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Dear readers,

2018's second edition of the Economic Review covers both broad and more specific issues relevant to the Riksbank. Two articles have been written by former and current advisers to the Riksbank and discuss the Riksbank's 350-year history and the interaction between fiscal policy and monetary policy. The other articles are written by economists working at the Riksbank and describe the various operational frameworks for implementing monetary policy used by the Riksbank since the mid-1880s, and a method for calculating market expectations of inflation by using yields on nominal and real government bonds. A little more detailed information on each article is provided below:

• The political economy of the Riksbank

Torsten Persson describes important historical reforms of Sweden's monetary institutions to ensure price stability and a safe and efficient payment system. The article takes a stepping stone in modern institutional economics, where institutional reforms are seen as the result of large and important events, or of conflicts of interest. The author argues that the Riksbank's history over 350 years often repeats itself. With regard to the payment system, the question of competition vs. monopoly reoccurs over and over again. With regard to price stability, the focus alternates between, on the one hand, the importance of a nominal anchor and, on the other hand, the short-run temptation to use the power over money.

Sweden's fiscal framework and monetary policy

Eric Leeper's article reminds us of the important insight that basic economic theory suggests that monetary policy and fiscal policy always jointly determine aggregate demand for goods and services and the general price level in the economy. In his article, Leeper analyses Sweden's monetary and fiscal policy frameworks in light of this insight. He argues that the theory and recent developments in Swedish inflation and interest rates raise the question of whether the two macroeconomic policy frameworks are mutually consistent.

The Riksbank's operational framework for monetary policy 1885–2018

Peter Sellin describes how the Riksbank's operational framework for steering interest rates in the economy with various types of economic instrument has changed since the mid-1880s. He shows how these changes have been driven by changes in the environment in which the Riksbank operates as well as by the stated aims of its monetary policy.

Liquidity premiums in the Swedish inflation-indexed government bond market

Lisa Alexandersson writes that the difference between nominal and real bond yields, the so-called inflation compensation, has become an important source of information for central banks in measuring market participants' inflation expectations. Unlike other measures of expectations, such as questionnaires, the inflation compensation can be based on high-frequency data. However, studies have shown that inflation compensation is affected by risk premiums, such as liquidity and inflation risk, which can reduce their information value. In this article the author develops a method for taking these premiums into account, and presents corrected measures for market participants' true inflation expectations available daily.

Read and enjoy!

Jesper Lindé and Marianne Nessén

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The political economy of the Riksbank

Torsten Persson*

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What important changes have Sweden's monetary institutions – regarding price stability and a safe and efficient payment system – undergone over time, and what forces have driven these reforms? This article uses modern institutional economics as a starting point, where one regards institutional reforms as the result of large and important events, or of conflicts of interest. The presentation shows how the Riksbank's history over 350 years often repeats itself. With regard to the payment system, the question of competition or monopoly is repeated over and over again. With regard to price stability, the focus alternates between, on the one hand, the importance of a nominal anchor and, on the other hand, the short-run temptation to use the power over money.

1 Introduction

We have gathered here in the Riksdag, the Swedish parliament building, on this beautiful May morning to celebrate the Riksbank's 350th anniversary.

Over these 350 years, the Riksbank has been housed in four different buildings. Its history began with twelve years in Axel Oxenstierna's palace at Storkyrkobrinken in the old town, followed by 225 years in Södra Bankohuset at Järntorget, also in the old town. After that the Riksbank resided here in this building on Helgeandsholmen for several years – one of two good reasons for us to gather here – and finally it has been housed in more modern premises at Brunkebergstorg since 1976.

Now, I do not intend to discuss architectural design – other than in a figurative sense. For those who are curious about the history of Sveriges Riksbank are also curious about the design of Sweden's monetary institutions. When I say monetary institutions, I refer of course to the two objectives that are inscribed in the introductory paragraph of the Sveriges Riksbank Act. As we know, the objective of the Riksbank's activities is to maintain price stability. The Riksbank shall also promote a safe and efficient payment system. In daily speech, we refer to price stability and financial stability. Economics textbooks talk about two of the fundamental functions of money in the economy, namely to function as a store of value and as a means of payment.

History in terms of calendar or function There are different approaches to examining history. One is in terms of the calendar – to consider events on a time line. There is a large amount of material on the Riksbank's time line. The fact is that a great deal of this material came about in connection with earlier anniversaries. One interesting example is Sven Brisman's book from the 250th anniversary about the Riksbank's early history and David Davidson's review of this book in the journal Ekonomisk Tidskrift (Brisman 1918 and Davidson 1919, which I strongly recommend you to read!). A number of newer books also provide important insights. One is Gunnar Wetterberg's magnificent work Money and Power (Wetterberg 2009). Other gems include three books with the same editors, namely Rodney Edvinsson, Tor Jacobson and Daniel Waldenström, who are all present here today. The first two books are Sweden's historical monetary statistics and entail many useful readings

^{*} This article is based on a lecture held by Torsten Persson on 25 May 2018 in connection with the Riksbank's 350th anniversary conference at the Riksdag (the Swedish parliament). The author would like to thank Marianne Nessén and Anders Vredin for their input and Fabian Sinn for assistance with data and diagrams.

(Edvinsson et al. 2010 and Edvinsson et al. 2014). The third book, which was written for this year's anniversary, will be presented to us this afternoon, when several of the authors speak about the contents (Edvinsson et al. 2018).

But one can also take a more functional approach to history. This is the angle I have chosen today. It involves asking the question: what driving forces do we see repeating themselves over time? To establish this angle, I shall take a stepping stone in modern institutional economics. Accordingly, institutional reforms arise either in connection with major and important events, shocks, in the surroundings and/or when new and growing conflicts of interest challenge the current order. As we will see, history repeats itself several times, albeit in different forms.

Institutions' driving forces It is possible to illustrate my approach by means of a simple matrix. Figure 1 illustrates that reforms in the institutions regarding price stability or the payment system will arise when the prevailing institutions and various challenges collide with one another. When I say institutions, I mean the existing regulatory frameworks or provisions, quite simply the prevailing system. When I say challenges, I mean important events or growing conflicts of interest. The challenges can have different origins: technological or financial innovations, events outside of Sweden's borders, or developments in domestic policy. We will see a number of collision points that will help us understand the development of the institutions.

Challenges Institutions	Innovations	Foreign developments	Domestic policy
Price stability			
Payment system			

Figure 1. Institutions and challenges

2 Challenges to the payment system

Let me begin by looking at the payment system. All economies begin their economic transactions with some form of barter system. But this is quite inefficient. When the economy becomes more complex, society instead changes over to some form of coinage. In Sweden this took place during the Middle Ages, although different parts of the country still had different payment systems. As the state became stronger, the payment system became more uniform, even though several different types of coins made of both silver and copper still circulated. During the middle of the 17th century, for instance, ten Daler coins minted in copper plate and weighing 19.7 kg were in use. Obviously, this means of payment did not make for very smooth transactions, even if it was better than the barter system.

During this period, there were establishments on the continent known as exchange banks, where one could hand over one's coins and receive a certificate of deposit in one's hand that could then be redeemed at a later date. One of the most well-known exchange banks was in Amsterdam.

The birth of the Riksbank Meanwhile, Johan Palmstruch moved from Amsterdam to Sweden and received a special licence to open a bank in Stockholm in the 1650s. His

Stockholm Banco actually became the first bank in Europe to issue banknotes for fixed amounts, in connection with lending to the general public. These banknotes began to circulate in the economy and quickly became very popular. One example was a note that represented one hundred Daler in silver coins. That is, a piece of paper instead of 197 kg of copper. It is easy to see that this was an interesting innovation that many people were willing to adopt.

The Palmstruch bank did not last very long. We experienced Sweden's first banking crisis, the estates of the realm closed the bank, prosecuted Palmstruch and forbade the issuing of banknotes in the economy. But it did not take long before the estates opened the bank again. People remembered the bank and there was considerable demand for a smoother means of payment, as well as for deposits and lending. One could jokingly say that the state needed to borrow money, the aristocracy needed a private bank, the merchants needed a merchant bank and the priests blessed the whole idea. Even if the farmers did not want to climb on board until the 19th century, this meant that Stockholms Banco became a bank under parliament. And this is of course the second reason why today's anniversary celebration is located in the Riksdag.

The bank's position with regard to parliament has changed over the years and its relation to the Crown has varied in line with changes in the constitution. So if one wants to summarise the emergence of the Riksbank, one can say that Sweden's first banking crisis in the bank that issued Europe's first banknotes led to the establishment of the world's oldest central bank. What do you know!

The Riksbank's own innovations Time passed and many people were still interested in a smoother means of payment. Some improvement occurred when the Riksbank began to issue so-called transport bills in the early 18th century. These transport bills were certificates received when depositing copper or silver coins with the bank, showing the depositor's name. The bills could be used in payment, but their administration was rather complicated, one had to formally transfer the transport bill in a legal manner to another person with regard to the original amount of the deposit.

It was therefore a much greater leap forward when the Riksbank began to issue banknotes in fixed denominations in the 1740s. These were anonymous and needed no transfer to another named person. An important driver behind this innovation in the Age of Liberty was that the state needed money. The reigning Hat Party had started a war against Russia. This was very costly and the state borrowed from its own bank and used the new banknotes to buy goods.

The private banks' means of payment A century on, the economy was beginning to grow in earnest, first because of the Great Partition and later on because of industrialisation. As incomes increased, the first savings banks were established in the 1820s and the first commercial banks in the 1830s. Now not only the Riksbank but also the private commercial banks filled the demand for a means of payment. Figure 2 shows two banknotes: a one-krona banknote issued by the Riksbank and a hundred-krona banknote issued by Stockholms Enskilda Bank, both from the middle of the 1870s. Here the private banks became part of the payment system in parallel with the Riksbank, and they competed with the Riksbank not merely with regard to issuing banknotes, but also with regard to deposits and lending.

Figure 2. Private and public sector banknotes



Unclear division of responsibilities public – private But the roles of the private and public banking systems were not clear. The fact is that the relationship between the Riksbank and the private banks became a political bone of contention. The farmers – who at this time had a strong position among the estates of the realm, and later within the new parliament – tried to influence the Riksbank to block the expansion of the commercial banks. But the merchants and the new industrialists wanted to pave the way for these banks and made use of their influence on the government, which had power over economic policy and banking legislation. The separation of powers between the government and parliament in the 1809 constitution made it difficult to agree and to make progress.

But the confusion was dispersed to some extent with the 1897 Riksbank Act. Karl Langenskiöld was a very important figure in bringing about this legislation. He also became the first Riksbank Governor under the new Act. This meant that the Riksbank was given a monopoly on issuing banknotes and the country's only banknote office was located at Södra Bankohuset on Järntorget square in the old town. The Riksbank Act refined the division of labour with regard to the private banks. The Riksbank was given the sole right to issue banknotes and became a bank to the banks, rather than a bank to the general public.

History repeats itself Developments continued during the 20th century. We gained modern payment systems and later on enjoyed further innovations in the private banking-sector: cheques, a giro transfer system, and payment cards, all connected to private bank accounts. And the Riksbank became, as I mentioned before, bank to the banks and cleared transactions between the banks.

Gradually, we gained the latest technology, and are now facing increasing digitalisation of physical transactions. It is quite interesting to see a discussion strikingly similar to that held during the 19th century being replayed today. It applies to the same conflicts of interest and same questions of principle. Should there be competition or should there be a monopoly with regard to means of payment? In favour of competition is the fact that we want to take advantage of private innovations. In favour of a monopoly is the fact that we cannot be certain that a payment system in private banks will remain stable. It is thus not so easy to have a payment system that is both safe *and* efficient at the same time, despite the wording of the Sveriges Riksbank Act. Historically, the development of the institutions has rather been a case of balancing the objectives of safety and efficiency.

3 Banking crises and financial stability

Evidently, the safety of the banking system concerns banking regulations, bank crises, and financial stability, so let me say a few words about these too, before I move on to price stability.

Early crises A number of early banking crises struck the only existing bank at the time. As I mentioned, Sweden's first bank, Palmstruch's Stockholms Banco, had to close down and a ban on banknotes was introduced. The background to this was the first 'bank-run' crisis in 1664, when worried depositors flocked at the bank to withdraw their deposits. Their concern was that the bank had lent too much money and would not be able to pay back all the depositors. There was panic on the streets and the bank was forced to close down.

The Riksbank itself got to experience a bank crisis in connection with the Great Northern War. When Charles XII's war fortunes turned around at Poltava in 1709, those who had deposited money in the Riksbank became worried that they would not get their money back, as the bank had lent large sums to the king. They wanted their deposits returned and it was necessary to freeze deposits and lending and keep them frozen for a couple of decades.

Private bank crises Then we come to the 19th century, when private commercial banks in particular took on an important role in the funding of the new industrial companies, the new railways and other infrastructure projects. Moreover, there was a fairly large capital import during the first real wave of globalisation that swept across the world from approximately 1870. This was the time of the first private bank crises. Some of the crises were imported, others were home-made. Banks come under great stress. During the 'Panic of 1857', the authorities were forced to step in and save Skånska Banken, while during the 1878 railway crisis they had to give emergency liquidity assistance to Stockholms Enskilda Bank. The banks fared a little better during the 1890 Baring crisis, but the authorities were ready to provide credit nevertheless.

20th century regulation cycle In this period we see a number of new public authorities with tasks concerning financial supervision appear, but the division of responsibility between them and the Riksbank is not clear. This applies to Hypoteksbanken and to the Swedish National Debt Office. There are discussions on new regulations and new instruments. Who should provide emergency liquidity assistance? Who should act as 'lender of last resort'? Should the interest rate be used to cool down the economy when it becomes overheated? It was used as a short-run policy tool for the first time during the Baring crisis in 1890, when the discount rate was used to intervene.

One can describe the whole of the 20th century as a kind of cycle between bank crises and regulations. This was especially apparent during the first decade, when we had new banking crises in the years 1903 and 1907 and new banking acts in the years 1903 and 1907. The first proper supervisory authority, the Bank Inspection Board, was established in 1907.

A few decades later came the Kreuger crash and the Great Depression of the 1930s, which had a huge effect, not least psychologically. After the war, both the economy and the financial markets were regulated.

During the 1980s, a process of deregulation took place. One reason for this was the global wave of deregulation; when other countries were deregulating, Sweden's capital controls began to leak like a sieve. The controls became difficult to maintain and were phased out during the second half of the decade. Another reason is that the state needed to finance a large budget deficit within Sweden. This meant that the interest-rate regulation became unsustainable; one cannot force the banks to hold an unlimited amount of government bonds. So during a few years at the beginning of the 1980s, the domestic fixed-income market was set free from regulation.

In the wake of this deregulation came the 1990s domestic banking crisis. We also experienced the global financial crisis in the 2000s, which demonstrated how quickly contagion works in today's interconnected global economy. This led to a new discussion on banking regulation. The cycle between bank crises and regulation thus goes back and forth.

Summary Let us try to summarise the history of reforms to the payment-system institutions with the aid of Figure 3. We see a development towards more efficient payment systems, which are driven by technological or financial innovations in the private sector. However, the risk of crises in the private banking system entails other reforms that try to balance the requirement for a safe and efficient payment system. The same questions that

arose with regard to issuing banknotes in the 19th century arise today with regard to digital payment systems.



Figure 3. Institutional reforms in the payment system

4 The value of money and price stability

Let me now move on to the history of the institutions concerned with the value of money.

Price developments since 1290 The discussion of these becomes clearer as we can measure what we are talking about. Thanks to Rodney Edvinson's and Johan Söderberg's path-breaking research, we now have a price index that traces Swedish prices all the way back to 1290. Figure 4 shows this price index for every year from 1290 and onwards on a ratio scale. Here we can clearly see the long-term trends in the Swedish price level. An 'odd pattern' emerges across centuries. During the 14th century we see rising prices, partly due to the plague, while in the 15th century prices were more stable. The war-torn 16th century was a disaster, with substantial inflation, while the 17th century was once again marked by relatively stable prices. During the 18th century, prices rose again and in the 19th century they were stable. The 20th century was a new century of inflation. It still remains to be seen whether the 21st century will follow the same pattern with stable prices – at least, it has started well.





Source: Edvinsson and Söderberg (2010)

The average rate of inflation calculated over these 730 years is around 2.5 per cent, a figure which – interestingly enough – is fairly close to the current inflation target.

Inflation since 1600 If one is more interested in the short-run fluctuations in the value of money, it is easier to see them in a figure depicting the rate of inflation. Figure 5 shows average inflation during each five-year period from the year 1600 and onwards, so we can focus on the period that overlaps with the existence of the Riksbank. We see fairly substantial variations in the five-year inflation rate. The highest listing is 36 per cent while the lowest is -12 per cent. The obvious question is: What is the driving force behind these fluctuations in prices and inflation and how are they linked to the underlying institutions?



Note. The thick colored lines are period averages. Sources: Edvinsson and Söderberg (2010) and the author's own calculations

Different standards An old Swedish institution attempts to anchor long-term price stability by choosing a suitable standard – attaching the value of money to a precious metal or a foreign currency by giving the citizens the right to redeem their domestic currency at a given rate. Of course, this requires a certain measure of state capacity. One can view the right to redeem as an attempt to tie oneself to the mast with a long-term regulation to credibly stabilise the value of money. This type of standard naturally becomes more stable – and more difficult to manipulate – if its anchor has a relative price that is determined outside of the country's borders.

Let us take a look at the standards that Sweden has adopted during this period. Each of them corresponds to one of the colourful fields in Figure 5. From 1624 to 1725 we had a kind of double metal standard that was based on the redemption of both silver and copper. In addition, there were two different coins in circulation: Marks and Dalers. This was a fairly complicated regime. Copper was not a random choice of anchor: during this era Sweden accounted for 50 per cent of the world production of copper, and from time to time also tried to push up the copper price, for example by trying to withdraw metal from commercial use by minting copper coins and then using the large copper plates. This hybrid regime lasted around 150 years, with an average inflation rate around 3.5 per cent.

In 1776, Gustav III and the Riksbank introduced a silver standard, which was to last around 100 years. The silver standard was linked to a coin reform where the Riksdaler became the only domestic currency. The rate of inflation during this century was around 2.5 per cent on average.

Then we had the gold standard in 1873. This was not a unilateral regime, but part of an international agreement, where around twenty of the most important economies all undertook to redeem their currencies for gold. The gold standard was also linked to the Scandinavian Monetary Union, where Sweden, Norway and Denmark all introduced Crowns and exchanged them one for one. The gold standard lasted until 1931 and the average rate of inflation during this time was down at 1.5 per cent. In 1944 (we will temporarily skip the period in between), Sweden introduced a greenback regime. This was a dollar standard, or actually a reciprocal paper standard in that all of the Western world countries pegged their currencies to the US dollar, and the United States in turn allowed redemption for gold. The paper-note standard was part of the global Bretton-Woods Agreement that also included a number of other rules. For instance, the countries undertook not to change their exchange rates, as long as their economies were not in fundamental disequilibrium. The rate of inflation during this period was around 4 per cent, or 3.8 per cent to be more precise.

Following the breakdown of the Bretton-Woods system in 1973, we had a unilateral paper standard. Initially, we tried to peg the Swedish crown to various currencies, followed by a period with a floating exchange rate and an inflation target. The rate of inflation was now on average 4.5 per cent, with much higher inflation at the beginning of the period.

Rules with escape clauses One can describe Sweden's different standards as rule systems. But even the best rules fail to apply under all circumstances: there is always an escape clause to the rule. In this case, the exception reflects the sovereign's temptation to utilise his or her power to undermine the value of money, either to give the state income or to expand the economy. The rule concerning a long-term anchor aims to reduce the credibility problem linked to this temptation. But almost all our anchors in history have been raised and then dropped again. As Figure 5 shows, the result is a reasonably distinct inflation cycle.

High-inflation periods During the upswings of the inflation cycle, we observe episodes of higher inflation. These entail a departure from the right to redeem, expansion by minting new coins with a low metal content, printing new banknotes, or devaluation. Since the year 1700, we have seen five occasions with an inflation rate higher than 10 per cent (in terms of five-year averages).

The first and highest inflation came during the Great Northern War of 1700 to 1720. Charles XII minted new copper coins with a very low metal content and these were used to buy goods while the general public was demanding higher prices when selling their own goods to maintain the value of their incomes.

The second inflation episode occurred during the 1740s and 1750s when the Hat Party was at war against Russia and later against Pomerania. They borrowed from the Riksbank (and printed new banknotes) to finance the war and prices rose quite sharply.

The third episode took place in connection with Sweden's final period of war, from 1788 to 1814. During this time, the state was also printing banknotes, but in a new way. The King established the Swedish National Debt Office, and borrowed money from this new institution in exchange for new banknotes. However, these could not be redeemed for silver. On the other hand, the Riksbank was left alone, and its banknotes could still be redeemed for silver, although the Swedish National Debt Office's banknotes gradually took over from the Riksbank's notes.

The fourth period of high inflation was during the First World War, when the gold standard was put out of action, Swedish goods were in great demand and prices rose. Finally, we have the inflation period in the 1970s and 1980s when the government decided on repeated devaluations to prevent cost crises due to rapid domestic wage increases and price rises.

Costly deflation How can one restore credibility and stability in the wake of such inflationary impulses? It is tempting to try to drop anchor by restoring the earlier right to redeem. But what should one do about the exchange rate? Should one return it to the earlier peg, which could provide better credibility – if one succeeds? Or should one accommodate the rising prices through an internal devaluation and thus reduce the value of money?

To avoid costly deflation, the stabilisation of the economy often becomes a compromise between these courses of action. However, after the five high inflation episodes we encounter three marked deflation periods. The first of these took place in the 1730s, when Arvid Horn had to clean up after the many wars at the cost of a fairly heavy deflation. The second period came during the Age of Liberty in the 1760s, when the Caps took over from the Hat party. They had a secret plan to withdraw banknotes and then to reintroduce the Riksdaler copper value at its original level, but their plan was halted to avoid a deflation spiral. There were nevertheless widespread expectations of new price falls and these made their mark on Swedish poet Carl Michael Bellman's 24th epistle:

'Times are bad! People are sad - but with a lower nicker comes cheaper liquor'.

And finally, we have the period after the First World War, when the government brought Sweden back to the gold-standard regime, with the right to redeem at the earlier gold price. This led quickly to falling prices and the most severe depression in modern times.

1930s experiment Let me conclude by pointing to two periods of stabilisation that stand out. The first occurred when the Riksbank launched a new regime that had never been tried before, namely a paper note standard with a domestic rather than a foreign anchor. This began in 1931, when Sweden – unlike the monetary policy line following the First World War – did not return to the gold standard, but instead gave it up. As a result, the Krona was devalued and the interest rate cut to keep prices up, avoid deflation and the global depression as far as possible. The Riksbank became the first central bank to introduce a direct target aimed at a stable domestic price level, and this lasted until 1939.

Many economists were involved in the discussions leading up to this experiment, including Sweden's leading economists of the time – such as Cassel, Lindahl and Ohlin. With the 1920s deflation fresh in their memories, most commentators felt that a domestic anchor was a better means of anchoring the value of money. Irving Fisher, possibly the world's most famous economist at that point, describes this strategy as 'the Swedish experiment' in his book Stabilized Money (Fisher 1935), which deals with inflation and how to combat inflation – very interesting reading! To get the new regime to work, the authorities wanted to measure prices more often than once a year and they therefore began to gather a weekly price index. The task of putting this price index together fell to a young, promising economist named Dag Hammarskjöld, who later went on to pursue other endeavours.¹

Inflation target The second stabilisation episode began in the year 1992, after two decades of inflation. Once again, the Riksbank was forced to give up its fixed exchange rate and once again a depression was lurking around the corner during the domestic crisis of the 1990s. Now Sweden introduced a floating exchange rate, and the Riksbank became one of the first central banks to formulate a domestic inflation target (after New Zealand, Canada and the United Kingdom, who had done so about a year earlier). This time, too, the reforms coincided with a discussion among academic economists, which this time was more international than domestic. After a few years, the Riksbank was also given formal legal independence, although it had been dependent de facto since 1993. There were discussions in Sweden regarding this institutional reform by the commission of inquiry into the Riksbank, on which I had the pleasure of being an expert.² But the EU Treaty also contained a requirement for central bank independence. Depending on who you are talking to, you will receive one of these explanations with regard to the Riksbank reform. One can possibly mention that the provision in the EU Treaty largely reflected arguments within the international academic discussions.

Summary Allow me to try to summarise the institutions surrounding the value of money with the aid of Figure 6. Over the past 350 years, the governing powers and the Riksbank have in different ways tried to anchor the value of money in the long term, often by pegging the value of money to a precious metal or to a foreign currency. These attempts at rulemaking reflect a latent credibility problem, which stems from domestic politics: the ruling powers' temptation to use their power over money to create income or to expand the economy. A number of exceptions to these rules give rise to inflation cycles. The institutional reforms in the area are often linked to foreign shocks or to reforms of global institutions.

2 See SOU 1993:20.

¹ Dag Hammarskjöld was Chairman of the Governing Council of the Riksbank 1941–1948, cabinet minister in the Swedish government and member of the Swedish Academy before serving as Secretary-General of the United Nations.

