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Dear readers,

The year's second edition of the Economic Review contains four articles spanning a broad field of central-bank-related areas. The first article is about the Riksbank's balance sheet and the link to financial independence. The second article contains a review of a new and rapidly growing area – online lending platforms. The final two articles concern wage formation in Sweden. Below you will find a short summary of the articles.

- **The Riksbank's balance sheet and financial independence**

  David Kjellberg and *David Vestin* go through how the Riksbank's balance sheet is structured, how it has changed over time and how earnings capacity has developed over time. They point to a combination of decreasing banknote volumes and low interest rates having contributed to a declining earnings capacity. If this trend continues, it means that the Riksbank will eventually need more equity to ensure its financial independence.

- **FinTech credit: online lending platforms in Sweden and beyond**

  Christoph Bertsch and *Carl-Johan Rosenvinge* describe and analyse online lending platforms. These are new players in the financial sector that enable households or companies to borrow directly from investors online, without going via traditional banks. In the article, they describe developments internationally, and are also first to analyse the development of the Swedish FinTech credit sector.

- **How can various structural changes in the economy affect wages and inflation?**

  Andreas Westermark provides a review of the research literature on different structural changes that may have affected wage formation and price-setting in Sweden over the last 25 years, in light of the large-scale changes that have taken place in Sweden and abroad during this period. In the article, he discusses the effects that domestic reforms, increasing foreign trade, technical development that favours highly educated people, and sharply rising migration have had. Somewhat surprisingly, he finds in the research literature that the rise in migration and labour market integration within the EU in recent decades have had limited effects on wages in general. However, this does not rule out the possibility that the effects may have been greater for certain sectors, such as construction.

- **Wage formation in Sweden: With Germany as a compass?**

  In this article, *Andreas Westermark* studies how wage formation in Sweden has worked since the Industrial Agreement was reached at the end of the 1990s. Estimated wage-setting equations confirm that the Industrial Agreement has so far worked as a benchmark for other sectors, and that industrial wages provide a significant and strong explanatory value for wages in both the construction and the service sector. Industrial wages, in turn, shall guarantee the industrial sector's long-term competitiveness and be in line with the Riksbank's inflation target in the long run. The findings in the article show that wage-setting in Swedish industry is affected by wages in Germany – and to an even greater extent by wages in the euro area – over and above what fundamental factors in a standard competitive price-setting model indicate.

Read and enjoy!

Jesper Lindé and Marianne Nessén

Contents

The Riksbank's balance sheet and financial independence

David Kjellberg and David Vestin*

The authors work at the Markets Department and the Monetary Policy Department of the Riksbank respectively.

Financial independence prevents the Riksbank's financial position from having a negative impact on its tasks concerning price stability, financial stability and payments. There have been a substantial change in the Riksbank's earning capacity during the last ten years, also changing the prospects for financial independence. This article reviews how the Riksbank's balance sheet is structured, how it has changed over time and how the Riksbank's earning capacity has developed. Historically, the volume of banknotes in circulation has formed the basis of stable earnings for the Riksbank. Recently, however, the combination of decreasing banknote volumes and low interest rates has contributed to reduced earnings. If this trend continues, it will eventually increase the need for more equity to ensure satisfactory financial independence. In a scenario with declining earnings, it will be difficult for the Riksbank to build up more equity itself. Our conclusion is that, if we want to avoid the a need to recapitalise the Riksbank a contingency plan will be needed so that other sources of earnings are available, such as fees of some sort or a flexible framework for the level of equity. This would allow the Riksbank to be able to manage both losses in its asset portfolio and changed macroeconomic conditions in the form of low interest rates and decreasing banknote volumes.

1 Introduction

In this article, we investigate the development of the most important items on the Riksbank's balance sheet and examine how these affect the Riksbank's ability to fund its operations with its own earnings. We conclude by discussing how the Riksbank's solvency can reasonably be measured and by illustrating how a number of current balance sheet issues affect earning capacity and the exposure to financial risks.

There have been major changes to the Riksbank's balance sheet and earnings in recent decades. The size of the balance sheet has quadrupled over the last ten years and currently amounts to just over SEK 900 billion. On the asset side, the Riksbank has increased the size of its foreign exchange reserves and has purchased a larger quantity of Swedish government bonds, and is now borrowing money from the banks instead of lending it. At the same time, the number of banknotes and coins in circulation has fallen substantially. Historically, this item has been the most important source of revenue for the Riksbank – the so-called seigniorage.

This development affects both the Riksbank's revenue and expenditure over time, as well as the financial risks to which the Riksbank is exposed. Macroeconomic trends also affect the

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Riksbank's earnings. For example, interest rates have gradually declined over an extended period, which probably does not just reflect the downturn during the financial crisis. This has had a negative effect on the Riksbank's earnings, which can be seen in the form of lower profits in recent years.

According to the applicable legislation, which is guided by EU law, the Riksbank must be independent in its exercise of monetary policy. To create good conditions for this independence, the Riksbank should also be financially independent by being able to fund its operations by itself (see, for example, ECB (2018), pp. 34–35, and further references therein). The development of the Riksbank's balance sheet thus becomes relevant, as it affects both average earnings and the financial risks to which the Riksbank is exposed.

This article is structured so that we open section 2 by constructing a fictitious central bank balance sheet with a starting point in which all assets and liabilities equal zero. After this, we study the Riksbank's balance sheet to understand how it has developed in recent years and why it looks like it does. Section 3 describes financial independence and the links between the Riksbank's balance sheet, sources of income, costs for conducting policy tasks, policy measures, financial risks and equity. Finally, in Section 4, we describe the most important risks for the Riksbank's financial independence.

2 The balance sheet

The central bank has several tools at its disposal to be able to carry out its statutory remit within monetary policy, financial stability and payments. Several of these tools, including, for example, the payment system and the operational framework for monetary policy, directly affect the central bank's balance sheet. The balance sheet is also important to the financial independence of the central bank. We will illustrate the attributes of the balance sheet by starting a fictitious central bank. The structure of this bank's balance sheet helps us to understand the rudiments of how a balance sheet changes, what its various components are, and how it is linked to the central bank's financial results and risks. After having illustrated the factors that influence the size and composition of the balance sheet, we can look more closely at the Riksbank's balance sheet in order to understand why it looks like it does today.

2.1 Building up a central bank's balance sheet

To understand how a central bank's balance sheet works, it is helpful to study how it originates. We therefore start by assuming we have a 'new-born' central bank with no balance sheet at all, that is, entirely without assets and liabilities. First of all, this new central bank creates a payment system – which we can call RIX, the name of the Riksbank's payment system. The private banks and central government are each given an account in the system, initially with balance of zero. In the payment system, there is also a contra account, which, by definition, is the sum of the other accounts with inverse signs, and reflects the central bank's aggregated position in relation to all participants. To differentiate different forms of liquidity, we call the banks' funds in these accounts 'central bank reserves'.[1] If the banking system as a whole has a deficit of central bank reserves, the banking system has a liability to the central bank, which is an asset for the central bank. If, on the other hand, the banking system has a surplus of central bank reserves, the central bank has a liability to the banking system. We assume that the central bank implements its monetary policy primarily by setting the interest rate for central bank reserves, regardless of whether it is a question of a liability or an asset

1 This concept is linked to the fact that central banks sometimes force the banks to keep funds in these types of account, also referred to as reserve requirements or required reserves. Funds held over and above the required reserves are referred to as 'non-required' reserves. This is why deposits at central banks are often referred to as central bank reserves, without it necessarily being a question of deposits made by virtue of a reserve requirement.

for the central bank.[2] Finally, we assume that banknotes issued by the central bank can be exchanged for central bank reserves, at an exchange rate of one.

We assume that there is a private banking system, where the banks' balance sheets consist of lending on the asset side and deposits on the liability side, and that there is a national debt owned by the private sector.

Given these conditions, we will now see how the central bank's issuing of banknotes and receipt of equity from central government provides the central bank with good conditions for making profits. We will then see how the central bank can reallocate its assets and acquire a foreign exchange reserve. Finally, we look at how the central bank can finance a larger asset portfolio via interest-bearing funding.

2.1.1 The central bank issues banknotes – creating seigniorage

A classic function for a central bank is to provide the economy with means of payment. We therefore assume that there is a demand for banknotes among the general public and that the central bank wants to issue them. It is the private banks that manage their customers' demand for cash. If customers wish to withdraw their money in cash, the banks contact the central bank, which supplies banknotes and debits the banks' RIX accounts by the corresponding amount. Conversely, the central bank offers the banks the option of exchanging banknotes for central bank reserves, which turns the banknotes into promissory notes issued by the central bank. Outstanding cash is therefore an item on the central bank's liability side, just like central bank reserves.

Let us assume that the banks' customers wish to withdraw SEK 60 billion in cash. The central bank prints the banknotes and debits the banks' accounts in RIX with SEK 60 billion, from their previously aggregated balance of zero. At the end of the day, the banking system as a whole will have SEK −60 billion in its accounts in the payment system, as illustrated in Table 1a.

Table 1a. Effect on accounts in the payment system when the central bank issues banknotes
SEK billion

Accounts in the RIX payment system			
The banking system	0	→	−60
Central government			0
Total central bank	0	→	+60

At the end of the day, we can assume that the central bank pays interest to those banks that have a surplus in the payment system and charges interest to those banks that have a deficit. Simplified for our purposes, we can assume that the central bank makes both types of transaction at the repo rate. We enter the total of all the accounts in the payment system, which in this case will be negative and therefore seen as lending to the banks and will be an asset item on the balance sheet (Table 1b). In this example, an increase in cash results in an equally large increase of the asset side.[3]

Table 1b. Balance sheet effect when the central bank issues banknotes
SEK billion

Assets				Liabilities			
Lending to banks	0	→	60	Banknotes and coins	0	→	60
TOTAL	0	→	60	TOTAL	0	→	60

2 See Elmér et al. (2012) for a detailed description of how the Riksbank's operational framework for monetary policy works, that is, how the Riksbank steers the overnight rate so that it is close to the desired level for monetary policy.
3 If the Riksbank initially has a liability to the banking sector, there will instead by a reallocation, in which the liability decreases and the cash increases.

The returns from the asset side, arising from the issuance of banknotes and coins, is normally referred to as seigniorage. In textbooks, seigniorage is normally defined as the one-off income for central government from printing money for almost no cost, which it then uses to buy goods and services. Thus, the seigniorage will be equal to the increase in the amount of cash in circulation. In the case we describe in Table 1b, seigniorage instead arises from the issuance of an amount of cash, *M*, giving the central bank a claim on the banking system of the same size, which is in line with how it works for the Riksbank. This claim is an asset that provides interest income equal to the policy rate *i* multiplied by *M* for a given period.[4, 5] We can note that if the policy rate is negative, the seigniorage will be negative in this case, which leads to an erosion of equity.

We can also note that if the central bank were to issue non-remunerated central bank reserves, which, for example, would be the case with a non-interest-compensated reserve requirement, these reserves would also give an interest-bearing asset similar to what cash does. Under the current operational framework for monetary policy, the Riksbank pays interest on all central bank reserves, which leads to them not giving rise to any seigniorage income.

2.1.2 Central government provides the central bank with equity

The next important balance sheet item we wish to study is equity. We assume that central government wants to build up equity in the central bank to increase its financial independence. We assume that central government borrows from or imposes taxes on its citizens to the tune of SEK 130 billion, which is paid in by lenders or citizens instructing private banks to transfer funds from their deposit accounts at the banks to central government. This means that the banks' account balances in RIX decrease by SEK 130 billion while central government's account balance in RIX increases by the same amount (Table 2a).

Table 2a. Effect on accounts in the payment system when central government borrows from or imposes taxes on its citizens
SEK billion

Accounts in the RIX payment system			
The banking system	−60	→	−190
Central government	0	→	+130
Total central bank			+60

Central government then transfers SEK 130 billion to the central bank, which affects the balances in RIX (Table 2b).

Table 2b. Effect on accounts in the payment system when the central bank receives equity
SEK billion

Accounts in the RIX payment system			
The banking system			−190
Central government	+130	→	0
Total central bank	+60	→	+190

On the Riksbank's balance sheet, the asset item Bank lending increases and equity totalling SEK 130 billion will be a new item on the liability side (Table 2c).

4 In some circumstances, the discounted present value of this future seignorage will coincide with the textbook definition.
5 If the central bank makes the choice to obtain assets with more risk, the expected return of the invested capital is higher. This extra return should reasonably be called risk compensation instead of seignorage, but in this article, we are not making that distinction to any great extent.

Table 2c. Balance sheet effect when the central bank receives equity
SEK billion

Assets				Liabilities			
Lending to banks	60	→	190	Banknotes and coins			60
				Equity	0	→	130
TOTAL	60	→	190	TOTAL	60	→	190

As neither equity nor banknotes and coins lead to any direct costs for the central bank, these two added together can be called 'interest-free capital'. The income from the assets will therefore be pure profit for the central bank, which can be used to finance regular expenses, build up more equity or be distributed to central government.

With the balance sheet in Table 2c and a positive policy rate, the central bank will receive interest on its lending to banks and the central bank can therefore be said to have 'invested' all its interest-free capital in its bank lending.

2.1.3 The central bank acquires a foreign exchange reserve

The new central bank now has assets of SEK 190 billion. Assume that the central bank sees a need to hold foreign currency to be able to perform its statutory remit. This could for example be to be able to offer loans in foreign currency to the country's banks in a scenario of financial stress, or to be able to intervene on the foreign exchange market to influence the exchange rate for monetary policy reasons. Therefore, the central bank buys foreign government bonds and gold for SEK 190 billion from the private sector. This is done, for example, by the central bank using the local currency to buy US dollars on the foreign exchange market, which it then uses to buy US government bonds. The exchange is paid for by the central bank crediting the RIX accounts of those banks whose customers sold the foreign currency (Table 3a). The central bank has now transferred back SEK into the RIX system and the balance sheet item for lending is zero. This is a major foreign exchange transaction that can be expected to influence the exchange rate.[6]

Table 3a. Effect on accounts in the payment system when the central bank acquires a foreign exchange reserve
SEK billion

Accounts in the RIX payment system			
The banking system	−190	→	0
Central government			0
Total central bank	+190	→	0

As the sum of the two purchased assets, SEK 190 billion, is precisely the same as the sum of the central bank's equity and banknotes and coins, the central bank has therefore reallocated its asset portfolio from lending in SEK to securities in foreign currency and gold – a foreign exchange reserve (Table 3b). Now, the income valued in SEK will depend on the return from the foreign exchange reserve, which depends on both how the SEK exchange rate develops against other currencies, and how foreign yields develop.

6 The Riksbank's foreign exchange reserve has been built up over a long period of time and has also grown due to returns in foreign currency.

Table 3b. Balance sheet effect when the central bank acquires a foreign exchange reserve
SEK billion

Assets				Liabilities	
Lending to banks	190	→	0	Banknotes and coins	60
FX reserves and gold	0	→	190	Equity	130
TOTAL			190	TOTAL	190

Which financial assets the Riksbank chooses to buy affects expected return and risk. Bonds with longer maturities, for example, tend to give higher returns than short-term bonds. However, the price of such bonds varies more than the price of short-maturity bonds, which is usually referred to as interest-rate risk.

2.1.4 The central bank expands the size of the balance sheet

As the liabilities must add up to the same value as the assets, the sum of the central bank's equity and banknote volume forms a lower limit for the size of the balance sheet. However, the central bank's remit can sometimes imply a need to expand the balance sheet over and above this lower limit, for example, if the appropriate size of the foreign exchange reserve exceeds the equity and cash added together. Other examples of measures that can expand the balance sheet are the central bank buying assets for monetary policy purposes, or providing liquidity support in the form of lending to private banks during a financial crisis.

Let us assume that the central bank decides, for monetary policy reasons, to buy government bonds for SEK 300 billion. The central bank buys the bonds on the government bond market and pays, once again, by crediting the RIX accounts for those banks whose customers sold the bonds. As the central bank supplies SEK to the payment system, the banking system as a whole receives a total surplus of SEK 300 billion in its accounts (Table 4a). We note here that the central bank creates the money that is deposited in the banks' accounts in the payment system, as the total volume of money in the payment system has increased.

Table 4a. Effect on accounts in the payment system when the central bank buys government bonds
SEK billion

Accounts in the RIX payment system			
The banking system	0	→	+300
Central government			0
Total central bank	0	→	−300

The bond holdings is then added to the balance sheet in Table 4b as an asset item, and an item is added on the liability side for the central bank reserves which we call *deposits from banks.* The deposits refer to the banks' surplus in RIX in relation to the central bank (Table 4b). Sometimes, this liability item is also referred to as the monetary policy debt, as the central bank pays the monetary policy rate on deposits to stabilise short market rates at levels close to the decided policy rate (see Elmér et al., 2012).[7] An open question is what share of the reserves has to be rate-compensated in order to attain an efficient operational framework. For example, the Swiss Central Bank excludes large parts of the reserves from negative rates. Non-remunerated reserve requirements would exclude some of the reserves from compensation, which would reduce the central bank's interest costs, at the expense of the banks.

7 In the current situation, however, the policy rate is negative, which means that banks pay interest to the Riksbank (entered as interest income in the financial statement). This may sound favourable, but the return on several of the bonds is at the same time negative. The net profit over a certain period depends on the difference between the return on assets and the policy rate during this period.

