, the current economic outlook becomes less dire due to the FG announcement, and the unconstrained policy rule therefore warrants a less expansive stance. Hence, under FG the target policy rate becomes less negative, and in our forward-looking model this relieves part of the constraint the central bank faces. This *indirect* intervention effect stems from the fact that the constraint on policy prior to the *direct* intervention period has become less binding, which implies that the shocks which implement the FG policy are invariably less restrictive (i.e. smaller) than the policy without it, as shown in the right panel in Figure A.1.

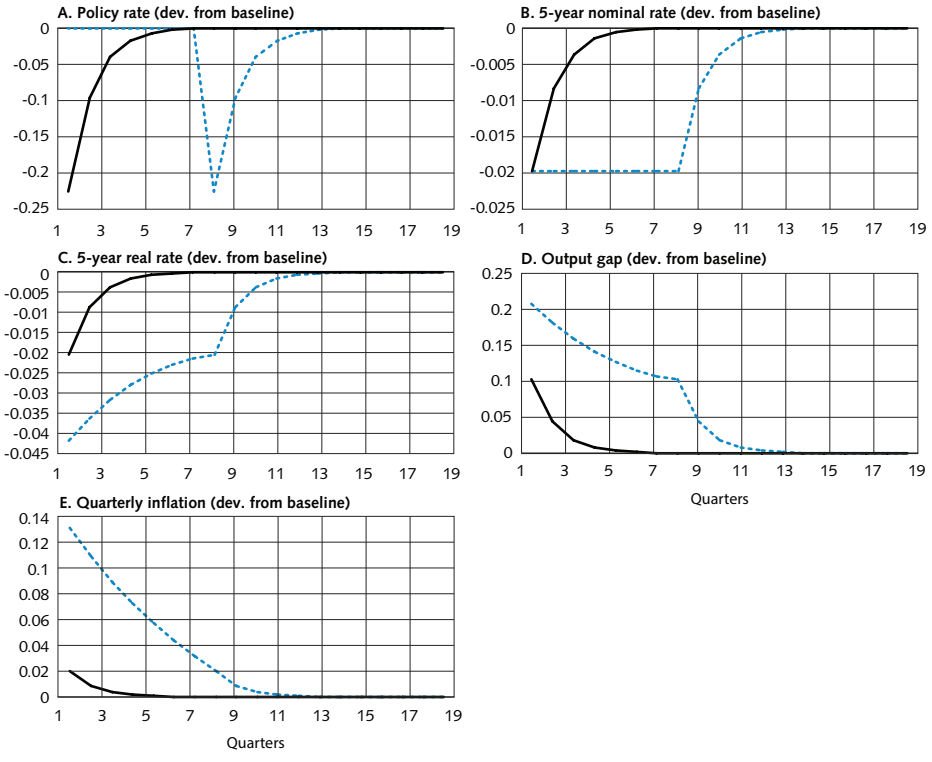
The two effects combined explain why FG may be a potent tool in an environment with downward restrictions on policy rates. Not only do anticipated shocks allow for an immediate onset of the expansion, but in doing so they also reduce the extent to which the effective lower bound (ELB in Figure A.1) binds.

To offer an alternative way of understanding why forward guidance may be effective, we compare FG with a standard policy rate intervention in Figure A.3. In the figure, the dashed line plots the effect of the FG policy in Figure A.1, i.e. a credible commitment by the central bank to keep the policy rate at zero for an additional quarter. Specifically, the FG path for the policy rate shown in panel A of Figure A.3 is computed as the difference between the FG path and the ELB path in Figure A.1. The paths for the other variables in Figure A.3 are calculated in the same way, relative to their evolution under the ELB.

Today's announcement of the low policy rate at $t=8$ (staying at the ELB for an additional quarter) implies an immediate drop in the nominal long-term interest rate (shown in panel B), which simply equals the average of the expected path of future policy rates in our simple model. Since there is no change in the policy rate for some time (it is at the ELB and remains there until $t=8$), the nominal yield curve thus *flattens* as a result of FG. Moreover, as prices only adjust gradually, the reduction of the nominal long rate translates into a lower real long-term interest rate (panel C in the figure, via eq. 4), and immediately stimulates economic activity as witnessed by the notable increase in output (panel D) and inflation (panel E).

Now, to provide a reference point for how significant these effects are, the solid line in Figure A.3 shows the effect of a standard policy intervention which reduces the policy rate *today* by the same amount with an equal degree of persistence. Accordingly, we see in panel A that the policy rate profile of both policies is the same, except shifted in time.

Figure A.3. Comparing forward guidance with conventional monetary policy interventions



Note. Inflation and interest rates in annualized terms.