Challenges Institutions	Innovations	Foreign developments	Domestic policy
Price stability			
Payment system			

Figure 6. Institutional reforms regarding the value of money

5 The future history

What will be discussed at the Riksbank's 400th anniversary? I would not like to make a forecast about this right now, but the subject will most probably arise during the panel discussion that is the next point on the programme. But it would appear that a number of eternal questions will recur time after time in the discussions regarding the Riksbank. They will probably also crop up again over the coming 50 years. One such question concerns the balance between private and public sectors in the payment system. Given technological developments, this will certainly include the question whether we should have domestic or international payment systems, especially digital payment systems. Will we then see another nuance in the balance between a safe and an efficient payment system? It is very likely that we will see a new turn of the cycle between bank crises and bank regulations. I would also guess that the division of labour between the Riksbank and other public authorities will remain a bone of contention, not least in the current Riksbank Committee of inquiry. Another subject this committee is discussing is the independence of the central bank. However, the Riksbank has two related tasks: to safeguard the payment system and price stability. Can one be independent in one task but not in the other? How could that be achieved? Finally, we may perhaps have had a further exception from the long-term rule for price stability. I hope not. But if we rely on history, we usually see at least one inflation cycle in every monetary policy regime. So who knows?

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Sweden's fiscal framework and monetary policy

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Basic economic reasoning tells us that monetary and fiscal policies always interact to jointly determine aggregate demand and the overall level of prices in the economy. This article interprets Sweden's explicit monetary and fiscal frameworks in light of this reasoning, bringing recent Swedish inflation and interest-rate developments to bear on the interpretations. Theory and evidence raise the question of whether the two policy frameworks are mutually consistent.

1 Introduction

Basic economic reasoning tells us that monetary and fiscal policies necessarily interact in the short, medium, and long runs. These interactions jointly determine an economy's macroeconomic developments. This reasoning is completely general, independent of any particular economic model or view of how the economy operates.

Most countries' monetary and fiscal policy institutions, in contrast, are founded on the presumption that the two policies *can and should* operate independently of each other. This presumption underlies the creation of central banks that are given well-specified mandates to control inflation and stabilize the real economy and to operate in isolation from pressures that might emanate from fiscal authorities. Fiscal policy, meanwhile, is assigned the task of stabilizing debt – what is called 'sustainable fiscal policy' – and often little else. Underlying this institutional construct are the beliefs that

- (i) fiscal policy has little, if any, impact on inflation;
- (ii) monetary policy has negligible fiscal consequences;
- (iii) the single-minded fiscal pursuit of debt stabilization supports, rather than thwarts, the central bank's mandates.

Sometimes, this institutional arrangement works. At other times, the arrangement leads to monetary and fiscal policies that are mutually inconsistent.

The presumption that policies can and should operate independently denies an essential fact about modern public finance: governments issue *nominal* bonds – bonds denominated in local currency – but bondholders care about the *real* value of those bonds. The real value comes from deflating nominal debt by the overall level of prices in the economy, something like the consumer price index. Because modern central banks aim to target the rate of change of the price level – the inflation rate – it is impossible to separate monetary and fiscal policy completely. And efforts to do so can create policy conflicts.

Recent Swedish monetary and fiscal actions illustrate the possibility of conflict. At a time when monetary policy has been aggressively expansionary in an effort to raise inflation – negative policy interest rates for three years, coupled with significant asset purchases that have produced a more than four-fold increase in the central bank's balance sheet from 2007 to 2017¹ – fiscal policy has become more contractionary, with net lending

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Total assets more than tripled between the third quarter of 2008 and the first quarter of 2009 and remained elevated until the second half of 2010. Assets have nearly doubled over the negative policy rate period beginning in 2015.

moving from -1.6 percent of GDP in 2014 to 1.2 percent in the first two quarters of 2017. Fiscal policy has been deflationary when monetary policy has been inflationary.

Sweden is a fascinating case to study how monetary and fiscal policies interact to influence the aggregate economy. The country stands out for being explicit about the objectives and targets of its macroeconomic policies. Sveriges Riksbank, Sweden's central bank, flexibly targets inflation at two percent, while the government currently pursues a medium-term net-lending target of 1 percent of GDP. Explicitness makes Swedish policy behavior amenable to assessment, which is one goal of this article. I raise the possibility that the policy rule that Swedish fiscal authorities follow, particularly in recent years, may be at odds with the Riksbank's primary goal of targeting inflation.

1.1 Targets vs. rules

Explicit policy targets are not sufficient to ensure effective policy performance. Central banks with explicit inflation targets communicate much more than their target to the public. There are infinitely many ways that the Riksbank could try to achieve its two percent target. Each way – or 'policy rule' – affects private-sector expectations differently. Each rule and its associated expectations has unique impacts on the public's economic decisions. To reduce the likelihood of mistaken public expectations, the Riksbank communicates the particular rule that it tries to follow.

Communicating the rule is challenging. To achieve its inflation target, the Riksbank analyses a vast array of data – domestic and foreign inflation and real economic developments and forecasts, current and prospective values of the krona, public and financial market expectations of inflation, and even political events at home and abroad.² By describing how these facts and conjectures influence its choice of the path for the repo rate, the Riksbank is explaining its policy rule: how the central bank reacts to various kinds of news that affect Swedish inflation and real activity. Of course, the Riksbank, and no central bank, follows a simple algebraic rule that can be precisely and succinctly communicated. But it does respond systematically to economic conditions and that systematic behavior guides the public's formation of expectations about future monetary policy actions.

The Swedish government's net-lending target, while commendable from the viewpoint of fiscal sustainability, does nothing to communicate the fiscal behavior that tries to achieve the target. Different governments are free to choose exactly how and when to hit the target; the same government can choose different methods for achieving the target at different points in time. This is a potentially serious shortcoming of Sweden's fiscal framework, a shortcoming shared by governments the world over. Governments can perhaps be forgiven for confounding rules and targets. Even the International Monetary Fund uses the term 'rule' to describe fiscal targets and restraints, rather than to characterize how the fiscal authority behaves.³

Because this article focuses on how interactions among fiscal, monetary, and public *behavior* determine the economy-wide price level, to avoid confusion I will delineate between targets and rules. Targets refer to inflation at two percent and net lending at one percent, while rules describe the policy behavior that achieves those targets. A rule characterizes how the choice of a policy instrument – the repo rate, tax rates, expenditure components – depends on prevailing economic conditions. I argue that the policy rules are all-important for determining the price level and, by extension, the performance of the macro economy.

² See Sveriges Riksbank (2018, chapter 1) for examples.

³ Schaechter et al. (2012).

1.2 Sketch of article

Before getting into details about Sweden, it is necessary to lay some groundwork for understanding how and why it is essential to study monetary and fiscal policies together, rather than separately. To that end, I describe the nature of policy interactions in any wellfunctioning equilibrium. Fundamental economic principles carry some critical implications that conflict with beliefs (i)–(iii). First, it is the *joint* monetary-fiscal policy regime that determines an economy's inflation rate. Second, monetary policy actions always have fiscal consequences – consequences that may be large at times – and how fiscal policy reacts to those consequences matters for the ultimate impacts of the monetary policy actions. Finally, the rule that the government implements to pursue debt stabilization matters for the central bank's ability to achieve its mandates.

With that economic background in place, the article turns to analyse features of Swedish macroeconomic policies and recent Swedish economic developments. These include

- 1. negative bond yields over the maturity structure, which constitute *prima facie* evidence of a fiscal policy that reduces social welfare, but also reflect the low-interest rate environment in which the Swedish economy finds itself;
- the fragility in the sense of potentially inducing instability in government debt of Sweden's net-lending target, for reasons first articulated by Phillips (1954);
- evidence of Swedish fiscal policy behavior and the backing that it provides for monetary policy;
- 4. an explanation of how, particularly in low-inflation periods, monetary policy actions can generate potentially substantial fiscal impacts in subtle ways that are not part of typical economic analyses at central banks and ministries of finance.

The article's aim is not to criticize Swedish policies. Sweden's fiscal situation is sound: the government owns equities and its net financial position is positive. But the Swedish government nonetheless issues krona-denominated debt, so the analysis in this article applies to Sweden, as it would to less fiscally sound economies. The article tries to shed light on how monetary and fiscal policies in Sweden jointly determine macroeconomic outcomes. Along the way, the article points toward alternative fiscal rules that are consistent with the aims of Sweden's Fiscal Policy Framework and are more compatible with the job that the Riksbank has been tasked to perform.

2 Monetary and fiscal policy basics

Much discourse about macroeconomic policies applies the following logic. The central bank sets its policy instruments – a short-term nominal interest rate, the level of bank reserves, the size and composition of its balance sheet – but does not set taxes and government expenditures. The government chooses the level and composition of various taxes and expenditures and the quantity and maturity structure of the debt it issues, but not the variables the central bank controls. Having established who controls what, analyses of policy impacts often proceed along similar lines to ask: How do changes in the central bank's (government's) instruments affect the economy, holding fixed fiscal (monetary) instruments? Although such questions seem to make sense on the surface, basic economic reasoning tells us that it is rarely possible to change a monetary (fiscal) instrument without eventually changing fiscal (monetary) instruments in particular ways.

Research over the past 25 years establishes this reasoning to emphasize that monetary and fiscal policy *jointly* determine the economy-wide level of prices and the rate of inflation.⁴

⁴ Early contributors include Leeper (1991), Sims (1994), Woodford (1995), and Cochrane (1999). Leeper and Walker (2013) and Leeper and Leith (2017) are recent overviews. Leeper (2016) explains why central banks – even when they are politically and operationally independent – need to pay attention to fiscal behavior.

Out of that literature has emerged the understanding that two distinct combinations of monetary and fiscal policy behavior – policy regimes – can determine the price level and stabilize the level of government debt.

2.1 Policy regimes

Table 1 summarizes the policy mixes that determine inflation and stabilize debt. To make the arguments clear, I make stark and unrealistic assumptions about policy behavior. The arguments go through with more plausible assumptions.

The first regime reflects the conventional view that monetary policy actively adjusts the policy interest rate to lean against inflation, while fiscal policy passively adjusts primary budget surpluses – revenues less expenditures, not including interest payments on government debt – to stabilize the long-run debt-GDP ratio. This is sometimes called 'monetary dominance'. Taylor's famous rule⁵ falls into this regime: the central bank raises the policy interest rate more than one-for-one with the inflation rate and raises the interest rate more modestly when the output gap increases.⁶ Because monetary policy focuses on stabilizing inflation and the real economy, fiscal policy must ensure that government debt remains well behaved. When fiscal policy makes taxes rise with the level of real government debt – nominal debt deflated by the price level – by more than enough to cover interest payments and some of the principal, the debt-GDP ratio will be stable in the long run. Many economists believe this regime prevails during 'normal' economic times. All inflation-targeting central banks believe they operate in this regime.

Policy authority	Monetary-fiscal policy regimes that determine inflation and stabilize debt				
Monetary rule Fiscal rule	Conventional view Aggressively raises interest rate with inflation Raises primary surplus with real debt	Alternative view Weakly raises interest rate with inflation Pursues other objectives besides debt stabilization			
Label	'Active monetary passive fiscal policies' or 'Monetary dominance'	'Passive monetary active fiscal policies' or 'Fiscal dominance'			

Table 1. Monetary-fiscal policy mixes

A second, alternative, regime can also determine inflation and stabilize debt. In this regime, fiscal policy pursues other objectives, such as countercyclical policies or redistribution of income, by setting primary surpluses – defined as tax revenues less expenditures, excluding interest payments on outstanding debt – independently of debt and the price level. Monetary policy chooses the interest rate so that it responds only weakly – or not at all – to inflation, which permits expansions in government debt to raise the price level. Higher price levels and lower bond prices reduce the *real* market value of debt – the quantity of goods and services that a government bond can purchase – to make the debt-GDP ratio stable. Some economists call this regime 'fiscal dominance'.

At a general level, there is nothing 'good' or 'bad' about the two policy regimes. Recent research on jointly optimal monetary and fiscal policies finds that the best mix of policies in terms of social welfare has elements of both the conventional and the alternative views.⁷ Both regimes deliver the broad macroeconomic policy goals of determining inflation and stabilizing government debt. But because monetary and fiscal actions have different impacts in the two regimes, it is essential for policymakers to know in which regime the economy resides.

⁵ See Taylor (1993).

⁶ For reasons first articulated by Obstfeld and Rogoff (1983), monetary policy cannot deliver a unique inflation rate in a pure fiat currency regime. Cochrane (2011) and Sims (2013) recently emphasized that the Taylor rule permits explosive inflation paths to be equilibria, along with the stable inflation outcome that economists usually focus on.

⁷ See Sims (2013) and Leeper and Zhou (2013).

Because U.S. monetary policy behavior was been widely studied, I will point out several instances since America left the gold standard in April 1933 in which the Federal Reserve seems to have followed this alternative behavior: from April 1933 until about 1936; throughout World War II until the Treasury-Fed Accord in March 1951; much of the 1970s; the 2008 financial crisis and its aftermath.⁸ And there have been times when fiscal policy pays scant attention to debt in order to pursue other objectives: despite extremely high war debt, in 1948 Congress overrode President Truman's veto and cut taxes; the Economic Recovery Plan of 1981 increased primary deficits even as the debt-GDP ratio was rising from its post-war low in the early 1980s; both the Economic Growth and Tax Relief Reconciliation Act of 2001 and the Jobs and Growth Tax Relief Reconciliation Act of 2009 increased spending and cut some taxes despite rising debt; even with record peacetime government debt levels, in December 2017 the U.S. government passed a major cut in taxes.⁹

During and since the financial crisis of 2007, central banks around the world have maintained policy interest rates that are pegged at extraordinarily low levels with the aim of stimulating real economic activity. This behavior places monetary policy into the 'alternative view' category. At the same time, fiscal policies – particularly in Europe – have been adjusting to stabilize government debt following brief excursions into stimulative stances designed to help lift economies out of recession. By Table 1's categorizations, the mix of pegged interest rates and stabilizing fiscal policy, if people expect it would last forever, does not deliver an equilibrium in which inflation is determined.¹⁰

2.2 Fiscal consequences of monetary policy

To keep this discussion focused, in what follows I consider only the conventional mix of monetary and fiscal policy behavior. That policy combination underlies the Riksbank's perceptions of its behavior and the rationale for Sweden's Fiscal Policy Framework. The independent Riksbank pursues its inflation target, while the government acts to ensure debt is stable. This conventional view of macroeconomic policies is the foundation of monetary and fiscal institutions in nearly all countries.

My key message is: under this conventional policy mix, monetary and fiscal policies *must* interact in certain well-specified ways. It is not possible for monetary and fiscal policy to operate independently of each other and still deliver good economic performance. Understanding the nature of these interactions is essential to formulating effective policy rules.

Monetary policy actions always have fiscal consequences.¹¹ Let's start with something routine: the Riksbank lowers the repo rate in order to raise inflation. This isn't the end of the story: a lower repo rate tends to lower all interest rates, including those on government debt, so interest payments on outstanding debt decline.

Now fiscal policy comes into play. Those lower interest payments reduce fiscal needs. To ensure that government debt is stable, taxes must be lower or expenditures must be higher in the future to offset the reduced debt service. Without these fiscal adjustments, government debt would steadily fall, eventually making the government a net lender to the private sector.

But there is actually more to the fiscal response than simply stabilizing debt. Lower interest payments on government bonds reduce the wealth of holders of those bonds. If

⁸ See Taylor (1999), Clarida et al. (2000), Lubik and Schorfheide (2004), and Davig and Leeper (2006, 2011).

⁹ See Davig and Leeper (2006), Bhattarai et al. (2016), and Bianchi and Ilut (2017).

¹⁰ This is called 'price-level indeterminacy,' and is a topic that has received a great deal of attention in the academic literature. Indeterminacy means that the inflation rate is not pinned down by policy and is subject to potentially volatile fluctuations that arise from self-fulfilling expectations of inflation by the private sector. Woodford (2003) explains that determinacy is a minimal requirement for optimal policy.

¹¹ Tobin (1980) and Wallace (1981) make this point.

those lower interest receipts do not trigger an expectation of eventually lower taxes to compensate for the reduced wealth, lower wealth will lead to reduced demand for goods and services – lower aggregate demand – and a lower price level.

Because the Riksbank initially reduced the repo rate in the hope of *raising* aggregate demand and inflation, the negative wealth effect can thwart the Riksbank's efforts. To support monetary policy, fiscal policy needs to provide fiscal backing that adjusts future taxes in the opposite direction to price-level movements. A higher price level – the Riksbank's immediate goal – requires a fiscal rule that lowers future taxes, while a lower price level calls for a policy that raises taxes. Such a rule eliminates the wealth effects of central bank changes in interest rates to deliver the desired effect of monetary policy on aggregate demand.

The fiscal rule under the conventional view in Table 1 both stabilizes debt and provides the necessary fiscal backing for monetary policy. A rule that raises future surpluses whenever *real* debt increases has two components to it. First, for a fixed price level, higher nominal debt brings forth higher surpluses to ensure government debt is stable. Second, for a fixed level of nominal debt, a lower price level creates the expectation of higher future taxes to provide the fiscal backing for monetary policy's inflation-targeting actions. The passive policy rule in the table happens to deliver both desirable outcomes.

The message is: to successfully raise inflation, the Riksbank's *looser monetary policy* (lower repo rate) necessarily requires *looser fiscal policy* (smaller budget surpluses) at some point. That fiscal response is essential for the Riksbank to be able to control inflation and fulfill the price-stability policy mission that the Riksdag set out for the bank in the Sveriges Riksbank Act.

Unfortunately, not all fiscal rules both stabilize debt and back monetary policy. This is why it's important for governments to move beyond adopting targets, toward describing the behavior that achieves the targets. Both outcomes rely on fiscal expectations. If markets know that higher real debt eventually leads to higher stabilizing surpluses, then fiscal policy will not run into sustainability problems, as investors are assured the government will fulfill its financial commitments. This argument figures prominently in the Swedish fiscal policy framework.¹² If bondholders know that lower taxes are sure to follow lower interest receipts, then monetary policy's adverse wealth effects will not arise, and interest-rate policy will affect inflation as intended. This point is missing from the Swedish fiscal framework.

Appropriate fiscal backing for monetary policy is critical for the Riksbank to achieve price stability. By giving the Riksbank the task of targeting inflation, Sweden has chosen an active monetary policy, which places Swedish macroeconomic policies in the monetary dominance regime in Table 1. To be consistent with this monetary policy behavior, it is essential that the fiscal rules used to implement the target provide appropriate backing for monetary policy. This calls for passive fiscal behavior. A correctly designed fiscal rule anchors people's expectations on the belief that fiscal policy will, in time, react appropriately to monetary policy by eliminating the wealth effects that monetary policy produces.

12 Swedish Government (2011), pages 5, 7, and 12, for example.

3 International examples

To gain a deeper understanding of the monetary-fiscal combinations in Table 1, it is helpful to consider actual instances when policy behavior departed from the conventional monetary-fiscal regime.

3.1 An important American case

Recovery from the Great Depression illustrates that the alternative monetary-fiscal policy mix – fiscal dominance – has been an explicit policy choice.¹³ President Franklin D. Roosevelt took office in March 1933 at the lowest point of the Great Depression. Compared to the third quarter of 1929, real GNP was 36 percent lower, industrial production had been cut in half, unemployment rose from almost nothing to a quarter of the workforce, and the price level had fallen 27 percent. The new president committed to raise the price level by achieving '…the kind of a dollar which a generation hence will have the same purchasing power and debt-paying power as the dollar we hope to attain in the near future'.¹⁴ The first step toward permanently raising the price level was to abandon the gold standard in favor of what Roosevelt called a 'managed currency'.¹⁵

Abandoning convertibility of the dollar to gold included abrogating the gold clause, a contractual provision that gave creditors the option to receive payment in gold, on all future and past public and private contracts. This changed the nature of government debt. Under convertibility, even though government bonds paid in dollars, the Treasury was required to convert those dollars into gold on demand. When the Treasury didn't have the gold on hand, it had to acquire the gold, typically through higher taxes. The new 'managed currency' standard broke the automatic link between new bonds and future surpluses: government bonds were simply promises to pay dollars, which the U.S. government could freely create without adjusting taxes.¹⁶

Roosevelt used three strategies to convince the public that higher government debt would not necessitate higher future taxes. First, he made policy depend on the state of the economy, saying he would run bond-financed deficits until the economy recovered. Second, he emphasized the temporary nature of the policy by distinguishing between the 'regular budget,' which he balanced, and the 'emergency budget,' whose deficits were driven by spending designed to provide relief to those the depression had harmed. Finally, Roosevelt raised the political stakes by pitching economic recovery as a 'war for the survival of democracy'.¹⁷ The strategies appeared to work because expected inflation began to rise by spring 1933.¹⁸

Monetary policy behaved passively through the recovery. After the United States left gold, the Fed no longer needed to keep interest rates high to staunch the outflow of gold and the New York Fed reduced its discount rate to 1.5 percent in February 1934, where it remained until August 1937, when it was lowered to 1 percent. One contemporary observer wrote that the Federal Reserve 'served merely as a technical instrument for effecting the Treasury's policies'.¹⁹ Clearly, the Fed did not follow anything resembling a Taylor rule; instead, monetary policy permitted the expansion in government debt to stimulate the economy, as it does in the alternative policy mix.

Economic recovery was rapid. Real GNP returned to its pre-depression level in 1937. Price levels – consumer and wholesale price indexes and the GNP deflator – rose. The deflator regained its 1920s levels, while the other two fell somewhat short.

¹³ This draws on Jacobson et al. (2017).

¹⁴ See Roosevelt (1933b).

¹⁵ See Roosevelt (1933a).

¹⁶ Today all but the 10 percent of Treasury debt that is indexed to inflation is also merely a promise to pay future dollars.

¹⁷ See Roosevelt (1936).

¹⁸ See Jalil and Rua (2017).

¹⁹ See Johnson (1939, p. 211).

Historians like Friedman and Schwartz (1963) and Romer (1992) attribute recovery to higher growth in the supply of money. After America left the gold standard, the Treasury bought the gold that flowed into the country from a politically unstable Europe and paid for that gold by directly expanding bank reserves and high-powered money. But that explanation overlooks the significant expansion in government debt that took place. The dollar value of federal debt outstanding doubled in the six years after leaving the gold standard, reflecting the substantial fiscal stimulus associated with Roosevelt's relief programs.

Remarkably, this expansion in nominal debt did not raise the debt-GNP ratio. Figure 1 plots the par and market values of gross federal debt as percentages of GNP from 1920 to 1940.²⁰ The vertical line marks departure from gold in April 1933. After bottoming out in September 1929 at 15.6 percent, the debt-GNP ratio rose steadily while the United States was still on gold, reaching 44.7 percent in March 1933. It then remained below 45 percent through the end of 1937. Economic recovery raised both the price level and the real level of economic activity, ensuring that the debt-GNP ratio was stable.



Sources: Hall and Sargent (2015), Balke and Gordon (1986), and authors' calculations

In this alternative policy mix, the Federal Reserve behaved passively, permitting the fiscal expansion to raise aggregate demand and with it, prices and output. With this policy mix, there need not be any conflict between fiscal expansion and fiscal sustainability because, as the data in Figure 1 neatly illustrate, the fiscal expansion did not increase debt relative to the size of the economy.²¹

3.2 Recent international cases

3.2.1 Brazil

Countries have not always provided appropriate fiscal backing.²² In recent years, Brazil followed a fiscal policy that was unresponsive to debt, while its central bank sought to target inflation. The 1988 constitution indexed government benefits to inflation, which placed 90 percent of expenditures out of legislative control. At the same time, tax increases were politically infeasible, leading to growing primary deficits with no prospect of reversal. When inflation began to rise, the central bank aggressively raised interest rates, just as the

²⁰ Par value is the face value of outstanding government debt and is the most commonly cited measure of debt. Market value incorporates current bond prices, which may change over time to affect the value of debt.

²¹ The Great Depression was not the only instance of this policy mix. See Davig and Leeper (2006), Erceg and Lindé (2014), and Leeper et al. (2017) for further examples.

²² Leeper (2017) discusses these and other examples in detail.

Taylor principle instructs. Debt service rose, driving up aggregate demand and inflation. In December 2015, the primary deficit was 1.88 percent of GDP, but the gross deficit – primary plus interest payments – was 10.34 percent of output. Figure 2 plots Banco Central do Brasil's policy rate, the Selic, along with the consumer price inflation rate from 2013 through 2015. Despite a doubling of the policy rate, the inflation rate rose by nearly 5 percentage points: monetary policy does not appear to be controlling inflation. In fact, inflation began to retreat in 2016 only after the central bank had stabilized the Selic at 14.25 percent for a year.



It is tempting to infer that Brazil's problems stemmed from dysfunctional fiscal policy. Surely, if fiscal policy follows well-specified guidelines that ensure 'responsible' fiscal behavior, monetary policy will be able to control inflation. In fact, the explanation lies in an incompatible combination of monetary and fiscal policies that were both active, in Table 1's nomenclature.

3.2.2 Switzerland

Switzerland has had 'responsible' fiscal targets for 15 years and it takes those targets seriously. By 'seriously' I mean the government actually achieves those targets.²³ Since a nationwide referendum in 2001, Switzerland has pursued a debt brake, which limits spending to average revenue growth over several years. If spending differs from this limit, the difference is debited or credited to an adjustment account that has to be corrected in coming years. Debt brakes have a built-in error-correction mechanism intended to restrict the size of government debt.²⁴

²³ This draws on Leeper (2016) and Bai and Leeper (2017).