Table 4b. Balance sheet effect when the central bank buys government bonds
SEK billion

Assets				Liabilities			
Lending to banks			0	Banknotes and coins			60
FX reserves and gold			190	Equity			130
Government bonds SEK	0	→	300	Deposits from banks	0	→	300
TOTAL	190	→	490	TOTAL	190	→	490

Now the central bank has created a balance sheet in which some of the assets are financed via interest-bearing debt. Interest-bearing debt implies a financial cost in the form of the interest paid by the central bank for banks' deposits, if the central bank's policy rates are positive.[8] It can also imply increased financial risk in the form of greater variation in the central bank's results (see Section 4).

Let us further assume that the central bank sees it as appropriate to strengthen its foreign exchange reserve by the sum of SEK 250 billion. It can do this, for example, by buying foreign assets financed by interest-bearing loans in foreign currency. In this case, the central bank then asks the national debt office to borrow foreign currency equivalent to about SEK 250 billion on overseas markets and then loan this on to the central bank, which in turn invests the money in foreign government securities. In this way, no exchange from SEK to foreign currency need take place and as a result, there will be no effect on the RIX accounts. However, the size of the balance sheet increases by SEK 250 billion (see Table 4c).

Table 4c. Balance sheet effect when the central bank strengthens the foreign exchange reserve via loans from central government
SEK billion

Assets				Liabilities			
Lending to banks			0	Banknotes and coins			60
FX reserves and gold	190	→	440	Equity			130
Government bonds SEK			300	Deposits from banks			300
				Loans from central government	0	→	250
TOTAL	490	→	740	TOTAL	490	→	740

2.1.5 The central bank's balance sheet and financial income statement

Typically, a central bank's primary objective is not to make a profit but to perform its remit within monetary policy, financial stability and payments. As long as it does not affect these primary tasks, however, it is reasonable for the central bank to try to perform its operations as cost-effectively as possible, which includes the bank's financial management.

The connection between the balance sheet and the income statement is normally that assets generate financial income and interest-bearing liabilities generate financial expenditure.[9] The difference between this income and expenditure can be referred to as a financial net result and is a measure of the central bank's earning capacity. The combination of banknotes and coins constituting an interest-free liability and central government not having an explicit required rate of return on its capital investment in the central bank often

8 Note that if the volume of banknotes were to increase in this situation, the size of the balance sheet would not change. Instead, there would only be a reallocation on the liability side, in contrast with the example above, in which the issuance of cash increased the size of the balance sheet. The difference is due to the fact that when the central bank initially has a liability to the banking system, this liability decreases at the same time as the volume of banknotes increases, leading only to a reallocation on the liability side.

9 However, if the repo rate is negative, as it currently is, the interest on the monetary policy debt will be interest income rather than an interest expenditure.

provides the right conditions for positive and relatively stable earnings.[10] Any profits from the central bank can be distributed to central government if they are not needed to safeguard the central bank's operations and financial independence.

2.2 The Riksbank's balance sheet

Based on the fundamental reasoning above regarding how a central bank's balance sheet emerges and is determined, we can now discuss why the Riksbank's balance sheet looks like it does at present. In Table 5, you see the Riksbank's balance sheet as of 31 December 2018.

Table 5. The Riksbank's balance sheet as of 31 December 2018
SEK billion

Assets		Liabilities	
Gold reserve	46	Banknotes and coins	62
Foreign exchange reserve	457	Deposits SEK	457
Securities SEK	396	Foreign currency loans (Swedish National Debt Office)	256
Other	36	Other	32
		Revaluation accounts	67
		Equity	57
		Result 2018	4
TOTAL	935	TOTAL	935

Source: Sveriges Riksbank

We will discuss the various asset and liability items on the balance sheet, and finally the size of the balance sheet. Where appropriate, we will also include a historical perspective and compare the Riksbank's balance sheet with other central banks. The size and composition of the balance sheet reflects both the degree to which the Riksbank uses it as a tool to achieve its objectives, and the conditions for the Riksbank's earning capacity.

2.2.1 Asset items

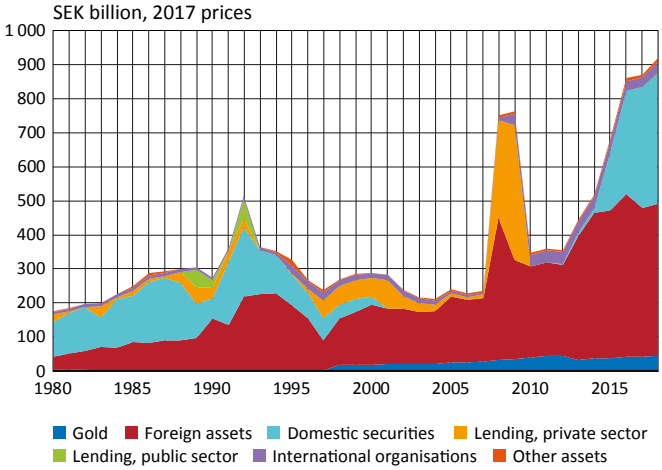
The central bank's assets are often invested in safe securities with a high credit rating, such as government bonds in domestic and foreign currencies, and in gold. The assets are usually chosen based on a policy perspective but sometimes also from a financial management perspective. In the first case, it may be a question of a small open economy needing a foreign exchange reserve in order to be able to rapidly provide banks with liquidity support in foreign currency, or to have the readiness to make foreign currency interventions. Sometimes, the choice of assets is primarily motivated by the need to manage the interest-free capital that a central bank has in the form of banknotes and coins and equity. As far as the Riksbank is concerned, policy needs are most important, but in the more detailed allocation of assets, there are also elements of considering asset risk and return in a financial management perspective.

Figure 1 illustrates the Riksbank's recorded assets since 1980 in 2017 prices. The Riksbank's recorded assets have mainly consisted of the gold and foreign exchange reserve and holdings of Swedish government bonds. Normally, the assets are in the form of liquid assets with a high credit rating. Sometimes, however, the assets can also consist of direct lending to banks, for example. Thus, the assets are mainly some form of interest-bearing

10 However, some countries, including the United Kingdom, have chosen to let the seigniorage go directly to central government. In the United Kingdom, the central bank is instead financed by private banks depositing a certain amount of money in non-interest-bearing accounts at the Bank of England, which is invested with positive return, and the net interest income finances the cost of both financial oversight and monetary policy.

asset, but also physical assets like gold bars to some extent. The Riksbank also has some other assets, which include its real property, but these constitute a relatively small part of the bank's total asset value.

Figure 1. The Riksbank's financial assets
SEK billion, 2017 prices



Note. The currency category includes both the foreign exchange reserve and any lending in foreign currency.
Sources: Sveriges Riksbank and Statistics Sweden

The foreign exchange reserve

The Riksbank's foreign exchange reserve played a key role in monetary policy when Sweden had a fixed exchange rate regime. At that time, the Riksbank needed to hold foreign currency to be able to support Swedish krona when the exchange rate threatened to depreciate. With the current inflation target regime, with a floating exchange rate, a foreign exchange reserve is not normally needed to be able to make currency interventions of this kind as often. There are, however, examples of countries with inflation target regimes where currency interventions are used. Both Switzerland and the Czech Republic have experimented in recent years with a floor for the exchange rate. In Switzerland, this was done in order to prevent further appreciation of the currency and in the Czech Republic it was to weaken it. In both cases, the objective was to bring inflation closer to the inflation target. The result was that both central banks purchased large volumes of foreign currency and sold their own currency, which led to bulging foreign exchange reserves and balance sheets.

Recently, the foreign exchange reserve has been given a different role, in which it can be used to provide liquidity support in foreign currency for financial stability reasons. As Swedish banks fund their lending in foreign currency to a relatively large extent by borrowing foreign currency at short maturities, they can encounter problems if they have difficulty renewing their funding in a situation with financial stress. Furthermore, the Swedish banking sector is large, with an aggregate total balance sheet of almost 300 per cent of GDP, which makes this a question of potentially large amounts of foreign currency. As Swedish banks are, by and large, not considered to be systemically important in other countries, they cannot count on borrowing foreign currency from foreign central banks in a crisis situation (see Sveriges Riksbank, 2019a). Neither can the Riksbank count on being rapidly able to borrow foreign currency from other central banks. The Riksbank therefore holds a foreign exchange reserve that can be used as a last resort to provide liquidity support in foreign currency to Swedish banks (see Sveriges Riksbank, 2019a).

An alternative to having a foreign exchange reserve on the balance sheet is for the Swedish National Debt Office only to borrow currency when a need arises. The advantage with this alternative is that the Riksbank then avoids paying the interest rate spread that a loan-financed foreign exchange reserve often involves if the Swedish state's funding

costs are slightly more expensive than the return that the Riksbank can obtain from the enlarged foreign exchange reserve. The disadvantage is that it is uncertain how quickly the Swedish National Debt Office can borrow currency in stressed scenarios when banks require immediate liquidity support. Ultimately, it will be a question of judgement as regards how much currency it is appropriate to hold in advance and how much can be borrowed if the prospects deteriorate or the risks increase.

In addition to preparedness for currency interventions and liquidity support in foreign currency, the Riksbank also has commitments in relation to the International Monetary Fund (IMF), which adds to the need for a foreign exchange reserve (see Sveriges Riksbank, 2019a).[11]

In Figure 2, we can see how the value of the foreign exchange reserve and foreign currency lending have grown since the 1980s up until the present day. Note that the value of the foreign exchange reserve is also affected by the market value of the foreign assets and exchange rate movements. To be able to be ready to provide liquidity support in foreign currency, the Riksbank has increased the size of the foreign exchange reserve over the last ten years. The foreign exchange reserve was increased twice, in 2009 and 2012, by a value of SEK 100 billion each time. These enlargements were funded by loans in foreign currency from the Swedish National Debt Office.[12]

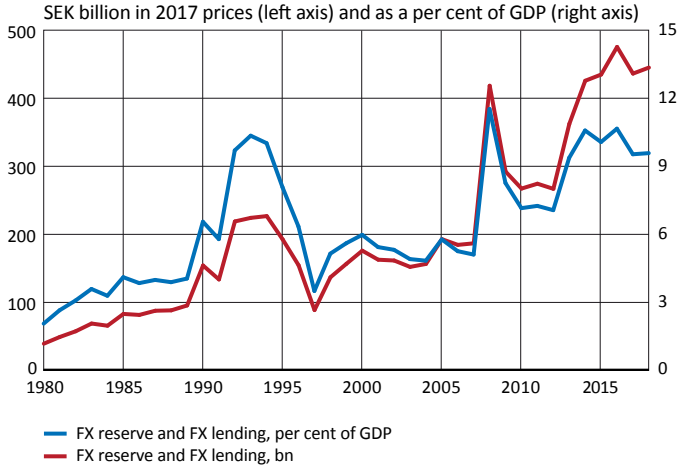
The foreign exchange reserve has also grown gradually over a number of years as a result of much of the return being reinvested, as the profit distribution to the state, management costs and interest expenses in SEK have mostly been disbursed directly in the RIX payment system, without drawing on the return in foreign currency from the foreign exchange reserve. Thus, the Riksbank has not needed to sell foreign currency and buy SEK in the currency market in order to convert the profits in foreign currency into SEK. However, this reduces the Riksbank's net balance in RIX and causes the interest-bearing liability to increase.

The foreign exchange reserve has grown at approximately the same pace as GDP over the last five years and now amounts to just over 10 per cent of GDP, which can be seen in Figure 2. If we compare the central banks in Figure 3, we can see that this is quite a normal level, especially bearing in mind that the Swedish banking system is relatively large in relation to GDP. In March 2019, the Riksbank decided that the need for the foreign exchange reserve had decreased slightly and that the Riksbank shall therefore pay back parts of the currency loans from the Swedish National Debt Office (Sveriges Riksbank, 2019b). This illustrates how the size of the foreign exchange reserve is driven by the policy needs identified by the Riksbank to achieve its objectives.

11 Irrespective of monetary policy regime, the foreign exchange reserve also has an important purpose in the event of serious crises in society, for example in times of war.

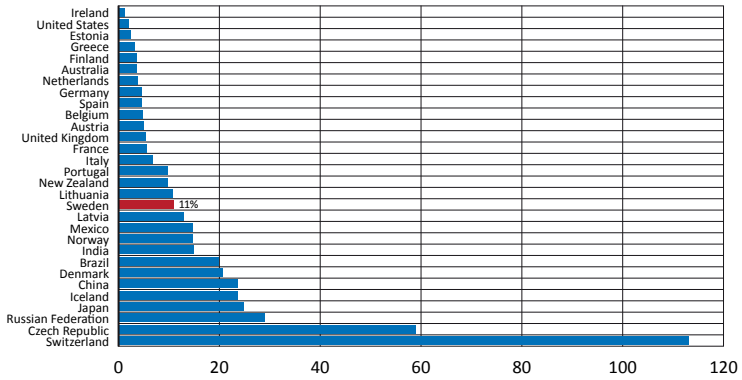
12 The total sum of currency assets increased substantially during the global financial crisis in 2008 and 2009, which was due to the Riksbank, together with a few other selected central banks, being given the opportunity to provide liquidity support in US dollars thanks to an agreement with the US Federal Reserve. In this way, the Riksbank was able to provide liquidity support during the crisis without having to use the entire foreign exchange reserve, which at the time was significantly smaller than it is now. However, this was to be considered a one-off occurrence and not something to be relied on in the future.

Figure 2. The size of the foreign exchange assets
SEK billion in 2017 prices (left axis) and as a per cent of GDP (right axis)



Note. Value of currency assets in SEK. Note that fluctuations may be due to exchange rate changes.
Sources: Sveriges Riksbank and Statistics Sweden

Figure 3. The Riksbank's foreign exchange reserve compared with other central banks
Per cent of GDP, 2018



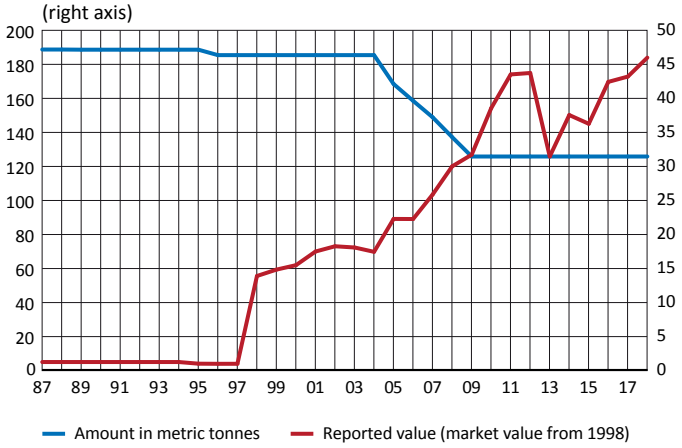
Source: IMF

The gold reserve

Many central banks have some of their assets invested in *gold*. Historically, this was needed during the era of the gold standard as central banks undertook to exchange banknotes on request for a certain amount of gold.[13] Gold can also be used as a means of payment in turbulent times, which is one of several reasons why central banks have elected to retain this asset on their balance sheets. The Riksbank's holdings are currently 125.7 tonnes of gold and Figure 4 illustrates how the holdings have developed, both in tonnes and in reported value in SEK. Recently, the Riksbank upgraded some of its gold so that it meets a standard called London Good Delivery (LGD). Among other things, this has increased the tradability of the holdings in case gold needed to be quickly sold for some kind of policy reason.

13 See Wetterberg (2009) for a description of how the gold standard worked.

Figure 4. The Riksbank's gold holdings
Number of tonnes of gold (left axis) and reported value in SEK billion (right axis)



Source: Sveriges Riksbank

Securities in SEK

Just like most other central banks from time to time, the Riksbank has earlier had securities in domestic currency, but it had zero holdings between 2001 and 2012. As a lesson learnt from the financial crisis of 2008–2009, the Riksbank reintroduced, in 2012, a smaller holding in government bonds in SEK of a maximum of SEK 10 billion in order to have better preparedness to act on the market. The Riksbank's holdings of securities in SEK has grown rapidly since 2015. At that time, the Executive Board of the Riksbank took a monetary policy decision to start purchasing government bonds in order to make monetary policy more expansionary in a situation where the repo rate was starting to approach a lower bound. At the end of 2018, the holdings were worth about SEK 400 billion and the purchases have been funded by increased central bank reserves. The current holdings are expected to be a temporary monetary policy measure and their size is expected to decrease in the long run, as new purchases are stopped and the bond holdings mature (Sveriges Riksbank, 2017).

Other assets

The Riksbank also has a number of other assets including its claims on the IMF, accrued interest income, the bank's real property, etc.

Finally, we can note that the asset item *lending to banks* currently is zero. Lending SEK to banks is not occurring frequently at present within the current operational framework for monetary policy implementation, as banks have claims on the Riksbank in RIX due, among other things, to the large volumes of Swedish government bonds purchased by the Riksbank. Instead, the Riksbank is inviting banks to invest their surpluses at the Riksbank and this is being booked as deposits, which is a liability item (see below). However, the Riksbank is currently considering adjusting the operational framework, see Sveriges Riksbank 2019c.

During the financial crisis, from October 2008 to November 2010, the Riksbank provided liquidity support in the form of lending to banks, both in SEK and in foreign currency. The aim of the lending was to mitigate the effects of negative developments on several key markets for liquidity management and funding, including the negative macroeconomic effects to which the financial crisis contributed. The Riksbank's lending in SEK led to the sum of the balances of the counterparties' RIX accounts increasing by the same amount as the total lending sum. Consequently, the liquidity support led to an increase in both the Riksbank's lending and deposits in SEK, as this extra liquidity was injected into the payment system for SEK.