Source: Authors' own calculations

Because the profile of the policy rates is the same, the impact effect on the nominal long rate – shown in panel B – is the same in both cases. However, contrary to FG, the policy rate falls substantially on impact, implying that the yield curve *steepens* in this case. Together with the fact that the policy rate recedes back to its baseline equally fast as under FG, this implies that a standard monetary intervention *today* results in a less long-lived reduction in the long rate. This is in marked contrast to FG, for which the policy rate cut occurs further in the future and thus implies a more long-lasting effect on long-term interest rates. This feature has significant economic consequences in our stylized model: a standard monetary policy expansion leads to a lower and less persistent fall in the real long

rate (panel C) and thus exerts a much smaller expansive effect on output and inflation as shown by panels D and E, respectively.

In sum, while the change in the policy rate is of the same magnitude in both cases, a credible forward guidance announcement by the central bank faced with the ELB has the potential to provide more stimulus to economic activity and inflation.

Nowcasting

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Nowcasting refers to methods for forecasting the current state of the economy and developments in the short term. For example, the National Accounts are published with a time lag and consequently no statistics are usually available for GDP growth in the current and preceding quarters when making a forecast. However, more up-to-date indicators are available and can be used in forecasting models to determine the current level of GDP growth. This article presents two ways of using large amounts of information to make forecasts in the short term, namely by aggregating many models and methods in which the weighting of series takes place prior to modelling. Particular focus is placed on how a dynamic factor model, with the help of more than 100 indicator variables at a monthly frequency can forecast quarterly percentage changes in GDP. We show that the model makes accurate forecasts. The factor model is also useful in understanding how the flow of information over time affects the forecasts for a macro variable. An application shows how GDP forecasts during the fourth quarter of 2008 were gradually revised downwards because the availability of new indicators changed the assessment of how the global financial crisis affected the Swedish economy.

1. Introduction

The repo rate affects the economy with a certain time lag. Forecasts therefore play an important role in the monetary policy decision-making process. In order to be able to make good decisions on the repo rate the Executive Board of the Riksbank must have quick access to reliable information on the current state of the economy and the most likely developments in the period immediately ahead, including uncertainties concerning the accuracy of the forecasts. A sound understanding of the macroeconomic situation is also a prerequisite for being able to make good assessments of developments in the long term. A forecast is built up by estimating where the economy is at present and is likely to be in the near future and then forming a view of where it is heading going forward. Depending on the forecast horizon, the Riksbank uses different models and methods to gain a good understanding of the development of the economy. In the case of the long forecast horizon, the Riksbank uses structural economic models that are based on theoretical economic links. For the shortest forecasts, the Riksbank uses statistical models that utilise empirical links in a large volume of available data.

* The authors would like to thank Claes Berg, Jesper Lindé, Mårten Löf, Caroline Richards, Carina Selander, Maria Sjödin and Ulf Söderström for their comments.

A large amount of indicator information is published at different frequencies. For example, financial market data, such as share prices and exchange rates, is available in real time, while the expectations of economic agents are observed every month, for example in the form of consumer confidence surveys and the purchasing managers' index. Another variable that is observed on a monthly basis is industrial production. Figures on this are published with a time lag of six weeks as it takes time to compile the data. Together, all the indicator variables comprise a large volume of time series at different frequencies that can be used, for example, to forecast GDP.

New statistical models that make use of this considerable flow of information have been developed over the last 10 years. In the case of the shortest forecast horizons, the forecasting performance of the statistical models improves when current indicators are included. As this improved forecasting performance relates to the current situation and the immediate future, these specific forecast models are usually referred to as nowcast models[1] in the world of central banking and in the research field. The Riksbank has reviewed its nowcast models, which we discuss in this article. In the first section of the article we discuss forecasts at different horizons. We then focus on nowcast models that are used for the shortest forecast horizons. In conclusion, we provide an example of how one of the nowcast models, the dynamic factor model, uses the flow of data to update the GDP forecast.

2. Different forecasting methods for different horizons

A forecast is built up by estimating where the economy is at present and then forming a view of where it is heading. It is normally assumed that the economy is moving towards a state of equilibrium, with normal resource utilisation, in which inflation is in line with the central bank's target. Due to publication time lags, that is the time it takes before new outcomes are published, we must also often make forecasts for the current situation and the immediate future. The current situation is the starting point for the forecast path that describes how the economy is expected to get from the current situation to the state of equilibrium. This three-step procedure for forecasting is described by Faust and Wright (2013) and comprises the following components (see Figure 1):