²⁴ See Danninger (2002) and Bodmer (2006) for additional details and analyses.



The top panel of Figure 3 suggests that Swiss fiscal targets have worked to limit debt growth. Government debt has steadily fallen over the past 15 years and now is about 35 percent of GDP. Remarkably – and Switzerland, along with Sweden, may be the sole exceptions – debt either continued to fall or remained flat during the financial crisis. This stunning outcome is a testament to the effectiveness of fiscal targets that are reached.

But this prudent fiscal policy may have come at a cost in terms of inflation targeting. Switzerland has a two percent inflation target that has been missed chronically. In Switzerland, inflation has been persistently below target since the beginning of 2009. Low inflation rates do not seem to be the result of inadequate efforts by monetary policy: policy interest rates have been negative since the beginning of 2015.

The Swiss case illustrates that fiscal backing for monetary policy must be symmetric. When monetary policy reduces (raises) interest rates and interest payments on government debt, fiscal policy needs to reduce (raise) taxes. Fiscal rules designed primarily to reduce government debt may interfere with the symmetry of fiscal backing.

3.2.3 Japan

Japan is a spectacular case: despite rapidly expanding government debt, the country has been saddled for decades with extraordinarily low inflation rates. Surely this combination of outcomes undermines the argument that government debt has an impact on inflation. Sims (2014, 2016) argues that 'fiscal pessimism' in the United States, Europe, and Japan has made monetary policy ineffective in bringing inflation up to target. He applies this argument to aging populations in those economies, who are aware that painful fiscal adjustments lie in the not-too-distant future in order to maintain sustainable policies. This means that when people's holdings of government debt increase, fiscal policy adjusts passively to make people feel less wealthy. Combined with a passive monetary policy that fixes the interest rate indefinitely near its lower bound, passive fiscal behavior makes inflation indeterminate, but with a downward drift. This is the low-inflation trap that Benhabib et al. (2002) model.

Although inflation in the United States appears now to be approaching its target level of two percent, in both Europe and Japan it remains stubbornly low despite aggressive expansionary monetary policy actions. Figure 4 shows that despite some inconsistency in the 1990s and the period before the global financial crisis, the Bank of Japan has maintained a very low policy interest rate, which has now been negative since early 2016. The rapid increase in base money that started in 2012 reflects the Bank's aggressive government-bond buying operations.



Along with aggressive monetary expansion, Japanese governments have run chronic fiscal deficits that have driven Japanese government debt to unprecedented levels, as Figure 5 shows. How can the combination of easy monetary policy and growing government debt as a share of the economy be reconciled with persistently low inflation?

The answer lies in recognizing that debt can grow as a share of the economy only if bondholders anticipate higher primary surpluses in the future. Debt's value can rise only if its backing rises commensurately. Figure 1 showed that despite sizable fiscal deficits, the debtoutput ratio in the United States was stable in the 1930s. This is evidence that bondholders at the time did not expect expansions of nominal debt to generate larger future surpluses.



Do Japanese citizens, who hold the bulk of Japanese government bonds, have reason to be fiscally pessimistic, in Sims's terminology? Figure 6 provides some reason for such pessimism. That figure plots consumer price inflation, with vertical lines marking instances when the Japanese government raised the consumption tax in response to fears of fiscal sustainability.²⁵ A sharp decline in inflation follows each tax rate hike. Although Prime Minister Abe has delayed the planned rate rise to 10 percent until October 2019, there is little doubt among Japanese citizens that higher taxes lie in their futures. The IMF's Article IV consultation buttresses that belief. Among other urgent calls, the consultation states: 'Replacing the

25 As an aside, the 10-year yield on government bonds in Japan has fallen steadily since 1990, from a peak of about eight percent to negative values in 2016. The yield is now about 0.10 percent. Financial markets do not seem to fear fiscal sustainability.

Figure 5. Net and gross general Japanese government debt as

planned 2 percentage point consumption tax hike in 2019 with a path of gradual increases of about 0.5–1 percentage points over regular intervals until the rate reaches at least 15 percent will better balance growth and fiscal sustainability objectives'.²⁶ IMF pressure is unlikely to relax as long as Japanese government debt remains at elevated levels.

Systematic increases in tax rates back higher government debt levels and place fiscal policy in the passive regime. This is why Japanese debt expansions are not inflationary and may explain why the Bank of Japan's monetary expansions have been ineffective in permanently raising inflation.

These international examples offer evidence of how monetary and fiscal policies that are inconsistent with each other can produce undesirable economic outcomes. Of course, many other factors also affect Brazilian, Swiss, and Japanese data, so this evidence is merely suggestive. The first two are cases in which monetary and fiscal authorities independently pursue their objectives and fiscal authorities fail to provide the fiscal backing needed for the central banks to control inflation. Japan is a situation in which the inflationary potential of monetary and fiscal expansions is thwarted by fiscal responses that eliminate the wealth effects of government debt.



Note. Vertical lines mark increases in the consumption tax rate. Solid line is consumer price inflation on all items. Sources: OECD.Stat and Nippon.com

Sources. OECD.Stat and hippon.com

4 Negative nominal bond yields

Like several other European countries, Sweden has been going through the unusual situation in which nominal government bond yields have been negative, even at horizons as long as five years. While there are many reasons that nominal yields have turned negative – economic weakness in the wake of the global financial crisis, aging populations, and so forth – monetary policy behavior is certainly a major factor. Lower monetary policy interest rates tend to reduce interest rates across the maturity spectrum.

Persistently negative real government bond yields may be *prima facie* evidence that fiscal policy could be improved. Essentially, the private sector is telling the government that it is willing to *pay* for the right to lend to the government. When real yields remain negative, it must mean that the government is not taking the private sector up on its generous offer.

Medium-term government bond yields are negative because demand for those safe assets is very strong. Strong demand bids up bond prices at the relevant maturities, driving down yields. If the government were to respond to the strong demand by increasing supply of the desirable assets, yields would rise. Negative yields, therefore, may reflect a 'shortage' of high-demand assets.²⁷

²⁶ See International Monetary Fund (2016).

²⁷ See Caballero et al. (2017).

Although the logic of why negative bond yields suggest suboptimal fiscal behavior may be obvious, a simple numerical example may clarify the issues.²⁸ Suppose that in 2017, the market price of a government bond that pays SEK 100 in 2018 is SEK 105, implying a –5 percent annual yield. For the sake of this example, imagine that the bond is bought by the Riksbank by crediting the government's account at the Riksbank by SEK 105, the amount by which assets and liabilities of both the government and the Riksbank increase. When the bond comes due in 2018, the government pays the Riksbank SEK 100, so its assets with the central bank decline by SEK 100, while its liabilities decline by SEK 105. The mirror of this transaction has the Riksbank's assets decline by SEK 105 and its liabilities by SEK 100.

The following year, the government transfers SEK 5 to the private sector, paid for by crediting banks' deposits at the Riksbank by SEK 5. Government balances with the Riksbank fall by SEK 5; liabilities of the Riksbank decline by those 5 krona and rise by the equivalent amount from the increase in bank reserves. Banks' deposits with the Riksbank earn the repo rate, which in fall of 2017 was -0.5 percent. If we denote the repo rate by r^{D} , then each year the Riksbank's liabilities *decline* by $1 + r^{D} < 1$ because $r^{D} < 0$. After *K* years, the Riksbank's liabilities in the form of bank reserves have declined by $-5(1 + r^{D})^{K}$. Over time, this number gets smaller, so that the initial expansion in reserves is self-extinguishing and the total expansion in bank reserves is $5/(1 + r^{D}) = 5.025$ krona.

This example illustrates one channel by which the private sector can be made better off when government bond yields are negative and the government issues additional government bonds to take advantage of those negative rates. More generally, the government could do practically *anything* productive with the proceeds from negative bond yields – invest in a sovereign wealth fund, finance infrastructure projects with positive returns, or drop newly printed cash onto Gamla Stan. A government that does not pursue these policies is reducing its citizens' welfare.



Figure 7 plots estimated government bond yields at maturities of one, three, five, and 10 years, along with the path of the repo rate set by the Riksbank. Immediately before and fairly continuously since the Riksbank adopted a negative repo rate in February 2015, bond yields out to five years also turned negative. In August 2016, even the 10-year yield briefly flirted with zero. Table 2 reports the average yields over the 33 months since the negative interest rate policy was adopted. All maturities out to five years have averaged negative yields for over two and a half years, plenty of time for the government to adopt welfare-improving policies that capitalize on bondholders' willingness to *pay* for the privilege of lending to the government.

28 This example comes from a conversation with Jon Faust.

I do not know why governments refuse to issue more bonds when their nominal yields are negative. But the current fiscal climate in many countries seems to maintain that any expansion in government debt is 'bad,' while any contraction in debt is 'good'. This is a climate that locks up fiscal policy and throws away the key.

Average between 18 February 2015 and 18 October 2017, daily data.				
3-month	-0.61			
6-month	-0.64			
1-year	-0.64			
2-year	-0.54			
3-year	-0.39			
4-year	-0.23			
5-year	-0.06			
10-year	0.67			
Repo	-0.42			

Table 2. Average	of estimated	zero-cou	pon yields
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Source: Sveriges Riksbank

5 How a net-lending target works and why it's fragile

Swedish fiscal policy pursues a net-lending target that is currently one percent of GDP over the medium term. To understand that policy's implications for government debt developments, we need to study how government debt evolves over time. Government debt's evolution is governed by the government's budget identity, which may be written as

(1)
$$Q_t B_t = (1 + \rho Q_t) B_{t-1} - S_t$$

where B_t is the nominal value of the government's bond portfolio, Q_t is the nominal price of the portfolio, and S_t is the nominal primary budget surplus (the surplus, excluding debt service costs). The primary surplus is the difference between total tax revenues and total government expenditures, excluding interest payments on outstanding debt. As written, the budget identity assumes that all government bonds are in nominal krona. In fact, Sweden also issues inflation-linked bonds and foreign currency bonds, but in 2017 over half of Swedish government debt was krona denominated.

We specialize the specification of government debt by assuming that all debt pays zero coupons and that the maturity structure decays at the constant rate ρ each period. If $B_{t-1}(t+j)$ is the quantity of zero-coupon bonds outstanding in period t-1, which come due in period t+j, then $B_{t-1}(t+j) = \rho^j B_{t-1}$, where B_{t-1} is the portfolio of such specialized bonds in period t-1.²⁹ Recent Swedish National Debt Office guidelines aim for an average maturity of nominal krona debt of between 4.3 and 5.5 years.³⁰

Define the gross nominal rate of return on the bond portfolio as

(2)
$$1 + R_t = \frac{1 + \rho Q_t}{Q_{t-1}}$$

²⁹ This specialization permits us to extract the implications of the existence of a maturity structure for government debt in a straightforward and intuitive manner.

³⁰ Riksgälden Swedish National Debt Office (2017).

This permits expressing the budget identity in terms of the evolution of the market value of debt, denoted by $Q_t B_t$, as

(3)
$$Q_t B_t = (1 + R_t) Q_{t-1} B_{t-1} - S_t$$

Let N_t denote net lending by the government, defined as

(4)
$$N_t \equiv -(Q_t B_t - Q_{t-1} B_{t-1})$$

Net borrowing is the change in the market value of outstanding government debt, so net lending is the negative of this change.

Then we can write the budget identity as

(5)
$$N_t = -(Q_t B_t - Q_{t-1} B_{t-1}) = S_t - R_t Q_{t-1} B_{t-1}$$

where the term $R_t Q_{t-1} B_{t-1}$ reflects interest payments on outstanding debt, which is also called debt service costs.

To relate the budget identity to the government's net-lending rule, we scale all variables by nominal GDP, Y_t , and express ratios to aggregate income as lower-case letters. Letting b_t denote the ratio of the market value of debt to GDP, expression (5) becomes³¹

(6)
$$n_t = -\left(b_t - \frac{1}{1+G_t}b_{t-1}\right) = s_t - \frac{R_t}{1+G_t}b_{t-1}$$

Denote the net-lending target by n^* . When Sweden sets this target at 1 percent of GDP, $n^* = 0.01$. Government policy aims to achieve this target by adjusting its fiscal instruments – taxes, government consumption and investment, and transfer payments – which are summarized by the primary surplus, s_t . We shall treat the primary surplus as the government's fiscal instrument.

5.1 Always on target

Initially, let's make the simplifying and extreme assumption that the government hits this target every period, so that $n_t = n^*$ all the time. Imposing this on the government's budget identity in expression (6) implies that

(7)
$$s_t = n^* + \frac{R_t}{1 + G_t} b_{t-1}$$

This expression is a rule for setting the surplus that makes net lending always equal to its target. To hit the net-lending target every period, the primary surplus must equal that target value plus the real interest payments on debt carried over from the past. In this expression, $R_t/(1 + G_t)$ is the real – inflation-adjusted – rate of return on the government's bond portfolio.

The extreme assumption produces extreme policy behavior: the government must adjust the real primary surplus one-for-one with real debt service. This has two consequences. First, to achieve the net-lending target every period, the government loses the flexibility to pursue other fiscal goals – macroeconomic stabilization, income distribution, and so forth – even in the short run. Forcing net lending to be always on target makes primary surpluses the exact function of select economic conditions that expression (7) describes.

Second, the government must react to any economic disturbance that raises debt service by raising the primary surplus. If the Riksbank reduces the reportate in order to

³¹ In (6) the variables are defined as $b_t \equiv \frac{Q_t B_t}{Y_t}$, $s_t \equiv \frac{s_t}{Y_t}$, $n_t \equiv \frac{N_t}{Y_t}$, and $1 + G_t \equiv \frac{Y_t}{Y_{t-1}} = \frac{P_t}{P_{t-1}} \frac{Y_t}{Y_{t-1}} = (1 + \pi_t)(1 + g_t)$, where G_t is the net growth rate of nominal GDP, y_{tr} and P_t is the general price level, so π_t is the net inflation rate, and g_t is the net growth rate of real GDP.

stimulate inflation, for example, then at least initially real interest rates are likely to fall at all maturities. This reduces the real return on outstanding debt and, hence, debt service costs. The government then must reduce primary surpluses – that is, engage in expansionary fiscal policy – to maintain the net-lending target.

Many other economic shocks will also affect debt service because interest rates on government debt are highly sensitive to both domestic and foreign disturbances. Any shock that reduces debt service, must be met with lower primary surpluses if net lending is to stay on target.

Notice that debt service costs in (7) can be rewritten as

$$(8) \qquad \frac{R_t}{1+g_t}\frac{B_{t-1}}{P_t}$$

where $1 + g_t$ is real economic growth. Now passive fiscal behavior is apparent: a higher price level calls for a lower surplus. In principle, there is no conflict between a net-lending target and passive fiscal backing for monetary policy. The fiscal behavior that (7) describes delivers both the lending target and the fiscal backing.

5.2 Gradually on target

Neither the Swedish government, nor any government, aims to keep net lending on target all the time. Instead, the target is intended to be hit on average over the course of economic cycles. We can generalize this analysis by allowing the adjustment to the net-lending target to be gradual. One fiscal rule that gradually achieves the net-lending target is

(9)
$$s_t - \bar{s} = -\gamma (n_t - n^*), \qquad \gamma > 0$$

where \bar{s} is the long-run primary surplus-GDP level. By this rule, whenever net lending is above target, $n_t > n^*$, the government makes the primary surplus lower than its long-run value. A lower surplus reduces net lending (or increases government borrowing) to reduce net lending back to target over time. The rule in (9) is a stylized description of fiscal behavior. Economic theory often posits stylized behavior in order to focus attention on a single aspect of what policy does – in this case, how surpluses react to net lending. A rule like (9) could be far more complicated to try to capture actual policy behavior, but that would merely make the analysis more complex and less transparent.

For this net-lending rule to stabilize government debt and reach the net-lending target in the long run, primary surpluses must respond to net lending with sufficient strength. This implies a restriction on the coefficient γ in (9). To derive that restriction, substitute the fiscal rule, (9), into the government's budget identity, (6), to obtain an equation that describes how the real market value of outstanding debt-GDP evolves over time

(10)
$$b_t = \frac{1}{1+G_t} \left(1 + \frac{R_t}{1+\gamma} \right) b_{t-1} - \frac{\bar{s}+\gamma n^*}{1+\gamma}$$

Stability requires that over time the market value of debt as a share of output converges to a constant, which requires that the coefficient on lagged debt in (10) lies between 0 and 1^{32}

(11)
$$0 < \frac{1}{1+G_t} \left(1 + \frac{R_t}{1+\gamma}\right) < 1$$

After some manipulation, we see that this restriction implies an appropriate range for the policy parameter γ

³² Technically, the coefficient on debt could also lie between 0 and -1, but negative coefficients create oscillatory behavior that governments would usually want to avoid.

$$(12) \qquad 1+\gamma > \frac{R_t}{G_t}$$

Because debt stabilization is by nature about the long run, we can consider this condition when inflation, economic growth, and interest rates are at their constant long-run values. Substituting these long-run relations in for R/G yields the restriction that government must make primary surpluses react to net lending with a coefficient that satisfies

(13)
$$\gamma > \frac{(1+\pi^*)(r-g)}{(1+\pi^*)(1+g)-1} = \frac{(1+\pi^*)(r-g)}{G}$$

This expression has a straightforward interpretation. π^* is the central bank's inflation target, so in the case of Sweden, $1 + \pi^* = 1.02$, given the Riksbank's two percent inflation target. r - g is the difference between the real interest rate on government bonds and the growth rate of real GDP in the long run. Economies that permanently grow faster than the cost of borrowing have no need for fiscal rules because tax revenues are assured to grow more rapidly than real debt service; those fortunate economies can simply 'grow out of deficits'.³³

It is reasonable to assume that over the broad span of time in Sweden, the real interest rate exceeds the real growth rate. The denominator in (13) may be rewritten in terms of the growth rate of nominal GDP as $(1 + \pi^*)(1 + g) - 1 = G$, where G is the *net* growth rate of nominal GDP, so it is a number like 0.04 when the price level and real output both grow at two percent annually. Higher nominal growth requires a smaller reaction of surpluses to net lending for two reasons. First, higher real growth automatically reduces the debt-GDP ratio. Second, higher inflation reduces bond prices and, therefore, the market value of debt.

Table 3 reports threshold values for the responsiveness of surpluses to net lending in order to stabilize debt-GDP when long-run real interest and growth rates take on different combinations. Because the rule in (9) is written with a $-\gamma$, values in the table should be understood as making surplus deviations move in the opposite direction from net-lending deviations. These calculations impose that the Riksbank hits its 2% inflation target in the long run. When γ exceeds these thresholds, in the long run the debt-GDP ratio is constant and equal to the discounted present value of the long-run primary surplus-GDP ratio.

Growth rate (%) Real rate (%)	0	1	2	3	4	5
0	0					
1	0.51	0				
2	1.02	0.34	0			
3	1.53	0.68	0.25	0		
4	2.04	1.01	0.51	0.20	0	
5	2.55	1.35	0.76	0.40	0.17	0

Table 3. Implications of combinations of long-run real interest rates and real growth rates for the minimum response of primary surpluses to net lending that will stabilize the debt-GDP ratio

Note. Entries report threshold values that γ in fiscal rule (9) must exceed. These calculations assume an inflation target of 2%. Table excludes the negative threshold values when g > r.

33 Since the global financial crisis in 2008, many countries have experienced economic growth rates that exceed real interest rates. Although that experience has been quite persistent, few economists believe it will last forever.

Inflation rate (%) Real rate (%)	0	1	2	3	4	5
2	0	0	0	0	0	0
3	0.50	0.33	0.25	0.20	0.17	0.15
4	1.00	0.67	0.51	0.41	0.34	0.30
5	1.50	1.00	0.76	0.61	0.51	0.44

Table 4. Implications of combinations of long-run real interest rates and inflation rate targets for the minimum response of primary surpluses to net lending that will stabilize the debt-GDP ratio

Note. Entries report threshold values that γ in fiscal rule (9) must exceed. These calculations assume a growth rate of real GDP of 2%. Table excludes the negative threshold values when g > r.

Table 4 makes clear how the central bank's inflation target affects this threshold. A higher inflation target reduces the threshold, permitting the debt-GDP ratio to be stabilized with a weaker response of surpluses to net lending. It might seem odd that the inflation target would have an impact on long-run stabilization of the government debt. The reason for this is that a higher inflation target produces lower bond prices, which reduce the market value of debt as a share of GDP. A lower market value of debt, on average, makes it easier to stabilize the ratio.

The message is that even in the long run, monetary and fiscal policies must be consistent with each other.

5.3 Alternative representation of fiscal rule

We can derive an alternative representation of the fiscal behavior that underlies the netlending target. This representation ties more closely to theoretical work on how monetary and fiscal policies interact. Combine (6) with the net-lending rule (9) to arrive at a rule that sets the primary surplus in response to net interest payments

(14)
$$s_t = \frac{\gamma}{1+\gamma} \frac{R_t}{1+G_t} b_{t-1} + \frac{1}{1+\gamma} (\bar{s} + \gamma n^*)$$

This expression generalizes the extreme policy behavior that appears in (7) when we assumed the government exactly hit the net-lending target, n^* , every period. Whereas in (7) the government increased the primary surplus one-for-one with interest payments, expression (14) instructs the government to gradually raise surpluses by the fraction $\gamma/(1 + \gamma)$ of debt service to cover rising interest expenses.³⁴

Section 6 reports some estimates of the surplus rules in equations (9) and (14).

5.4 Net lending vs. change in debt

A policy that targets net lending is a very close cousin to a policy that targets the *change* in debt. Net lending is $n_t = -\left(b_t - \frac{1}{1+G_t}b_{t-1}\right)$, so when nominal GDP growth, G_t , is zero, this is simply the change in the market value of the debt-GDP ratio. For this reason, it is useful to study the properties of a policy that targets the change in debt. Let Δb_t denote the change in debt and Δb^* its target value.

Now the government sets policy to raise the primary surplus whenever the change in debt exceeds target

(15) $s_t - \bar{s} = \delta(\Delta b_t - \Delta b^*)$

³⁴ The coefficient in (14), $\gamma/(1 + \gamma)$, is less than one to make the adjustment gradual.

so we restrict δ to be positive. Combining this rule with the government's budget identity produces an expression for debt's evolution over time³⁵

(16)
$$b_t = \left(\frac{\beta^{-1} + \delta}{1 + \delta}\right) b_{t-1} - \frac{1}{1 + \delta} \left(\bar{s} - \delta \Delta b^*\right)$$

Debt will be stabilized by this policy only if the coefficient $\frac{\beta^{-1} + \delta}{1 + \delta} < 1$. But this can never happen because it requires that real interest rates are negative in the long run.³⁶

The reason targeting the change in debt can never stabilize the debt-GDP ratio is obvious. If the change in debt target is positive and it is successfully achieved, then debt is growing at a constant rate as a share of the economy; if the target is negative and achieved, then debt is declining as a share of the economy. In either case, debt is not a stable fraction of GDP.

The only difference between a negative change in debt target and a net-lending target is that net lending scales past debt by the growth rate of nominal GDP. Of course, in periods when nominal GDP growth is small, positive net lending is essentially equivalent to a negative change in debt.

5.5 What these fiscal targets aim to accomplish

Countries adopt fiscal targets, not because the targets *per se* are virtuous, but because the targets help to achieve some broader objectives. Those broader objectives, according to the Swedish fiscal policy framework, are to use fiscal policy to raise the welfare of Swedish citizens through economic growth, redistribution of income, and stabilization of the macro economy. As the framework words it, 'A fundamental precondition for being able to attain the overall objective of fiscal policy is the long-term sustainability of the public finances'.³⁷ One way to operationalize 'long-term sustainability' is the achievement of a stable debt-GDP ratio over the long run.

Many years ago Phillips (1954) applied the theory of control to categorize three types of policy rules: proportional, integral, and derivative. He argued that the main driver of policy needs to be a proportional rule. The behavior that equation (9) describes makes deviations of the primary surplus from its long-run value proportional to deviations of net lending from target. One can add to that proportional behavior a response to cumulated deviations of debt from target – the 'integral' component – if it is desirable to reduce how long it takes to return to target. Phillips points out that changes in the deviation of debt from target – should be used only to dampen any oscillations that might otherwise be present.

Phillips' point is that a fiscal response to *changes* in debt – 'derivatives' – may serve as a supplement to, but not a central component of, policy rules that deliver good economic performance. Because a net-lending target is very close to a change-in-debt target, as I argued in section 5.4, Phillips' argument is that such a target is likely to deliver unstable outcomes for government debt.³⁸

Like Switzerland, Sweden stands out among advanced economies by experiencing declining or flat government debt-GDP ratios in the wake of the global financial crisis. After peaking at close to 75 percent during Sweden's banking and debt crisis in the early 1990s, central government debt has fallen steadily, as Figure 8 shows. It was about 35 percent when the global financial crisis hit in 2008 and is now around 30 percent. This has occurred during

³⁵ As before, we examine how this rule operates over the long run in which interest rates and growth rates are constant. 36 That is, making the coefficient on b_{t-1} less than 1 requires that $1/\beta < 1$. But β , which determines how

much people discount the future, is always between 0 and 1, implying that people are impatient and prefer to consumer sooner rather than later.

³⁷ Swedish Government (2011, p. 5).