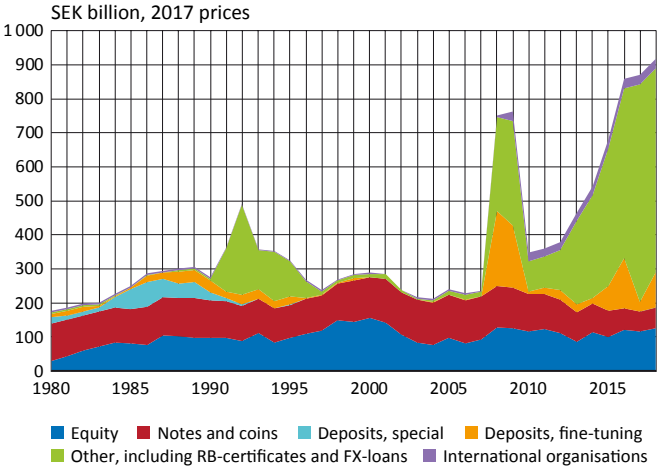
2.2.2 Liability items

The Riksbank's interest-free capital, in the form of equity and banknotes and coins, can be

seen as the basic foundation of the liability side of the Riksbank's balance sheet. Interest-free funding invested in interest-bearing assets contributes to favourable net interest income. During periods in which the Riksbank has little need to use the balance sheet to implement its objectives, the interest-free capital will constitute the greater part of the liability side's items.

At present, the Riksbank's objectives have led to larger asset holdings, funded by interest-bearing liability items. The interest-bearing liabilities in the form of currency loans and deposits in SEK thus fund parts of the foreign exchange reserve and the monetary policy-motivated holdings of Swedish government bonds. In Figure 5, you can follow the Riksbank's liabilities since 1980, in 2017 prices, and there we can see that interest-bearing liability items in particular have varied considerably over time.

Figure 5. The Riksbank's liabilities
SEK billion, 2017 prices



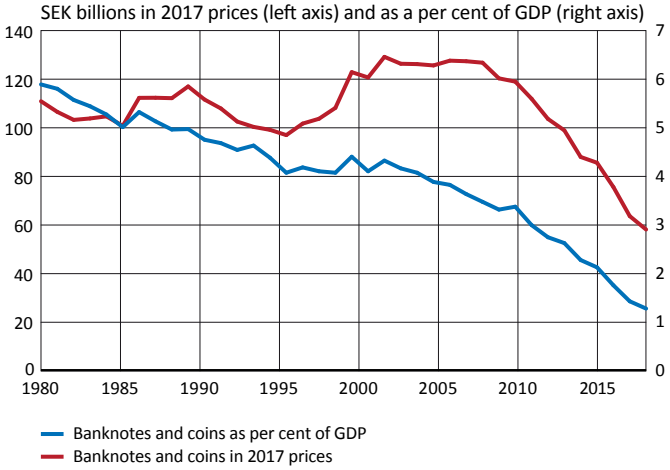
Note. Here, equity also includes unrealised gains.
Source: Sveriges Riksbank

Banknotes and coins

Banknotes and coins in circulation constitute interest-free capital for the Riksbank and are booked as a liability, as we have described above. In the short term, the Riksbank has no independent control over the volume of banknotes and coins in circulation as the Riksbank only supplies the volume in demand. The value of banknotes and coins can obviously be affected by the Riksbank's actions and how advantageous it is for households and companies to use banknotes and coins.

There has been a clear change of direction in the use of cash in Sweden over the last decade, resulting in a decline in the value of banknotes and coins in circulation, see Figure 6. The reduced interest in cash is also evident from the Riksbank's survey on payment patterns (Sveriges Riksbank, 2018), in which, for example, the proportion who say their last purchase was made using cash has fallen from 39 per cent in 2010 to 13 per cent in 2018. The reduction in banknotes and coins in circulation seems to be greater than can be explained by any cyclical effects. One cause of the reduction is said to be the decline in the demand for cash as the payment market has developed increasingly efficient electronic payment solutions (Erlandsson and Guibourg, 2018). Furthermore, the number of bank branches handling cash has decreased sharply since 2010, which may also have contributed to the declining interest in cash among both households and companies (Engert et al., 2019). A complicating factor is that much of the decline is due to a sharp reduction in the volume of the SEK 1000-banknotes in circulation, which now constitute only a small part of total cash in circulation. As the volume of the SEK 1000-banknotes cannot decrease much more, it is difficult to estimate whether the trend of sharply reduced cash will continue over the next few years.

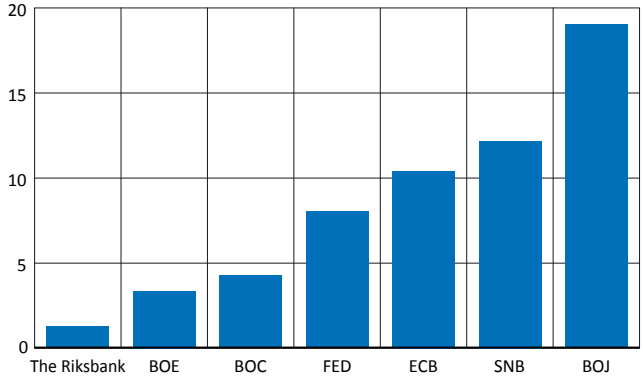
Figure 6. Banknotes and coins in circulation
SEK billions in 2017 prices (left axis) and as a per cent of GDP (right axis)



Sources: Sveriges Riksbank and Statistics Sweden

If we measure the size of the banknote stock as a percentage of GDP and compare with other central banks, it is clear that we have a relatively small banknote volume, which we can see in Figure 7.[14] Bank of Japan (BOJ) and Swiss National Bank (SNB) have issued large volumes, but even the Federal Reserve (Fed), the European Central Bank (ECB) and Bank of Canada (BOC) have significantly larger volumes of banknotes in circulation than the Riksbank. Bank of England (BOE) also has a larger banknote volume than the Riksbank but banknote seigniorage goes in full to the central government. The larger value of outstanding banknotes in some of the larger economies partly reflect their 'reserve currency' status, meaning that citizens in other countries also choose to hold their cash in these currencies for different purposes. The relatively low value of Swedish cash in circulation leads to little seigniorage, which can affect the Riksbank's earning capacity and financial independence in the longer term.

Figure 7. Comparison of banknotes in circulation for a number of central banks
Per cent of GDP



Sources: Annual reports for each central bank respectively (for year 2017), and the OECD

All else equal, fewer banknotes and coins automatically leads to an increase in deposits from banks if the payment system as a whole is in surplus in relation to the Riksbank, as the Riksbank credits the banks' RIX accounts with an amount equal to the reduction in the volume of cash. Thereby the size of the Riksbank's balance sheet remains unchanged. If,

14 Note that in several countries only banknotes are on the central bank's balance sheet, whereas as far as the Riksbank is concerned, both banknotes and coins are a liability item on the balance sheet.

instead, the banking system as a whole is in deficit in relation to the Riksbank, so that the item 'lending to banks' is positive, this item instead decreases as does the size of the balance sheet.

Central bank reserves

The sum of *deposits from banks* and *Riksbank Certificates* measures the size of the aggregated banking system's surplus in relation to the Riksbank in the RIX payment system. Banks must ensure that they balance their accounts in RIX overnight and, when they have positive balances, they can choose to deposit these at the Riksbank or invest them in Riksbank Certificates, which are interest-bearing securities with a one-week maturity. Banks' surplus in the payment system can also be referred to as central bank reserves and, in Sweden, this type of liability is interest bearing, where the interest rate is linked to the Riksbank's monetary policy rates. Consequently, this liability is also called the monetary policy debt.

In Figure 8, you can see how the total net balance for the banks in the payment system has developed since 1994, and how this position has been distributed among different types of deposits and lending with the Riksbank. From 1994 and 1998, the banks had a surplus in RIX, which was largely a consequence of the defence of the Swedish krona a few years previously.[15] Between 1998 and 2008, deposits via fine-tuning deposit operations and Riksbank Certificates were zero or very close to zero, as the aggregated banking system had a structural deficit in the payment system in relation to the Riksbank. A deficit for banks, for example a surplus for the Riksbank, was then booked as the asset item *lending to banks* instead (see above)

From the beginning of the 2000s, the aggregated banking system's deficit gradually decreased as a result of the Riksbank choosing, on several occasions, to let the returns from the foreign exchange reserves be reinvested in foreign currency and the dividend to the central government instead to be paid out by increasing the amount of central bank reserves. In connection with the crisis of 2008–2009, the Riksbank provided temporary liquidity support to banks by lending 'newly created' central bank reserves. The sum of the banks' accounts in RIX therefore increased, which led to the banks increasing their deposits by the equivalent sum over the same period.

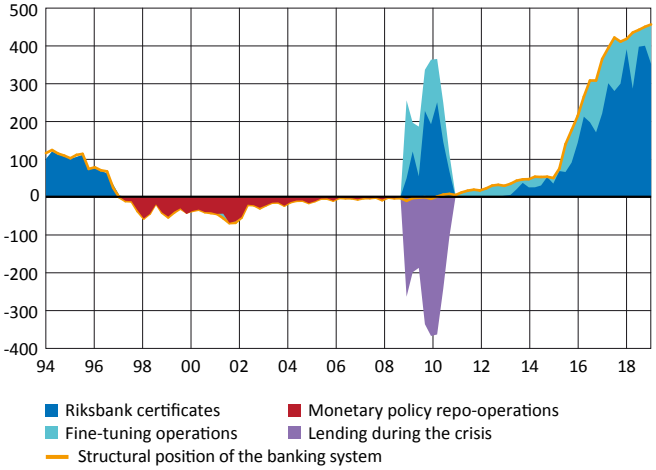
Even after the crisis, once the extra liquidity had been phased out and deposits had fallen back, it can be seen that the sum of the banks' accounts in RIX has continued to increase. This is again largely due to the Riksbank choosing to pay dividends using central bank reserves. Another important cause is that the banknote and coin stock has decreased by just over SEK 50 billion since 2009, which has also contributed to an increase in the banks' surplus in relation to the Riksbank (see above).

At the start of 2015, the Riksbank began purchasing Swedish government bonds for monetary policy purposes, funded with central bank reserves in the form of deposits and Riksbank Certificates. Once this monetary policy stimulus is no longer needed, these holdings can be phased out and the sum of deposits and Riksbank Certificates will then decrease again. If nothing unexpected occurs, however, the monetary policy debt will continue to be positive even if the Swedish government bond portfolio would decrease.[16]

15 In conjunction with the defence of the Swedish krona, the Riksbank sold large amounts of foreign currency forward (a deal in which the transaction takes place at a future date). When the currency was eventually to be delivered, the Riksbank extended the position by 'fx swaps' (in which foreign currency was bought to be able to indemnify existing forward contracts, while a new forward sale of foreign currency was also established). When the fixed exchange rate for the krona ceased in November 1992, the krona depreciated and, in order to be able to extend the forward position with the same amount of foreign currency, more krona were needed, which led to an increase in the banking system's surplus in relation to the Riksbank in the payment system. The extension of the forward position decreased gradually up until 1997 (see Sveriges Riksbank, 1998).

16 It was already a positive monetary policy debt before government bond purchases were initiated. Since then, banknotes and coins have declined further without the assets having decreased, which leads to an increase in the monetary policy debt.

Figure 8. Total deposits and lending
SEK billion



Source: Sveriges Riksbank

Foreign currency loans

The Riksbank has funded some of the foreign exchange reserves by borrowing foreign currency from the Swedish National Debt Office when the foreign exchange reserves were expanded in 2009 and 2012 (see above). The Debt Office has borrowed euros and dollars on the financial market specifically for this purpose. These currency loans are an interest-bearing liability for the Riksbank, where the interest rate is the Debt Office's market borrowing rate.

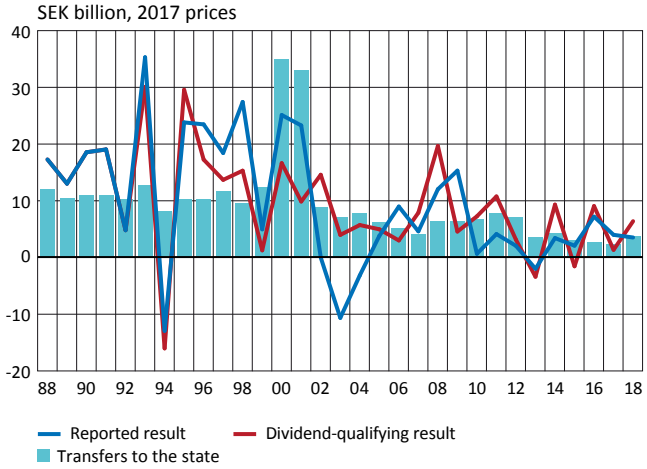
Equity

Equity can be considered as a liability to the Swedish state as the state owns the Riksbank. When the Riksbank makes a profit, equity increases, and a loss causes it to decrease. However, any profit dividend to the central government also reduces equity. In Figure 5, we can see that since 1980, a broad definition of equity, which includes unrealised gains, has varied around approximately SEK 100 billion in 2017 prices. At the end of 1990s, equity increased, but, for 2000 and 2001, extra-large profit dividends were disbursed for a total of SEK 40 billion. In the 2018 annual accounts, the Riksbank's equity was SEK 61 billion, including the profit for the year, and unrealised gains were SEK 67 billion. As the central government does not have an explicit required return from the Riksbank, equity can be seen as interest-free capital for the Riksbank, just like banknotes and coins.

In 1988, the General Council of the Riksbank decided that the Riksbank should follow a profit dividend model in which 80 per cent of the five-year average result is transferred to the central government, see Gardholm and Gerwin (2011).[17] Figure 9 shows transfers to the central government from the Riksbank since 1988, in fixed prices. The financial result on which the dividends are based deviates in some respects from the reported result in the annual report, which is also illustrated in Figure 9. The difference is that the dividend-qualifying result is calculated excluding all changes in the value of gold and currency, but including unrealised changes in the value of bonds.

17 An important motive for using a five-year average was that it was desirable to have dividends that were stable over time, in order to avoid unmotivated fluctuations in the state's budget outcomes.

Figure 9. The Riksbank's results and transfers to the state
SEK billion, 2017 prices



Sources: Sveriges Riksbank and Statistics Sweden

The exclusion of gold and currency effects from the dividend-qualifying result is due to the fact that the krona exchange rate can vary considerably and to thereby ensure that temporary fluctuations do not create unmotivated fluctuations in the dividend to the central government. Furthermore, it is undesirable for the Riksbank to have to sell parts of the foreign exchange reserves in order to distribute profits that are due to a krona depreciation. For example, it may depend on the policy need requiring the foreign exchange reserves to consist of a certain volume of dollars and this volume is not affected by fluctuations in the exchange rate (Gardholm and Gerwin, 2011). The fact that unrealised gains and losses for bonds are included is due to the Riksbank, when the profit model was introduced, having had an income concept that included all unrealised changes in the value of bonds. When the Riksbank later introduced different accounting practices with revaluation accounts, in which only certain negative unrealised changes in value were included, the General Council also chose to change how the dividend-qualifying result was calculated so that the dividend principle would not change (Gardholm and Gerwin, 2011).

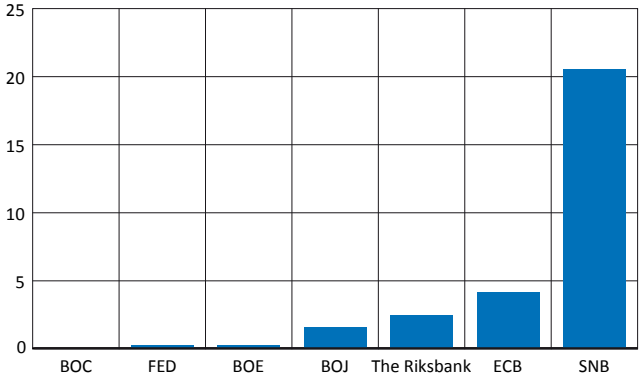
This model for profit dividends means that if the Riksbank has a dividend-qualifying result that is positive over time, nominal equity will have a net addition of 20 per cent of the dividend-qualifying profit. This implies that the Riksbank's equity can grow over time, which is a reasonable arrangement as both the economy and price levels typically increase over time.[18] A disadvantage of this model is that, if the Riksbank ends up with low equity due to large losses, it will take a long time to build up equity again with the help of its own profits, as the intention is to disburse 80 per cent of these in dividend to the government. In such a situation, the Riksdag can, if necessary, deviate from the model and decide not to disburse dividends for a period of time.[19]

If we consider a broad definition of equity, which includes non-realised gains or losses, the Riksbank has equity of 2.5 per cent of GDP. In Figure 10, we compare with other central banks. Fed, BOE and BOC have equity that is very small, 0.2 per cent of GDP or less. ECB has almost twice as much equity as the Riksbank. SNB stands out with equity equal to just

18 If the Riksbank's return on equity were 10 per cent over the long term, equity would increase by two per cent per year after dividends, which would lead to equity being able to grow in step with an inflation rate of two per cent. A return on equity of 10 per cent is obtained, for example, if the Riksbank's entire liability side consists of equity of SEK 40 billion and banknotes and coins for SEK 60 billion, and the long-term return on assets is four per cent, on condition that the costs of the bank are zero.
19 The Riksbank also has an option to take decisions on this itself, if equity is too low given the financial risk, without involvement from party politics, by making provisions for financial risk. The right to make such provisions is based on the ECBS accounting guideline, which has been made binding for the Riksbank via Chapter 10, Article 3 of the Sveriges Riksbank Act.

over 20 per cent of GDP. The reason why we see such substantial differences between levels of central bank equity may be due to discrepancies in mandate, legislation, accounting practices, relationship to the state, policy situation and so on.[20]

Figure 10. Comparison of equity for a number of central banks
Per cent of GDP



Sources: Annual reports for each central bank respectively (for year 2017), and the OECD

Revaluation accounts

The Riksbank applies market valuation of its assets in its reporting. To avoid unnecessarily large fluctuations in the reported profit, the Riksbank uses so-called revaluation accounts. This also follows ECBS accounting guidelines, which the Riksbank is obliged to do in accordance with the Sveriges Riksbank Act. Each asset, like a bond or a currency, has its own revaluation account. Unrealised gains and losses are booked on these accounts so that they do not affect reported results and equity. If a revaluation account is negative at the end of the year, a so called write-down is implemented, which leads to the negative amount affecting the reported result and the revaluation account is set to zero.[21, 22] If a profit for an asset is realised, which occurs when the asset is sold, it is recorded by the revaluation account in question being decreased and the financial result for the year being increased.