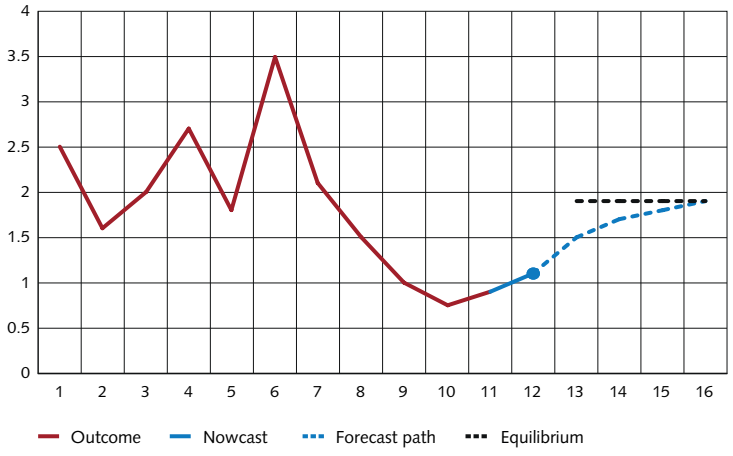
1. The current situation – *where* the economy is,
2. Long-term equilibrium – *where* the economy is going,
3. The path – *how* the economy will get from the current situation to equilibrium.

Usually, economic theory and estimated correlations in the data are used to understand and generate forecasts. In the case of the current situation, statistical models that utilise the historical correlations in the data are used. In the case of long-term equilibrium and the path that leads there, structural economic models that are more based on theoretical links

1 Nowcasting is used in meteorology as a term for weather forecasts for the next 12 hours. The term was introduced in the field of economics by Giannone et al. (2008).

are used. The economic and statistical models generate model forecasts with the help of a computer-based econometric programme. Even a very sophisticated model represents a simplification of reality and its results therefore need to be interpreted. Consequently, model forecasts are always complemented by analyses and assessments by sector experts. By using information that is not included in the models and insights that the models are not able to capture, these experts play an important role in the forecasting work.

Figure 1. Outline of a forecast showing nowcast, equilibrium and the forecast path between them



LONG-TERM EQUILIBRIUM AND THE PATH TO IT

In simple terms, we can say that long-term equilibrium in the economy arises when we ignore temporary seasonal and cyclical effects. In structural economic models, the long-term equilibrium[2] is determined by growth theory. There are two different categories of structural economic models and the Riksbank uses both.

The first is econometric models consisting of several equations that are often estimated on quarterly data from the National Accounts. In these models, the various components of the economy are described by single equations. The system of equations then simulates how the different components of the economy interact with each other. The assessment of the development of the economy in the long term is largely based on theoretical analysis, while the path taken is determined by patterns in the data. Moses[3] is one such model that is used by the Riksbank.

The other category of modern economic models are Dynamic Stochastic General Equilibrium models (DSGE[4]) of the new-Keynesian type. These models are based on the optimal behaviour of forward-looking consumers and producers. In such a model, the

2 Equilibrium should be understood as the state the economy is in when the effects of all shocks have faded. A shock is an unexpected disruption to the economy.
3 See Bårdsen et al. (2012).
4 DSGE models are based on the assumption that all markets return to equilibrium after the economy has been exposed to a shock that led away from equilibrium.

economy returns to its state of equilibrium because individual agents adapt their supply and demand. The Riksbank's main macroeconomic model is such a DSGE model and is named Ramses.[5]

FORECASTS OF THE CURRENT SITUATION

According to the approach in Figure 1, forecasts of the initial position differ from those for other horizons due to the access to indicator information. The horizon for nowcasts is usually the current and next quarters. Sometimes, however, the horizon may be six months after the latest National Accounts' outcome, as this is normally published with a time lag of six weeks. Such publication time lags thus mean that nowcasts sometimes have to be made after the event. This means that the term nowcast is somewhat misleading as it refers to describing the current situation. A forecast for the future, even if we mean the very near future, should really be called a "nearcast" and a forecast for an earlier period should be called a "backcast". Despite the fact that a backcast is conceptually different from a nowcast and a nearcast, the same statistical models are used for all three types of model forecasts. We can therefore view these models as one category and discuss them together. For this reason, we hereinafter refer to all these models as nowcast models.

A typical feature of nowcast models is that they use a large quantity of data and information from indicators that are available before the outcome of the forecast variable. An application with Swedish GDP as the forecast variable is presented later in the article. Nowcast models usually consist of statistical time series models that focus on regularities in economic and financial data. The good availability of a large amount of data has contributed to the development of new statistical procedures for exploiting this data. One such procedure is a factor model that compresses a large amount of data into a summarising measure, which makes it possible to estimate a relation between this measure and the forecast variable.

Nowcast models that use large amounts of data have become very popular at central banks.[6] This can be explained by the fact that powerful computers make it possible to make advanced and time-consuming calculations, but also by the fact that these models often produce a good forecast.

Publication time lags may lead to indicator information being published before an outcome for the forecast variable is published. Such complementary data therefore represents important input to short-term models if it is published at more frequent intervals than the forecast variable. One way of using information of this type is in bridge equations in which the higher frequency (for example a month) is bridged (converted) to the lower (for example a quarter). The bridging procedure is described in more detail in the section below.