³⁸ By Phillips's reasoning, a proportional rule that is more stable than those underlying either the net-lending or change-in-debt targets would simply make surpluses depend on deviations of debt from some target debt-GDP ratio, b^* . Such a rule would be $s_t - \bar{s} = \gamma(b_{t-1} - b^*)$ with $\gamma > \beta^{-1} - 1$. This restriction on γ instructs the government to raise surpluses with debt by enough to cover the increase in real interest payments plus some amount to return debt to target.

a period in which government debt in nearly every other country expanded rapidly and, in most cases, has remained elevated a decade after the crisis began.

At one level, this remarkable stability in government debt underscores the success of the Swedish fiscal policy framework. At the same time that debt has declined in recent years, many nominal bond yields have been negative, as section 4 documents. As I argued in that section, Swedish governments have declined the bond market's offer of a free lunch, which presents an opportunity to raise welfare among Swedes. Perhaps this is a sign of an overly-rigid desire to reduce government debt, regardless of prevailing economic conditions.



Source: Riksgälden Swedish National Debt Office, Debt Statistics

Government bond developments in Figure 8 are reflected in net-lending data. Figure 9 plots net lending as a percentage of GDP, along with the net-lending target, which was two percent of GDP until it was reduced to one percent in 2007. Most notable in this figure is the sharp increase in net lending over the past few years. In the process of refusing the free lunch, the government actually chose to *reduce* its borrowing when the bond market was willing to pay for the privilege to lend.



Source: Riksgälden Swedish National Debt Office, Debt Statistics

6 Some estimates from Swedish data

Can we find support in Swedish data for the fiscal policy actions that underlie the net-lending target? This section turns to some estimates of Swedish fiscal policy behavior to address that question.

6.1 Estimates of net-lending rule

As a first pass at applying this theoretical reasoning to Swedish data, I estimate versions of the fiscal rule in expression (9), which adjusts the primary surplus to target net lending. Table 5 reports estimates of fiscal behavior using quarterly data from 1993 through the first half of 2017.

These estimates do not lend support to the hypothesis that Swedish fiscal policy adjusts primary surpluses to target net lending, as fiscal rule (9) posits. Negative values of the thresholds in Table 3 give the minimum response of surpluses to net lending – the γ coefficient in the rule – that stabilizes government debt. To return net lending to target, surpluses must move in the opposite direction of net lending's deviation from target: if net lending is too high, surpluses must be reduced. Taken at face value, the estimates in the first three columns of Table 5 report that when net lending is high, the government raises surpluses. This reaction does not appear to be consistent with a net-lending target because it makes net lending increase to deviate farther from target. This pattern holds in both the ordinary least squares and the instrumental variables panels. The instrumental variables estimates aim to address the fact that the ordinary least squares estimates are contaminated by the naturally positive relationship between net lending and the primary surplus that the government's budget identity delivers.

The fourth columns in the two panels seem more promising. That specification alters fiscal rule (9) by making surpluses react to lags in both net lending and in surpluses, a specification that smooths the fiscal response over time. Although the coefficient on lagged net lending is negative, as stabilizing behavior requires, it is not statistically different from 0. The long-run response of surpluses to net lending takes account of how current surpluses depend on past surpluses, a dependence that raises the response well above the estimate of 0.107 reported as the coefficient on lagged net lending. But because that coefficient is not statistically significant, it is difficult to conclude there is strong evidence that fiscal policy follows the net-lending rule in equation (9).³⁹

The fourth column of the instrumental variables panel reports a somewhat more significant coefficient on lagged net lending. Unfortunately, the estimate on lagged surpluses implies that the equation is not stable, with surpluses exploding over time. This economically nonsensical estimate makes it hard to take the equation seriously as a description of fiscal policy behavior.

³⁹ In the regression $s_t = \rho s_{t-1} + \gamma(n_{t-1} - n^*) + \bar{s}$, the long-run response of surpluses to past net lending is $+\gamma/(1 - \rho)$, where in Table 5, ρ is estimated to be 0.979.
Dependent variable <i>s</i> _t						
Ordinary Least Squares						
n _t	0.974*** (0.028)		0.597*** (0.059)			
<i>n</i> _{t-1}		0.848*** (0.043)		-0.107 (0.123)		
<i>S</i> _{<i>t</i>-1}			0.372*** (0.055)	0.979*** (0.121)		
const	0.276*** (0.101)	0.321** (0.155)	0.224*** (0.101)	0.043 (0.125)		
Instrumental variables						
n _t	0.921*** (0.045)		0.046 (0.108)			
<i>n</i> _{t-1}		0.788*** (0.052)		-0.182* (0.099)		
S _{t-1}			0.854*** (0.099)	1.073*** (0.103)		
const	0.308*** (0.101)	0.374*** (0.133)	0.111 (0.086)	0.042 (0.091)		

Table 5. Estimates of y in expression (9)

Note. Dependent variable is primary surplus, s_i , as percentage of GDP. Independent variables are n_t and n_{t-1} , net lending as percentage of GDP. Sample for least squares is 1993Q1 to 2017Q2 and for IV is 1994Q4 to 2017Q2. Standard errors in parentheses. Instruments are two lags each of revenues to GDP, government expenditures to GDP, nominal GDP growth, CPI inflation, and the repo rate. Significance levels: ***(1%), **(5%), *(10%).

An important shortcoming of the regressions that Table 5 reports is that they do not indicate how primary surpluses and net lending interact dynamically. Although the simple theory above makes surpluses respond immediately to higher net lending, in practice there is no reason to expect such instantaneous reaction. To explore the dynamic interactions, we estimate a two-variable vector autoregression (VAR) with the primary surplus and net lending, both measured as shares of GDP.⁴⁰ VAR estimates generalize the regression in the fourth column of Table 5 in two ways. First, it permits surpluses to respond to current net lending plus four lags of net lending and surpluses. Second, it models net lending as depending on lags of surpluses and net lending, so the VAR tracks net lending's evolution over time.

40 The VAR employs the Bayesian methods in Sims and Zha (1998). In their notation, the prior sets $\lambda_1 = 1.0$, $\lambda_2 = 0.5$, $\lambda_3 = 1.0$, $\lambda_4 = 0.1$, $\mu_5 = 1.0$, $\mu_6 = 1.0$. The VAR includes four lags and a constant term in each equation and was

estimated over the period 1993Q1 to 2017Q2.



Figure 10. Dynamic responses to shocks in net lending and primary surpluses As a percentage of GDP

Note. Horizontal labels are quarters. Dashed lines are 90 percent probability bands.

Figure 10 reports how net lending and primary surpluses are correlated with each other over time. Solid lines are point estimates and dashed lines are 90 percent probability bands. The left panel of the figure shows that when net lending rises, primary surpluses also rise, remaining high for about three years. There is some evidence that eventually surpluses begin to fall, as fiscal rule (9) calls for, but even after 10 years the decline in surpluses is not likely to be different from zero. The right panel looks very much like the dynamics that the government budget identity triggers: higher surpluses raise net lending for some period.

As with the static regressions in Table 5, the dynamic patterns in Figure 10 do not support the notion that the Swedish government has systematically followed a rule that reduces primary surpluses whenever net lending is above target.

6.2 Response of surpluses to debt service

A central theme of the monetary-fiscal policy interactions that section 2 lays out is that for the central bank to successfully target inflation, fiscal policy must react in particular ways. Whenever monetary policy actions raise (lower) debt service, fiscal policy must eventually respond by raising (lowering) primary surpluses. This is the pattern of response that the alternative representation of fiscal behavior in equation (14) reflects. We now turn to Swedish data to seek evidence of this behavior.

Dependent variable <i>s</i> _t						
Ordinary least squares						
$r_t b_{t-1}$	0.649* (0.373)		0.183 (0.120)			
$r_{t-1}b_{t-2}$		0.687* (0.348)		0.107 (0.123)		
<i>S</i> _{<i>t</i>-1}			0.871*** (0.032)	0.872*** (0.033)		
const	-0.733* (0.376)	-0.618* (0.353)	0.019 (0.123)	0.043 (0.125)		
Instrumental variables						
n _t	0.408 (0.301)		0.175* (0.102)			
<i>n</i> _{t-1}		0.308 (0.290)		0.182* (0.099)		
S _{t-1}			0.889 ^{***} (0.034)	0.891*** (0.034)		
const	0.067 (0.267)	0.094 (0.266)	0.047 (0.090)	0.042 (0.091)		

Table 6. Estimates of $\frac{\gamma}{1+\gamma}$ in expression (9)

Note. Dependent variable is primary surplus, s_i , as percentage of GDP. Independent variables are $r_i b_{t-1}$, net interest payments in period t and $r_{t-1} b_{t-2}$, net interest payments in period t-1. Sample for least squares is 1993Q1 to 2017Q2 and for IV is 1994Q4 to 2017Q2. Standard errors in parentheses. Instruments are two lags each of revenues to GDP, government expenditures to GDP, nominal GDP growth, CPI inflation, and the repo rate. Significance levels: ***(1%), **(5%), *(10%).

Table 6 reports estimates of variants on equation (14), which depicts how surpluses react to debt service. As with the estimates in Table 5, these results must be interpreted cautiously. The government's budget identity induces a positive relationship between the primary surplus and interest payments on the debt. To see this, write the identity in (6) as

(17)
$$b_t + s_t = \left(\frac{1+R_t}{1+G_t}\right)b_{t-1}$$

On the right side of this identity are the real principal on the debt-GDP ratio, $\frac{1}{1+G_t}b_{t-1}$, and the real interest payments on that ratio, $\frac{R_t}{1+G_t}b_{t-1}$. The identity says that when interest payments rise, they must be financed by either higher surpluses, s_t , or more debt issuance, b_t . But this relationship stems from an accounting fact, not from any explicit *policy behavior*, which is the object of our interest.

With this cautionary note in mind, we turn to Table 6. Although all the estimated coefficients on debt service, either $r_t b_{t-1}$ or $r_{t-1}b_{t-2}$, are positive, none are statistically different from zero. This includes both the least squares and the instrumental variables estimates and specifications with and without lagged surpluses. Despite the positive correlation that the budget identity imposes, these regressions do not provide strong evidence that higher debt service leads to higher surpluses, as passive fiscal behavior in the conventional policy regime requires.

Figure 11 reports dynamic correlations between primary surpluses and debt service from a VAR that includes those variables. With a two-year lag, higher debt service is followed by higher surpluses (first column of figure). The second column shows that higher surpluses are followed by lower interest payments, as expected if surpluses are used to retire outstanding debt.



Figure 11. Dynamic responses to shocks in net interest payments and primary surpluses As a percentage of GDP

Whether these estimates recover fiscal behavior or merely reflect fiscal dynamics created by the government's budget identity is an open question. The evidence is, at best, merely suggestive of how Swedish fiscal policy has behaved. The estimates are crude because they do not account for the fact that variables in the regressions may be determined simultaneously. Leeper and Li (2016) point out, for example, that regressions of surpluses on past debt – or, as in Table 6, interest payments on debt – can be seriously biased, depending on which monetary-fiscal regime prevailed over the sample. Less crude estimates would entail jointly estimating policy behavior and private sector behavior as a means of identifying the fiscal rule. Work of this sort ought to be routine in any country that seeks to follow a well-specified fiscal target.

7 Subtle ways that monetary policy affects fiscal policy

Government debt is like any other asset: its value depends on discounted expected cash flows. Cash flows associated with government debt are real primary surpluses – the excess of revenues over expenditures, not including net interest payments on outstanding debt. Primary surpluses are debt's cash flows because they provide the real future payments that back government debt. Real interest rates determine the rate at which surpluses are discounted.

7.1 Demand for government bonds

Debt valuation can be understood using basic supply and demand analysis in the bond market. Start from the government budget identity above, which I repeat here, slightly rewritten by dividing through by the price level to convert debt and surpluses from krona into real units of goods

(18)
$$\frac{Q_t B_t}{P_t} + s_t = \frac{(1 + \rho Q_t) B_{t-1}}{P_t}$$

We want to know the value of debt outstanding at the beginning of the current period, period t, which is $\frac{(1 + \rho Q_t)B_{t-1}}{P_t}$. Already from the left side of this identity, we see that the higher is the current real primary surplus, s_t , the higher is the value of inherited debt (holding fixed the value of newly issued debt). But this identity implies the value of outstanding debt depends on *all future* primary surpluses as well, which leads to the debt-valuation equation⁴¹

(19)
$$\frac{(1+\rho Q_t)B_{t-1}}{P_t} = E_t \sum_{\tau=t}^{\infty} q_{t,\tau} s_{\tau}$$

Using this expression in the budget identity in (18) yields

(20)
$$\frac{Q_t B_t}{P_t} = E_t \sum_{\tau=t+1}^{\infty} q_{t,\tau} s_{\tau}$$

This expression says that the value of debt sold in period t equals the expected (E_t) sum of future discounted real primary surpluses beginning in period t + 1. The variables $q_{t,T}$ are real discount factors, which are products of all future one-period real interest rates between periods t and T, inverted. Suppose the one-period real interest rate between periods t and t + 1 is $1 + r_{t+1}$, then the one-period discount factor between those periods is $1/(1 + r_{t+1})$. The two-period discount factor between periods t and t + 2, $q_{t,t+2}$, is simply $\frac{1}{1 + r_{t+1}} \frac{1}{1 + r_{t+2}}$, and so on.

The real interest rate is an intertemporal price. Today's real rate, $1 + r_{t+1}$, is the price of goods today expressed in terms of future goods, so a lower real rate corresponds to goods today being relatively cheap. In economic models of the sort that many central banks employ, the real interest rate is the linchpin for the transmission of monetary policy: when the central bank reduces nominal interest rates, real rates also tend to fall, inducing people to substitute away from demanding goods in the future toward demanding goods today. But expression (20) reveals another channel through which real interest rates affect the economy. The real discount factors in this debt-valuation equation express goods in the future (primary surpluses) in terms of goods today to deliver the value of current debt in units of current goods ($Q_t B_t / P_t$). A lower path for real interest rates raises the value of future goods relative to current goods, which increases the real backing – the present value of surpluses – and, therefore, the value of debt.

The important point is that discount factors multiply – and therefore compound – interest rates. If the real interest rate is low today – for example, if r_{t+1} is negative – then that low rate affects all future discount factors and can have a large impact on the present value of surpluses and thereby on the value of outstanding debt. This creates an important channel through which monetary policy actions can have fiscal consequences. More persistent and larger changes in the monetary policy interest rate will translate into bigger fiscal impacts.

Valuation equation (20) emerges from interactions between supply and demand for government bonds and, as such, it is a condition that holds in equilibrium. Demand for government bonds, like demand for other saving devices, is the mirror image of demand for goods and services: the stronger is the desire to save by accumulating assets, the weaker is the desire to consume by buying goods and services. When the present value of debt's cash flows – primary surpluses – is high, debt becomes more attractive and people substitute out of buying goods into buying bonds. This reduces aggregate demand. Bond prices may rise and/or the overall level of prices in the economy may fall. As the valuation equation makes

⁴¹ Dependence on the entire future arises because the budget identity holds for all dates t in the future, so the value of debt issued at t, B_t , rises with surpluses the next period, s_{t+1} , and so on through time.

clear, the present value of debt's cash flows can rise because people expect higher primary surpluses – through higher taxes or lower expenditures – or because people expect higher discount factors (that is, lower real interest rates).

When bond supply is inelastic, expression (20) delivers the demand for nominal bonds in date *t*, which may be written as

(21)
$$B_t^d = \frac{1}{Q_t} P_t E_t PV(S_{t+1})$$

This demand is readily understood. Demand declines with the price, Q_t , of bonds, so in a graph with the price of bonds on the vertical axis, the demand for bonds is downward sloping, like most demand curves. Because bondholders care about the *real* value of the bonds they hold, B_t^d/P_t , demand for *nominal* bonds is homogeneous of degree one in the price level, just as it is for any nominal asset, such as money. Bond demand also rises with the real backing for government debt, the expected present value of primary surpluses, denoted by $E_t PV(S_{t+1})$, because higher real backing raises the expected stream of payouts to bond holders.

Figure 12 plots supply and demand for government bonds when the aggregate price level is on the vertical axis. Vertical supply means bonds are supplied perfectly inelastically. The initial equilibrium price level is P_1 when the demand schedule is B_1^d . A lower bond price, lower expected path of real interest rates (or higher expected path of discount factors), or a higher expected path of primary surpluses pivots demand to the dashed schedule B_2^d . At this new demand curve, bondholders wish to hold more bonds at any given aggregate price level, so at price level P_1 there is an excess demand for bonds. With an inelastic supply of bonds, the price level must fall to eliminate the excess demand for nominal bonds. A lower price level increases the real market value of debt.



This reasoning can be understood in terms of the impacts on aggregate demand. An increase in demand for bonds is the mirror image of a decrease in demand for goods and services. When government bonds become more desirable, people reduce their purchases of goods and services in order to increase their bond holdings. That decrease in goods demand is a decline in aggregate demand, which drives down the price level, as Figure 12 depicts.

7.2 Applying this reasoning to Sweden

How is any of this relevant for Sweden? Section 4 reviewed that Swedish government bond yields have now been negative for more than two years. At times, those negative yields have applied to bonds that do not come due for five years. Table 7 reports a variety of measures of short-term real interest rates in Sweden over three recent periods. Since January 2008, nearly all measures have been negative on average. But over the past two and a half

years, the measures have been strongly negative, well over -1.50 percent in some cases. In contrast, over the seven years before the financial crisis, real interest rates were around positive 1.50 percent. Evidently, Sweden is entrenched in a low-interest rate environment.

Low interest rates have been a worldwide phenomenon in recent years. But one clear reason that Swedish real rates have turned sharply negative is the Riksbank's policy stance, a stance that includes negative policy interest rates. Because negative real interest rates imply real discount factors greater than 1, negative rates have important fiscal consequences. Those consequences can be understood through the lens of the debt valuation equation in (20) and the supply-demand graph in Figure 12.

Table 7. Average real interest rates

Real interest rates are computed as the nominal interest rate in the current month minus the actual inflation rate in the future

Average real interest rates					
	Repo	3-month treasury			
Jan 2001–Dec 2007					
СРІ	1.41	1.46			
CPI-F	1.22	1.29			
Core CPI	1.56	1.63			
Jan 2001–Aug 2017					
СРІ	0.55	0.75			
CPI-F	0.23	0.44			
Core CPI	0.40	0.60			
Jan 2008–Aug 2017					
СРІ	-0.08	0.23			
CPI-F	-0.48	-0.19			
Core CPI	-0.45	-0.16			
Jan 2015–Aug 2017					
СРІ	-1.26	-0.94			
CPI-F	-1.79	-1.48			
Core CPI	-1.85	-1.54			

Note. For the reporate, future inflation is next month's rate. For the 3-month treasury rate, future inflation is the average of the next three months. Real rates computed using the 3-month Treasury end in June 2017. The 3-month rate is estimated by the Riksbank using zero-coupon bond yields and a term structure model. Sources: Sveriges Riksbank, Swedish National Statistical Office, and author's calculations

Monetary policy actions are closely linked to bond prices: as interest rates decline, bond prices and the nominal value of outstanding debt rise. Figure 13 plots the 'price' of government bonds (left axis) against the repo rate (right axis). The 'price' of bonds is calculated as the ratio of the market value of government bonds to the par value and is a measure of the Q_t variable that appears in the equations.⁴² There is a clear negative relationship between bond prices and the Riksbank's policy interest rate, just as theory would predict. Focusing on the last few years, bond prices rose sharply as the reporate headed toward negative territory. Since the repo rate turned negative, bond prices have remained elevated.

42 This is an approximation to the krona price of the government's outstanding bond portfolio.



Negative real interest rates, as in Table 7, beget high real discount rates. Holding the expected path of primary surpluses fixed, higher discount rates raise the current value of those surpluses to shift out the demand for government bonds, as Figure 12 depicts. As people substitute out of buying goods and services and into buying bonds, the aggregate price level declines, either now or in the future.

Through the debt-valuation relation alone, lower real interest rates exert some direct deflationary pressures on the economy. Deflationary pressures work *against* the Riksbank's aim to use negative policy interest rates to raise inflation. To support the Riksbank's actions, fiscal policy can eliminate these deflationary pressures by making government bonds less desirable. Bonds lose their appeal when their real backing – future primary surpluses – declines. In terms of Figure 12, a lower path for surpluses would offset the effects of lower real interest rates to pivot the B_2^d demand schedule left toward its initial position, B_1^d .

Swedish fiscal policy during the negative policy interest rate period has not aimed to offset the impacts of low interest rates on the desirability of government debt. Instead, net lending as a percentage of GDP has moved from –1.6 percent in 2014 to 1.2 percent over 2016 and the first two quarters of 2017. To the extent that this shift in net lending raises the path of surpluses that people expect, this fiscal policy makes government debt still more attractive, amplifying the deflationary pressures and reducing the Riksbank's effectiveness to raise inflation.

Recently in Sweden, both monetary and fiscal policy have increased the desirability and value of government bonds. Policies have shifted the demand curve down, as in Figure 12, to create deflationary pressures through the bond market. This may help to explain Sweden's chronically low inflation rates and why it has been so difficult for the Riksbank to return inflation to its two percent target.

8 Concluding remarks

The article has pointed to types of analysis that are not commonly undertaken by either monetary or fiscal authorities, but may shed light on how those policies are affecting the economy. For example, many central banks estimate or calibrate interest-rate rules, which are used in policy analyses to provide information on how actual policy choices compare to some useful benchmarks. To my knowledge, such exercises are not typically conducted as an input to fiscal decisions. As I argued elsewhere, there is much that can be done to improve the quality of fiscal analysis in ministries of finances.⁴³

This article does *not* deny the value of explicit targets for monetary and fiscal authorities to achieve. It also does *not* deny the potential value of monetary and fiscal rules. The article's thesis is that these targets and rules should not be designed in isolation. If monetary and fiscal actions are not mutually consistent in ways that this paper has explained, it may be impossible for the central bank and the government to achieve their objectives.

The article's examination of Swedish macroeconomic policies raises some concerns about whether fiscal policy is compatible with monetary policy's pursuit of an inflation target. I am concerned that in recent years the desire to hit a one percent net-lending target conflicts with the Riksbank's efforts to hit its two percent inflation target. Because these two targets and any operational rules for achieving the targets have been chosen independently of each other, the potential for conflict is real.

43 See Leeper (2011).

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The Riksbank's operational frameworks for monetary policy, 1885–2018

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In this article, we study how the Riksbank's operational framework for controlling the level of interest rates in the economy using different kinds of monetary policy instruments has changed over time. We show how these changes have been driven by changes in the environment in which the Riksbank operates as well as by the stated aims of its monetary policy.

1 Introduction

An operational framework for monetary policy consists of the monetary policy instruments, counterparties and collateral for credit used by a central bank to control the level of interest rates in the economy. The use of these different components primarily depends on the environment in which the central bank operates. When this environment changes, it is natural that the central bank may need to reform its operational framework. During the period 1885–2018, the Riksbank has used four different operational frameworks:

- 1885–1961: The discount rate system
- 1961–1985: The penalty rate system
- 1985–1994: The interest rate scale
- 1994–2018: The interest rate corridor

An important question discussed below is what reasons the Riksbank has had for changing its operational framework. Another question we discuss is which rates the Riksbank has tried to control during different periods and why it has chosen these rates in particular. A third question is which instruments, counterparties and collateral the Riksbank has used to control interest rates and how these instruments have been used. To provide an answer to the last question, certain historical events have also been depicted that illustrate how the Riksbank has acted in different situations. However, we do not provide a complete historical overview. The sole intention has instead been to illustrate how certain instruments have been applied.¹

The focus of this article is on the Riksbank's operational framework for monetary policy. For this reason, the various exchange rate systems used during the period are not discussed in any detail. For much of the period 1885–2018, Sweden has had some form of fixed exchange rate system, see Figure 1.² Neither do we discuss in detail the extensive regulatory system applied after the Second World War up until its deregulation in 1985. These systems cannot of course be completely disregarded, but they are discussed only to the extent that they interact with the operational framework.

We go through each of the four operational frameworks used by the Riksbank and explain how they have worked. Such a detailed and comprehensive account of the Riksbank's

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¹ For a review of the Riksbank's 350-year history, see Fregert 2018 and Wetterberg 2009.

² See Lobell 2010 and Bohlin 2010 for a presentation of Sweden's various exchange rate regimes, and Berg and Jonung 1998 and Carlsson 2011 for the experiment with a floating exchange rate and price level targeting in the 1930s.

operational frameworks has never before been published.³ In conclusion, we summarise and draw some general conclusions from the review. We also try to look forward and ask ourselves whether the current operational framework needs to be reformed.



Sources: Bohlin 2010, Edvinsson and Söderberg 2010, Lobell 2010, Sveriges Riksbank and Statistics Sweden

2 The discount rate system 1885–1961

We start our study of the Riksbank's operational frameworks in 1885, as, according to Fregert (2018, p. 112), that was the year when the Riksbank started re-discounting private banks' bills of exchange. Monetary policy prior to that, as Fregert describes it, can hardly be characterized as distinctive interest rate policy. By re-discounting bills, which involved the Riksbank exchanging the bills for banknotes, the Riksbank essentially became a bank for other banks. It therefore seems reasonable to talk about a monetary policy *operational framework*.