If the Riksbank sold all the assets on its balance sheet, at prevailing market values, actual total equity would then be the sum of the reported equity and the revaluation accounts. A broader definition of equity can therefore include the sum of the revaluation accounts, even though this is an unlikely event. In the 2018 annual accounts, the sum of the revaluation accounts was SEK 67 billion, see Table 5. SEK 34 billion of the revaluation accounts comes from unrealised gains for the gold holdings, SEK 4 billion from unrealised price gains for bonds in foreign currency, SEK 19 billion from unrealised exchange rate gains for foreign assets and just under SEK 10 billion from unrealised gains for bonds in SEK.

Other liabilities

Other liabilities mainly consist of a counterpart item in relation to the IMF, accrued expenses and pre-paid income.

20 The Federal Reserve, for example, has a stable earning capacity from a large seigniorage, which may be one reason why equity can be kept so low. The SNB's high figure is due to the inclusion of the provision made by the SNB to maintain currency assets on an appropriate level from a monetary and exchange rate policy perspective, and to constitute a buffer for the risks posed by its large holdings of foreign assets.

21 This can be seen as the reporting of unrealised gains occurring according to some form of precautionary principle, in which the reported result is affected by unrealised losses but not by unrealised gains. Technically speaking, the write-down takes place by the acquisition value being reduced to the market value, which leads to the revaluation account going to zero and the financial transaction net result decreasing by the same amount as the write-down.

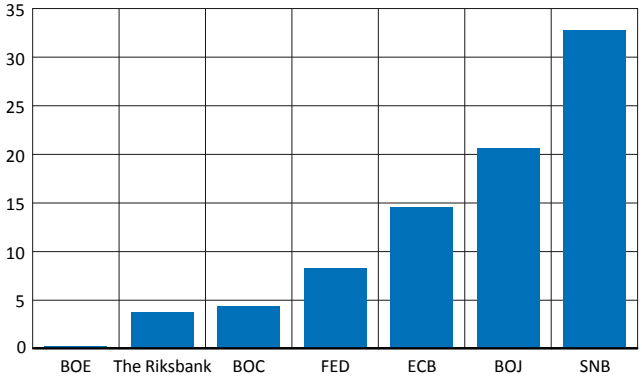
22 An original idea with revaluation accounts was that the central bank would not distribute unrealised gains. It does not work this way for the Riksbank, as the General Council's guidelines on dividends includes unrealised changes in the value of bonds in the dividend-qualifying result.

2.2.3 The size of the balance sheet

As we discussed in Section 2.1, a central bank has a fundamental size of asset holdings based on the size of its equity and banknotes and coins in circulation, and the balance sheet cannot be less than the sum of these two items. If the central bank chooses only to utilise this size of asset holdings, we can say that the size of the balance sheet over time is driven by the size of the liability side. This means that fluctuations in the demand for banknotes and coins and changes in equity, from profits, losses, capital injection or dividends, determine how the size of the balance sheet changes. If the central bank needs to have a larger balance sheet than this minimum level, interest-bearing loans of different kinds are normally required. In these cases, we can instead say that the size of the balance sheet is allowed to be driven by the asset side, for example if the central bank executive deems it necessary to buy assets on the fixed income and foreign exchange market for monetary policy purposes.

The size of the interest-free capital can be seen as a rough indicator of the degree of financial independence for a central bank. Compared with many other central banks, the Riksbank's interest-free capital as a share of GDP is relatively low, which you can see in Figure 11.[23] As we have noted above, an important reasons for this is the low demand for banknotes and coins in Sweden, which means that the conditions for earnings via seigniorage are by and large worse for the Riksbank than for many other central banks.

Figure 11. Comparisons of interest-free capital for a number of central banks
Per cent of GDP

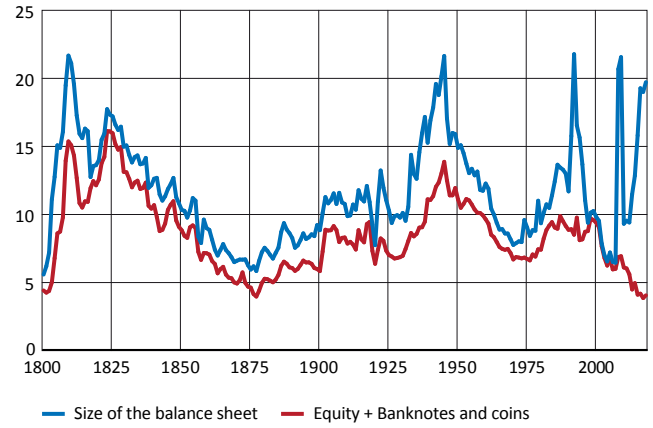


Note. Interest-free capital is here defined as the sum of equity and banknotes. Note that a few of these central banks (for example BOE) also can have a non-interest-bearing liability in the form of the deposits banks need to place with the central bank without interest, which is sometimes called a non-interest-bearing reserve requirement.
Sources: Annual reports for each central bank respectively (for year 2017), and the OECD

In Figure 12, you see the Riksbank's interest-free capital and total balance sheet respectively since 1800, expressed as a percentage of GDP. If we see the interest-free capital as a minimum level for the Riksbank's total balance sheet and compare this level with what the total balance sheet has actually been over the last 218 years, we see that the interest-free capital seems just now to be at historically low levels. At the same time, balance sheets are at historically high levels. The large discrepancy between the minimum level and the total balance sheet size shows that the Riksbank has needed to implement major policy measures over the last decade, while the interest-free capital has shrunk as a consequence of fewer banknotes and coins in circulation. As we can see in the figure, this discrepancy varies over time, which reflects that the Riksbank's need for balance sheet measures also varies over time.

23 In the case of the Bank of England, we have excluded cash from interest-free capital since seigniorage is remitted in full directly to the Treasury.

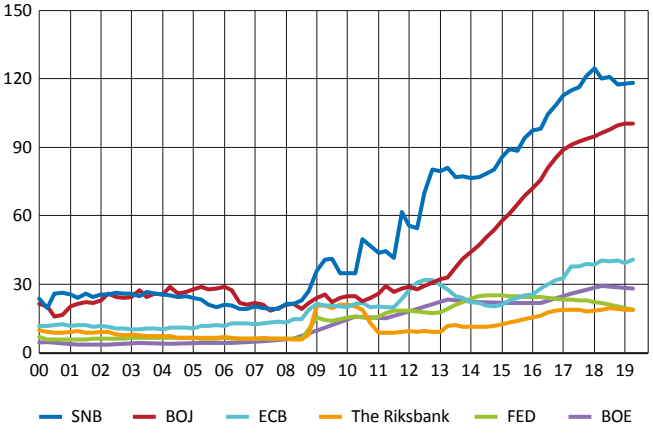
Figure 12. The Riksbank's interest-free capital and total balance sheet size
Per cent of GDP



Sources: Sveriges Riksbank and Statistics Sweden

In Figure 13 you can see that many central banks, all over the world, have expanded their balance sheets in the wake of the global financial crisis in 2008–2009. The level of the Riksbank's current balance sheet in relation to GDP is hence not remarkable in an international perspective.

Figure 13. The balance sheet sizes of a number of central banks
Per cent of GDP



Sources: Respective country's central banks and national accounts

The historically low level of the Riksbank's interest-free capital shows that the conditions for the Riksbank's earning capacity have worsened over the last decades, which we could also see in Figure 9. The question is whether lower earnings have affected the degree of financial independence for the Riksbank. We look more closely at this question in the next section, where we discuss the concept of financial independence.

3 Long-term financial independence

One way of manifesting and strengthening a central bank's independence in the execution of its tasks is for the central bank to be financially independent. One condition for such independence is for the funding of the central bank's operations not to be part of the political budget process. For the Riksbank not to be dependent on appropriations in the budget requires a durable source of income that can cover the operating costs the Riksbank incurs in executing its tasks in monetary policy and financial stability. As we saw in Figure 9, the Riksbank's earnings are enough to pay its operating costs and, in addition, to make a

profit, which shows that the Riksbank is financially independent, even if its earning capacity and profits have become lower recently. In addition, the Riksbank's earning capacity must be robust towards the financial risks linked with the Riksbank's assets and liabilities, so that its long-term earning capacity remains sufficient, even after periods in which the Riksbank has made major losses.

3.1 The Riksbank's income statement and profit

A central bank has four main sources of financial revenue:[24]

- seigniorage from banknotes and coins (see section 2.1.1)
- return on equity
- interest rate spread from debt-financed investments
- fees, including revenue from any reserve requirement

There is no direct link between specific asset and liability items on the balance sheet. This means, for example, that no specific asset is purchased with equity. Naturally, the Riksbank's choice of portfolio composition affects the yield the Riksbank gets from its assets. The composition of the portfolio is driven partly by pure policy needs, for example that a certain amount of the portfolio is to be invested in dollars, and partly by normal financial administrative considerations, such as how long the foreign exchange reserves' average maturity should be at present. The more risk, the higher the average yield, but also the greater the variation in the Riksbank's earnings.

As we mentioned above, equity and the natural investment scope from banknotes and coins is invested in some form of asset that generates an income for the Riksbank. The contribution to the financial result thus becomes the yield from this investment, as the funding cost can be considered to be zero from the Riksbank's perspective.

An interest rate spread from debt-financed assets is the yield that the Riksbank could get, for example by investing in long-term bonds and funding this with short-term central bank reserves, such as the Swedish government securities holding built up for monetary policy purposes. The other example from the Riksbank's balance sheet concerns currency loans from the Swedish National Debt Office that fund a large part of the foreign exchange reserves. As a consequence of its tasks, the Riksbank most often has liquid assets with low credit risk (as discussed above), which means that yield is relatively low compared with the funding rate. This means that net yield tends to be low, or even negative, when assets are funded using interest-bearing debts.[25]

The use of central bank reserves as funding provides increased leverage that entails a higher risk of losses. Consequently, a lower amount of interest-free capital cannot be replaced by a greater proportion of central bank reserves without affecting the risk and therefore the need for buffers. It cannot be ruled out that central banks, for various reasons, may also decide to keep the central bank reserves on a positive level further on, for example if the implementation of monetary policy demands that there is a lot of liquidity in the system. The Riksbank has sent a proposal for consultation about moving towards an operational framework with deposits and loans at the repo rate +/− 10 basis points (Sveriges Riksbank, 2019c). In such a system, banks with surpluses may make deposits at the Riksbank and banks with deficits can borrow money from the Riksbank (known as gross clearing), in which case the interest rate spread of 20 basis points would make a positive contribution to the Riksbank's financial result.

24 We disregard the additional possibility of direct fiscal transfers from the government due to the arguments about financial independence discussed above.

25 The part of the foreign exchange reserves funded using interest-bearing currency loans from the Swedish National Debt Office can be considered to contribute an expected loss, as loans and assets are relatively uniform in maturity, but the Swedish National Debt Office's currency borrowing is slightly more expensive than the government bonds in which the Riksbank, in turn, invests.

Fees and reserve requirements presently play a very small role for the Riksbank's income. Fees are formed, for example, of membership fees in the RIX payment system, and cover the system's operating costs, more or less. Formally, the Riksbank also has the possibility of applying a reserve requirement, if this is for monetary policy purposes. Under the current law, this is therefore not something that the Riksbank can use solely to increase earnings. If a reserve requirement was applied, the banks would have to hold reserves at their account with Riksbank in proportion to their customers' deposits, receiving a relatively low interest rate. This would increase the Riksbanks access to cheap funding and in the special case of zero interest on required reserves contribute to earnings analogous to the case of cash described above. However, since 1994, the level of the reserve requirement has been set at zero and, naturally, the effect on earnings has been zero since then.[26]

The most important source of revenue for the Riksbank can therefore be considered to be the yield on interest-free capital in the form of the stock of banknotes and coins M and equity EK. The average yield on the assets is assumed to be the long-term nominal interest rate

$$(1) \qquad i = r + \pi + tp,$$

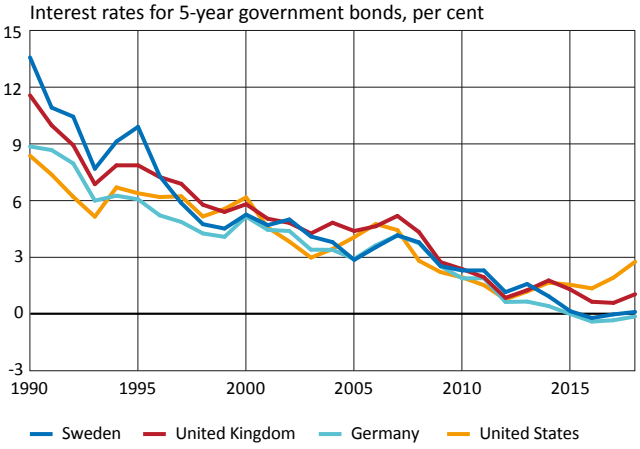
where r is the long-term real interest rate, π is average inflation and tp is a term premium. For positive earnings, a positive average yield is needed. We examine a simple example where we assume that the Riksbank only uses the natural investment scope from the interest-free capital. The average profit over the long term then becomes the difference between the revenues for the assets A and the Riksbank's operating costs DK and can be summarised in the following equation (see Appendix: Calculations for long-term earning capacity)[27]:

$$(2) \qquad PROFIT_t = (r + \pi + tp)(A_{t-1}) - DK_t = (r + \pi + tp)(M_{t-1} + EK_{t-1}) - DK_t.$$

From the simplified description above, we can identify two key reasons for the Riksbank's decreased earnings, as we discussed in section 2.2.1 and Figure 9, which also explain why these can be expected to continue to be lower than previously. Fist, the volume of banknotes in circulation has decreased, leading to a lower level of interest-free capital, which is visible in Figure 5. Second, interest rate levels have been trending down both in Sweden and internationally, see Figure 14 and the discussion in Laubach and Williams (2003) and Holston et al. (2017).

26 At the abandonment of the reserve requirement, the banks had about SEK 14 billion tied up in interest-free assets and the level of the requirement was two per cent (Lotsberg, 1994), while the compensation rate was zero per cent.
27 We disregard here detailed accounting rules and the use of revaluation accounts.

Figure 14. Downward trend for interest rates
Interest rates for 5-year government bonds, per cent



Source: Thomson Reuters

The Riksbank is still making a profit, on average, which indicates that earnings are compatible with financial independence. However, this could be considered to be a lower degree of financial independence than previously. But how can sufficient earnings and a sufficient degree of financial independence be defined? In the next part, we discuss this question and its connection with central banks' need for capital.

3.2 How large is the Riksbank's need for interest-free capital and equity?

An initial question is: does the Riksbank need any revenue or equity at all? Unlike private companies, a central bank can always pay its own way in its own currency by crediting the account in the payment system for the recipient's bank. Cannot the Riksbank just 'print money' and thereby always be financially independent?

The Riksbank can certainly pay its bills over the short term by crediting the banks' accounts in the RIX payment system. However, if the Riksbank's costs permanently exceed its revenue, the banking system's surplus towards the Riksbank in the payment system will grow infinitely.[28] If the losses are small, this could take a long time, but it is neither a sustainable nor a responsible approach towards safeguarding the central bank's financial independence.

With the present approach towards the Riksbank's earnings, in which banknote seigniorage and equity form an interest-free capital, the question arises of how much equity is needed for sufficient financial independence, for a given real amount of banknotes and coins. The need for equity is determined by two main factors with several components (see also Figure 15):

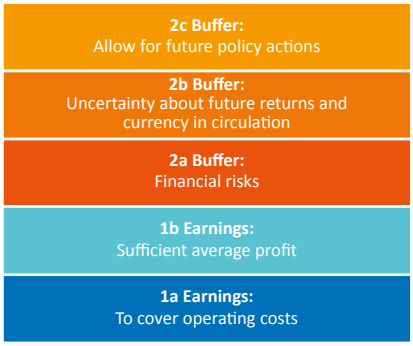
1) Earnings
    a. Equity needs to be big enough to create, together with banknotes and coins, a sufficient 'interest-free capital' that can provide financial net revenues to cover the central bank's running operating costs.
    b. The total interest-free capital also needs to ensure an average profit that is sufficient to allow the Riksbank to rebuild equity in case of large losses.
2) The risk buffer
    a. In addition to the above, equity needs to be large enough to be able to form a buffer for the existing financial risks towards which the central bank is exposed via its assets and liabilities.

28 In addition, it would probably not be compatible with the prohibition on monetary financing under Article 123 of the Treaty on the Functioning of the European Union.

b. A buffer may also be needed to cover for uncertainties over the future size of average yield and the amount of cash, so that the central bank's earnings do not need to be affected by a lower seigniorage, for example.

c. A further buffer may be needed to allow the central bank to temporarily extent the financial risks in conjunction with certain policy requirements (for example crisis measures or asset purchases for monetary policy purposes).