5 See Adolfson et al. (2013)
6 See for example Norges Bank (2014).

3. Two nowcast models that can mix different frequencies

Here we will present two different types of nowcast model that can use a large amount of indicator information to improve forecasting performance. The first type consists of bridge equations that estimate many small models and then aggregate their forecasts. The second type consists of factor models that weigh together information in several series and then make a forecast based on the aggregate variable or factor.

BRIDGE EQUATIONS

Bridge equations are used to convert variables that are observed at different frequencies. Assume that we have a variable Y that is measured once a quarter and an indicator variable x_1 that is measured once a month. In order to forecast Y we must first convert x_1 to a quarterly frequency. In addition, the observations of x_1 usually stretch over a longer period than the observations of Y, but not always an entire quarter longer. Bridging takes place in two steps.

1. x_1 is extended with forecasts where necessary to "fill out" the quarter.
2. x_1 is converted to a variable (X_1) at a quarterly frequency with the help of the mean value or sum of the monthly observations carried out during the quarter.

With the bridged monthly variable one can then make a new model for the forecast of *Y*

(1) $$Y=a+b\times X_1+e,$$

where e is a (randomly distributed) error term. Using the equation, we can then forecast the next value of Y.[7] MIDAS[8] is a development of the bridge equation and makes it possible to estimate the equation without first converting the monthly indicator variable x_1 to the quarterly frequency X_1. The MIDAS equation relates the quarterly variable Y directly to the monthly variable x_1.

If more indicator variables are used we will get more forecasts for Y, one from each bridge equation. From the total number of model forecasts we can either try to select the "best" model or use information from all the models[9]. In the latter case, it is usual to calculate the mean value of the model forecasts or to study the entire distribution.

FACTOR MODELS

Another type of nowcast model is the factor model, which compresses the information in a large number of indicator variables into a few summarising factors. In order to illustrate the factor concept we posit two indicator variables x_1 and x_2 and that they have a common underlying, non-observable factor f in accordance with the following model

7 Note that the bridged variable X_1 (due to outcomes and projections) can be treated as observed a quarter beyond Y.
8 MIDAS stands for MIxed DAta Sampling, see Ghysels et al. (2007)
9 See Kuzin et al. (2013)

(2) $x_1 = c \times f + e_1$
$x_2 = d \times f + e_2$

where e_1 and e_2 is the variation that is unique for x_1 .respectively x_2, while the factor f is common. The estimated factor $\hat{f}$ can be seen as a weighted aggregate of the observed variables

(3) $\hat{f} = L_1 x_1 + L_2 x_2$

where the weights L_1 and L_2 are estimated with the help of principal component analysis[10]. Although we show two variables in the example there is no limit on the number of variables. The factor model is used to reduce the information in hundreds of indicator variables to a few common factors. For example, a common factor can be interpreted as a business cycle. The starting point then is that there is only one common cycle whose cyclical variation affects the different sectors of the economy. It is also the case, however, that even if the business cycle is clearly expressed in many macroeconomic variables it is in actual fact not possible to observe it. One way of capturing the business cycle is by using the estimated common factor $\hat{f}$. The Riksbank's indicator of resource utilisation, the RU-indicator[11], is one example of this. The RU-indicator is estimated as a non-observable factor with the help of labour market data and survey data from the Business Tendency Survey of the National Institute of Economic Research. This measure of the business cycle can then be used in, for example, bridge equation (1). In this way, we can use the information in a large number of macroeconomic variables to make forecasts for the variable Y.[12] We can also model the interaction and the dynamics between the variable Y and the measure $\hat{f}$. The interaction means that *Y* and $\hat{f}$ mutually affect each other. Dynamics here means that Y and $\hat{f}$ are affected by their own histories. One example of such a multiple equation system is the Factor-Augmented Vector Autoregressive model (FAVAR).[13]

MORE THAN JUST FORECASTS

The forecasting performance of the factor model that calculates a statistical measure of the economic situation is normally good. Understanding the underlying economic forces that govern the forecasts is also important, not least for the decision-makers. This has led to the development of methods[14] that that make it possible to quantify the underlying driving forces. Forecasters can themselves define a driving force as a single indicator variable or as a group of indicator variables. If we continue with the example in which we have a forecast

10 Principal component analysis is a statistical method that calculates the linear combination of the variables that explain as much as possible of the variance in the data. The first principal component then follows the direction in which the data varies most. By using the principal components that summarise the main part of the variation we can represent a large proportion of the information in a few components.
11 http://www.riksbank.se/sv/Statistik/Makroindikatorer/Resursutnyttjandeindikatorn-RU-indikatorn/
12 See Stock and Watson (2002) and Marcellino and Schumacher (2010) for the MIDAS factor.
13 See Bernanke et al. (2005) for an application to monetary policy.
14 See Bańbura and Modugno (2014).