From 1885 onwards, the discount rate system meant that the trade bills discounted, i.e. exchanged for banknotes, by commercial bank customers at the bank could, when necessary, be re-discounted at the Riksbank. Riksbank Governor Arnberg advocated the so-called 'real bills' doctrine, when he spoke of the assets that should be accepted for re-discounting: The bank 'must mainly restrict these to one type of security, namely short-term payment pledges generated by industrial sector or trade sector commercial transactions or what are colloquially referred to as 'commercial bills', i.e. the basis of which is a completed commercial deal. The bank's actual operations thereby comprise exchanging their banknotes in return for such payment pledges, ...' (Arnberg, 1886, p. 87, my italics). For commercial banks, therefore, a portfolio of re-discountable bills was an attractive alternative to maintaining a cash liquidity reserve. The bills were redeemed at the Riksbank in exchange for banknotes at a value that was below their nominal value. In other words, the bank paid an implicit interest rate - the discount rate. According to Wetterberg (2009, pp. 216-218), the Riksbank used the discount rate policy for the first time in connection with the Baring crisis of 1890.⁴ This crisis had resulted in higher international interest rates, which led to a high demand for relatively cheap lending and the re-discounting of bills at the Riksbank. The General Council of the Riksbank promptly raised the discount rate from 4 to 6 per cent, see Figure 2. The discount rate system had thereby replaced the so-called 'strangulation system'. If previous practice

³ The interest rate scale is described by Norgren (1986), Westman Måtensson (1992) and the interest rate corridor by Hörngren (1994), Mitlid and Vesterlund (2001), Otz (2005) and Sellin and Åsberg Sommar (2012, 2014). The main sources are otherwise from Kock 1961 and 1962, Jonung 1993, the annual administration reports of the General Council of the Riksbank to Sveriges Riksdag (1978-1989), SOU 1982:52, Sveriges Riksbank (1986, 1988) and the annual accounts of monetary policy in the Riksbank's Economic Review.

⁴ Discount rate policy was applied earlier according to Ögren (1995), who has studied the period 1869–1881.

had been followed, lending would instead have been 'strangulated' and the Riksbank would have refused to re-discount bills instead of raising the interest rate. In Great Britain, France and Denmark, discount rate policy had already had its breakthrough in the 1860s.

The effectiveness of the discount rate policy before the Riksbank was given the monopoly for issuing banknotes in 1904 can of course be questioned. Prior to this date, some 'private' banks had the right to issue banknotes and they did not always depend on being able to re-discount bills at the Riksbank as they periodically had a large 'cash reserve' in the form of the unutilised part of their right to issue new banknotes. Bank Director A.O. Wallenberg gave his opinion on the effectiveness of the Riksbank's discount rate policy: 'Large banking institutions in other countries could, with their capital strength, influence the money market and raise or cut the interest rate depending on the circumstances. The Riksbank does not currently have the capital strength to do this and therefore the powers-that-be want to have exclusive power over the circulating capital'. (Wallenberg, 1885, p. 183). The last banking committee had just presented its proposal to give the Riksbank a monopoly on banknotes, to which Wallenberg was opposed.

Whether or not the Riksbank would be given a monopoly became a long-running issue at the end of the 1880s. But on 12 May 1897, it was finally decided that the Riksbank would be the sole note-issuing bank. The then 27 private note-issuing banks, with a banknote circulation amounting to half of the banknotes in circulation at the time, were allowed to continue to issue notes until the end of 1903. To compensate for the loss of their bank-issuing right, the Riksbank provided lending on favourable terms to the private banks until the end of 1910. Against promissory notes and certain mortgage bonds, these banks could borrow from the Riksbank at an interest rate that was 2/3 percentage points below the applicable discount rate.

If the liquidity was unevenly distributed among banks, this was solved by them lending to each other. The interbank market rate was normally the same as the rate for discounting bills at the Riksbank. An interbank loan was more favourable, however, as the Riksbank applied a minimum maturity period of eight days and the interest for the entire maturity period had to be paid even if the loan was redeemed prematurely.⁵ If the banking system as a whole needed liquidity, it could be supplied by the Riksbank by the banks re-discounting bills or, from 1879 onwards, by them taking loans with bonds as collateral.⁶ The latter was less common up until the 1930s, however, when borrowing from the Riksbank became the most common practice.

In connection with the First World War, the issue of the effectiveness of the discount rate policy resurfaced. After war broke out in July 1914, the demand for Swedish goods from both belligerent parties increased, leading to very strong economic activity. But instead of raising the discount rate to restrict lending, the Riksbank cut the discount rate in January 1915 and again in May 1916. This gave rise to harsh criticism from one of the leading economists of the time, Gustav Cassel, who felt that the Riksbank could have applied the brakes on the economy by conducting a forceful discount rate policy. However, the Riksbank Governor was of the opinion that discount rate rises would not be effective enough in the prevailing climate. Large commercial enterprises that spotted major profit-making potential would not be swayed by a discount rate that was a few percentage points higher, he thought, while a similar move would have inflicted serious damage on smaller players.⁷ The already strong economic activity continued to strengthen even further, causing the Riksbank to eventually cave in and increase the discount rate several times over starting in November 1916 from 5 to 7 per cent, see Figure 2.⁸ It did not dare to raise the discount rate to such levels that would have had a real

⁵ See Kock 1961, pp. 19–20.

⁶ In 1879, state leveraging of railway bonds was introduced to increase liquidity within the banking system, see Larsson 1993.

⁷ See Cassel 1916 for the exchange of views between Cassel and the Riksbank Governor (first deputy in the General Council of

the Riksbank) Victor Moll at the Swedish Economic Society's meeting on 26 September 1916.

⁸ See Wennerberg 1924 for a detailed account of the Riksbank's discount rate policy during and after the First World War.

restraining effect on the economy. The result was extremely high inflation of over 40 per cent in the latter stages of the war, see Figure 1. The Riksbank reacted in September 1918 by calling on commercial banks to exercise restraint when granting credit and threatened to repeal their re-discounting rights if the directives were not followed.

In conjunction with the economic boom of 1936–1937, the Riksbank had a new monetary policy instrument at its disposal, once again referring to the ineffectiveness of the discount rate policy. In 1937, the Swedish Riksdag decided to authorise the General Council of the National Debt Office to make treasury bonds and other debt instruments available to the Riksbank for use in monetary policy. The background to this was that the sharp rise in banks' credit balances at the Riksbank as a result of the economic boom would lead to a discount rate rise being relatively futile as a restraining instrument. As a complement, the thinking was that the Riksbank could sell bonds and treasury bills to drain the market of liquidity and in that way push up interest rates.⁹

2.1 The Riksbank's return discount rate

A new instrument in the Riksbank's toolbox was introduced in 1893 in the form of a *return discount rate*.¹⁰ The return discount rate was normally half a percentage point and was paid back at the end of each year. Private banks that had re-discounting agreements with the Riksbank could thereby re-discount their commercial bills at a discount rate that was lower than the official discount rate, see Figure 2. When applied, the banks could re-discount their bills at the Riksbank at the official discount rate minus the return discount rate.



The Riksbank could change the return discount rate without any connection with a change in the official discount rate. This could be perceived as a signal from the Riksbank, which could be interpreted either as a recommendation to banks to adapt their credit policies without changing interest rates or as a sign of an imminent change to the official discount rate.¹¹ The usual pattern was for the Riksbank, when tightening policy, to firstly remove the right to the return discount rate and then raise the official discount rate a few weeks later. When the Riksbank wanted instead to ease monetary policy, it firstly reintroduced the return discount rate and then cut the official discount rate a few weeks later. The following quote from Svenska Dagbladet on 9 November 1905 gives an example of this:

'We don't know whether a further raise will become necessary, but the Riksbank has already given an initial warning signal by withdrawing at the end of last week the return

⁹ See Kock 1961, p. 166.

¹⁰ See Håfors 1995, p. 10.

¹¹ See Kock 1961, p. 22.

discount rate of ½ per cent, which the Riksbank normally grants private banks that have a re-discounting agreement with the Riksbank, excepting as always the special re-discounting rate, which is offered to previous note-issuing banks in accordance with Article 41 of the Sveriges Riksbank Act'.

For their best customers, commercial banks normally discounted bills at the Riksbank's official discount rate. This meant that when the Riksbank removed the right to the return discount rate, banks discounted these bills without making any profit on the deal.

The private banks normally adhered to the Riksbank's changes in the discount rate, as illustrated by the following quote from Svenska Dagbladet on 6 June 1908:

'In view of the Riksbank's rate cut, representatives of private banks with offices in the capital held a meeting in the local office of Sundsvall Bank. The meeting was convened by the Deputy Chairman of the Swedish Bank Syndicate, Bank Director K.A. Wallenberg. It was decided at the meeting to reduce the bill discount rate, loan ratios and credit rates, and deposit rates by ½ of one per cent'.

However, problems occasionally arose as regards adherence as the savings banks were not always willing to cut their deposit rates. When this happened, it also led to hesitance among commercial banks to reduce their deposit rates, as they had started to compete with savings banks for customers. Saving banks saw it as their mission to promote saving in the country and therefore maintained relatively high deposit rates.

During the period 9 April 1920 to 1 January 1927, the Riksbank did not apply a return discount rate. The return discount rate made a short-lived return between 2 January and 30 April 1928 before being reapplied on a more permanent basis on 1 June 1933. On 6 June 1952, the Riksbank switched to using a flexible return discount rate adapted to the market situation.

2.2 Low interest rate policy

Discount rate policy after the Second World War came to be characterised by a distinctive low interest rate policy, with the discount rate parked on a low level. This principally applied to the long-term interest rate, which was stabilised on a low level via purchases of government securities. The background was that banks had built up their holdings of government bonds during the Second World War. After the end of the war, banks started selling off their bond holdings and instead increase their lending, which exerted upward pressure on interest rates. The Riksbank was then forced to purchase bonds to achieve the goal of stabilising the interest rate on the level that prevailed at the end of the war. Figure 3 clearly shows how the size of the domestic securities balance sheet item increased dramatically from 1946 onwards. The aim of holding interest rates at a low level (below market rates) was to support central government and, above all, housing sector funding. There was also a perception that interest rate policy was not the best weapon against inflation. Instead, fiscal policy and direct regulations were considered more effective and appropriate. The low interest rate policy lasted until October 1954, while the bond purchasing policy lasted until the end of spring 1963.



Source: Sveriges Riksbank





Source: Sveriges Riksbank

Periodically, the Riksbank was also forced to sell bonds to prevent a downturn in the longterm interest rate. One example is towards the end of 1945, when expectations of a rate cut spread through the market, putting downward pressure on short-term government securities which the Riksbank did not normally buy and sell. To prevent downward pressure on the long-term interest rate as well, the Riksbank sold significant amounts of longer-term bonds at a fixed interest rate. Sometimes, the Riksbank was put in a very difficult situation due to conflicts of interest, such as in 1947–1948 when a directive from the Committee on Banking and the Riksdag involved keeping the long-term rate at 3 per cent while simultaneously creating a tight credit market. By buying bonds, the Riksbank supplied liquidity which eased the credit market, but this was in direct conflict with the other part of the directive.

During the second half of 1947, the Riksbank began conducting a more differentiated interest rate policy. It concentrated its purchases to more recent issues of long-term loans at a 3-percent interest rate, while allowing more flexible pricing of shorter bonds. But there was no consensus in the General Council of the Riksbank regarding the desirability of more flexible pricing. After much ado, which also led to the Riksbank Governor's resignation, the purchasing policy was redesigned in November 1948. The new design involved consistent

and uniform implementation of the three-percent line throughout the interest rate structure. In 1950, an increase in the level of interest rates had to be accepted in order not to exacerbate the ongoing credit expansion. The level of interest rates for long-term bonds was approaching 3.5 per cent and the discount rate was raised on 1 December 1950 for the first time since February 1945, see Figure 2. Via limited purchasing, the expectations of a continued rise in interest rates were broken.

2.3 The regulatory system

When the Riksbank was unable to use the interest rate weapon, it tightened the economy when necessary by means of voluntary agreements with commercial banks. The crux of these agreements was that the commercial banks were to show restraint in their lending. But it did not always have the desired impact. For example, the discount rate hike of 1950 did not have a credit-tightening effect. Out of necessity, tougher regulations were successively introduced to try to reduce non-priority lending (lending other than to central government and the housing sector). As a result, the monetary policy operational framework was gradually supplemented with a *regulatory system*.¹² A *currency regulation* had already been in place since 1940 which enabled the Riksbank to control the domestic credit market without having to pay too much attention to foreign financial influence. This regulation was a prerequisite for the regulations of the domestic market introduced during the 1950s.

In November 1951, the Riksdag passed an enabling act on the regulation of interest rates, giving the Riksbank the right to determine the interval for banks' lowest and highest interest rates. Banks were thereby obliged by law to give notice of planned interest rate adjustments. According to the new act, companies were furthermore not allowed to issue bond loans without the Riksbank's permission. This act was inspired by the price regulation that applied during the Second World War. An enabling act could enter into force as and when necessary, and the threat of bringing it in empowered the Riksbank to negotiate 'voluntary' agreements with banks.

In 1952, two new monetary policy instruments were introduced as a result of an agreement with banks: *liquidity ratios* and *issuing controls* for commercial banks. The liquidity ratios stipulated the minimum ratio between the banks' liquid assets (cash plus government and housing bonds) and their deposits and other commitments. The agreement imposed higher demands on liquidity than the previous provisions laid down in the Cash Reserves Act, which was abolished. By increasing the liquidity ratio, the Riksbank could force commercial banks to buy more bonds, thereby simultaneously keeping bond rates down and restricting the scope for new loans. This was supplemented with issuing controls, according to which the Riksbank's permission was required before a company was allowed issue bonds or other securities to fund its operations. Issuing controls had two main functions. Firstly, they regulated the rate of interest and other issuing conditions, and secondly they satisfied the government's priority requirements regarding, for example, housing finance and central government borrowing. Both these regulations – liquidity ratios and issuing controls – made it possible to continue with the low interest rate policy for a few more years. The regulatory system survived in a variety of forms up until 1985.

2.4 More flexible rate-setting

At the beginning of the 1950s, the Riksbank implemented certain changes with regard to rate-setting on the money market. In June 1952, for example, the Riksbank abolished the fixed discount rate for re-discounting. The return discount rate would instead be adjusted according to the market situation and the Riksbank's current monetary policy objectives. This measure can be seen as part of the Riksbank's endeavour to create some flexibility in

¹² See Larsson and Söderberg (2017) for a historical overview of the regulatory system.

the money market. In connection with the cut in the discount rate in November 1953, the Riksbank also set out the principle that the discount rate would be linked to the money market and only indirectly affect longer-term interest rates on the capital market. This was part of the Riksbank's attempt to divide the market into a money market and a capital market, on which the short-term interest rate could be more flexible while the long-term rate was kept more constant.

The low interest rate policy lasted until October 1954 when the National Debt Office, in consultation with the Riksbank, issued a 16-year government bond loan at an interest rate of 4 per cent to tighten the money and capital markets. They did this after a loan with an interest rate of 3.5 per cent in October proved to be inadequate in order to sufficiently tighten the market. The Riksbank clarified that it was not striving for a similar rate rise across the board, but wanted to promote competition and a partitioning of different loan types into various groups of credit institutions with differentiated and flexible interest rates. At the same time, the Riksbank stopped listing lending rates other than the discount rate, making it possible to freely set lending rates against collateral to credit institutions. No bills were rediscounted during this period. Instead, credit institutions borrowed from the Riksbank with bonds as collateral, see Figure 5. Banks no longer saw it as common practice to create funds where necessary by re-discounting bills but preferred to generate funding by pledging bonds or treasury bills at the Riksbank in the event of emergency liquidity needs.



The tightening in April 1955 provides another example of how the Riksbank and the National Debt Office cooperated at the time to increase the interest rate on both the money market and the capital market. The Riksbank raised the discount rate from 2.75 to 3.75 per cent while the National Debt Office issued a 24-year loan at 4.5 per cent in order to directly influence the bond rate. To generate more funding from the general public, the National Debt Office also issued two premium bond loans during the first half of 1955. The same type of coordination was apparent when the discount rate was raised by 0.25 per cent in November 1956. The Riksbank itself also intervened directly on the bond market on a few occasions in order to regulate rates even though the era of low interest rate policy was over. During the first quarter of 1957, there was selling pressure on the bond market and the Riksbank took action by purchasing bonds. Instead, a period of rising bond rates began in January 1958, lasting until August that same year. During the year's first quarter, the Riksbank sold bonds from its portfolio to stabilise the interest rate at a suitable level.

On 10 July 1957, the Riksbank increased the discount rate by one percentage point, from 4 to 5 per cent, which aroused considerable attention, as the General Council of the Riksbank had deviated from common practice by not notifying the Government in advance. Indeed, Riksbank Governor Per Åsbrink and the General Council saw a rate rise as absolutely necessary and did not want to risk the Government saying no. This 'interest rate coup' led to a political crisis. The majority of the Committee on Banking did not consider the situation to be so serious as to expunge the scope for consultation with the government. General Council Chairman Per Eckerberg, whom the government viewed as the natural contact person between the Government and the Riksbank, was forced to resign.

2.5 Summary

In this section we have seen how the Riksbank's discount rate originally referred to the rate at which banks could re-discount bills at the Riksbank. But when banks no longer rediscounted bills, the discount rate became a more general policy rate and in the latter stages of the period primarily focused on controlling interest rate levels on the money market. When it was desirable to influence the level of interest rates on the capital market, the Riksbank cooperated with the National Debt Office.

3 The penalty interest rate system, 1961–1985

There was some tendency in the spring of 1961 for banks to start viewing loans from the Riksbank at the discount rate as a normal form of funding rather than a monetary policy instrument. In order to clarify that loans from the Riksbank should only be considered a temporary way of managing short-term liquidity problems, the General Council decided in May 1961 to introduce a higher interest rate – a *penalty rate* – on the portion of banks' loans at the Riksbank that exceeded a certain amount.

To begin with, the penalty rate in the new monetary policy operational framework was set at the discount rate plus 4 percentage points. But the idea was that the penalty rate could be changed as and when necessary. But at the first signs of a new recession, the Riksbank stopped applying the penalty rate in January 1962. It was reintroduced during the next boom in February 1964 with reference to expansionary economic developments and continued extensive bank lending despite a discount rate hike in January. Beginning on 15 December 1967, the penalty rate was set as equal to the discount rate plus a couple of percentage points, see Figure 6.

To explain in a little more detail how the penalty rate system worked, we can use the stylised illustration in Figure 7. The figure illustrates that a bank was entitled to borrow an amount equal to a certain percentage of its equity at the discount rate, r2. But for loan amounts above this, the bank was obliged to pay a penalty interest rate, r3. A bank with surplus liquidity could deposit these funds in an account at the National Debt Office at the deposit rate r1.

A bank had to ensure that it had sufficient liquidity every day in order to fulfil the Riksbank's *reserve requirement*. In Figure 7, R represents the sum of all banks' reserve requirements. The reserve requirement that applied each time specified the amount a bank was obliged to hold in a current account at the Riksbank. If a bank's reserve funds looked like they would be less than the reserve requirement, the bank had to borrow from another bank on the overnight market to cover the need. If funds at the end of the day were nevertheless below the reserve requirement, the bank was obliged to borrow from the Riksbank. Depending on the level of the reserve requirement chosen by the Riksbank, banks were allowed to borrow at the discount rate or at the higher penalty rate.

Typically, banks were a long way into the penalty rate zone for long periods, which corresponds to the demand curve R' in Figure 7. All banks were borrowing from the Riksbank

at that time and the overnight market was inactive. But when a bank had money to lend, it did so on the interbank market at approximately the penalty interest rate. When credit policy needed to be tightened, the Riksbank could ensure that banks fell within the penalty rate zone by setting the reserve requirements sufficiently high or by lowering the amount limit for when the penalty rate was to apply.



Source: Sveriges Riksbank





Note. R and R' is the banks' demand for reserves/total reserve requirements, r1 is a deposit rate, r2 is the Riksbank's discount rate, and r3 is the penalty rate. See the description in the main text. Source: Sveriges Riksbank

3.1 Reserve requirements

From 1969 onwards, reserve requirements constituted an important component in the penalty rate system. At the request of the General Council, the Government decreed on *cash ratios* for banks in accordance with the 1962 Act Concerning Liquidity and Cash Ratios. The Riksbank then issued regulations on how to apply the ratios that were to come into force on 2 January 1968. These regulations stipulated that the five largest banks were to hold at least 2 per cent and other banks at least 1 per cent of their deposits from the general public in a non-interest-bearing current account at the Riksbank. The decree on cash ratios was revoked just one month later, in February 1968, but later reintroduced on 18 July 1969. As from August 1969, every commercial bank was, according to the Riksbank regulations, to hold an amount in their current account at the Riksbank equal to 1 per cent at the end of the day, see Figure 8. To further incentivise banks to fulfil the cash ratios, they were allowed to earn interest from May 1970 until the end of the year on the amount in their current account at the Riksbank that corresponded to the cash ratio. The interest rate was set at the discount rate and was to be disbursed after the end of the year.

The cash ratios were increased from 1 to 5 per cent on 2 April 1974 to reduce banks' high level of cash liquidity and thereby exert greater pressure on them to limit their lending. From the autumn of 1970 and by the end of 1971, the Riksbank had acquired relatively large amounts of Swedish bonds and treasury bills. The subsequent easing in the liquidity situation led to the banks completely phasing out their borrowing from the Riksbank at the end of 1971 and only having to borrow small amounts temporarily during 1972–1973, see Figure 9. The banks' liquidity position in relation to the Riksbank largely corresponded to the funds that were in their current accounts to fulfil the reserve ratio requirements. When liquidity was withdrawn at the beginning of 1974, banks that previously did not need to borrow from the Riksbank were now forced to do so at an amount that exceeded the limit for the penalty interest rate. The measure was intended to reduce the gap between the lower interest rate level in Sweden and the higher level abroad. Figure 9 shows how the net positions of commercial banks in relation to the Riksbank changed at a stroke in 1974. The short-term interest rates on the money market rose sharply. The Riksbank now tried to keep bank borrowing at the Riksbank on a level that was within or close to the penalty rate zone. In this way, the interest rate on the short-term market could be maintained at the intended level.



Source: Sveriges Riksbank



Figure 9. Commercial bank net positions in relation to the Riksbank, 1962–1977

Note. The net position during one month has been calculated as the mean of the differences on the four reporting days of the month between commercial banks' credit balances in their current accounts at the Riksbank and their debt to the Riksbank for loans taken. The current account credit balances do not include funds kept in the account in accordance with provisions laid down in the Cash Ratios Act. Source: Sveriges Riksbank

Changes in banks' reserve requirements could have a major impact on short-term interest rates if the Riksbank allowed this to happen. An example of this is when the Riksbank

reduced the reserve requirements from 5 to 2 per cent in 1975, which released SEK 3,000 million tied up in banks' current accounts at the Riksbank. This was one of the reasons why the overnight rate fell to a one-year low of 3.5 per cent in mid-November. On other occasions, lower reserve requirements have not been allowed to impact short-term rates, for example on 14 April 1980 when they were cut from 8 to 2 per cent. In conjunction with this reduction, the National Debt Office issued two government bond loans to absorb the increased liquidity. When short-term interest rates on special deposits and bank certificates fell slightly in May, the National Debt Office counteracted this by issuing treasury bills at an elevated discount rate at the beginning of June.

During the summer and autumn of 1979, international interest rates were raised to counteract ever-stronger inflationary tendencies. This was due to the readjustment of monetary policy initiated by the Federal Reserve in October 1979 and resulting in high interest rates to which other OECD countries were also obliged to adapt. In connection with this, Swedish interest rates also needed to be adjusted upwards to counteract currency flows that were attracted to countries with higher interest rates. The Riksbank's discount rate was increased on three occasions – 5 July, 27 September and 23 November – from 6.5 to 9 per cent and the reserve requirements were raised from 2 to 8 per cent, their highest ever level according to Figure 8.

The outflow of currency that began towards the end of 1980 increased sharply in strength in January 1981 when expectations of an imminent devaluation grew ever stronger. At that point, the Riksbank General Council decided on 20 January to raise the Riksbank discount rate from 10 to 12 per cent. To achieve a more substantial increase in interest rates on the money market (special deposits, bank certificates, etc.), the penalty rate was also raised from 13 to 17 per cent, see Figure 6. To increase the impact of the penalty rate, the reserve requirements for commercial banks were also raised from 2 to 4 per cent, increasing the banks' need to borrow from the Riksbank. At the request of the General Council, the Government also decreed on reserve requirements for saving banks and cooperative banks, which were now to hold funds equal to 1 per cent of commitments in current accounts at the Riksbank as from 26 January 1981.

3.2 Control of bank deposit and lending rates

In conjunction with each change in the discount rate, the Riksbank expressed how it wanted banks to adjust their rates. Banks then discussed in the so-called interest rate syndicate (part of the Swedish Bankers' Association) and agreed on proposals for new interest rates, which they presented to the Riksbank the following day. The Riksbank then approved the banks' proposal, possibly after making an adjustment. This is a pattern revealed by Jonung (1993) in a review of minutes taken at regular meetings between banks and the Riksbank during the period 1956–1973. In light of this, it is not particularly surprising that the deposit rates announced by the banks were very much in line with the changes in the discount rate. Even banks' variable lending rates largely adhered to the changes in the discount rate. In 1970, the Riksbank introduced semi-annual analyses of bank lending rates, in which a certain upward drift over the years could be noted. To limit this drift in interest rates, the Riksbank reached agreement with banks at the beginning of 1974 on a maximum permitted increase in average interest rates.¹³

The fixed lending rates for secured loans, local authority loans, industrial loans, etc., followed the variations in issuing rates for corresponding bond loans. As a result of its issuing control instrument, the Riksbank had plenty of opportunities to influence the banks' fixed lending rates.