Figure 15. The need for equity
Illustration



The aim of risk buffers is to ensure that interest-free capital remains large enough to provide reasonable earnings, even if the central bank makes major losses. Reasonable earnings can be considered to cover running costs and, additionally, to provide an average profit large enough to build up the buffers again.

Hall and Reis (2015), as well as the second parliamentary inquiry (SOU, 2013:9), advocate an automatic recapitalisation of the central bank if the interest-free capital decreases due to losses. Under the assumption that such an arrangement can credibly be implemented in practice, the risk buffers can be discarded. However, if equity is calibrated so that the combined revenues from banknotes and coins and equity are just enough to fund operations, there will be an equal chance that the state will have to pay money into the central bank or that a dividend will be paid to the Treasury. Given that political majorities can change, it is unclear how much long-term financial independence such a central bank could be said to have unless the suggested automatic rule for recapitalisation is written into the constitution and thereby becomes very difficult to change.

If the amount of banknotes and coins is sufficiently high, the need for equity could be zero or even negative, as seigniorage leads to such a large surplus that no equity buffers are needed. This means that the central bank can be solvent even though equity is negative, unlike the usual situation for a normal company.

Both Buiter (2009) and Del Negro and Sims (2016) argues that what determines whether the central bank is solvent, which has to be seen as a minimum requirement for financial independence, is whether the current value of future expected surpluses exceeds the absolute value of negative equity. In other words, negative equity can be possible over the short term if future surpluses are expected to be great enough to prevent equity from becoming more and more negative. In this case, the central bank is solvent despite the negative equity.

If the central bank is not solvent, future losses will lead to constantly increasing negative equity, which would eventually lead to the private sector gaining a larger and larger claim on the consolidated government. The interest paid by the central bank on this claim would contribute towards the further accumulation of debt, which would approach infinity over the long term. One solution would be to set the interest rate at zero to avoid rising debts. However, this would prevent the central bank from using the interest rate to meet its inflation target. Del Negro and Sims (2016) argue that a situation in which central bank

reserves approach infinity cannot be considered to be a well-defined equilibrium, as the private sector will then be accruing infinite assets against the state, and thus instead argue for a definition of solvency as above.

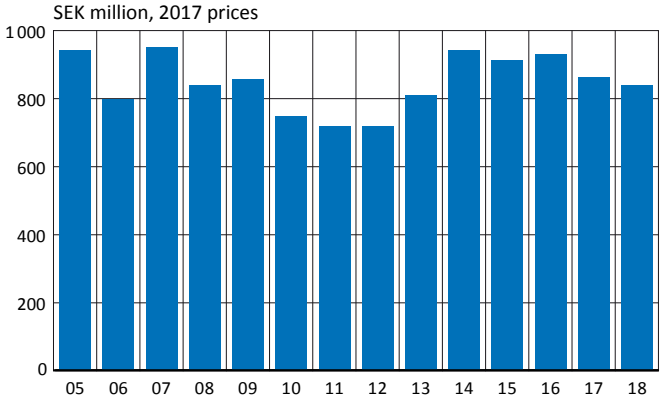
A real-world example of how negative equity need not be an acute problem for a central bank is provided by the Czech National Bank, which currently has negative equity but very high current and expected future seigniorage. The logic is that the central bank can retain future profits to restore equity. One condition, of course, is that the regulatory framework that governs the central bank's operations allows this. The US central bank also has very small albeit positive equity in relation to its assets, but there too the present value of the seigniorage is very high. However, both of these cases require historical correlations and assumptions for cash demand and interest rates to apply in the future too.

Archer and Moser-Boehm (2013) argue that there are negative signal effects of a central bank having negative equity, as the general public may find it difficult to estimate the value of the future seigniorage. According to this reasoning, central banks can therefore be recommended always to have positive equity, regardless of whether the solvency condition has been fulfilled.

3.3 The Riksbank's costs and some possible financing reforms

According to point 1a above, the Riksbank's average revenues must at least cover running operating costs, which currently amount to about SEK 850 million per year. A first parliamentary inquiry (SOU, 2007:51) presented two alternative financing strategies. In the first of these, seigniorage is used to cover running costs, in combination with return on calibrated equity if necessary. In the second alternative, only equity is used to create earnings to finance operations. In the second case, seigniorage would be paid directly to the state.

Figure 16. The Riksbank's operating costs
SEK million, 2017 prices



Sources: Sveriges Riksbank and Statistics Sweden

A second parliamentary inquiry (SOU, 2013:9) decided to recommend the Riksbank to have an interest-free capital whose real return would exactly cover operating costs in the long term, under the assumption that the real interest rate would average at least 1 per cent, which was considered to be a low assumption. In addition to this, the inquiry advocated the introduction of an automatic rule for recapitalisation and therefore argued that the risk buffers could be kept very small.[29]

Hence a sufficient part of the nominal return on assets would be retained to preserve the size of the Riksbanks' interest-free capital. With this system a decline in the volume of cash

29 The equity that the inquiry advocated was included in the interest-free capital that would safeguard earnings (factor one in section 3.2). The size was certainly justified by gold price risk and interest rate risk, but only in the short term as greater losses would automatically lead to a capital injection to restore the interest-free capital.

would automatically lead to an adjustment of the appropriate amount of equity needed to ensure a sufficient income.

The Riksbank is striving to keep cost increases in its operations in line with inflation. This is also a critical assumption for the proposal above, as the real return then becomes enough to pay the constant real operating costs.

But the Riksbank's costs may rise faster than inflation, for example if demands are made for increased security in cash handling, the production of more statistics or new payment services, potentially including the work of developing and running an e-krona in the future. For example, in the event that the Riksbank's costs were instead to grow at the same rate as growth in the economy, the model would only work if the real interest rate were to exceed the growth rate in the economy. This is because equity must increase at the same growth rate to be able to give a sufficient return in the next period. Consequently, only the difference between the real interest rate and the growth rate can be used to finance the Riksbank's expenses in the current period. The assessment of the central bank's long-term cost development is therefore an important input when we try to find a sustainable model for financial independence.

Finally, we can note how the proposals of the inquiry would be affected under the assumption that the nominal amount of cash would instead grow. In this case, the Riksbank would not have to retain as much of the profit for interest-free capital to grow apace with inflation, and this difference could then be distributed to the state or used in the event that the Riksbank is faced with a need to retain profits and build up equity, as in point 1b in section 3.2. This also indicates, for long-term earnings based on interest-free capital, that seigniorage is a more advantageous source of revenue than equity for the central bank. This holds under the assumption that the amount of cash grows apace with inflation or nominal GDP (one example of such a calculation can be found in Appendix: Calculations for long-term earning capacity).

3.4 A conceptual framework for financial independence and balance sheet risks

All else being equal, it is evident that the larger the revenue and the more equity the central bank has at its disposal, the smaller the risk is that the bank will lose its financial independence. In addition, it will have a better ability to manage unexpected events. At the same time, binding up equity in the central bank may possibly entail a disadvantage for the state, as this capital has an alternative cost. The state will thus have to make a trade-off concerning how much equity it considers appropriate to bind up in the central bank.

If the central bank instead pays out part of its equity to the state, the national debt can be reduced by an equivalent amount. For example, if the market uses the proportion of the national debt to GDP as a basis for pricing the risk premium for government bonds, a lower national debt could eventually reduce interest expenditure for the entire national debt. This would apply, in particular, to a strained situation in which national debt is approaching the fiscal limit where future budget surpluses would scarcely be enough to repay the debt (see Leeper and Walker (2011)).[30]

Larger equity also implies increased possibilities for the central bank to act by taking on risk in future unforeseen scenarios, in accordance with point 2c in section 3.2 above. The increased freedom of action entailed by a high level of equity could, however, also be seen as inappropriate by politicians unwilling to allow the central bank to expose the consolidated government budget to any risks. Quite simply, an excessively increased capital buffer could lead the central bank to undertake unnecessarily high-risk measures, which would not be efficient from a societal perspective. Major losses for the central bank mean that the state

30 The governments' consolidated net debt will remain unchanged, and if market participants instead focus on this quantity to determine the risk premium the effect should be very small.

misses out on future transfers of profit and, in the worst case, needs to recapitalise the central bank. The amount of equity that the central bank is allowed to retain can be said to reflect the size of the risks that the politicians can accept that the bank takes. Plosser (2019) discusses the political risks inherent in a large balance sheet and points out that an operational framework for monetary policy that allows interest rate management in combination with a large amount of central bank reserves could lead to pressure to use the central bank's balance sheet for political purposes. See also Cavallo et al. (2018) for a discussion of political risks associated with a large balance sheet.

How, then, can a reasonable 'risk mandate' for a central bank be formulated? Buiter (2009) points out that the static balance sheet for a central bank does not say so much about its solvency, as the central bank's most important asset – the monopoly on issuing banknotes and coins – is not typically taken up on the asset side. Consequently, current book equity alone is not enough to measure the central bank's financial strength.

One alternative, which, in line with Buiter (2009), Hall and Reis (2015) and Del Negro and Sims (2015), focuses on the intertemporal aspects would be to examine the probability that the central bank will require a capital injection from the state over the next 10–20 years. Setting a limit on how high this probability can become is compatible with the definition of financial independence. This can then be translated into how much equity it is appropriate to keep, partly depending on the financial and macroeconomic risks currently affecting the prospects for the central bank's earnings, and partly depending on the need for financial buffers entailed by the execution of the central bank's tasks.[31]

The advantage of defining such a risk mandate, instead of focusing on a statutory level of equity, is that it automatically becomes dynamic and reacts to changed conditions. For example, declining seigniorage means an increased need for equity, and decreased risks will mean a decreased need for equity. In purely practical terms, it is conceivable that the Riksbank would update, at appropriate intervals, its calculations of the risk that capital injections from the state would be needed and provide suggestions, based on these calculations, of how much profit could be distributed.[32]

The disadvantage of such an approach would be that this type of long-term risk assessment is difficult to perform, although this kind of reasoning could still be helpful when considering policy decisions with major consequences for the balance sheet. If the Riksbank were considering a policy measure that affects the balance sheet, it would need to update its calculations of the probability for recapitalisation and develop an impact analysis with alternative courses of action. For example, assume that the Riksbank wishes to purchase more government bonds that are financed using central bank reserves. This would lead to a heightened interest rate risk in the total asset portfolio. If equity was initially well balanced, the extension of the portfolio could entail an excessive risk of recapitalisation in the following period. Whether this is the case depends on the initial size of the Riksbank's buffer. If the 2c buffer is not enough to keep the risks within the intended mandate, the situation could be managed either by reducing the risk from one other component in the balance sheet, for example by reducing the interest rate risk by shortening the maturity of the foreign exchange reserves, or by temporarily increasing equity with retained profits. Occasionally, perhaps, it may be impossible to stay within the risk mandate, for example if the increase of the risk becomes so high that not even retaining all profits over the next few years would be enough to return the probability of recapitalisation to an acceptable level. In this case, the Riksbank could either refrain from the measure or inform the Riksdag that the risk of recapitalisation had been raised due to a necessary policy measure.

31 A similar alternative would be to make a long-term Value-at-Risk calculation, for example over a 15-year horizon, and set a limit for the maximum losses the Riksbank may make in 99 per cent of the sample space.

32 A variation of this approach would be to regulate on the basis of the amount of capital the Riksbank may retain. This would limit the risks the Riksbank would be *able* to take on, given that the probability of recapitalisation must be kept within a framework.

If the Riksbank has a target for interest-free capital, this level must be reassessed when conditions change. For example, the amount of equity will need to be increased if the long-term real interest rate falls. If the Riksbank is allowed to increase the interest-free capital due to these changed conditions, the question arises of how the target is to be attained. If the buffers 1b and 2b are slim, it is likely that the Riksbank, in such a scenario, will lack the possibility of retaining enough profit within a reasonable time horizon. In this case, the state will instead have to inject capital into the Riksbank. Given the definition of financial independence above, this means that the buffers 1b and 2b must be in proportion to the uncertainty of earning capacity, as otherwise the state will have to inject funds 'too often'. If the Riksbank has a target for equity instead of interest-free capital, this mechanism will become even stronger, as variations in the volume of banknotes will then also affect the need for equity.

For example, Flam (SOU, 2013:9) considered that a conservative assumption for the real interest rate was a level of at least 1%, completely in line with the established economic theory that the real interest rate should, at a minimum, exceed the growth rate of the economy. Under this assumption, SEK 85 billion in interest-free capital should just be enough to finance costs of SEK 850 million. However, over the last 10 years, the real interest rate has been negative, and it has been argued that it will continue to be very low for a long time to come, for example for demographic reasons. This period shows partly how difficult it is to estimate how key variables for the Riksbank's earnings can be expected to develop, and partly that making calculations based on long-term averages is insufficient, as the system also has to function during lasting deviations.

4 The greatest risks to financial independence

When discussing financial portfolio risks focus is often on nominal values, for example how many billion that the Riksbank risks losing at a certain horizon. When thinking about the risks to the funding ability of a central bank it is more natural, as done above, to focus on the real interest-free capital. Whether focus should be on nominal or real quantities matters. For example, eliminating part of the nominal exchange rate risk from the currency portfolio may not necessarily reduce the real risks.

Hall and Reis (2015) focus on three primary financial risks for a central bank's balance sheet, all of which come from the assets and liabilities that the central bank holds or may hold in future: exchange rate risk, interest rate risk and credit risk. To these risks, we would like to add two factors that are important to the Riksbank: the risk of declining future seigniorage and the value of the long-term real interest rate.

4.1 Exchange rate risk

At the end of 2018, the Riksbank held foreign currency worth about SEK 450 billion, primarily so as to be able to offer funding to Swedish banks during a financial crisis. Changes to the krona exchange rate affect the value of this holding and returns measured in kronor. As long as the amount of foreign currency is not affected, exchange rate risk in kronor is not normally something that affects the Riksbank's preparedness to provide liquidity support in foreign currency. On the other hand, it could form a risk for the Riksbank's earnings expressed in kronor if this involves a long-term change in the krona exchange rate. The factor that affects the Riksbank's earnings is real interest-rate free capital. The covariation of fluctuations in price levels in Sweden with changes to the nominal exchange rate is therefore important for assessing how the exchange rate risks affect the financial independence of the Riksbank.

At the end of 2018, about SEK 250 billion of the foreign exchange reserves were borrowed in foreign currency (euros and US dollars) via the Swedish National Debt Office (see section 2.2.). The Riksbank invests the foreign currency in government bonds with

relatively similar maturities and foreign currency exposure to the borrowing. This makes the risks inherent in this part of the foreign exchange reserves small from a management perspective.[33] For example, if the krona appreciates, the assets' value in kronor will certainly fall, but so too will the krona value of the Riksbank's foreign debt.

The potentially high exchange rate risk arise from the fact that part of the foreign exchange reserves is funded by liabilities in kronor, such as equity, central bank reserves, and banknotes and coins. This part was worth about SEK 200 billion at the end of 2018. If the exchange rate appreciates, the value of the currency assets counted in Swedish kronor decreases, but the value of the liability items does not change. For example, if the exchange rate permanently appreciates by 10 per cent, this immediately entails a decline in value of around SEK 20 billion from the part of the foreign exchange reserves with a foreign currency exposure.[34] As no guarantee exists that the nominal exchange rate will return to its earlier value, this entails a real long-term risk to the Riksbank's nominal equity. The reason that the nominal exchange rate will not necessarily return to earlier levels is related to the Riksbank's inflation targeting policy. For example, if a domestic economic shock leads to lower inflation in Sweden for a period, but does not affect the rest of the world, the level of prices in Sweden will fall more than the level of prices abroad. If we assume that the real exchange rate is stable in the long-term, the nominal exchange rate, which is the product of the real exchange rate and the ratios of price levels, thus falls. However, the real value of the foreign exchange reserves does not change in this case, and thus a non-hedged foreign exchange reserve becomes preferable, if the aim is to achieve a stable real interest-free capital. However, if the real exchange rate is not stable, or if the foreign price level often fluctuates independently of the Swedish one, the conclusion could be the opposite. Weighing up how much of the foreign exchange reserves should possibly be hedged also requires a thorough analysis of the short-term fluctuations of exchange rates and interest rates.

A further potential exchange rate risk would arise if the Riksbank should choose to intervene on the foreign exchange markets, for example with the aim of avoiding an excessively strong exchange rate. In such a situation, both the size of the balance sheet and the exchange rate exposure from foreign currency could increase heavily, as both the Czech and Swiss National Banks have experienced in recent years.

4.2 Short-term interest rate risk

At present, the Riksbank holds a large portfolio of Swedish bonds financed using monetary policy liabilities. If the Riksbank holds these bonds to maturity, their return will be known in advance but the funding cost depends on the development of the repo rate over the portfolio's lifetime. This variation in the difference between revenue and expenditure is a kind of interest-rate risk. Note that here we refer to variations in market rates and central bank policy rates around the long-term levels of the real interest rate and inflation compensation as discussed in section 3 on the long-term return on central bank assets. Whether or not these risks translates into risks for the real interest-free capital depends on the covariation of the repo rate and inflation. Sometimes the repo rate is increased more than inflation, in which case risks are reinforced – an unexpectedly high funding cost would coincide with a lower real value of equity.[35] But sometimes the interest rate is decreased to

33 On the other hand, some risk will remain if the foreign exchange reserves must be used. In the best case, the holding of foreign government securities can be repoed out to receive short-term liquidity that can be lent to the banks against good collateral, while the interest to be paid is invoiced to the Swedish banks. In the worst case, the foreign government bonds must be sold, and an interest rate risk arises for the Riksbank.