variable Y and an estimated factor $\hat{f}$ based on two indicator variables x_1 and x_2, we can with the help of the factor model (3) above substitute in the indicator series.

$$4) \qquad Y=\alpha+\beta\hat{f}+\vartheta=\alpha+\underbrace{\beta L_1 X_1}_{\substack{Contribution\\ from\ x_1}}+\underbrace{\beta L_2 X_2}_{\substack{Contribution\\ from\ x_2}}+\vartheta.$$

This is the simplest way to divide up the indicator variables' contributions to the forecast for the variable Y. The forecast for the variable Y is then gradually updated as new observations of the indicator variables become available. To do this, we need data from two different points in time. Assume that the later body of data is the previous body of data plus new observations for some of the indicator variables (for example variable X_1 in equation 4). If the new observations are exactly in line with those that the factor model predicted, then the forecast is not revised. If, on the other hand, the outcome for an indicator variable deviates from the earlier forecasts of the factor model, then the forecast for Y will be revised.[15] The size of the revision depends on how big a surprise the indicator is (that is the forecasting error for X_1) and how relevant the indicator is for the forecast variable (that is the term βL_1 in equation 4).[16] The division of the factor model in (4) can therefore quantify news contributions, that is how surprises in the flow of information from one or more indicator variables lead to forecast revisions for the variable Y. Such news interpretation can be formulated as follows: "As the growth rate for industrial production was lower than expected (according to the model) the GDP forecast has been revised downwards by x percentage points".

4. A factor model for Swedish GDP

Above we discussed two different types of nowcast model that can use a large amount of indicator information to improve forecasting performance. In this section we provide an example of how one can use the dynamic factor model. In the example, quarterly percentage changes in seasonally-adjusted GDP are forecast and analysed.

We first study how accurate the factor model's forecasts have been on average.[17] We then use the model to study the fourth quarter of 2008, when GDP growth was surprisingly low due to the global financial crisis.

15 If X_1 and also X_2 are included in the model above then it will be natural to measure how Y changes when X_1 and X_2 deviate from the model's forecasts of them.

16 In the empirical example below we also correct for the indirect effect of the forecasting error for X_1 affecting the contribution of X_2 even if there is no new observation for X_2.

17 As the model was not in use at the Riksbank we have conducted a study "as though we had" used the model.

INDICATORS OF GDP

126 indicator variables that are measured every month are used for the illustration of GDP. The indicators come from different parts of the economy:

i) indicators that affect the business cycle (such as monetary policy, fiscal policy, developments abroad and terms of trade),

ii) variables that react at an early stage to the business cycle (such as corporate profits and stocks of manufactured goods),

iii) series that measure the beginning of a production chain (such as incoming orders and approved building permits),

iv) the expectations of economic agents (such as consumer and producer confidence, the purchasing managers' index and the share index).[18]

Category iv) differs from the others as it consists of the survey responses of various economic agents. In its Business Survey[19], for example, the Riksbank attempts to acquire up-to-date information on developments in the business sector by interviewing companies that predominate in their sectors and then quantifying the responses to form an indicator of economic activity. This means that the information is available long before the official statistics are published.

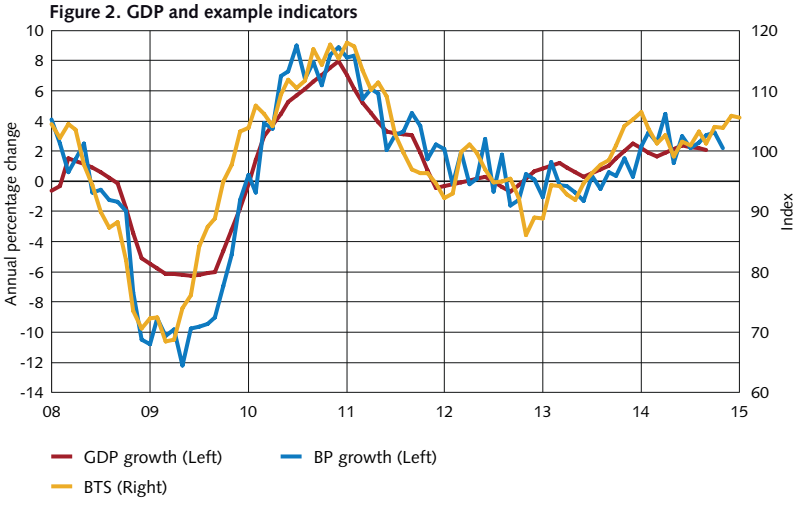
Survey responses are sometimes referred to as soft data, while hard data may for example be the statistics included in Statistics Sweden's calculation of GDP. Survey data becomes available before hard data, but hard data is considered to contain more reliable information. Figure 2 shows GDP together with two indicators: a hard data series, namely production in the business sector (BP), and a soft data series, the Business Tendency Survey (BTS). The first thing we can see in Figure 2 is that there is a lot of background noise[20] in the indicators. Neither of the two series can explain GDP. This shows that it is difficult to forecast GDP, but it also demonstrates the importance of studying many indicators and trying to extract the common information embedded in them. Figure 2 also shows that the indicator information stretches further into the future than GDP does. We can also see that BTS stretches a month further than BP.