¹³ The interest rate drift is calculated as the difference, over and above the discount rate rise, in the average interest rate on all variable-rate loans according to the Riksbank's interest rate analysis adjusted for changes in fees.

3.3 Control of money market rates

From the mid-1960s, a growing proportion of credit institution deposits consisted of deposits from professional investors in, for example, large companies, local authorities, insurance companies and foundations. These investors were constantly on the look-out for profitable investments for temporary liquidity surpluses and banks were forced to compete for these funds in an entirely different way to how they competed for slow-moving household deposits. From the beginning, these deposits took the form of 'special deposits', i.e. deposits of large amounts on special terms. In March 1980, *bank certificates* were introduced on the Swedish money market, providing an additional funding option.

Money market rates were of strategic importance for currency flows. Control of shortterm money market rates – special deposit rates and rates on bank certificates – was mostly implemented by making changes to the penalty rate. The penalty rate was therefore used in situations when the Swedish krona was under pressure. One example of this is when currency turbulence broke out in the late summer and autumn of 1976 and the General Council's first action was to raise the penalty rate by 2 percentage points. The aim was to counteract the outflow of short-term capital abroad.

The Riksbank's typical reaction to the outflow of currency linked to expectations of an imminent devaluation was as follows. As an initial measure, it raised the discount rate. To achieve a more substantial increase in interest rates on the money market (special deposits, bank certificates, etc.), this was supplemented by a penalty rate hike. To reinforce the impact of the penalty rate, the Riksbank could also raise the reserve requirements for commercial banks, increasing their need to borrow from the Riksbank. From 1982 onwards, a pattern developed whereby the Riksbank's discount rate was adjusted to longer-term trends in international interest rates and the domestic economic situation while the penalty rate and amended reserve requirements were used for short-term adjustments of the interest rates on the money market as dictated by the currency situation.

During the first half of the 1980s, there was a tendency for central banks to use market operations to a greater extent in order to control interest rates. It seems that the Riksbank has also been influenced by this. In January 1985, the Riksbank sold off large volumes of treasury bills to push up interest rates on the money market by as much as 2 percentage points. The intervention on the money market, which was also supplemented by sales of US dollars, was justified by a continuing and accelerating outflow of currency. However, the Riksbank's discount rate and penalty rate were left unchanged, something commented on by the Riksbank Governor in an interview in Svenska Dagbladet on 23 January 1985:

'Will the discount rate and penalty rate now be changed? – No. We concern ourselves less and less often with administratively set interest rates. Instead we use the interest rate weapon via market operations, a strategy we think is very successful'.

3.4 Control of interest rates with longer maturities

The issuing control exercised by the Riksbank since the early 1950s continued to be an important instrument for controlling longer-term interest rates during the penalty rate system era. The Riksbank cut the discount rate four times in 1971, by half a percentage point each time, from 7 to 5 per cent. To create a better balance between long-term and short-term interest rates, the fixed rate on bond loans and other long-term loans was only cut by a quarter of one percentage point during the same period. Long-term interest rates did not always need to follow short-term rates. On 22 August 1975, for example, the Riksbank cut the discount rate from 7 to 6 per cent while fixed rates on long-term loans and interest terms for bond issues were kept unchanged to increase the availability of credit on the domestic capital market. Thanks to the favourable development of the current account and the krona's stability after the devaluation in August 1977, the Riksbank had scope to cut the discount rate in 1978. This was done on three occasions by 1.5 percentage points in total, from 8

to 6.5 per cent. Long-term interest rates were maintained, however, in order to stimulate investment on the capital market and hence facilitate the long-term borrowing of central government and other borrowers.

From 1980 onwards, interest rate setting on the capital market was increasingly determined by the market, with the exception of priority central government and housing loans. On 10 April, the Riksbank General Council requested the Government to issue a decree on general investment obligations and the regulation of interest rates. The General Council considered that a formal application of interest rate regulation was preferable to the informal interest rate regulation applied during the 1970s. The Government granted the General Council's request and pursuant to the decree, the General Council issued regulations on how interest rate regulation should be applied. The maximum interest rates allowed were stipulated for different categories of priority loans. However, the interest rate regulation provided scope for a significant upward adjustment of interest rates on non-priority loans. The intention was to achieve greater differentiation of the interest rate structure in the non-priority sector (i.e. not the housing sector and central government). Market participants were to take responsibility for adjusting the interest rates for the business sector's bond and debenture loans, taking into account the market situation, borrowers' credit rating, the loan's maturity and amortisation rate, etc. The aim was to increase the scope of the business sector to compete for capital market resources and create a better balance with interest rates on foreign borrowing. With this freedom in place, interest rates rose significantly on the non-priority section of the capital market. In August, the General Council also decided to allow a hike in the long-term rates for priority bonds of 1 percentage point. At the end of June 1980, the scope of the Act on credit policy funding was broadened so that the decree on issuing control and lending regulation could also be issued for financial companies, which up until then had been outside the Riksbank's control. For insurance companies, the interest rate regulation was abolished as from the beginning of 1982 and in October 1983, central government also started to issue bond loans at the market rate, known as treasury notes.

3.5 Deregulation of the credit market

Ever since the second half of the 1970s, liquidity growth in the economy had been very substantial and its primary breeding ground was in the constantly growing budget deficit. From 1978 until the end of June 1982, when the treasury bill was introduced, most of the budget deficit was financed through borrowings in the banking system and abroad. During the autumn of 1983, treasury notes were introduced and in December the Riksdag took a decision on public savings programmes, which would directly facilitate borrowing from households. These new savings forms made it easier to avoid the budget deficit liquidising the banking system and led banks to increase their lending.

From the mid-1970s onwards, the Riksbank used liquidity requirements and guidelines for the lending that can be approved in order to control bank lending. The Riksbank used liquidity requirements to limit banks' lending that was not funded abroad, that is, lending other than priority construction credits. The practice was that the Riksbank would normally stipulate guidelines for lending growth and then set liquidity requirements so that they were compatible with the stipulated growth. This control method was applied until September 1983 when the Riksbank decided to abolish the liquidity requirements and control lending solely on the basis of a *lending recommendation* with a maximum lending cap for banks' other lending in Swedish kronor.

The main justification for the Riksbank deciding to abolish the liquidity requirement was the unreasonable situation that this had led to for banks. On the one hand, banks would help central government to sell new government securities, such as treasury bills and treasury notes, aimed at the general public but on the other, they were obliged to compete for the same liquid funds from the general public in order to fulfil the liquidity requirements. At the same time as the Act on finance companies entered into force in 1980, finance companies also became subject to the credit policy legislation. Pursuant to this legislation, the lending of financial companies was also regulated in the same way as banks' lending.

The Riksbank had been aware for some time that external preconditions had gradually limited the scope for conducting an effective credit policy with support from direct regulations. To maintain effectiveness, the dose of measures must be gradually increased both in terms of number and size. As a result, long-term, uninterrupted use of the lending regulation had an increasingly distorted effect on the credit market. For this reason, some regulations were relaxed while others were totally abolished at the beginning of the 1980s. For example, the liquidity ratios for banks were abolished in 1983. The issuing control was also gradually relaxed, as were the investment requirements for insurance companies and the general pension fund, creating the preconditions for the emergence of a secondary market in government and housing bonds. In May 1985, regulation of banks' lending rates was abolished.

3.6 Summary

In this section, we have seen how the combination of the penalty interest rate and reserve requirements could be used by the Riksbank to rapidly tighten the liquidity situation on the money market and thereby control currency flows when it was considered necessary. We also saw how a large number of regulations were used to control several different interest rates and bank lending up until the deregulation of the credit market during the first half of the 1980s.

4 The interest rate scale, 1985–1994

On 21 November 1985, the Riksbank decided to implement a few comprehensive changes. The measures taken were a technical readjustment and not aimed at either tightening or easing monetary policy. For example, it was decided to immediately abolish the lending cap for banks, mortgage institutions and financial companies. To counteract the risk that this would lead to excessively rapid credit expansion, the reserve requirements were simultaneously increased from 1 to 3 per cent and interest compensation for cash funds was discontinued. To be able to adjust short-term interest rates to changes on the money and foreign exchange markets more quickly, the penalty rate system was replaced by an *interest rate scale* for bank borrowing at the Riksbank with effect from 9 December 1985. The right to borrow from the Riksbank at a fixed interest rate without any amount restrictions had been considered problematic. There was therefore a desire to have a system in which market operations could change the prevailing interest rate in smaller steps.

In the new interest rate scale system, banks could borrow an amount equal to a maximum of 25 per cent of their equity overnight at an interest rate of 10.5 per cent. Interest cost increased stepwise for larger amounts in accordance with the following scale:

- 25–75% of equity: 12.5%
- 75–125% of equity: 14.5%
- 125–175% of equity: 16.5%
- over 175% of equity: 18.5%

The interest rate scale is illustrated in Figure 10. A specific interest rate scale applied to each individual bank, in which each step was established in relation to the individual bank's equity. This construction meant that costs for bank borrowing at the Riksbank rose when the borrowing volume increased. The Riksbank controlled liquidity in the banking system by buying and selling securities, primarily in the form of repo transactions, so that banks could borrow on a specific step of the interest rate scale at the marginal rate. In other words, the

interest rate scale specified the various marginal rate levels that the Riksbank could apply by controlling liquidity in the banking system.

The Riksbank implemented its market operations either by buying and selling treasury bills or via repos and reverse repos.¹⁴ Initially, the maturities of the repos were normally one or two days, but were sometimes extended to one week. All dealers in securities could be counterparties in these transactions. The Riksbank announced a desired total volume and the counterparties submitted offers for interest rate and volume. These offers were ranked based on interest rate, and allocation began from the highest bidder and then went downwards until the announced volume had been achieved. In some cases, the Riksbank also used volume bids at a fixed repo rate. By implementing these types of operations on the open market, the Riksbank was able to directly influence the interest rate on banks' short-term loan transactions on the interbank market.



The interest rate scale's bank-specific construction made it beneficial for banks to even out relative differences in borrowing needs on the interbank market at the overnight rate. The bank with the worse liquidity would otherwise have been forced to borrow from the Riksbank at a higher marginal rate. The final result was normally that all banks borrowed at the same marginal rate at the end of the day. However, it was of the utmost importance to the Riksbank that there was an impact on money market rates at 3 and 6 months maturity, as these rates were the most significant for the currency flows that the Riksbank wished to influence.¹⁵ The strategically important rate for six-month treasury bills follows the marginal rate quite well during the period January 1987–May 1994 in Figure 11.

To be able to implement market operations in the form of repos or reverse repos that placed the banking system on a certain desired step of the scale, the Riksbank was forced to make daily forecasts of the banking system's borrowing requirements at the Riksbank. This involved forecasting changes in factors that affected the banking system's borrowing requirements: currency flows, central government borrowing requirements, the National Debt Office's borrowing on the market, special accounts at the Riksbank and the demand for banknotes and coins. In the event of major deviations between the Riksbank's forecasts and the banking system's actual borrowing, the Riksbank could quickly adjust liquidity in the banking system either by supplying liquidity or draining the banking system of it via a market participant.

¹⁴ A repo (short for 'repurchase agreement') involves the Riksbank buying securities on the market with agreements on repurchasing at a later date.

¹⁵ See Westman Mårtensson 1992, p. 25.

If the Riksbank wished to bring about a significant change in the marginal interest rate, it made direct purchases or sales of government securities at times when the Swedish krona had come under strong pressure. By establishing the interest rate scale, the General Council had to some extent delegated the daily decisions on the marginal rate to the Riksbank Governor, allowing the Riksbank to react rapidly to market developments and adjust the interest rate level. A certain amount of automation had also been introduced in that currency flows affected liquidity in the banking system and hence banks' borrowing requirements at the Riksbank and the interest rate level via the interest rate scale, as long as the Riksbank did not counter with a market operation. The Riksbank also implemented market operations in the form of interventions on the money market in order to directly influence the interest rates for treasury bills.





Sources: Sveriges Riksbank and Thomson Reuters

Periodically, the Riksbank's signals became unclear when it relied on market operations to influence money market rates, instead of explicitly determining a certain interest rate level. An example of this was reported in Svenska Dagbladet on 5 December 1989:

'An increasing number of dealers on the market are wondering about the Riksbank's tightened monetary policy. The interest rate for six-month treasury bills has been allowed to rise to 12.87 (selling rate). Throughout the spring and summer, the Riksbank has previously held this strategically important interest rate below twelve per cent'. '... There is some irritation aimed at the Riksbank, which is regarded as giving contradictory signals as to where interest rates should be'.

A review at the Riksbank of the period 1 June 1986 to 30 April 1987 compared to the penalty rate period 1 January 1983 to 8 December 1985 showed that the overnight rate had become significantly more variable after the Riksbank had introduced the interest rate scale. On the other hand, variability in interest rates with longer maturities had either decreased or stayed the same, see Koivisto and Zettergren (1988). As variability had decreased the most for slightly longer treasury bill interest rates, which were the Riksbank's primary target variable as they influenced short-term currency flows, the conclusion was that the Riksbank had increased its control over the target variable. According to Hörngren (1994, p. 52), the overnight rate became more stable after the Riksbank switched to always specifying the applicable marginal rate level from 6 April onwards. From 13 May 1993, changes in the marginal rate were announced in direct conjunction with the interest rate decision.¹⁶

16 See press release 18/1993 of 13 May 1993: 'The marginal rate is being cut to 9.00 per cent'.

In April 1988, the Riksbank was forced to tighten the economy. It raised the reserve requirements from 3 to 4 per cent, introduced a 4-percent reserve requirement for financial companies, increased the discount rate from 7.5 to 8.5 per cent and sold large volumes of treasury bills to bring up short-term market rates. In the autumn of 1988, banks were in dire need of being able to borrow from the Riksbank, due both to the increased reserve requirements and to the surplus in the government budget. According to its own assessment, the Riksbank would have withheld far too large volumes of securities from the market if it had continued to only use repos to prevent banks from being high up on the interest rate scale. In this situation, the Riksbank therefore supplemented its repo operations with direct loans to banks without collateral. By not demanding collateral for the loans, the Riksbank avoided withholding government and mortgage securities from the market. Technically, the direct loans worked in the same way as repos with sales being subject to bids, but the maturity period was longer. During the first half of 1991, the requirement for collateral when lending to banks was reintroduced.

4.1 Reduced role for reserve requirements and the discount rate

The reserve requirement did not play as active a role in the new system as in the penalty rate system. From the beginning, the requirement was set at 3 per cent, which meant that reserve requirement funds amounted to rather modest amounts. The reserve requirement for one month was calculated based on a bank's average deposits two months earlier. This resulted in a change in a bank's deposits affecting its borrowing from the Riksbank with a two-month time lag.

As from 1 July 1988, reserve requirements for financial companies were introduced and the reserve requirement for banks was simultaneously increased from 3 to 4 per cent. The reserve requirement for financial companies was calculated based on their borrowing in both Swedish and foreign currency. The reserve requirements were gradually relaxed over the next few years. In November 1990, the Riksbank decided that reserve requirements would no longer apply for deposits from banks and financial companies. The Riksbank then halved the reserve requirements for banks from 4 to 2 per cent in 1991 and abolished them for finance companies, which bolstered liquidity in the banking system by SEK 12 billion. At the same time, the interest rate scale was adjusted so that the interest rate level for the bank borrowing at the Riksbank was maintained. By 1 April 1994, the role of reserve requirements had run its course and they were reduced to zero. The reason was that other policy instruments were more flexible and did not create the same competitive disadvantages for banks that reserve requirements do.¹⁷

Initially, the lowest step on the scale was equal to the discount rate. But from January 1986 onwards, the role of the Riksbank's discount rate waned. In January, the Riksbank cut the discount rate without changing the applicable interest rate scale. As a result, the discount rate was for the first time completely decoupled from the applicable terms for bank borrowing at the Riksbank. The Riksbank then changed the discount rate as a signal that, in its view, a new interest rate level had been established on the market and this level was expected to continue for some time. The discount rate's controlling effect on interest rates thereby decreased and it came to serve mostly as a guide to banks when setting the interest rate on their deposit accounts and to a lesser extent their lending rates to households. Banks continued to adjust these rates for a while when the Riksbank's discount rate changed despite the abolished regulation of banks' lending rates. From the second quarter of 1992 onwards, the Riksbank began to mechanically set the discount rate entirely on the basis of interest rate developments during the immediately preceding quarter. The discount rate

thereby became a reference rate, entirely decoupled from monetary policy. On 1 July 2002, the discount rate was replaced by the Riksbank's reference rate.¹⁸

4.2 Adjustments of the interest rate scale

The Riksbank implemented an important change to the interest rate scale on 1 June 1986. The basis for lending terms initially comprised the borrowing bank's equity. But a weakness of this measure was that it could be influenced by the bank's year-end accounting strategy. The Riksbank therefore decided to change the capital base from taxed equity to taxed equity plus 50 per cent of the revaluation accounts. The Riksbank also decided to lower the steps in the interest rate scale, as it would otherwise have required huge market operations to prevent bank borrowing rates at the Riksbank being pushed up far above the prevailing interest level. The new interest rate scale was designed as follows:

- loans up to 20% of the new capital base
 8%
- loans at 20–40% of the new capital base 10%
- loans at 40–60% of the new capital base
 12%
- loans at 60–80% of the new capital base 14%
- loans over 80% of the new capital base 16%

The new interest rate scale actually involved a deepening of the steps in the scale. In the event of maximum borrowing by all banks, each step now corresponded to SEK 6 billion, compared with SEK 5 billion previously, apart from the first step which previously corresponded to SEK 2.5 billion. Deeper steps reduced the likelihood of unforeseen fluctuations in the banking system's liquidity affecting the interest rate level. The Riksbank adjusted the depth of the steps in the interest rate scale once a year taking into account banks' changed capital bases.

On 1 February 1988, the Riksbank once again adjusted the interest rate scale to improve the functioning of the overnight market. The number of steps was increased and their height was lowered from 2 to 1 percentage point while their depth was halved from about SEK 7.3 billion to SEK 3.7 billion. More steps with less height gave the Riksbank better scope to fine-tune the marginal rate and led to softer control of short-term market rates. From 1 March 1990, a step-depth of SEK 3.5 billion applied in a scale in which the lowest step was 9 per cent and the highest was 20 per cent. An upper limit was determined for bank borrowing in the interest rate scale. For borrowing above this limit, the Riksbank reserved the right to apply a higher borrowing rate. The idea was that this could allow flexibility in rate-setting and cope with serious speculation against the krona. In April 1991, the interest rate scale was adjusted so that banks could also deposit funds at a gradually lower rate. Later adjustments to the scale resulted in further lowering of the steps, firstly to 0.5 of a percentage point on 1 September 1991 and finally to 0.25 of a percentage point in April 1993.

4.3 The Riksbank changed its circle of counterparties

Until 30 June 1991, the Riksbank used National Debt Office dealers to implement its market operations on the money market. A trial period of six months then began for institutions that had expressed an interest in being counterparties, known as *primary dealers*, to the Riksbank. In January 1992, the Riksbank entered into primary dealer agreements with four banks and four securities institutions that were adjudged to fulfil the requirements.¹⁹

¹⁸ The reference rate is an interest rate that is determined by the Riksbank once every six months. The rate can be changed on 1 January and 1 July. The reference rate corresponds to the Riksbank's reportate at the end of the previous six-month period, rounded up to the nearest half-percentage point if necessary. The reference rate serves no monetary policy purpose but is used in some private agreements and in the Interest Act with reference to interest on overdue payments.

¹⁹ See Bergqvist and Westman Mårtensson (1992). The four banks were JP Bank, Skandinaviska Enskilda Banken, Sparbankernas Bank and Svenska Handelsbanken. The four securities institutions consisted of the brokerage firms Consensus, Transferator, United Securities and E. Öhman.

More primary dealers were approved later in the year. The Riksbank saw several benefits of having its own system of counterparties. Above all, there was a need for clearer ground rules between the Riksbank and these counterparties, which, in the Riksbank's view, would contribute to greater liquidity and better transparency on the market. With direct agreements, the Riksbank could impose demands on primary dealers to be active in both the Riksbank's market operations and in the primary and secondary market for government securities. The latter was considered to be of importance to enable monetary policy to have a rapid impact.²⁰

To increase competition and efficiency on the Swedish money market, the Riksbank also decided on 20 December 1990 to allow foreign bank branches to borrow in accordance with the interest rate scale. One problem was, however, how to determine the borrowing base for such branches. This was solved by a branch formed as a result of the conversion of a foreign subsidiary bank being allowed to retain the subsidiary bank's borrowing base while a branch established alongside a subsidiary bank was given a joint borrowing base with the subsidiary bank. A newly formed branch was temporarily given a standard borrowing base of SEK 60 billion.

4.4 Currency turbulence and interventions

At the end of March 1989, a rumour began circulating about an imminent revaluation of the Swedish krona, leading to extensive currency inflows. The reported inflow for the month of April was SEK 6 billion, but the actual inflow was SEK 18 billion. Through forward transactions of SEK 12 billion, however, the Riksbank could avoid increasing the foreign exchange reserves by the actual amount. Forward transactions were used like this to counteract self-reinforcing expectations of a forthcoming change in the exchange rate generated by the currency flows. On 1 June, the Riksbank decided to phase out currency regulation as from the end of June, which caused the currency flows to pick up again. But the inflows did not have any appreciable impact on Swedish interest rate levels.

When doubts about the Riksbank's ability to maintain the fixed exchange rate refused to go away, the Riksbank drastically increased the marginal rate in October 1990 from 12 to 17 per cent in less than a week. Furthermore, it implemented interventions on the money market by selling treasury bills. The interventions were so extensive that the Riksbank was forced to requisition treasury bills from the National Debt Office to a value of SEK 34 billion. This turned the tide and resulted in large currency inflows in late-October. When the Riksdag in December decided that Sweden should seek membership of the European Union, the prerequisites from foreign exchange policy changed. Confidence in the fixed exchange rate increased and in May 1991, the krona was pegged to the European Currency Unit, the ecu. But a new wave of distrust in the Swedish krona occurred after the Finnish mark had been devalued on 14 November 1991. The Riksbank was once again forced to drastically increase the marginal rate by 6 percentage points to 17.5 per cent and to intervene on the money market. This time, treasury bills to an amount of SEK 119.1 billion were requisitioned from the National Debt Office.

However, interest rates in 1991 did not come close to those that the Riksbank was forced to adopt in order to defend the fixed exchange rate in September 1992. On 8 September, the marginal rate was raised from 16 to 24 per cent, after the Finnish mark had been allowed to float freely. On 10 September, the marginal rate was increased to 75 per cent and on the 16 September to 500 per cent! This arrested currency outflows and the marginal rate could be lowered to 50 per cent only four days later, on 20 September. But the average borrowing costs for banks were never close to the extreme marginal rate levels on account of the Riksbank implementing a number of measures to reduce the negative effects of the high

²⁰ In November 2003, a new regulatory framework for monetary policy was introduced, part of which involved primary dealers being renamed primary monetary policy counterparts.

interest rates. To reduce banks' funding costs, the Riksbank extended the 15-percent step in the interest rate scale and also gave mortgage institutions loans on special terms to facilitate their short-term funding. At a marginal rate of 50 per cent, the situation for mortgage institutions was eased by the Riksbank lending them SEK 18 billion at an interest rate of 20 per cent on maturities up to four weeks.

4.5 The interest rate scale during the period with a flexible exchange rate

On 12 November 1992, the National Debt Office published a central government borrowing requirement that was greater than expected. This marked the beginning of a week of large currency outflows and massive interventions by the Riksbank on the foreign exchange market. As a large proportion of the currency flows were caused by companies and banks settling their debts prior to closing their annual accounts and were being driven by concerns about increased interest rates, the Riksbank considered it counterproductive to raise interest rates as it had done in September. Instead, the Riksbank intervened on the foreign exchange market. This resulted in an emptying of the foreign exchange reserves and the abandonment of the fixed exchange rate as an intermediate target for achieving price stability on 19 November.

To stress its determination to continue to safeguard the price stability target, the Riksbank set the marginal rate at 12.5 per cent at the transition to a flexible exchange rate. This was one percentage point higher than the exchange rate that prevailed at the start of the November crisis. On 15 January 1993, the Riksbank General Council adopted an inflation target, according to which the rate of inflation in the consumer price index should be 2 per cent from 1995 onwards. The marginal rate was cautiously lowered in small steps over the next 12 months. The Riksbank also intervened on the money market on 25 February and 8 March to raise short-term market rates to a level more in line with the current marginal rate. In addition, the Riksbank intervened on the foreign exchange market during the first quarter of 1993 to signal that the exchange rate was still of considerable importance to monetary policy. But currency interventions decreased during the spring as political unease faded and the krona strengthened. During the summer, some krona purchases were made to support the currency but the Riksbank stopped intervening on the foreign exchange market after that.