34 For the Riksbank, previously unrealised depreciations can build up an earmarked buffer in the form of revaluation accounts for each currency. However, this could be distributed in the event that foreign currency exposure changes, for example between different currencies, as these would then be realised, in an accounting sense. Consequently, it is not a buffer that is completely under the Riksbank's control. However, the Riksbank has the possibility of making earmarked allocations for certain types of risk, including currency risk. These allocations act as restricted equity in which all or part of the profit is earmarked as a buffer for specific types of risk. The Riksbank can adjust these allocations on the basis of the risks the Riksbank perceives.

35 What happens with the interest-free capital depends on how cash demand reacts.

increase inflation, in which case the two effects work in opposite direction. Furthermore, there is a covariance between the interest rate risk and the above discussed exchange rate risk, which highlights the need for a comprehensive analysis of the entire balance sheet.

The yield of a government bond reflects partly the market's expectations of the short-term interest rate over the maturity of the bond according to the so-called expectation hypothesis, and partly a risk premium that is usually positive but that, recently, may occasionally have been negative.[36] If the short-term interest rate becomes unexpectedly high, the average funding cost will become unexpectedly high, pulling down the central bank's profit. Another source of interest rate risk comes from the possibility that any risk premiums may rise, causing the market price of the bonds to fall. If bonds need to be sold in such a situation, a loss will arise.

At the end of 2018, the Riksbank had almost SEK 400 billion in Swedish government bonds with an average maturity of just under five years (see section 2.2.1). The bond holding has been funded by central bank reserves with an interest expenditure closely tied to the repo rate. If the Riksbank holds the bonds to maturity and the repo rate becomes one percentage point higher than expected, on average, over the maturity of the bonds, the funding cost will thus increase by around four billion kronor per year. If the repo rate becomes one percentage point lower than expected, the funding costs will fall by the same amount.

4.3 Credit risk

The credit risk in the government bonds owned by the Riksbank is deemed to be low (see Sveriges Riksbank, 2019a). However, it cannot be ruled out that, in a future scenario, the Riksbank would purchase higher risk assets than it has so far. For example, for quite a long time, the US central bank purchased a very large proportion of newly-issued bonds with US mortgages as collateral (known as mortgage-backed securities) in a situation where uncertainty over their value, and thereby the credit risk, was so great that many investors refrained from purchasing them.

The Riksbank may be exposed to a further type of credit risk if it supports Swedish banks with liquidity in a crisis scenario. The Riksbank normally demands very good collateral for all its transactions with the banks. However, in a stressed scenario, it may be difficult to value certain assets on the banks' balance sheets. The amount of money the banks should be allowed to borrow if they deposit a certain asset as collateral at the Riksbank then becomes a matter of judgement. If a bank that has been allowed to borrow from the Riksbank enters bankruptcy, the Riksbank risks making a credit loss if it turns out that the value of the collateral lies below that of the loan (see, for example, SOU 2013:9, pp. 126–127 and 143, as well as Ernhagen et al., 2002).

4.4 Risks associated with seigniorage and the long-term real interest rate

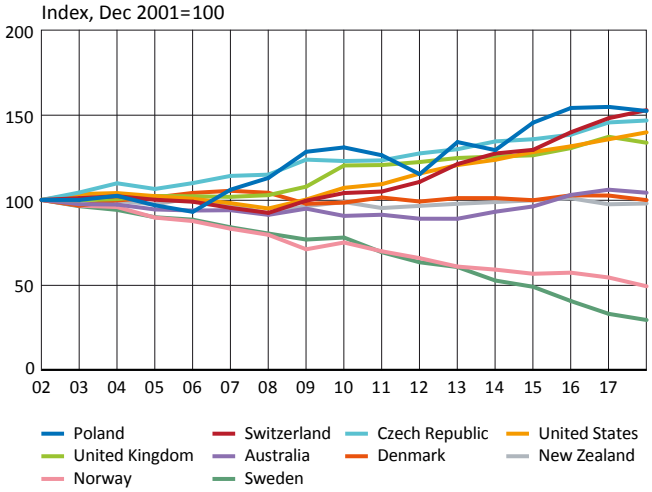
As we discussed above, the seigniorage from banknotes and coins arises from the fact that the investment rate is normally positive, while the cost for banknotes and coins is almost zero. One assumption that is made in many economic models and also in several of the risk calculations made for central bank balance sheets (see, for example, Hall and Reis, 2015) is that demand for cash follows the development of GDP, at least in the slightly longer term. This assumption is logical, as more cash is needed if the turnover rate for cash is constant and GDP is growing, both in real and nominal terms.

In Figure 17, we can also see that this development corresponds approximately with the data for many countries. For some countries, the real demand for cash has increased,

36 See, for example, Kim and Wright (2005) for estimates of risk premiums for US government bonds.

particularly in the wake of the 2008–2009 financial crisis. This may be due partly to the lower level of interest rates, which reduces the alternative cost for holding cash, partly to the lower confidence in the banks in some countries and partly to increased demand for what are known as reserve currencies such as the US dollar, the euro and the Swiss franc.

Figure 17. Index for the cash share of GDP
Index, Dec 2001=100



Note. An unchanged index level implies that the amount of cash grows at the same rate as GDP. A rising (falling) index level implies that the cash amount grows faster (slower) than GDP.
Sources: Respective country's central bank, IMF and the World Bank

With this assumption, the amount of banknotes and coins will grow 'by itself' when GDP grows. This would mean that the Riksbank would not have to transfer the nominal part of revenue (inflation compensation) from seigniorage, but instead would be able to use the entire nominal revenue to pay running costs. A billion banknotes and coins therefore generates greater earnings for the Riksbank than a billion in equity does, as long as the amount of banknotes is growing (see Appendix: Calculations for long-term earning capacity).

At present, the amount of outstanding banknotes and coins is about SEK 60 billion. If the long-term real interest rate is at least one per cent, as was assumed by the Flam Inquiry (SOU 2013:9) and the inflation target is two per cent, the long-term nominal interest rate becomes three per cent. If the Riksbank receives a yield of about three per cent on the amount of banknotes, this becomes SEK 1.8 billion per year in seigniorage that can be used to cover the Riksbank's costs. This corresponds to about twice as much as is needed at present. With these assumptions, we see that about SEK 30 billion in banknotes and coins at current prices is needed to finance the Riksbank's costs, as long as cash demand grows apace with inflation in the period ahead.[37] However, as we discussed in section 3, it is reasonable for the central bank to make a moderate profit on average so that it is able to increase its equity with retained profits if necessary. Consequently, a further decrease in banknotes and coins is a risk to the Riksbank's earning capacity.

The current value of future seigniorage would be infinitely large if the real growth in the economy were permanently to exceed the real interest rate at the same time as cash demand were to grow in line with nominal GDP. If the costs only grow in line with inflation, the Riksbank's income would then grow faster than the costs. Achieving a well-defined equilibrium requires the real interest rate to be greater than the growth rate in the economy (see Buiter 2009). The current value of the seigniorage is given by

$$S = \frac{iM}{r - \Delta y}$$

37 We note that interest rates are currently substantially below three percent, and it would therefore be a major problem if the only funding came from interest income from 30 billion of cash.

where Δy is growth in the economy. For example, if we assume that the real interest rate in the long-term equilibrium is three per cent, that inflation compensation is two per cent and that growth is two per cent, the nominal interest rate will be five per cent, and banknotes and coins for SEK 60 billion gives a current value equivalent to SEK 315 billion. Following the logic in Hall and Reis (2015) and Buiter's (2009) reasoning, the Riksbank should thereby have a further asset item of SEK 315 billion. However, this assumption is sensitive for the level of the repo rate. If it is 2.5 per cent instead, the current value will be approximately twice as great. This mechanism helps explain why the risk of insolvency for the Federal Reserve system is very small, in spite of the possibility of some quarters with losses, as confirmed by the calculations in Hall and Reis (2015), Cavallo (2018), Carpenter (2015), Christensen et.al. (2015) and Rudebusch (2011). Quite simply, this is due to the current value of future seigniorage being very high in relation to the risks present on the balance sheet. Figure 7 shows that the quantity of outstanding banknotes in the United States is approximately six times greater than it is in Sweden.[38]

However, the Riksbank's experiences from recent years indicate a weakness in these calculations. It is uncertain how robust cash demand will be, considering rapid technological changes, not least in the area of payment services. In Figure 6, we see that the assumption that the amount of banknotes follows nominal GDP does not work well for Sweden. Instead, it looks as though banknotes and coins are following a downward trend. In 1980, the amount of banknotes was six per cent of GDP, while today it has decreased to just one per cent. Development over the last five years has been particularly dramatic. Several factors have contributed to this development: improved and simplified card payments, new payment technologies such as Swish, increased online shopping, a reduced number of bank branches handling cash, and frequent banknote and coin changeovers (see. For example, Engert et al. 2019, and Erlandsson and Guibourg, 2018).

The question is how this development will continue in Sweden. There are signs that the development towards decreased cash usage is accelerating (see, for example, Sveriges Riksbank, 2018) and a continued decline of banknotes and coins is therefore an obvious risk for the future earning capacity of the Riksbank.

The value for the long-run real interest rate is a decisive factor for earnings

A reasonable value for the long-term neutral real interest rate is a much-debated question. Holston et.al. (2017) argues that the value has fallen substantially. Furthermore, Carvalho et.al. (2017) stresses that it is reasonable to expect this decline to be quite long-lasting due to demographic factors, as an ageing population tries to save for its future pensions. As the value of the real interest rate is a decisive factor for how much interest-free capital the Riksbank needs if it is to have reasonable average earnings, it is important to take account of uncertainty over the future level of the real interest rate. This is very much a relevant question when long-term government bond yields are negative, both in Sweden and abroad.

It is interesting to make a comparison with the Bank of England, which finances its operations by requiring private banks to deposit non-remunerated funds that are then invested in government bonds, which creates a source of income for the Bank of England. However, the low government bond yields of recent years have caused problems with falling revenues for the banks, and a new regulation now explicitly index links the amount of capital the private banks must deposit to the level of the government bond yield (see HM Treasury, 2018). If the government bond yield falls, the banks must thus deposit more money so that the interest incomes for the Bank of England remain unchanged. Correspondingly, index

38 These calculations assume that the central bank's costs are approximately zero, as they focus, in this context, on very high risks in the asset items. In a case where the costs are not approximately zero, the discounted current value of the seigniorage minus the costs must be calculated.

linking of the Riksbank's interest-free capital could be conceived, so that, if the average interest rate level is expected to fall, the Riksbank will be given the opportunity to build up its own capital.

5 Concluding remarks

In this article, we have attempted to illuminate the manner in which a central bank's balance sheet is constructed and how it affects the Riksbank's long-term ability to fund its own operations and thereby remain financially independent of the state. Possibly the most important risks for the Riksbank's future earning capacity concern the amount of banknotes and coins in circulation going forward, as well as what will happen to real interest rates over a longer perspective. Lower demand for cash and lower real interest rates have already had a negative effect on the Riksbank's earnings, even if the Riksbank is still making a profit, on average. Considering it is uncertain how these variables will develop in the period ahead, it will be difficult to set a static target for how much equity the Riksbank needs. Either the target needs to be flexible enough to allow it to be adjusted to changes in the level of interest rates and the number of banknotes and coins in circulation, or the target will have to be set with a margin that allows room for the uncertainty surrounding these variables.

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Appendix A – Calculations for long-term earning capacity

The Riksbank's long-term earnings and profit depend on the composition of the balance sheet, long-term interest rate levels and the Riksbank's operating costs.

The Riksbank's nominal net interest income can be expressed as[39]

$$(3) \qquad N_t = (r + tp + \pi)(M_{t-1} + EK_{t-1} + PP_{t-1}) - (r + \pi)PP_{t-1}$$

where r is the long-term real interest rate, tp is the term premium that investors receive in addition to r to invest in long-term bonds. π is the average inflation compensation that investors receive, which we assume coincides with average inflation. M is nominal banknote volume, EK is nominal equity and PP is nominal monetary policy liability, which is to say the banking system's surplus in the payment system.

The Riksbank's nominal interest-free capital can be expressed as

$$(4) \qquad K_t = M_t + EK_t$$

If we assume that the banknote volume grows with inflation over the long term and consider that equity grows with the net interest income minus the operating costs, we can rewrite (4) as

$$(5) \qquad K_t = (1 + \pi)M_{t-1} + EK_{t-1} + N_t - DK_t$$

$$(6) \qquad K_t = (1 + \pi)M_{t-1} + EK_{t-1} + (r + tp + \pi)(M_{t-1} + EK_{t-1} + PP_{t-1}) - (r + \pi)PP_{t-1} - DK_t$$

$$(7) \qquad K_t = (1 + \pi)(M_{t-1} + EK_{t-1}) + (r + tp)(M_{t-1} + EK_{t-1}) + \pi * M_{t-1} + tp * PP_{t-1} - DK_t$$

The real interest-free capital then becomes

$$(8) \qquad K_t = \frac{K_t}{P_t} = \frac{K_t}{(1+\pi)P_{t-1}} = m_{t-1} + ek_{t-1} + \frac{(r + tp + \pi)}{(1+\pi)} m_{t-1} + \frac{(r + tp)}{(1+\pi)} ek_{t-1} + \frac{(tp)}{(1+\pi)} * pp_{t-1} - dk_t$$

where lower-case letters represent real variables. We can then note that

$$(9) \qquad m_{t-1} + ek_{t-1} = k_{t-1}$$

Which means that the change in the real interest-free capital follows from (8)

$$(10) \qquad \Delta k_t = \frac{(r + tp + \pi)}{(1+\pi)} m_{t-1} + \frac{(r + tp)}{(1+\pi)} ek_{t-1} + \frac{(tp)}{(1+\pi)} * pp_{t-1} - dk_t$$

The first three terms now represent the real contribution from the sources of income seigniorage, invested equity and interest rate spread from debt-financed assets, respectively. Note that, as the real banknote volume is constant,

$$(11) \qquad \Delta ek_t = \Delta k_t.$$

39 Given that some of the assets are in the form of gold, a more detailed arrangement of the following calculations would have to take into account that the expected long-term return from gold may deviate from the real interest rate (normally, it could be expected to be lower). However, we have chosen to simplify the reasoning and not explicitly include this factor.

Consequently, avoiding a long-term negative trend in real interest-free capital or equity requires all three potential sources of income not to be smaller than operating costs. If we assume that real operating costs are constant in the long term, the condition for this becomes

$$(12) \qquad \frac{(r + tp + \pi)}{(1 + \pi)} m + \frac{(r + tp)}{(1 + \pi)} ek_{t-1} + \frac{(tp)}{(1 + \pi)} * pp_{t-1} \geq dk.$$

To simplify the expression further, as well as to be more compatible with the calculations and assumptions made by Flam (SOU 2013:9), we can assume that the effective interest rate spread the Riksbank can receive is zero.

$$(13) \qquad \frac{(r + \pi)}{(1 + \pi)} m + \frac{(r)}{(1 + \pi)} ek_{t-1} \geq dk$$

Under this condition, it can be seen that banknotes and coins make a greater contribution to earnings than equity as long as inflation is positive. This also means that, if this applies, a reduced long-term level for the real banknote volume will demand a greater increase of equity to maintain an unchanged long-term earning capacity.

FinTech credit: Online lending platforms in Sweden and beyond

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New digital technologies in banking and finance, commonly referred to as 'FinTech,' have the potential to transform established banking business models. This article studies online lending platforms, which are new players in the financial sector that allow individuals or firms to obtain loans directly from investors via the internet. To date, online lending is still small relative to total bank lending. However, online lending has expanded rapidly not only in China, the US and the UK, but also in Sweden. In 2018 Swedish platforms originated more than SEK 2bn of new loans – exceeding the 2017 volume by 51 per cent. We discuss how online lending platforms differ from commercial banks and how they are regulated. Moreover, we analyse market developments, such as the growing linkages between platforms and the banking sector. Against this backdrop, we review potential financial stability implications that may appear if online lending continues to grow in importance.

1 Introduction

Starting in the early 2000s, tech-driven companies developed digital financial technologies (FinTech) to enable online lending solutions as an alternative to bank-based credit intermediation.[1] The new FinTech players include online lending platforms such as LendingClub, the US market leader. More recently, e-commerce platforms such as Amazon in the US and Alibaba in China also began extending credit to suppliers and customers, leveraging on their vast digital platforms which provide them with very detailed information about prospective borrowers.

The focus of this article is on FinTech credit and, more specifically, on online lending platforms.[2] What are online lending platforms and how do online lending platforms differ from bank-based credit intermediation? What are the main trends regarding the evolution of online lending platform business models, the involvement of the traditional banking sector and financial regulation? Our objective is to address these questions with a view to their scope for financial stability implications.

FinTech credit has expanded rapidly, with the largest markets being in China, the United States and the United Kingdom. For some market segments FinTech credit has become an

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1 Other FinTech solutions not covered in this paper include digital payment system innovations such as mobile payment solutions and blockchain technology, as well as digital investment management solutions such as robo-advice.

2 In this article we use the term FinTech credit in a broad sense and adopt a definition introduced by the Bank for International Settlements (BIS) and the Financial Stability Board (FSB). According to this definition FinTech credit captures all credit facilitated by online lending platforms that are not operated by commercial banks (CGFS-FSB 2017; Claessens et al. 2018).

important source of alternative credit to households and to businesses. A leading example is the UK where more than one quarter of the total volume of new loans to small businesses is originated by online lending platforms. Also Swedish online lending platforms have experienced a strong growth in recent years, but they are not yet an important source of credit relative to commercial banks.