18 The points describe a conceptual division of available indicators. In the empirical example below we have dived the indicators into the categories real, financial, surveys, foreign and prices as this provides a clear way for the forecaster to interpret the flow of information.

19 See Hokkanen et al. (2012).

20 The term background noise refers to movements in the indicators that do not help to explain movements in GDP.

Figure 2. GDP and example indicators



Note. All three series are at a monthly frequency. GDP and BP (production in the business sector) are published by Statistics Sweden. BTS (the Business Tendency Survey) is an index series that is shown on the right axis and is published by the National Institute of Economic Research. BP and GDP are shown on the left axis in terms of the annual percentage rate of change. GDP is a time series at a quarterly frequency that is linearly interpolated to a monthly frequency.

Other examples of indicators used in the factor model for Swedish GDP are financial variables and international variables. The financial markets are a rich source of highly-frequent information where data on expectations of the future is continually updated. The international situation is important to Sweden and it is therefore also important to study variables from other countries, both for the forecasts themselves and in order to understand the economic situation. All-in-all, we have compiled a database consisting of 126 leading indicator variables at a monthly frequency.

FORECASTING ACCURACY

Based on this database, we have carried out a forecast evaluation for the dynamic factor model with regard to the quarterly growth of GDP. The evaluation period covers 28 quarters from the first quarter of 2005 until the fourth quarter of 2011. For each quarter during this period we have re-estimated the factor model from several points in time before and after the quarter the forecast relates to. For example, in the forecast for the first quarter of 2005 we used data that was available at the beginning of September 2004. The next forecast for the first quarter of 2005 is based on information from October 2004. As a month has passed between the two forecasting occasions an additional observation is available for each indicator variable that can be used to forecast GDP for the first quarter of 2005. Then a further month passes before we make yet another forecast for the same variable. Forecasts based on an increasing amount of data are made eight times until Statistics Sweden publishes the actual outcome for GDP growth in the first quarter of 2005

in May 2005. This means that we will have produced four forecasts from September to December that are thus made between six and three months before the end of the quarter in March 2005. Then we have a further three nowcasts from January to March. These will thus have been produced in the period between the two months preceding the end of the quarter and the actual end of the quarter. Finally, we have a backcast produced in April, that is one month after the end of the quarter. All-in-all, we have therefore produced eight different forecasts for the first quarter of 2005. Replicating this pattern, we have produced eight different forecasts for all of the 28 quarters in the period 2005 to the end of 2011.

In order to get an idea of the forecasting performance of the dynamic factor model we compare it with a simple model[21] that delivers a forecast that is the mean value of GDP during the period. We calculate the factor model's relative forecasting performance with the square root of the ratio between both of the models' root mean square error – relative RMSE.[22] In this measure, a value less than 1 means that the forecasting performance of the dynamic factor model is better than that of the simple model. The RMSE measure has several advantages. One is that positive and negative errors do not "cancel each other out" as the forecasting errors are squared. Another advantage is that bias (mean forecasting error) and the distribution of the forecasting errors are summarised in the measure.[23] This means that a forecaster who constantly has a small forecasting error is punished just as much as a forecaster who makes a significant forecasting error just once.

Figure 3 shows the forecast evaluation for the factor model in the example. The three lines refer to the average relative RMSE for the factor model compared to the simple model. The unit on the x axis is the number of months before the end of the quarter, which relate to the eight forecasting occasions for each quarter in the example. The average of the relative RMSE is calculated during three different periods. The yellow line shows the relative RMSE throughout the evaluation period from 2005 to the end of 2011. The yellow line is below 1 for eight months, which means that the forecasting performance of the dynamic factor model is better than that of the simple model. This result is explained by the fact that the factor model uses the information provided by observations of the indicator variables, while the simple model only takes the historical data on GDP into account. Moreover, the yellow line slopes upwards, which means that forecasting performance improves during the nowcasting months when there is better access to already published data than during the forecasting months when there is limited access to such data.