At the beginning of the 1990s, the Riksbank took on a market maintenance role. In 1992, the Riksbank started to provide a *repo facility* in which market makers could borrow government bonds. The idea was to improve liquidity in debt security trading. Operations were extended in March 1993 to include treasury bills and then again in June to cover housing bonds. Such a facility could help to reduce volatility in interest rates, which was due to a market maker, when necessary, having difficulty obtaining certain securities. Well-functioning money and capital markets were considered important to ensure efficient transmission from the Riksbank's policy rate to short-term market rates and then to longerterm interest rates on the capital market. The responsibility for the market maintenance repo facility was taken over by the National Debt Office in 1999.

4.6 Summary

In this section, we have seen how the Riksbank could affect short-term interest rates by implementing market operations that place banks on a certain step on the Riksbank's interest rate scale. The bank's costs for borrowing from the Riksbank was determined by which step it was placed on. The Riksbank gradually reduced the height of the steps on the interest rate scale. In the next section, we look at how this development ultimately led to abandonment of the interest rate scale and the introduction of a new monetary policy framework.

5 The interest rate corridor, 1994–2018

From the start, the interest rate scale seems to have been seen as a temporary solution if we read an article in Svenska Dagbladet on 31 October 1986 under the heading 'The Riksbank abolishes the interest rate scale'.

'Riksbank Director Anders Sahlén said that the Riksbank could consider abolishing the interest rate scale in the long run. Instead, the Riksbank would control interest rates by setting a price/interest rate on Riksbank loans overnight to every bank that asks to borrow. This would make the actions of the Riksbank more consistent with a free market. But these measures are not immediately imminent'.

On 1 June 1994, the interest rate scale was replaced by a new operational framework for monetary policy in the form of an interest rate corridor. The interest rate corridor is similar to some extent to the system proposed by Anders Sahlén in the 1986 newspaper interview. But according to Hörngren (1994), the reason for the reform of the operational framework was the change in conditions brought on by the transition from a fixed to a flexible exchange rate. With a fixed exchange rate, it was a question of keeping currency flows balanced and adjusting the interest rate in relatively large and clear steps could therefore be an appropriate course of action. With a flexible exchange rate system, however, small and gradual adjustment to the policy rate may be preferable. But a problem arises with the interest rate scale in this regard. For example, imagine if the height of the steps had been lowered from 0.25 percentage points to, say, 0.10 percentage points. The incentive for banks to lend money to each other in order to even out liquidity among themselves would then have risked being too weak. Instead, banks would probably have left their funds at the Riksbank overnight, which would have led to a deterioration in the functioning of the overnight market. The Riksbank therefore decided that it needed an entirely new operational framework for monetary policy.

In this new operational framework, an interest rate scale with many steps was replaced by just one deposit rate and one lending rate, see Figure 12. Each bank was offered a deposit and lending option corresponding to 4 per cent of the interest calculation base, which amounted to SEK 4.8 billion for the banking system as a whole. As before, the Riksbank controlled liquidity with the help of open market operations such as monetary policy repos or reverse repos, although the latter were now in the form of issued Riksbank certificates. However, the maturity of the repos was extended in the new system to 2 weeks and the intention was that the reportate would play a more central role in the operational framework. The operational framework became particularly clear when repos at a fixed interest rate were used and the banks only bid on volume. The Riksbank also had the option of setting repos at a variable interest rate, whereupon banks bid on both volume and the interest rate at which they wanted different volumes. The size of the weekly repos was balanced so that banks were not expected to have to either borrow or invest funds at lending or deposit rates during the repo's maturity period. Gradually, an overnight rate that was close to the reportate decided on by the Executive Board became the operational target for the corridor system. It was then anticipated that changes in the overnight rate would spread to interest rates with longer maturities, which also seems to have been the case according to Fransson and Tysklind (2016). They also find that adjustments to the repo rate have a significant impact on interest rates offered to households and companies.

5.1 Standing facilities

Deposit and lending rates in the so-called 'standing' deposit and lending facilities were set by the Riksbank General Council and constituted the corridor within which the Riksbank Governor could decide the level of the repo rate. These decisions could be taken every week and in as small steps as desired. The primary function of decisions on the interest rate corridor's deposit and lending rates was hence to signal slightly longer-term interest rate policy. However, the Riksbank's most important signalling interest rate was the repo rate, which specified the desired level of the overnight rate one week ahead. In February 2007, the Riksbank also started to publish its own forecast for the future repo rate.

Figure 12. Deposit and lending terms in the interest rate corridor



Source: Sveriges Riksbank

With a few exceptions, the corridor width has been 150 basis points since the new system came into operation on 1 June 1994:

- During the period 11 August 1994 to 12 April 1995, the width of the corridor was 200 basis points. On 11 August, the Riksbank announced that it had increased the lending rate to 8 per cent while the deposit rate was left unchanged at 6 per cent. At the same time, the repo rate was raised from 6.92 per cent to 7.20 per cent.
- When the Executive Board decided to cut the repo rate to 0.50 per cent on 20 April 2009, they also decided to narrow the interest rate corridor from 150 to 100 basis points to avoid a negative rate for the deposit facility.²¹ The corridor width was reset on 7 July 2010.

For the first few years with the new framework, the Riksbank applied a penalty interest rate of 1 percentage point if a bank's utilisation of the facilities exceeded 4 per cent of its rate calculation base (a measure of the bank's size). The primary purpose of the penalty rate was to continue to provide incentive for banks to participate in overnight trading, according to Hörngren (1994, p. 51).

Under the new Riksbank legislation that came into force in 1999, monetary policy decisions are taken by the *Executive Board of the Riksbank* and not as previously by the Riksbank General Council and the Riksbank Governor. On 5 October 1999, the Executive Board decided to change the decision process for setting the policy rates, i.e. the repo rate and the deposit and lending rates. According to the new process, the Executive Board would only decide on policy rates at the special monetary policy meetings held at intervals of six to eight weeks. This dissolved the close relationship between the repo-rate decisions and the weekly market operations. On 6 December 2000, the Executive Board decided that the monetary policy signalling function of the deposit and lending rates should be abolished. The deposit and lending rates would instead be changed when the repo rate was changed, so that the repo rate would always be in the middle of the interest rate corridor. According to the decision-making material²², the principal reason for the change was that there were other ways of signalling the long-term direction of monetary policy, to which the market attached more importance. Another reason mentioned was to remove the asymmetry

²¹ However, when the repo rate was cut to 0.25 per cent on 8 June 2009, the width of the corridor was left unchanged and the deposit rate thus became minus 0.25 per cent.
22 See Elvhult 2000.

regarding the relative costs of using the facilities compared with utilising the overnight market.²³ A third reason for the change was that the incentive for banks to bid for repos might decrease if the repo rate was close to the ceiling in the interest rate corridor.

5.2 Fine-tuning transactions

However, experience of the new system showed that the overnight rate did not on average correspond to the repo rate when the overnight rate was allowed to fluctuate freely within the interest rate corridor. According to Holmberg (1996), fluctuations in the overnight rate had sometimes been interpreted as policy signals in the market. This constituted an unwanted lack of clarity in monetary policy signalling, which meant that the Riksbank needed to stabilise the overnight rate in some way. This was achieved by introducing *fine-tuning transactions* at the end of each day in 1995. Fine-tuning transactions are normally carried out every banking day between 4 p.m. and 4.40 p.m. In these, the Riksbank offers credit against collateral or overnight deposits at the policy rate plus or minus 0.10 percentage points respectively. If the banking system as a whole has a liquidity deficit at the end of the day, the Riksbank lends funds, although not to an amount that exceeds the banking system's total deficit. A similar procedure applies if the banking system as a whole has a liquidity surplus at the end of the day. In this case, the Riksbank receives funds, but not to an amount that exceeds the banking system's total surplus. Allocation takes place on a 'first come, first served' basis, as long as there are funds left to lend or deposit.

During the period 29 October 2014 and 18 February 2015, fine-tuning transactions were performed at the repo rate instead of at the repo rate plus or minus 0.10 percentage points. The reason was that when the repo rate was cut to zero per cent, the intention was to avoid a negative fine-tuning rate due to uncertainty about how a negative interest rate would work. When the Riksbank cut the repo rate to -0.10 per cent on 18 February 2015, the rates for fine-tuning transactions were reset to the repo rate plus or minus 0.10 percentage points.

5.3 Monetary policy repos and Riksbank certificates

Already during the interest rate scale era, in December 1992, the Riksbank began issuing its own promissory notes, known as *Riksbank certificates*, instead of performing reverse repos when the Bank wanted to drain liquidity from the market. The reason was that the Riksbank wanted to help limit so-called 'supply commitments'.²⁴ A common practice had emerged on the money market of issuing a supply commitment instead of supplying the physical security in order to regulate payment in the event of a repo. In this way, the repo counterparty avoided the lengthier procedure of registering the underlying securities. But one of the risks associated with this was that the counterparty might not have coverage for the supply commitment.

The Riksbank certificate is a discount security. When the certificate is used in a reverse repo, it is discounted at the interest rate accepted when the bid was made. Since the interest rate corridor was put into operation, the Riksbank has exclusively carried out repos at a fixed interest rate, with the exception of four repos during the period February to March 1995 which were implemented at a variable rate. This meant that the repo volume was allocated according to private players' bids on volume and interest rate at auction. In this way, the bids acted as a guidance for the level of the repo rate. The experiment did not turn out well, however, as the change in method had undesirable effects on the interest rate level, exactly contrary to the Riksbank's expressed expectations²⁵.

²³ If, for example, the repo rate is close to the lending rate, the alternative costs for borrowing in the lending facility compared with borrowing at the overnight rate (close to the repo rate) will, relatively speaking, be lower than the alternative costs for utilising the deposit facility compared with investing the surplus at the overnight rate.

²⁴ See press release 65/1992 of 12 November 1992: 'The Riksbank issues Riksbank certificates'.

²⁵ According to press release 5/1995 of 9 February 1995: 'Prevailing interest rate expectations mean that the Riksbank now considers that variable repos can be introduced without the change in method having undesirable or drastic effects on the interest rate level'.
The Riksbank's recurring problem of determining the volume of Riksbank certificates to issue was made considerably easier as liquidity forecasts from 1994 onwards no longer needed to take central government payments into account. According to a government decision, these would occur directly in the market as a result of the National Debt Office's facility for investing surplus funds and financing deficits at the Riksbank being abolished as from 1 July 1994.

When the Riksbank defended the fixed exchange rate in late-1992, it bought Swedish kronor and sold foreign currency forwards, thereby building up a large negative forward position (SEK 131 billion on the last day of 1992) in foreign currency. As a result, the foreign exchange reserves looked larger than they actually were. In March 1995, the Riksbank decided to scale back the large forward liability in order to reduce the balance sheet total. This resulted in the reported foreign exchange reserves on the asset side of the balance sheet and the banking system's liquidity surplus on the liability side of the balance sheet decreasing by the same amount. As a result of the reduced liquidity surplus, the Riksbank changed the maturity period for weekly Riksbank certificates from two weeks to one week as from 2 July 1996. The forward liability was definitively abolished on 1 September 1997. Already by 15 April 1997, however, the scaling back of the forward liability had resulted in the banking system's liquidity surplus turning into a liquidity deficit, and the Riksbank had to switch to supplying liquidity to the banking system via monetary policy repos instead of, as before, draining the system of liquidity by offering Riksbank certificates. This shift is clearly visible in Figure 13.

The banking system had a liquidity deficit throughout the period 1997–2007, see Figure 13. The Riksbank then used weekly monetary policy repos with a maturity of one week to supply liquidity to the banking system. During the summer of 2008, the repos were so small that there was a risk of having to alternate between supplying liquidity to or draining liquidity from the banking system in the weekly operations. At that point, the Riksbank implemented a 'structural' transaction in foreign currency. Beginning on 8 September 2008, the Riksbank sold foreign currency and bought kronor to a value of SEK 5 billion. This was done so that the banking system would still have a funding requirement and the weekly repos could continue. This avoided a situation whereby, alternately, repos were carried out to supply liquidity or certificates were issued to reduce it. One reason for avoiding this was that the Riksbank's counterparties felt such weekly zigzagging would make short-term liquidity management more administratively demanding. The intention was to begin issuing Riksbank certificates once the banking system was in a stable situation with a liquidity surplus in relation to the Riksbank. However, this happened more quickly than expected.





In October 2008 it was clear that the international financial unease was also affecting the financial markets in Sweden. The market for long-term loans was working less and less effectively. In this situation, the Riksbank launched a *loan facility in Swedish krona* to increase access to credit with longer maturities. In the first auction of three-month loans on 6 October, banks borrowed SEK 100 billion. At a stroke, the banking system's short-term funding requirement at the Riksbank became an investment requirement. Figure 13 treats lending during the 2008–2009 crisis as temporary, as the loans were time-limited, and it therefore did not affect the banking system's structural liquidity position in relation to the Riksbank.

Initially, the Riksbank borrowed back the surplus liquidity via its daily fine-tuning transactions. To reduce the size of these transactions, the Riksbank began issuing Riksbank certificates with a maturity of one week on 14 October. The dramatic rise in lending to the private sector in Figure 14 is mirrored in increased issuance of Riksbank certificates and increased deposits in the form of fine-tunings in Figure 13 and Figure 15 (Riksbank certificates are included in the latter figure in the Other liabilities item). During the period 1 June to 13 October 2010, Riksbank certificates with longer maturities than one week were also offered. These certificates matured in conjunction with the next planned monetary policy meeting. In connection with the introduction of longer certificates with a maturity of one week and those with longer maturities. They could be resold to the Riksbank at an extra cost of 2 basis points and with next-day payment. The purpose of this option was to make the certificates more attractive and hence be able to scale back a larger share of the surplus liquidity at longer maturities instead of borrowing large amounts overnight every day.²⁶

In Queijo von Heideken and Sellin (2014), we studied how the Riksbank's operational framework for monetary policy functioned before, during and after the financial crisis, i.e. the period October 2007 to February 2014. We found that the banking system's large liquidity surplus, which was the result of the Riksbank's extraordinary lending during the crisis, can be associated with short-term interbank rates being pushed down towards the fine-tuning rate. However, this effect was minor, when most of the surplus was invested in Riksbank certificates. We also noted that the larger the surplus was, the less the turnover was among the monetary policy counterparties in the overnight market. But this effect was also minor, however, when most of the surplus was invested in Riksbank certificates. Our general conclusion was that the operational framework had successfully managed to stabilise short-term rates close to the repo rate. We had reached the same conclusion earlier with the help of a minor technical analysis in Sellin and Åsberg Sommar 2012 and 2014. How well short-term rates follow the Riksbank's policy rates is illustrated in Figure 16. For most of the period, rates with tomorrow-next maturities (STIBOR T/N) and one-week maturities (STIBOR 1W) follow the Riksbank's reportate and are within the corridor constituted by the Riksbank's deposit and lending rates.

²⁶ In 2014, a minor adjustment was made to the issuance terms to avoid excessively frequent resale, which would have an unnecessarily large impact on interest rates on the overnight market. The Riksbank consequently decided to raise the fee for resale from 2 to 10 basis points as from 16 December and to remove the right to resale on the bid submission date. The background to this was that participants who had been allocated Riksbank certificates had on occasion immediately resold them to the Riksbank to ensure that there was plenty of liquidity to invest overnight.







Source: Sveriges Riksbank



Figure 16. The Riksbank's policy rates and short-term market rates, 1994–2018

Source: Sveriges Riksbank

5.4 Purchase and sale of bonds

The Riksbank's portfolio of Swedish securities was phased out in 2001, see Figure 14. As early as 1998, the Riksbank announced that it intended to reduce its holdings of government securities by SEK 20 billion and that 'the reason is that the current size of the Riksbank's domestic securities portfolio – with a nominal value of SEK 47 billion – no longer fulfils any monetary policy function.'²⁷ At the end of the 1990s, the portfolio was mainly used for market maintenance purposes, which meant that the Riksbank provided a repo facility in Swedish securities to market makers. This enabled them to borrow a security which was difficult to gain access to on the market.

In November 1999, the Government decided to transfer the market-maintaining repo facility to the National Debt Office. In connection with this, it was also determined that there were no remaining reasons why the Riksbank should hold a portfolio of domestic securities.²⁸ Holdings in the Swedish portfolio consisted at that point mainly of government bonds. There was also a smaller holding of treasury bills and mortgage bonds, but these matured in 2000. On 17 May 2001, the Riksdag decided that the Riksbank should make an extraordinary transfer of profits to central government. On 13 June, the Riksbank transferred its remaining portfolio of Swedish government bonds to the National Debt Office to value of SEK 20 billion. The conclusion that a domestic portfolio does not fulfil any monetary policy function is built on the premise that 'today's efficient markets have led to interventions not in practice having any long-term effect on the formation of interest rates'.²⁹ The financial crisis of 2008–2009 showed, however, that it cannot be assumed that the markets will always function efficiently. We have also seen that short-term interest rates may approach zero in a crisis situation. If further stimulation of the economy is required in such a situation, one alternative is to buy bonds on the market.

As a supplementary monetary policy measure, the Riksbank started to purchase Swedish government bonds in February 2015. These purchases were funded by the Riksbank increasing deposits from the monetary policy counterparties, see Figure 13 and Figure 15. This has led to the banking system having a large liquidity surplus in relation to the Riksbank since 2015. The purpose of the purchases was to push down the general level of interest rates in the economy. When the rate on safe assets falls as a result of the central bank's purchases of government bonds, it becomes more attractive for investors to seek alternative assets. In this way, the lower government bond rates spread to other parts of the financial markets. Other channels function because the purchases are interpreted as the Riksbank's policy rate remaining low for a longer period or because the banking system's surplus increases.

The Riksbank purchased bonds with the help of reverse auctions in which the Riksbank's monetary policy counterparties and the National Debt Office's dealers could participate. A reverse auction is a lowest-bid auction in which the bidder offering the highest interest rate (the lowest price) receives the first allocation. After that, the bidder offering the second-highest interest rate receives allocation and so on until all the volume on offer has been allocated. In this way, the pricing and allocation of the Riksbank's transactions are transparent for the market. According to De Rezende, Kjellberg and Tysklind (2015), the Riksbank's purchases of government bonds have contributed towards pushing Swedish interest rates lower than they otherwise would have been. They also show that purchases have contributed to reducing the interest rate differential in relation to other countries and to the krona being weaker than it otherwise would have been.

29 See Risberg and Lybeck 2000, p. 4.

²⁷ Press release 11/1998 of 9 March 1998.

²⁸ See Risberg and Lybeck 2000.

5.5 Summary

In this section, we have seen how the Riksbank took yet another step to bring about a more flexible operational framework for monetary policy by replacing the interest rate scale with the interest rate corridor. In the new system, the policy rate could be adjusted in steps that were as small as desired. Thanks to daily fine-tuning transactions, the overnight rate could also be controlled with more precision regardless of whether the banking system had a liquidity deficit or a liquidity surplus in relation to the Riksbank.

6 Summary and conclusions

An operational framework for monetary policy needs to be continuously developed and adapted both to a changing environment and to what the system will be able to achieve. It is often a question of minor adjustments but in the event of major challenges, the changes may even involve replacing an entire operational framework with a new one. This is a pattern that we have found when studying the Riksbank's operational framework for monetary policy from 1885 until the present day.

In the discount rate system (1885–1961), the Riksbank introduced the return discount rate in 1893 giving the system more flexibility. But in the end, changes to the discount rate proved to be far too blunt an instrument to be able to rapidly counteract unwanted currency flows that threatened the fixed exchange rate. The penalty rate system (1961–1985), which replaced the discount rate system, enabled more rapid increases in the interest costs for banks to borrow from the Riksbank. Borrowing at the penalty rate primarily impacted money market rates, which was of crucial significance for currency flows. When the Riksbank General Council wanted to have the option of adjusting the interest rate in smaller steps, the Riksbank replaced the penalty rate system with the interest rate scale (1985–1994). The height and depth of the scale were adjusted on several occasions and the height of the steps was gradually reduced over time. Eventually, a point was reached where it was no longer possible to reduce the height of the steps without it having negative consequences for activities on the interbank market. At this point, the Riksbank introduced the interest rate corridor (from 1994), in which there were no restrictions on the size of the steps taken when adjusting policy rates. In 1995, the new operational framework was complemented with daily fine-tuning transactions to reduce variability in the overnight rate.

A lesson to be learnt from the Riksbank's application of different operational frameworks is how important it is for a central bank to control the shortest interest rate – the overnight rate. When it introduced both the interest rate scale and the interest rate corridor, the Riksbank seems to have undervalued the importance of the overnight rate. When introducing the interest rate scale, the focus was originally on the six-month interest rate, but after a while the Bank also started to take the development of the overnight rate into consideration. The same pattern was repeated when the Riksbank introduced the interest rate corridor in 1994: To begin with, the focus was on the two-week interest rate, but after a few months, finetuning transactions were introduced to stabilise the overnight rate. Although the Riksbank has the ambition to control a longer interest rate, the necessity to stabilise the overnight rate is unavoidable as it is of major importance as an anchor for the yield curve and is the interest rate that the Riksbank has typically found the easiest to influence. Provided fixedincome markets are working well, changes in the overnight rate will affect market rates with longer maturities and hence also the interest rates charged to households and companies. If fixed-income markets are not working well, the Riksbank must act to rectify the situation. At the beginning of the 1990s, the Riksbank took on a market maintenance role, which was later taken over by the National Debt Office. It is obviously in the Riksbank's interest that this or some other authority takes on the responsibility for the satisfactory functioning of the financial markets to ensure that monetary policy has an effective impact.

Another lesson to be learnt is the importance of clear *signalling* by a central bank. As early as during the discount rate era, the Riksbank developed a clear strategy for signalling how it expected interest rates to develop in the future via adjustments to the return discount rate. During the penalty rate era, adjustments to the penalty rate became instead a clear signal of what level short-term interest rates should be on. During the early stages of the interest rate scale era, the Riksbank changed its tactics. Instead of, as previously, announcing a policy rate, it implemented market operations and let the market guess which level of interest rates the Riksbank wanted to have. This led to the signalling periodically being unclear but the situation was rectified when the Riksbank started to announce decisions on adjustments to the marginal rate. During the early stages of the interest rate corridor era, the Riksbank's deposit and lending rates served as a tool for the General Council to signal the direction of monetary policy in the slightly longer term. When the Executive Board took over the decisions on all the Riksbank's policy rates, focus shifted to decisions on the repo rate. The deposit and lending rates were determined based on the repo rate that was in the middle of the interest rate corridor. The importance of clear signalling by the Riksbank is further illustrated by the less successful experiment with variable repos in early-1995. After that, the Riksbank always used a fixed interest rate for monetary policy repos. Since February 2007, the Riksbank has also published its own forecast for the future reporate.

A third lesson is that a central bank needs to choose its *monetary policy counterparties* based on what it wants to achieve. If it wants to control short-term money market rates, which seems to have been the natural choice for the Riksbank for most of the period studied, it needs to have counterparties that are active on the market. During the discount rate period, the most important tool was the re-discounting of commercial bills and the Riksbank then signing re-discounting agreements with commercial banks. When the Riksbank introduced the primary dealer system in 1991, it instead placed explicit demands on counterparties to be active on the markets that were relevant to monetary policy. When the Riksbank began buying Swedish government bonds in February 2015 as a complementary monetary policy measure, it turned to National Debt Office government bond dealers.

A fourth lesson is that the Riksbank must be prepared to change the kinds of *financial instruments* it uses in its operations and as loan collateral. The financial markets develop over time, which means that some financial instruments disappear and new ones are added. From the early-1930s onwards, the discounting of commercial bills dominated in the Riksbank's implementation of monetary policy. But when companies gradually stopped using bills, the Riksbank increasingly had to use credit with bonds as collateral. The early 1980s saw the development of the money market in Sweden and the Riksbank could use the new treasury bills to implement its market operations.

A final lesson we can learn is that a central bank needs to offer both *lending and deposits* for monetary policy purposes in order to effectively be able to control the shortest interest rates both when the banking system has a liquidity deficit and when it has a liquidity surplus. During the earlier periods, the Riksbank only offered lending for monetary policy purposes. This meant that monetary policy tended to be ineffective during periods when the banking system had plenty of liquidity. During the penalty rate period, this was rectified by introducing reserve requirements to force banks to borrow from the Riksbank. During the interest rate scale period, deposit steps were gradually introduced in the scale, and in the interest rate corridor period, the very idea is for the Riksbank to always offer both lending and deposits and hence set the bounds for the overnight rate. Using the implicit interest rate regardless of whether the banking system has a liquidity deficit or a liquidity surplus.

The current operational framework with an interest rate corridor and fine-tuning transactions has worked well. But can it cope with the new challenges facing the Riksbank?

These challenges primarily consist of rapid changes that are currently ongoing on the payments market, with a growing requirement to be able to make rapid payments round the clock, 365 days a year. These changes will impose greater demands on the payment systems provided by the Riksbank, as regards, for example, opening hours. The operational framework for monetary policy needs to be adapted to these changes. However, our preliminary assessment is that the corridor system is sufficiently flexible to be able to make the necessary adjustments within the current operational framework.