One of the key drivers of the expansion of online lending is the customer convenience benefits associated with the digital user experience, such as the 24/7 availability and the fast loan application process, which are particularly appealing for an internet-savvy younger generation.[3] Other factors include the lack of credit supply to underserved borrowers in certain segments of the uncollateralized consumer credit market or the small business loan market. In fact, these market segments have been targeted initially by online lending platforms. Another driver is the potential cost advantage of online lending platforms vis-à-vis commercial banks. This is because online lenders neither have to maintain an expensive branch network, nor a costly legacy mainframe computer system. Instead, online lenders rely completely on online platforms, call centres, automated credit risk assessment and cloud-based banking software.

In light of the recent growth in FinTech credit there has been heightened interest among the regulatory community and academic researchers, who are eager to study the new developments and to understand the implications for traditional banking and financial stability. To date, our assessment is that the Swedish FinTech credit market is still too small to pose significant risks for the broader financial system. This view is also reflected in the current regulatory discussion, which primarily focuses on consumer and investor protection aspects. However, financial stability risks may emerge, provided the FinTech credit market continues to grow in importance. To this end, the trend towards a growing exposure of commercial banks to FinTech credit and concerns regarding the viability of online lending platform business models merit attention.

Section 2 describes how online lending platforms operate and highlights the differences to bank-based financial intermediation. We also discuss the market segments targeted by online lenders and their business models. Moreover, we give a detailed account of the market developments in Sweden and beyond. Next, Section 3 addresses the regulatory landscape. We discuss how FinTech credit is captured by existing regulation and the different approaches taken in regulating new FinTech credit solutions. Thereafter, Section 4 considers the potential financial stability implications of the expansion in FinTech credit. We address aspects related to the viability of online lending platform business models and the trend towards reintermediation, that is, the offering of new financial services which make online lending platforms more similar to banks. We also discuss the exposure of the traditional banking sector to online lending platforms and the responses of banks to the changing environment. Finally, Section 5 contains our conclusions.

2 Online lending platforms

During the last decade FinTech credit has rapidly grown in size and scope. The first online lending platforms have targeted the market for uncollateralized consumer credit with a focus on borrower segments that are underserved by banks. Over time online lending platforms have expanded to other markets such as student loans, car loans, mortgage loans, small business loans, as well as corporate loans for small and medium sized enterprises (SMEs). Research on FinTech credit in the United States shows that online lending to the uncollateralized consumer credit market can often be a substitute for bank lending. At the same time, FinTech credit can also complement bank lending in the segment of underserved borrowers (Tang 2018). In fact, research on German data shows that online lending platforms

3 See special issue on banking in The Economist (2019).

target a riskier slice of the consumer credit market that is underserved by traditional banks, charging risk-adjusted interest rates that are comparable to bank loans (De Roure et al. 2016).

FinTech credit promises benefits to both investors and borrowers. These benefits from disintermediated credit via online lending platforms may arise if banks collect high intermediation rents or if online lending platforms have a more favourable cost structure (no costly branch network, automated credit scoring, no capital or liquidity requirements, etc.). This can give rise to a competitive edge especially in riskier borrower segments and for small loan sizes, where screening based on automated credit scoring technologies tends to be more profitable (Einav et al. 2013). The advantage of FinTech lenders in screening borrowers based on hard information may be related to the use of more sophisticated credit models (Fuster et al. 2018), or of new data sources (Berg et al. 2018).

The first P2P (peer-to-peer) online lending platform, Zopa, was established in the United Kingdom in 2005. P2P lending allows individual borrowers to be directly matched with investors, without the need of a financial institution to act as a middleman. Prosper, the first P2P online lending platform in the United States, followed in 2006. Both serve the uncollateralized consumer credit market segment. According to a recent survey by the Cambridge Centre for Alternative Finance more than three quarters of the global FinTech credit activity is now concentrated in China, which currently has more than one thousand active online lending platforms. Among the advanced economies the dominant FinTech credit markets are in the United States and the United Kingdom. The development of online lending in continental Europe has lagged behind, but the growth has been substantial in recent years.

Our paper provides the first study of the Swedish FinTech credit market. Based on the data we collected, the FinTech credit origination volume over the 2015–2018 period exceeded SEK 4.4bn. If we narrow down to uncollateralized consumer credit, we estimate that the loan origination volume of Swedish online lending platforms exceeded SEK 1.3bn in 2018. As a comparison, total outstanding credit card debt to households in Sweden stood at around SEK 49bn in 2018.[4] Hence, the size of the Swedish FinTech credit market volume was around 2.7 per cent when compared to the total outstanding credit card debt.

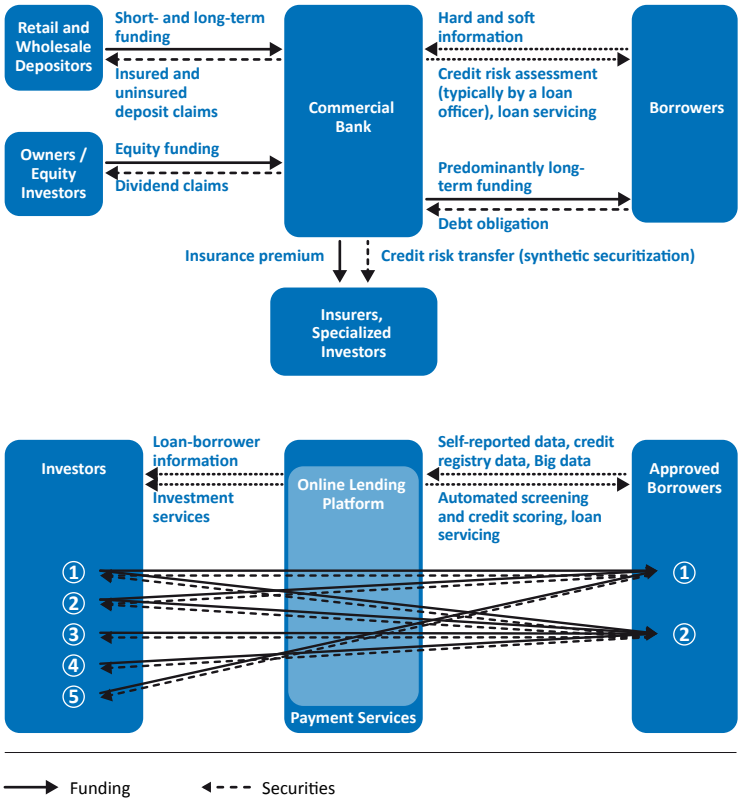
In Section 2.1 we describe schematically how online lending platforms differ from financial intermediation by commercial banks. Section 2.2 discusses business models of online lending platforms and zooms into the key aspects of financial intermediation. Thereafter, Section 2.3 offers a detailed account of the FinTech credit market development in Sweden and beyond.

2.1 How online lending platforms compare to commercial banks

Traditional bank-based credit intermediation is characterized by commercial banks offering credit to households and firms, which is primarily funded by insured and uninsured deposits, as well as wholesale borrowing and equity. Conversely, the classical P2P crowdlending model disintermediates credit by allowing investors to directly invest in loans that are originated on the platform. That is, P2P online lending platforms cut the 'middleman' by offering a marketplace where credit supply and credit demand are directly matched. Figure 1 depicts a schematic comparison of bank-based credit intermediation and of disintermediated FinTech credit based on the classical P2P crowdlending model.

4 Based on data from Statistics Sweden Financial Market Statistics from December 2018.

Figure 1. Schematic comparison: bank-based credit intermediation and the classical P2P crowdlending model



Note. The graphic at the top depicts bank-based credit intermediation and the graphic at the bottom depicts disintermediated FinTech credit based on the classical P2P crowdlending model.

Bank-based financial intermediation involves functions in four categories:[5] (1) liquidity and payment services, (2) asset transformation, (3) credit, liquidity and interest rate risk management, and (4) credit risk analysis and monitoring of borrowers. Two of these functions are also performed by online lending platforms pursuing the classical P2P crowdlending model, namely asset transformation and credit risk analysis. First, platforms transform the denomination of assets by dividing the loan demand of an individual borrower into smaller notes (for example 25 US dollar denominations). These notes can be bought by multiple investors who can conveniently diversify across borrowers as depicted in Figure 1. Second, platforms perform an automated credit risk assessment and act as information providers. The loans are serviced by the platform. To facilitate the transfer of funds between the bank accounts of investors and borrowers, platforms may cooperate with clearing banks who provide payment services.

An important feature of the commercial bank model is that banks take credit risk on their balance sheet and produce safe deposit claims, using bank equity as a loss buffer. Moreover, banks engage in maturity transformation, meaning that there is a maturity mismatch with the average maturity of the credit to borrowers (asset side of the bank balance sheet) exceeding the maturity of the funding (liability side of the bank balance sheet). As a result, banks need to manage credit and liquidity risk. For typical commercial banks a substantial part of the funding comes from demandable deposits that are covered by deposit insurance, as well as from secured and unsecured short- and long-term wholesale debt. While banks may offload some of the credit risk to insurers and other specialized investors, part of the

5 See Freixas and Rochet (2008).

credit risk stays on the balance sheet. Conversely, the classical P2P crowdlending model transfers all the credit risk directly to investors by matching individual borrowers with a large number of investors who provide long-term risk capital.

The borrower categories targeted by online lending platforms typically allow using an automated credit risk assessment to screen borrowers. A prime example of this is the market for uncollateralized consumer credit, which was targeted initially by online lending platforms. For certain other market segments like corporate debt, platforms also rely on manual inspection by loan officers. In contrast to banks, online lending platforms do not have a branch network and are heavily dependent on digital technologies. This makes them suitable for lending activities where it is important to screen borrowers before extending the loan and where lending contracts can be highly standardized. Instead, online lending platforms are less suitable for lending activities where standardized contracts are problematic. An example is monitoring intensive lending activities that build on long-term relationships, which are at the core of commercial banking. Here banks closely follow the customer over the duration of the loan, and regularly use more sophisticated contracts that are tailored to the client and regularly include instruments such as loan covenants. In such lending activities commercial banks have a clear comparative advantage with their emphasis on bank-firm relationships, soft information and in-person interaction, which is facilitated by the vast bank branch network and the expertise of loan officers.

Another important difference between commercial banks and online lending platforms is that they operate in different regulatory environments (see discussion of regulatory aspects in Section 3). Lastly, commercial banks engage in money creation, which is not the case for online lending platforms. A detailed discussion of this aspect is beyond the scope of our article.[6]

2.2 Online lending platform business models

Online lending platforms rely heavily on digital financial technologies that have become available during the last two decades. Over time the technologies to match credit supply and demand have been refined substantially. The first P2P crowdlending platforms facilitated their lending decisions and the interest rate determination with the help of an auction mechanism to harness the 'wisdom of the crowd' of investors. With the availability of more credit data and better models for credit risk analysis, major online lending platforms abandoned auctions in favour of a faster and more convenient origination process, which is heavily data-driven and uses a model-based interest rate determination.

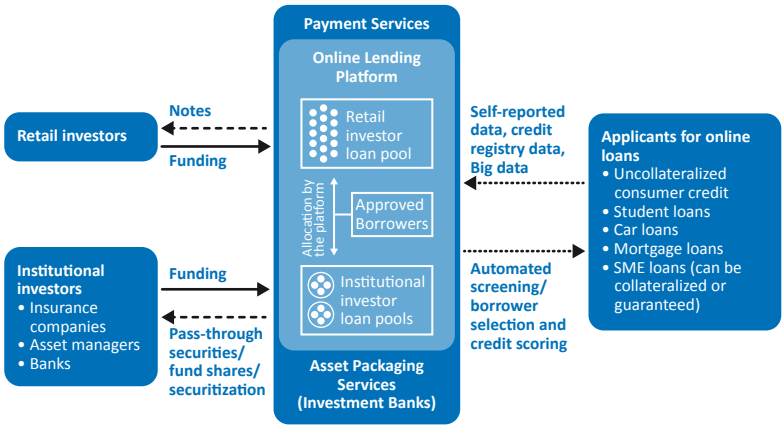
As said earlier, the market segment for uncollateralized consumer credit was the first to be served by online lending platforms. Early business models were tailored towards consumer debt consolidation. Moreover, online lending platforms targeted borrower groups that are underserved by traditional banks. This could, for instance, be the case because of usury laws or for other reasons that reduce the supply of bank credit to the riskier segments of the uncollateralized consumer credit market. The online lending platform's promise for consumers is to refinance expensive revolving consumer debt with a cheaper term loan originated by the platform, or to help consumers to meet larger (potentially unexpected) expenses. Among the key advantages of P2P loans advertised by platforms are the speed of the loan approval and origination process, as well as the digital user experience and the transparent loan terms, including the possibility of an early loan repayment without penalty.

6 The fractional reserve banking system allows banks to create money by issuing loans and matching deposits in the account of the borrower. This money creation by banks is limited by prudential regulation, monetary policy and market forces. In contrast, online lending platforms do not create money, but solely match funds of borrowers and investors. It remains to be said that there are other forms of FinTech credit, which can involve money creation. An example is the e-commerce platform Alibaba, which runs the mobile payment platform Alipay. Besides offering payment services Alipay also extends consumer credit that is matched by mobile money deposits in Alipay accounts.

Figure 2 illustrates the transformation of the classical P2P crowdlending model. Starting from the lending side, online lending platforms have expanded to other uncollateralized credit market segments like student loans and small business loans, as well as to markets that are typically collateralized, such as car loans and mortgage loans. Some platforms are also active in the market for corporate loans to SMEs, where loans may be secured with real collateral or with personal guarantees. In these latter markets, online lending platforms are often in direct competition with banks and strive to offer a substitute for bank-based credit intermediation. The benefits for borrowers may have to do with the transparency or flexibility of the products offered and the more favourable cost structure of online lending platforms. Unlike commercial banks, online lending platforms do not have to sustain an expensive branch network. Customer interaction happens using digital internet-based technologies and call centres. The loan approval process has a high degree of automation. Platforms collect self-reported and publicly available information about loan applicants such as credit registry data. For some market segments, such as uncollateralized consumer credit, the credit risk analysis is fully automated with models for screening and credit scoring. In other segments like SME loans the platforms employ loan officers. Going forward, the credit risk analysis will rely increasingly on Big Data and machine learning.[7]

The investor side of online lending platforms has also evolved drastically since the first securitization of P2P loans in 2013. The left-hand side of Figure 2 gives a schematic overview of the investor side that accounts for the transformation of the classical P2P crowdlending business model.

Figure 2. Transformation of the classical P2P crowdlending platform model towards a refined marketplace lending business model with retail and institutional investors



Major online lending platforms like LendingClub and Prosper in the US and the online lender FundingCircle in the UK now operate platforms that are open to both retail and institutional investors. The platforms screen loan applicants and use a data-driven credit model to determine the interest rate for the fixed maturity loans. Approved borrowers are allocated either to a loan pool dedicated for retail investors (retail investor loan pool; fractional loan market) or to a loan pool dedicated for institutional investors (institutional investor loan pool; whole loan market).

The fractional loan market for retail investors typically operates in the same way as the classical P2P crowdlending model described earlier. Retail investors purchase notes which correspond to a fraction of individual loans, so called fractional loans. It is possible for retail investors to handpick fractional loans, but the use of automated investment tools is

7 Big Data refers to the use of new data sources such as the 'digital footprint' of customers based on social media and internet usage data, which can then be automatically processed using algorithms and statistical models (machine learning).

dominant. Automated investment services offered by platforms allow investors to delegate the allocation of funds and to diversify investments on the platform across individual loans and rating categories according to the investors' risk preferences. The online lending platform provides information on loan-borrower characteristics and assigns a proprietary credit rating to guide investors. Moreover, online lending platforms publish performance statistics based on historic data for different rating categories. Typically, the fractional loan market is characterized by a full pass-through of the credit risk to retail investors. However, numerous platforms, especially in China, have experimented with (partial) insurance of credit risk offered by the platform's loss provision fund or by a third party insurer. After origination the loans are commonly repaid in monthly instalments. To allow retail investors to liquidate their investments prematurely, some platforms offer investors to return notes (potentially at a discount) or to sell them on a secondary market.

Since 2013 the institutional investor loan pool has grown in importance with insurance companies, asset managers and banks on the buyer side. Institutional investors purchase claims on loan pools serviced by the platforms. Similar to the retail investor market, there is also a trend towards for institutional investors towards passive investments, with investors delegating the loan screening to platforms (Bayluk and Davydenko 2019). There are three different funding models: pass-through securities, fund shares and securitization. The institutional investor market is characterized by a stronger link to the banking sector. Unlike retail investor funding, institutional investor funding often requires credit lines and asset packaging services from investment banks, who help to transform the underlying assets into securities and to access financial markets. Moreover, investment banks may also be involved in market making activities for P2P loan certificates that are traded over-the-counter, thereby providing liquidity services to institutional investors. In addition, there is a recent trend towards balance sheet lending in the institutional investor segment, which we can observe in the United States (CCAF 2018a) and in other jurisdictions, including Sweden. Under this model platforms do not fully pass through the credit risk, but take an equity share in institutional investor loan pools. This means that akin to banks, platforms start to have 'skin in the game' not only with their reputation but also with their balance sheet. One interpretation of the observed trend towards balance sheet lending is that online lending platforms want to tap new segments of the institutional investor market and address a potential moral hazard problem by giving assurance regarding the soundness of the underwriting standards and technology.