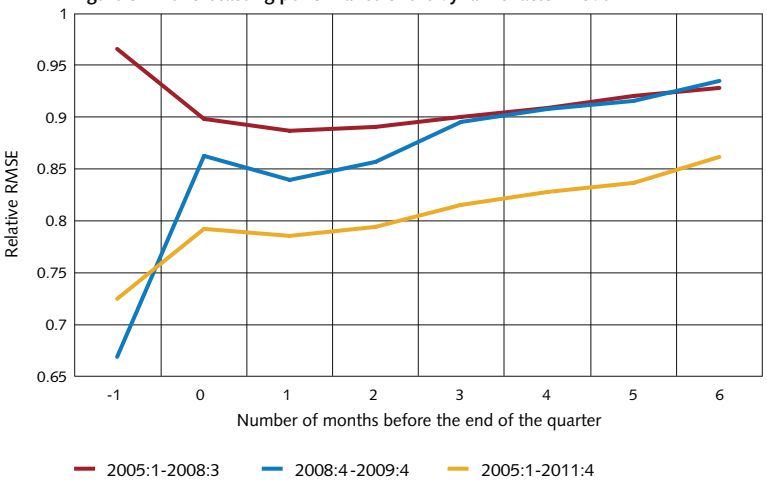
21 The simple model is univariate and uses only historical GDP outcomes. A better comparison is made against other methods that also use indicators such as the bridge equation (1). The forecasting performance of the dynamic factor model is better according to studies by Kuzin et al. (2013), Marcellino and Schumacher (2010) and Rünstler et al. (2009).

22 The RMSE (Root Mean Square Error) is calculated as the root of mean squared forecasting errors. The forecasting error is defined as the outcome minus the forecast. The relative RMSE for forecasts A and B is RMSE(A)/RMSE(B).

23 Bias (or the mean forecasting error) is an important statistic to study as it tells us something about the forecasts' systematic deviation from the outcomes. However, for means of comparison it is more reasonable to use the RMSE as this measure summarises bias and the variation in forecasting errors. It is not enough to be right on average if one nevertheless has significant individual forecasting errors. Both bias and the RMSE (and/or some other measure) are normally reported.

In addition to the entire period, averages have also been calculated for the stable period prior to the financial crisis and the most turbulent period during the crisis when GDP exhibited relatively substantial fluctuations. The first period refers to the first quarter of 2005 to the third quarter of 2008 and is illustrated by the red line in the figure. The second period refers to the fourth quarter of 2008 to the fourth quarter of 2009 and is illustrated by the blue line. The blue line shows that the dynamic factor model made best use of the indicator information in the nowcasting months during the turbulent period.[24]

Figure 3. The forecasting performance of the dynamic factor model



GDP FOURTH QUARTER 2008 – FORECASTS AND EXPLANATION OF REVISIONS

In the section above we studied the average performance of the factor model. We will now examine how the model performed for the final quarter of 2008 in a little more detail. With the new information and the updated forecast for the fourth quarter we can determine the news contributions from five groups.[25] The model is then re-estimated each month until Statistics Sweden publishes the actual outcome for GDP growth in the fourth quarter, which it does in February 2009.[26] The five groups are real indicators, financial indicators, surveys, international indicators and price indicators.[27] The division partly follows the availability of data. Financial data is available in real time while survey and price data become available with a certain time lag, although they are published much earlier than real data. Real data mostly consists of industrial production. Financial is data on interest

24 Note, however, the Figure 3 shows relative RMSE. The forecasting performance of both models deteriorates during the financial crisis, although the deterioration in the performance of the dynamic factor model is relatively less.

25 Decomposition is carried out using the method outlined by Bańbura and Modugno (2014).

26 We use the same data as in the forecast evaluation, except that we use real time data for GDP.

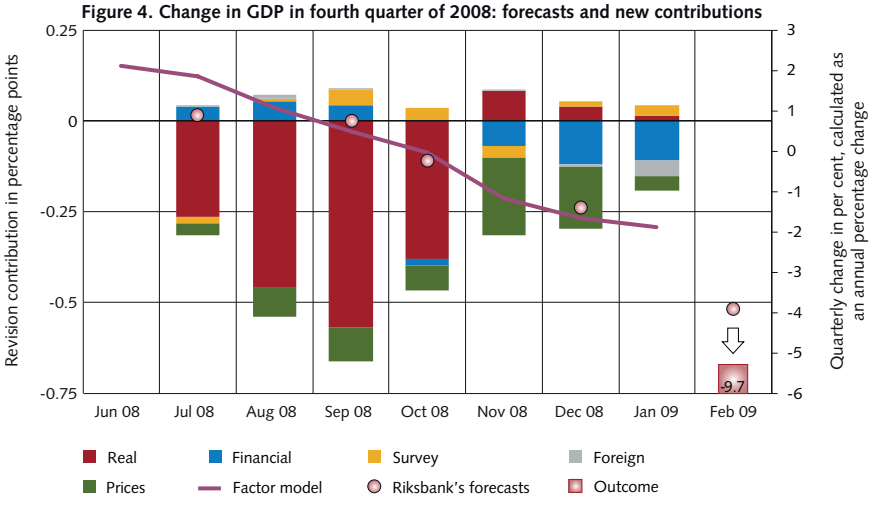
27 The indicators are taken from Swedish and foreign national accounts, consumer price indexes and surveys. Examples of such surveys in Sweden are the Labour Force Survey and the surveys of the National Institute of Economic Research.

rates at different maturities, interest rate spreads and exchange rates. Survey data refers to the surveys of the National Institute of Economic Research and various purchasing manager indexes. Statistics of various types are taken from abroad, particularly the euro area and the United States. Price indicators, finally, consist of both consumer and producer prices and world market prices.