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Liquidity premiums in the Swedish inflationindexed government bond market

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The breakeven inflation rate, or the difference between nominal and inflationindexed interest rates, has become an important source of information for central banks to gauge inflation expectations. However, studies have found that the breakeven inflation rate is affected by risk premiums such as liquidity and inflation risk, which if not addressed may distort its information value for inflation expectations. In this article, I address this issue by computing a measure of the liquidity premium in the Swedish inflation-indexed government bond market. The results show that the estimated liquidity premium explains a sizeable portion of the variability in the breakeven inflation rate and tends to increase during periods of heightened financial stress. By correcting the breakeven inflation for the existence of risk premiums I obtain a more accurate estimate of the market's true inflation expectations, available daily.

1 Introduction

As the markets for inflation-indexed bonds have grown in size, the interest rates on these bonds have become an increasingly important source of information about the general state of the economy. By purchasing this type of instruments, investors are able to eliminate the inflation risk embedded in nominal fixed-income securities, and to obtain a given real rate of return regardless of the inflation rate. Interestingly, the spread between nominal and inflation-indexed (real) bond rates of the same maturity – also known as breakeven inflation – measures market participants' inflation expectations for different horizons. Due to its availability in high frequency, several horizons and with a relatively long time history, the breakeven inflation rate has become an attractive measure of inflation expectations compared to other measures such as surveys, which are typically available at much lower frequencies and for fewer horizons.

Although markets for inflation-indexed bonds have grown significantly since their creation, they are still much smaller in size than their nominal counterparts. This creates liquidity issues, which tend to be exacerbated during episodes of financial stress, when investors desire to hold more liquid assets. As discussed by Shen (2006), Pflueger and Viceira (2016), D'Amico et al. (2014), among others, investors therefore typically tend to demand an extra premium for holding these less-liquid bonds – a so called liquidity premium – which tend to be time-varying and higher in periods of market stress. Hence, if the liquidity premium is not accounted for, it may distort the information value of the breakeven inflation rate as a measure of inflation expectations. To address this problem a number of studies have used regression analysis or term structure models to obtain an estimate of a time-

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varying liquidity premium for inflation-indexed bonds. By removing the estimated liquidity premium from the breakeven inflation rate (together with the inflation risk premium that is commonly embedded in nominal interest rates), central banks can obtain more accurate estimates of inflation expectations from financial instruments.

The aim of this article is to estimate a measure of the liquidity premium in the Swedish inflation-indexed government bond market, and thereby to obtain a better measure of inflation expectations based on a corrected breakeven inflation rate. To the best of my knowledge, this is the first study which attempts to estimate the liquidity premium in the Swedish government bond market.

Following Pflueger and Viceira (2016), I estimate a measure of the liquidity premium using regression analysis. More specifically, I regress the breakeven inflation rate on observable proxies for liquidity in the inflation-indexed bond market, while also controlling for inflation expectations and inflation risk¹. From the estimated regression I construct a liquidity measure that is used to correct the breakeven inflation for the distortions caused by the liquidity risk premium. The results show that the liquidity measure can explain a sizeable portion of the variability in the breakeven rate. The estimated liquidity premium is time-varying, and increases during periods of heightened financial stress such as the financial crisis of 2008 and the European debt crisis. After correcting the breakeven inflation rate for the liquidity premium and inflation risk, the adjusted series is generally more in line with the level of market participants' inflation expectations as measured by surveys. Since survey measures should not suffer from liquidity issues, this suggests that it can be misleading to use the unadjusted breakeven inflation as a measure of inflation expectations without correcting for the liquidity premium.

The outline for the rest of this article is as follows. I will start with a closer discussion of the liquidity premium, including a motivation of the liquidity variables used later in the study and the estimation strategy. The chosen liquidity measures will then be regressed onto breakeven inflation, while controlling for inflation expectations and inflation risk. The results from this regression is then used to compute the liquidity premium, which is used to calculate the breakeven inflation adjusted for liquidity issues. Next, I compare the unadjusted and adjusted breakeven inflation rates with survey measures of inflation expectations. Finally, I provide some concluding remarks.

2 Liquidity premium

2.1 Estimating the liquidity differential between inflationindexed and nominal bond yields

An inflation-indexed bond is a bond protecting the investor from fluctuations in inflation, since the cash flows are indexed to the consumer price index. These bonds give the investor a fixed real interest rate plus a compensation for the actual CPI inflation over the maturity of the bond. The difference between a constant maturity zero-coupon nominal and inflation-indexed bond yield is the breakeven inflation rate. This is the rate which would offer the investor the same total return on both bonds, given that inflation averages the breakeven rate over the maturity of the bonds.

¹ In order to control for inflation risk I add an inflation risk proxy consisting of the distribution of survey responses on inflation expectations, (for more details please see section 2.3.2). The estimated inflation risk premium has a mean of 0 bps and it does not seem to affect the estimation of the breakeven inflation during the chosen sample period, as shown by the preferred specification (5) in Table 1. Therefore, the focus in this article will be mainly on the liquidity premium.

The breakeven inflation should reflect investors' inflation expectations plus a timevarying compensation for bearing inflation risk.² However, the typically smaller size of the inflation-indexed bond market relative to its nominal counterpart has induced the appearance of liquidity issues, which tend to be more prominent during periods of market stress, complicating the interpretation of the breakeven as a measure of inflation expectations. To get compensation for the extra search friction the investors may encounter when selling the inflation-indexed bonds, they demand a liquidity premium in their interest rates, or equivalently a discount in their price. As discussed by Shen (2006), Pflueger and Viceira (2016), D'Amico et al. (2014), among others, it is essential to account for the lower liquidity of inflation-indexed bonds when using them to measure inflation expectations. Since the Swedish inflation-indexed bond market was first created in 1994, it has always been smaller in size than the nominal government bond market, which indicates that there could be a liquidity premium in the interest rates of the inflation-indexed bonds relative to their nominal counterparts.

Taking these two risk premiums into account, the breakeven inflation can then be expressed as follows:

BEI = inflation expectations + inflation risk – liquidity premium

The liquidity premium, if positive, will tend to push up the interest rates of the inflationindexed bonds relative to the ones for the nominal bonds, and tend to lower the breakeven inflation. The possible existence of a positive liquidity premium may explain the difference between breakeven inflation and inflation expectations measured by surveys. Figure 1 shows five-year inflation expectations as measured by the breakeven inflation rate and surveys. As can be seen, the breakeven is persistently lower than the survey expectations. Although surveys may still be an imperfect measure of inflation expectations, due to issues such as measurement errors,³ the persistent difference between the two measures of inflation expectations suggests that the breakeven inflation may be plagued by the existence of liquidity and inflation risk premium.





2 Studies using US data have found the inflation risk premium to be positive, when looking over a longer time period, while studies based on the more recent periods have found evidence of small and slightly negative inflation risk premiums, coinciding with the financial crisis. Looking at the theory, Kitsul and Wright (2013) suggest that the inflation risk premium tends to be positive and large when there is a risk of hyperinflation, but negative when deflation risks are prominent. For more studies on the inflation risk premium, see for example Abrahams et al. (2013), Grishchenko and Huang (2013), D'Amico et al. (2014). 3 For example, the survey's sample of respondents and their responses may not necessarily be representative of the true overall expectations of economic agents. Another problem arises from the fact that there might be different respondents available on each occasion the survey is conducted.

2.2 Estimating the liquidity differential between inflationindexed and nominal bond yields

The liquidity premium is estimated by regressing the breakeven inflation onto observable measures of liquidity in the inflation-indexed market, while controlling for inflation expectations, following Pflueger and Viceira (2016) and Gürkaynak, Sack and Wright (2010). In order to control for inflation risk, a proxy for the inflation risk premium is also included. The breakeven inflation can then be explained as a function of the following factors:

(1)
$$BEI_{n,t} = \alpha_1 + \alpha_2 \pi_t^e + \alpha_3 \delta_t + \alpha_4 X_t + \varepsilon_t,$$

where $BEI_{n,t}$ is the breakeven inflation, π_t^e is a measure of inflation expectations, δ_t is a proxy for the inflation risk premium, and X_t a vector of liquidity proxies.

The estimated liquidity premium is the negative in the variation of *BEI*_{*n*,*t*}, explained by the liquidity variables:

$$(2) \qquad \hat{L}_{n,t} = -\hat{a}_4 X_t.$$

The adjusted breakeven inflation is then estimated as follows:

(3)
$$BEI_{n,t}^{adj} = BEI_{n,t} + \hat{L}_{n,t} - a_3 \delta_t.$$

2.3 Data

In this section the variables that are used for the regression analysis are presented and discussed. I will start by briefly discussing the interest rate data used to measure the breakeven inflation rate. Thereafter I will proceed with a discussion of the measures used to control for inflation expectations and inflation risk. Finally, the selected liquidity variables for capturing liquidity in the Swedish inflation-indexed market will be introduced and discussed more in detail.⁴

The regressions are estimated using daily data. When data only exists in lower frequency, the series have been interpolated. The sample ranges from 4 January 1999 to 28 April 2017, but since data for some of the liquidity measures are only available for a more recent period, some regressions are estimated using a shorter sample.

2.3.1 Interest rate data

In this study I focus on the five-year forward breakeven inflation rate. One natural reason for that is that central banks are often interested in measuring whether long-term inflation expectations are anchored. Moreover, by using bond rates with longer maturities, any impact of the indexation lag and CPI seasonality, which tend to be a more prominent problem in shorter inflation-index bond rates, should be alleviated. One additional reason for using longer term maturities is that there are generally few outstanding bond contracts in the short end of the inflation indexed yield curve, which implies that the estimated series of the interest rates for these bonds tend to be very volatile and suffer from large fitting errors. I compute the forward breakeven rate using the model suggested by Svensson (1994) to calculate nominal and inflation indexed zero-coupon interest rates. Forward rates are used in order to match the inflation expectations measured from surveys, as explained below.

⁴ Earlier studies of the liquidity premium in the US government bond market have, for instance, used transaction volumes, fitting errors, the nominal off-the-run spread, bid-ask spreads, and the spread between an inflation swap and the breakeven of the same maturity as proxies to capture the relative illiquidity of US TIPS. Relative transaction volumes and the fitting errors will also be used in this study, while the other variables are not applicable to the Swedish case. Instead a set of new variables, suitable to capture the liquidity in the Swedish inflation-indexed bond market will be introduced.

2.3.2 Measures of inflation expectations and inflation risk

In order to control for inflation expectations, I use the survey on five-year average inflation expectations provided by TNS Sifo Prospera. Prospera ask the participants about their expectations for inflation five years ahead,⁵ which is consistent with what is captured by the five-year forward breakeven inflation rate.⁶ The respondents consist of labour market parties, purchasing managers and money market players.⁷ Up until September 2009, the survey was conducted only on a quarterly-basis. Since then Prospera have started publishing inflation expectations among money market players also on a monthly frequency. To obtain a longer history on inflation expectations, the series before 2009 has been interpolated from quarterly data.

I use the difference between the minimum and the maximum survey responses for the five-year inflation expectations as a proxy for inflation risk in the five-year forward breakeven rate. This is motivated by the fact that the dispersion among responses is likely to be higher when there is a high degree of uncertainty regarding future inflation (see Wright 2011).

2.4 Liquidity variables

2.4.1 Average fitting errors from the Nelson-Siegel-Svensson yield curve estimations

The Riksbank uses the Svensson (1994) method to estimate daily yield curves for a set of debt securities, including government bonds. From these estimations it is possible to also obtain the average daily fitting errors. As discussed by Abrahams et al. (2016), D'Amico et al. (2014), Hu et al. (2013), among others, large fitting errors can be a sign of stress in the market and investors' inability to take advantage of the arbitrage opportunities that appear due to mispricing when investors start behaving irrationally. As such the fitting errors have been described in the literature to be a good proxy for capturing liquidity crises in markets. For this study the daily root mean squared estimation error for the inflation-indexed bond curve, smoothed over the past 20 trading days, will be used. The series is missing data for a set of dates during the crises periods of 2008–2009 and 2011–2012, which implies that there are some gaps in the series that will persist even concerning the estimated liquidity premium. As can be seen in Figure 2a, the series spiked significantly during the financial crisis and then again during the European debt crisis, when investors ran away from less-liquid assets.

2.4.2 Relative transaction volumes

Relative transaction volumes is a measure that has been frequently used in earlier studies as a good proxy for capturing the differential liquidity between inflation-indexed and nominal government bonds.⁸ The idea is that very liquid markets tend to have a high turnover, which improves investors' ease of trading by lowering search frictions. This in turn leads investors to ask for a lower liquidity premium. This time series is constructed as the 20-day moving average of the daily secondary market transaction volumes in inflation-indexed government bonds, divided by the corresponding transaction volumes in nominal bonds. The data is

⁵ From 1995 to 2001, Prospera published the average for inflation expectations in the coming five years. Since most of the regressions in this study are run using a sample that starts from 2001 or later, any impacts from the difference in the calculation of the inflation expectations by Prospera on the results of this study should be negligible.

⁶ If spot yields were to be used they would capture the expectations up to five years, and thus not be comparable to the question asked in the Prospera survey.

⁷ The amount of participants approached has varied over the years. In the quarterly survey in June 2018, among all participants, around 200 organisations/companies were approached. In the monthly surveys, conducted only with money market players, around 40–60 organisations have generally been approached.

⁸ See for example Pflueger and Viceira (2016), D'Amico et al. (2014), Abrahams et al. (2016).

obtained from the Riksbank's database SELMA. As can be seen in Figure 2b, this measure remained relatively low up until 2009. It has then increased somewhat, especially in recent years.

2.4.3 Use of the Debt office's repo facility for inflation-indexed bonds

The Swedish National Debt Office has written agreements with a set of banks to act as the primary dealers in the Swedish government bond market.⁹ The primary dealers have to participate in the bond auctions announced by the Debt Office, and thereafter act as distributors of the government bonds at the secondary market. This implies that potential buyers of government bonds always can turn to the primary dealers to receive a price for a bond. In order to reduce the risk of shortages in the government bonds through a repo facility. This means that if primary dealers are selling a bond which they currently lack they can always borrow a similar bond from the Debt Office.¹⁰ A lower liquidity in the secondary market, implying a shortage of bonds to be traded, could then lead to a higher use of the repo facility, especially during times of increased financial stress.

The time series used in this study is constructed as the 20-day moving average of the daily transaction volumes of inflation-indexed bonds in the repo facility. The data is obtained from the National Debt Office. Notably the series shows a sharp spike during the financial crisis. The values for this series have then again increased in recent times, which is likely a result of the Riksbank's purchases of inflation-indexed bonds that started in 2016.

2.4.4 Volatility Index (VIX)

The Chicago Board Options Exchange's Volatility Index (VIX) measures the level of market expectations for 30-days volatility of the S&P 500 Index, as implied in the bid/ask quotations of SPX options.¹¹ It is a commonly used measure of market risk. VIX is obtained from Bloomberg.

VIX is included in the regressions in order to capture investors' variation in risk attitude over time towards any given liquidity risk. The intention with incorporating a risk measure in the model is to capture periods of increased market stress, with large flight-to-safety flows into more liquid instruments, such as nominal government bonds. During such periods the liquidity premium investors require for holding less-liquid instruments, such as inflation-indexed bonds, are likely to be higher (see e.g. Söderlind 2011). The coefficient for VIX in the regression will capture the part of risks that are related to the breakeven inflation, which are inflation risk and liquidity risk. Since I will control for inflation risk in the regressions, the part of risk left which this coefficient is capturing is the liquidity risk.

The liquidity variables are plotted in Figure 2d below. As can be seen in the graphs some of the liquidity variables spiked during the financial crisis period of 2008–2009, and during the European debt crisis in 2010–2011, indicating some intensified stress in the market for inflation-indexed bonds during these periods.

⁹ For a list of the primary dealers, see the Debt Office's website: https://www.riksgalden.se/en/For-investors/Government-securities/Primary-dealers/.

¹⁰ For a deeper discussion on the repo facility, see Arvidsson et al. (2003).

¹¹ A deeper definition on the construction of VIX can be found at CBOE's homepage: http://www.cboe.com/vix.



Note. The gaps in the series in figure 2a) are due to missing data for the fitting errors during these dates. Sources: Sveriges Riksbank, the National Debt Office and Bloomberg

3 Results

3.1 Liquidity risk premium in the breakeven inflation rate

Table 1 shows the results from the estimations of the liquidity proxies onto the breakeven inflation rate, while controlling for inflation expectations and inflation risk, in accordance with equation (1). The liquidity proxies are added to the regression one at a time. Regression (5) is the preferred regression where all the liquidity proxies and the control variables are included. It is also this regression, which will later be used to compute the measure of the liquidity risk premium. Regressions (6) and (7) verify the robustness of the results by excluding the financial crisis from the sample.¹²

¹² This is done by excluding the period 1 August 2008 to 2 August 2009 from the sample and re-running the regressions.

Dependent variable: 5-year forward breakeven											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)				
Sample start	04/01/99	04/01/99	04/01/99	29/01/02	03/11/03	04/01/99 – 31/07/08	03/11/03 - 31/07/08				
Sample end	28/04/17	28/04/17	28/04/17	28/04/17	28/04/17	03/08/09 – 28/04/17	03/08/09 – 28/04/17				
VIX		-0.02** (0.00)	-0.02** (0.00)	-0.01** (0.00)	-0.01** (0.00)		-0.01** (0.00)				
Fitting error, inflation indexed curve			4.65** (0.86)	4.21** (0.67)	2.38** (0.67)		1.58** (0.68)				
Repo facility, inflation indexed				-0.00 (0.00)	-0.00** (0.00)		-0.00* (0.00)				
Relative transaction volume					0.40* (0.17)		0.53** (0.17)				
Survey inflation 5 year	0.95** (0.07)	1.32** (0.07)	1.31** (0.06)	1.27** (0.06)	1.58** (0.06)	1.03** (0.07)	1.67** (0.06)				
Inflation risk premium	-0.11** (0.02)	-0.05* (0.02)	-0.05* (0.02)	-0.01 (0.01)	-0.01 (0.01)	-0.10** (0.07)	-0.01 (0.01)				
No. of observations	4563	4445	4151	3436	3011	4313	2899				
Adjusted R ²	0.33	0.42	0.48	0.55	0.68	0.35	0.69				

Table 1. Regressing breakeven inflation on measures of liquidity

Note. Numbers within parenthesis shows HAC adjusted standard errors.

* and ** denotes significance at the 5% and 1% levels, respectively.

Regression (1) shows that inflation expectations as measured by surveys and the inflation risk proxy jointly explain about 33 percent of the variation in breakeven inflation. The explanation power of the model increases for each additional liquidity variable that is added and the adjusted R^2 reaches 68 per cent in the preferred regression (5), which indicates that observable measures of liquidity explain a sizeable part of the variation in breakeven inflation.

The majority of the coefficients are statistically significant, with signs that follow economic intuition. VIX enters the regression with a negative sign, suggesting, as expected, that the liquidity premium tends to increase in periods where the risk aversion among investors to any given liquidity risk rises. When the fitting errors are added to the regression, the adjusted R² increases to 48 per cent suggesting that this series contains important information on the variation in breakeven, such as the importance of funding constraints and investors' inability to take advantage of mispricing during periods where liquidity becomes more scarce. The coefficient for the use of the repo facility for inflation-indexed bonds is negative, and signals that a higher use of the repo facility coincides with a higher liquidity premium. This is in line with expectations, as a higher use of the repo facility may be caused by a scarcity of bonds available to be traded in the secondary market, leading the primary dealers to instead turn to the Debt Office to borrow the bonds they need for their clients. Finally, when the relative transaction volumes are added to the regression, the adjusted R^2 increases by 13 percentage points. The positive coefficient for this variable goes in line with intuition, as a higher traded volume of inflation-indexed bonds leads to less search friction for investors and thereby lowers the liquidity premium they demand for

holding these less-liquid bonds. One consideration to make is that some coefficients seem to change values as new variables are included in the regression. One possible explanation for this is that some variables show some correlation between them. As can be noticed from Table A1, inflation expectations according to surveys show a correlation with all the liquidity variables. For example, the correlation with VIX, relative transaction volume and the repo facility is 0.40, -0.38 and 0.31, respectively. This may explain why the coefficients change in all specifications, in particular for the survey variable. In addition, the repo facility shows a correlation of -0.40 with the inflation risk proxy, which may explain the change in the coefficient and the significance of the inflation risk proxy in regression (4). Nevertheless, despite this we can see that the adjusted R^2 of regressions (1) to (5) increases as each liquidity variable is added, which indicates that each of them contains relevant information on the variability of the breakeven inflation.¹³

Figure 3 shows the estimated liquidity premium based on the fitted values from the preferred regression (5).¹⁴ The estimated liquidity premium has a mean of 17 bps. It spiked in 2008 during the financial crisis, similar to other studies (see e.g. Pflueger and Viceira, 2016, D'Amico et al., 2014, Gürkaynack et al., 2010). It also reached higher levels during the European debt crisis in 2010 and 2011, when the risk attitude among investors to any given liquidity risk again turned more negative. The spike in 2015 coincides with the Chinese stock market turmoil, and a period when there was a general flight to safer assets in financial markets.



Note. The gaps in the series are due to missing data for the fitting errors during these dates.

Figure 4 plots the adjusted breakeven together with survey expectations and the unadjusted breakeven. The adjusted breakeven is corrected for both the liquidity premium and the inflation risk premium,¹⁵ according to the relation in equation 3. After having corrected for these two premiums, the adjusted breakeven is more in line with the level of market participants' inflation expectations, as measured by the Prospera survey. In addition, one can compare the risk-adjusted and the risk-unadjusted measures of breakeven inflation in terms of their ability to predict the survey expectations. To do so, I first obtain a monthly average of the two daily series and regress the survey expectations on the two measures of inflation expectations.¹⁶ The results of these two regressions suggest that the risk-adjusted breakeven

¹³ It should be noted that this study has attempted to capture observable factors of liquidity and inflation risk that might drive the breakeven inflation rate. However there might be other risks that are not included in the regressions estimated in this study that may additionally explain the observed variation in the breakeven rate.

¹⁴ To ensure the positivity of the liquidity premium, the negative of the time series minimum is added to the estimated series, in line with what was done in e.g. Abrahams et al. (2016).

¹⁵ The estimated inflation risk premium has a mean of 0 bps and it does not seem to affect the estimation of the breakeven inflation as shown by the preferred specification (5) in Table 1.

¹⁶ The regressions are run using the same observations, which implies that the period of November 2008–April 2009 is excluded, since the adjusted breakeven lacks data for this period.

inflation outperforms the unadjusted breakeven in predicting the survey expectations. The adjusted R^2 of the regression increases from 0.56 to 0.71 when the risk-adjusted measure is used as predictor. Since the survey measure does not suffer from liquidity issues, this suggests that looking at breakeven inflation as a pure measure of inflation expectations can be misleading.

It is interesting to shed some light on the behaviour of breakeven inflation and the liquidity premium during the financial crisis. At the start of the financial crisis, the liquidity premium reached levels of 0.8 per cent (see Figure 3). At that time, there was a general worry about falling inflation expectations with breakeven inflation reaching levels of around 1.25 percent in late 2008. However, this sharp increase in the liquidity premium suggests that inflation expectations may not have fallen as low as the breakeven inflation indicates. Correcting the breakeven inflation for the high level of the liquidity premium at that time brings the inflation expectations to levels more in line with survey expectations.



2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016

Liquidity adjusted forward breakeven, 5 year
Forward breakeven, 5 year
Prospera survey expectations, 5 year

Note. The gaps in the series for the liquidity adjusted breakeven are due to missing data for the fitting errors during these dates. Sources: Sveriges Riksbank and TNS Sifo Prospera

4 Conclusion/Discussion

The aim of this PM was to estimate a measure of liquidity premium in the Swedish inflationindexed government bond market. This was done by regressing the time series of breakeven inflation onto observable proxies of liquidity for the inflation-indexed bond market, while controlling for inflation expectations and inflation risk.

Results show that the liquidity measures are able to explain a sizeable portion of the variability in the breakeven inflation rate, suggesting the existence of a liquidity premium in the Swedish inflation-indexed government bond market. The estimated liquidity premium is positive and relatively small, with a mean of 17 bps. Moreover, the liquidity premium varies over time, depending on market liquidity conditions. It has increased during periods of heightened financial stress such as the financial crisis of 2008 and the European debt crisis. Ignoring this premium can distort the information value of the breakeven rate as a high-frequency measure of investors' inflation expectations.

After having corrected the breakeven inflation for the liquidity premium and the presence of inflation risk we obtain a measure of inflation expectations that is more in line with the level of market participants' inflation expectations, as measured by surveys. Compared to the survey measure, the breakeven inflation corrected for the liquidity premium has the advantage of offering a measure of inflation expectations that is available at daily frequency.

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Appendix A

Table A1. Cross correlation between liquidity variables										
Correlation	Survey inflation 5 year	Inflation risk premium	VIX	Fitting error, inflation indexed curve	Repo facility, inflation indexed	Relative transaction volume				
Survey inflation 5 year	1.0000									
Inflation risk premium	-0.2084	1.0000								
VIX	0.3996	0.1217	1.0000							
Fitting error, inflation indexed curve	0.2916	0.0401	0.2493	1.0000						
Repo facility, inflation indexed	0.3128	-0.3855	-0.1391	0.0768	1.0000					
Relative transaction volume	-0.3809	0.1539	-0.0403	-0.0939	-0.1736	1.0000				



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