Figure 4 shows forecasts from the various points in time together with news contributions from the five indicator groups. The factor model's forecasts are shown in the unbroken line, which refers to the quarterly rate of growth calculated as an annual rate on the right axis. The red rings refer to the forecasts that the Riksbank published between July 2008 and February 2009 in its Monetary Policy Reports. News contributions from revisions of the indicators are shown in percentage points on the left axis. The total sum of the five indicator groups represents how much the forecast has changed since the previous month. The forecast in July (2.1 per cent) was for example 0.3 percentage points lower than in June (1.8 per cent), which is shown as a downward sloping unbroken line between the two months on the right axis. The forecast revision of minus 0.3 percentage points is also shown on the left axis as the net sum of the individual columns. We can also see that the major part of the news contributions, that is –0.27 percentage points, comes from the red column, which refers to real variables. This can be interpreted to mean that the economic downturn was more severe than the factor model predicted. This pattern is repeated throughout the third quarter. The forecasts from the summer of 2008 predicted moderate growth. The factor model forecast was thereafter gradually revised downwards and the largest contribution during the autumn came from the hard real indicators. The factor model forecast predicted zero growth in September and shrinking GDP in October. Lehman Brothers went bankrupt at the middle of September 2008, which led to a financial and real shock wave that swept through the global economy. The reactions of the financial markets, in the form of interest rate cuts and weaker exchange rates, can be seen in negative contributions from financial data after October. Similarly, the collapse in oil prices provided a negative contribution from price indicators. All-in-all, the factor model led to a further downward revision of the forecast, to –1.9 per cent, in January 2009. The model's forecast from January is nevertheless far above the outcome that was published at the end of February 2009, which was –9.7 per cent.

It is worth noting that the factor model has been estimated on the basis of historical correlations between GDP and the indicators as they have been in "normal" times. Events such as the bankruptcy of Lehman Brothers and its widespread consequences are highly unusual. Both standard forecasting models and professional forecasters made historically large forecasting errors when the attempted to estimate GDP growth in the fourth quarter of 2008.

Figure 4. Change in GDP in fourth quarter of 2008: forecasts and new contributions



Note. The line in the figure shows factor model forecasts for GDP in 2008:4 at various points in time. The circles show the forecasts that the Riksbank published between July 2008 and February 2009. The square presents the outcome that Statistics Sweden published at the end of February 2009. The columns show new contributions to revisions of the model forecast and add up to the difference in "the line" between two points in time. Note that the forecasts (the line and the circles) are shown on the right axis and the revision contributions on the left axis.

Sources: National Institute of Economic Research, Macrobond, national statistics agencies and the Riksbank

Figure 4 also compares the factor model's GDP forecasts with the assessments the Riksbank published in five monetary policy reports during the period July to February. The Riksbank's forecast in the first report, in February 2009, was historically speaking very low, but the outcome was significantly lower.[28] Other Swedish forecasters made assessments similar to those of the Riksbank during this period.[29] The factor model forecasts and the Riksbank's published forecasts were relatively concordant, apart from during the summer when the model forecasts were slightly more optimistic. The example suggests that the forecasting performance of the factor model holds up well compared with that of professional forecasters. In addition, the factor model quantifies how news in the flow of data lead to forecast revisions.

28 Note that the figure –9.7 per cent shown in Figure 4 is the quick estimate that Statistics Sweden published in February 2009. The actual figure for the fourth quarter of 2008 is –15.4 per cent.

29 See Figure 2.9 in Riksbank 2009.

5. Summary

In order to gain a quick impression of how the economy can be expected to develop in the period ahead, central banks use models of different types. One particular type is nowcast models, which focus on regularities in the data and are used to forecast the current situation and the immediate future. The current situation is the starting point for the forecast path that describes how the economy is expected to get from the current situation to the state of equilibrium.

The Riksbank's nowcast system has recently been extended with models that explicitly take into account the fact that indicator variables are observed at different frequencies and are published with different time lags. A further feature of the new forecasting methods is that they enable interpretations of the economic driving forces that lie behind a model forecast or a revision.

The dynamic factor model is one of the models that has been introduced as part of the Riksbank's nowcast system. In an evaluation of GDP forecasts during the period 2005-2011, we have shown how the model's use of indicator variables helped to improve forecasting performance. We have also shown in the article how the factor model forecasts for Swedish GDP in the fourth quarter of 2008 have been revised in line with the Riksbank's published forecasts. In addition, we have illustrated how one can quantify the news contributions coming from different sectors of the economy to forecast revisions.

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