To conclude the discussion of business models, it remains to address the question: How do online lending platforms earn money? While commercial banks earn a large part of their income from credit activity with the spread of the lending rate over the borrowing rate, online lending platforms rely on fee income. The major part of the fee income of online lending platforms accrues at the point of loan issuance, when platforms collect an origination fee that is typically paid by borrowers. Additionally, many platforms also charge fees to investors for loan servicing and for automated investment services.[8] To date, most online lending platforms are loss making and invest heavily in expanding their businesses.[9]

8 As an example, the fee structure at the largest online lending platform LendingClub consists of: 1) a one-time origination fee of 1–6 per cent on the borrower's rating category, which is higher for riskier borrowers; 2) an annual loan servicing fee of 1 per cent paid by lenders; 3) a late payment fee of 5 per cent of the unpaid instalment or a minimum of 15 US dollars; 4) a check payment fee of 7 US dollars for borrowers, which does not apply for online transfers; 5) a collection fee in the case of a delinquent borrower, which is paid by investors.

9 Table 4 of CGFS-FSB (2017) gives an overview of the profitability of leading UK and US online lending platforms.

2.3 Market development in Sweden and beyond

Online lending origination volumes have been growing rapidly during the last decade. In this section we first highlight the development of the three largest markets in China, the United States and the United Kingdom. Thereafter, we discuss the development of the Swedish online lending market.

Table 1. The expansion of online lending

	2017 P2P loan origination volumes in billions of USD	Annualized growth rate in the 2015–2017 period
China	327.8	49.8%
United Kingdom	6.0	53.2%
United States*	32.5	9.9%

Note. The data is based on survey data from CCAF (2018a,b,c) and the authors' computations. We use a subset of alternative finance, namely P2P consumer lending, P2P business lending and P2P property lending.
*For the US we also include balance sheet lending to consumers, which grew in importance for P2P platforms that now adopt the refined marketplace lending business model depicted in Figure 2.

China has the by far biggest online lending market. In 2017 the annual P2P consumer lending, P2P business lending and P2P property lending origination volume of the Chinese online lending market stood at USD 327.8bn.[10] The P2P segment of the Chinese online lending market experienced an annualized growth rate exceeding 100 per cent till 2016 and then slowed down. For the UK we have a similar picture. The online lending market in the US started to slow down earlier and stronger after growing by 84 per cent per quarter between 2007 and 2014 according to a Federal Reserve Bank of Cleveland study by Demyanyk and Kolliner (2014). In comparison, the development of online lending in continental Europe has lagged behind with an annual P2P origination volume of EUR 1.1bn in 2016. Nevertheless, also the European market expanded rapidly with an annualized growth rate exceeding 50 per cent in many European countries.[11]

The first P2P lending platforms were established in the mid-2000s in the United Kingdom, the United States and China. The oldest platform is Zopa from the UK, which was established in 2005 and specializes in uncollateralized consumer credit. As of 2018, Zopa had an accumulated origination volume of close to GBP 4bn. Today, the largest UK online lending platform is FundingCircle with an accumulated origination volume of GBP 4.2bn in 2018, serving 42,000 businesses. FundingCircle was established in 2010 and specializes in SME business loans. Together with a group of smaller platforms, it accounted for 9.5 per cent of all new loans to SMEs (firms with a turnover below GBP 25m) in 2017 in the UK and for up to 29.2 per cent of all new loans to small businesses (turnover below GBP 2m).[12] A notable aspect of the UK market is that public banks such as the British Business Bank (BBB) and the European Investment Bank have promoted lending to SMEs to a significant extent also via online lending platforms.[13] In many cases business borrowers are referred to online lending platforms by banks. Moreover, the BBB also operates an alternative business-funding platform.

In the United States, the first online lending platforms are Prosper, established in 2006, and LendingClub, established in 2007. Today they are the dominant US online lending platforms in the market for uncollateralized consumer credit. As of December 2018, the

10 Estimates are based on Cambridge Centre for Alternative Finance survey data (CCAF 2018b).
11 See CCAF (2018d) for a detailed report from the Cambridge Centre for Alternative Finance survey for Europe.
12 See CCAF (2018c). Estimates are based on Cambridge Centre for Alternative Finance and UK Finance data.
13 For example the British Business Bank has lent GBP 165m to conforming SMEs over the period from March 2013 till November 2018 on the FundingCircle platform and, additionally, committed up to GPB 150m of senior finance to its SME fund in November 2018.

total accumulated origination volumes exceeds USD 42bn for LendingClub and USD 14bn for Prosper. Another large US online lending platform is SoFI, established in 2011. It has a total accumulated origination volume exceeding USD 30bn and specializes in student loans and mortgages. SoFI was pioneering the expansion of the investor base by conducting in 2013 the first securitization of P2P student loans, which received a credit rating.[14] During the last years the aforementioned balance sheet lending model grew in importance. Today many US online lending platforms operate a marketplace lending business model alongside a balance sheet lending model. In fact marketplace/P2P consumer lending fell from USD 21.1bn in 2016 to USD 14.7bn in 2017, while balance sheet consumer lending grew from USD 2.9bn in 2016 to USD 15.2bn in 2017.[15] To date, online lending platforms are still small in relative terms. In 2016 the volume of marketplace/P2P consumer lending (USD 21.1bn) was just 2.17 per cent when compared to the size of the outstanding revolving consumer credit (USD 969.4bn).[16] In certain market niches it gained, however, significance. By 2018 online lending reached one-third of the US market for unsecured personal loans (Balyuk and Davydenko 2019).

The by far largest online lending market is China. The first Chinese P2P crowdlending platforms were established in 2007. By 2016 the number of active online lending platforms grew to more than 3,000. In 2017 and 2018 a market consolidation wave has reduced the number of active platforms. Relative to the US and Europe, the Chinese market is much more dispersed. Most platforms tend to be smaller in size and the largest Chinese platform is LUp2p with a total volume of outstanding loans exceeding USD 21bn in December 2018 according to data from Home of Online Lending. Also the size of FinTech credit relative to uncollateralized consumer loans from traditional banks in China is thought to be very high in an international comparison, reaching up to 20 per cent in 2016.[17] One explanation for the big size of the Chinese online lending market is the limited availability of bank-based consumer credit, but also the active promotion of the FinTech credit market development by government authorities.

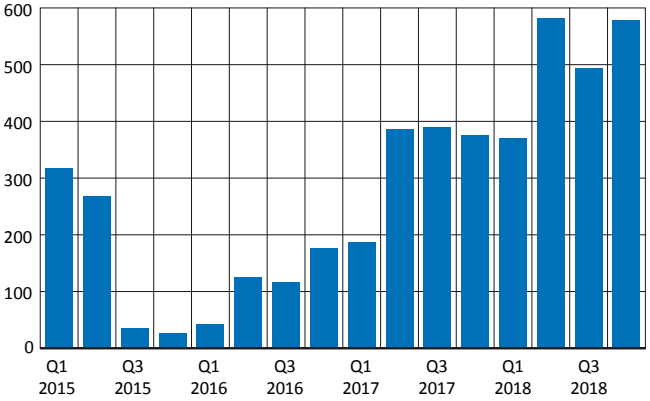
In Sweden the total origination volume by online lending platforms for the 2015–2018 period exceeded SEK 4.4bn with the platforms Lendify and Tessin (both established in 2014) being the dominant players. Figure 3 shows the evolution of the origination volumes in the Swedish P2P online lending market. Similar to the UK, the Swedish online lending market started to develop earlier than other continental European markets. However, the Swedish market experienced a major setback after the closure of the dominant platform Trustbuddy, which filed for bankruptcy in October 2015 after a scandal. This explains the sharp drop in loan origination volumes in the second half of 2015. Subsequently, the market took more than two years to recover, with younger platforms gradually filling the large gap left by the market leader Trustbuddy. We discuss the Trustbuddy scandal in Box 1 in the Appendix.

It appears that the Trustbuddy scandal slowed down the expansion of online lending platforms in Sweden. However, there does not seem to be a lasting negative effect on the growth prospects of competing platforms. According to our survey and estimates, the Swedish online lending market has grown at an annualized rate of around 190 per cent in 2017. Thereafter, the annualized growth rate has slowed down to around 51 per cent in 2018. To date, the size of the Swedish online lending market is still small relative to total bank lending. However, the high growth rates, as well as the market developments in other advances economies like the US and UK suggest that in a few years online lending may also become an important source of credit in certain market segments in Sweden. Namely, the riskier uncollateralized consumer credit segment or the Swedish mortgage market, where a

14 See Bloomberg article by Campbell (2019).
15 See CCAF (2018a) for a detailed report from the Cambridge Centre for Alternative Finance survey for the United States.
16 Based on data from the Federal Reserve Board of Governance and CCAF (2018a)
17 See Braggion, Manconi and Zhu (2018).

number of alternative non-bank credit providers have emerged recently alongside the online lending platforms.[18, 19]

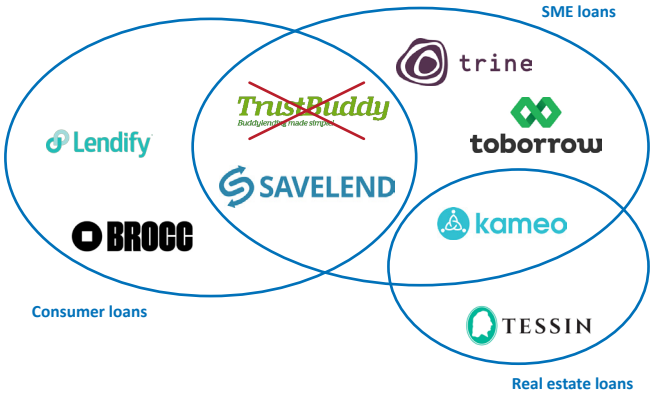
Figure 3. Evolution of the loan origination volumes of the largest Swedish P2P online lending platforms over the period 2015–2018
Million SEK



Note. We identify and survey the eight largest platforms, which are listed in Figure 4. Notably, we restrict attention to platforms that started off with the classical P2P crowdfunding model and continue to have retail investors. Moreover, we exclude other non-bank consumer credit institutions that specialize in online lending solutions, but exclusively focus on institutional investors (e.g. alternative investment funds) and balance sheet lending. Finally, we include Trustbuddy which closed and filed for bankruptcy in October 2015.
Sources: Riksbank survey and estimates based on authors' calculations

Figure 4 depicts the most popular Swedish P2P online lending platforms by market segment. The largest market segments is uncollateralized consumer loans, followed by collateralized real estate loans. The platform Trine plays a special role in that it originates credit to renewable energy projects outside Sweden.[20] Unlike in the UK, SME loans constitute a comparably small market segment in Sweden. Except for Kameo, all platforms are, or have been, registered as a payment institution or as a 'finansiellt institut' with the Swedish Financial Supervisory Authority. Kameo is registered with the Danish Financial Supervisory Authority and operates a Swedish branch.

Figure 4. The largest players in the Swedish P2P online lending space



Note. As before, we restrict attention to platforms that started off with the classical P2P crowdfunding model and continue to have retail investors. The platform Trustbuddy was closed in October 2015.

18 See Sveriges Riksbank Financial Stability Report 2018:1 (2018).
19 These other alternative credit providers do not directly match borrowers and investors, but exclusively rely on balance sheet lending and are targeted to institutional investors.
20 Investors in Trine loans receive a partial protection against losses from the Swedish development agency SIDA.

To date, our knowledge of the market niches targeted by online lending platforms is only limited. A better understanding would require analysing detailed information about the types of borrowers and investors. On the largest Swedish platform Lendify, interest rates range between 2.95 per cent and 17 per cent. Including the servicing fee, the average effective rate charged to borrowers is likely to exceed 10 per cent. On the investor side, Lendify advertises an average return after service fees and expected losses of around 4.8 per cent for retail investors in 'autoinvest long' and of around 3.4 per cent for 'autoinvest short' (as of the first quarter in 2019).

Interestingly, there is evidence that online lending platforms and banks compete directly for customers in the consumer loan segment. An example is again the largest platform Lendify, which is listed on the site of the online broker Lendo alongside a number of mid-sized and larger Swedish banks. Moreover, there are also direct and indirect links between the Swedish banking sector and online lending platforms in the form of ownerships or partnerships, as well as via the provision of asset packaging services. An example of a direct ownership link is the platform Toborrow, which is owned by Marginalen Bank.

In recent years funding from institutional investors has gained importance also in Sweden and many platforms starting to cater to both institutional and retail investors, as described in Figure 2. Notably, some platforms engage in balance sheet lending by retaining an equity stake in their funding vehicles, meaning that the platform assumes the first losses. Under this model platforms obtain funds from institutional investors by creating alternative investment funds or by issuing bonds, which are secured by loans originated on the platform. Typically secured bonds promise a fixed return and can be traded on the Nordic Derivatives Exchange NDX. When loans are repaid, the platform repurchases the bonds in the market. Notably, it is common that the credit risk is only partially transferred to investors since the platforms retain an equity stake in the funding vehicle. Besides the trend towards a dominance of institutional investors and balance sheet lending, some Swedish platforms also follow the reintermediation trend by offering loss provision funds or by offering secondary markets.

Having discussed the market development, we next turn to the drivers behind the growth of FinTech credit and expand on the discussion provided in the introduction. We can distinguish between demand and supply side factors (see, for example FSB (2017)). On the demand side, customers value the digital user experience that comes with convenience benefits such as a 24/7 availability and speedy processes. The general trend towards an increasing share of digital transactions (for example in e-commerce) constitutes a shift in consumption habits that also benefits online lending platforms which specialize in digital-only services. Besides, a dissatisfaction with services from traditional banks can also be a relevant determinant of the expansion of online lending, especially when the banking sector lacks competitiveness, or when trust in traditional banks is impaired, for example due to bank misconduct.[21] On the supply side, technological developments and internet penetration are key. Most importantly, technological advances reduce the cost of entry for new financial service providers and allow them to scale up rapidly with the help of cloud-based bank services. Also the operating costs of new entrants are often lower than the operating costs of incumbent banks which maintain a vast branch network and rely on legacy mainframe computer systems. Another potential supply-side factor is search for yield by investors. More specifically, the low interest rate environment may attract retail and institutional investors to consider alternative investments that promise attractive return, thereby, fuelling the expansion of FinTech credit.

Financial regulation also plays an important role.[22] New financial service providers benefit in many jurisdictions from a lower regulatory burden when compared to commercial banks.

21 See Bertsch et al. (2018) on how shocks to bank misconduct complaints (for example complaints about unfair contractual terms, opaque or unpredictable fees, or deliberate misselling) drive borrowers to online lending platforms in the United States.
22 See Rau (2018) for a cross-country study documenting the important role played by the quality of regulation and the rule of law.

In parts, this is because existing regulatory frameworks have a strong focus on bank-based financial intermediation, meaning that FinTech credit business models are not or only partially captured by existing regulation. However, authorities also seek to avoid a situation where regulation stands in the way of experimenting with potentially beneficial FinTech innovations. We will discuss the regulatory landscape in more detail in the next section.

3 Regulatory landscape and lessons from failures of online lending platforms

Financial innovations have the potential to offer substantial benefits and can improve the functioning of the financial system. However, new financial technologies can also pose new risks and challenges spanning from consumer and investor protection to financial stability considerations. Financial regulators strive to identify and manage new risks as they emerge. In the context of FinTech credit, managing new risks may require that the existing financial regulation has to adjust and find new ways to safeguard lenders and borrowers, as well as the stability of the financial system.

Thereby, regulators may face a delicate balancing act. The objective of minimizing financial stability risks can in some cases be in conflict with the desire to allow for a regulatory landscape that enables innovation and experimentation with new business models by new FinTech start-ups, as well as by incumbent financial institutions. As long as the FinTech credit market is small, regulators' main concern is that the new players adhere to appropriate consumer and investor protection standards. Currently, these aspects take centre stage in the regulatory discussion. Going forward, a continuation of the rapid growth of FinTech credit will, however, increase the relevance of financial stability considerations, which are often discussed in the context of the broader debate on non-bank financial intermediation, or shadow banking.

We first describe in Section 3.1 the regulatory landscape from an international perspective. Thereafter, Section 3.2 considers the Swedish case against the backdrop of the ongoing regulatory discussion on the European Union level. Finally, Section 3.3 discusses lessons learnt from scandals and failures of online lending platforms.

3.1 International perspective

Online lending platforms are outside the perimeter of regulated credit institutions. As a result, investments in online lending platforms are not covered by public deposit insurance schemes. In some jurisdictions, like Germany or the United States, only banks are allowed to extend credit. Here, online lending platforms have to rely on partner banks, typically small specialized credit institutions, who provide so called fronting services. Importantly, these partner banks administer payments and do not take on credit risk. In other jurisdictions online lending platforms can obtain a permit to broker credit based on recent regulation for crowdfunding institutions or based on existing regulation for payment institutions and for non-bank investment intermediaries.

To date, the largest online lending market is China. The Chinese market is relatively opaque and platforms have largely operated in a grey area. In late 2017, Chinese online lending platforms were asked to register with local authorities. This is part of an ongoing initiative to enforce the Interim Measures on Administration of Business Activities of Online Information Intermediaries introduced in August 2016, which stipulate the registration of platforms and the safeguarding of investor and borrower funds in custody accounts with commercial banks.[23] The pooling of funds via the balance sheet of online lending platforms has been prohibited so that investors have to be directly matched with borrowers. Additional

23 See Financial Times article by Suya (2019), as well as TechCrunch article by Liu (2018).

new measures are designed to increase transparency about platform ownership and investments, as well as to reduce the risk that platform owners abscond investor funds. In mid-2018, government authorities intensified the clampdown after widespread misconduct and a large number of defaulting platforms, which we will come back to in Section 3.3.

Online lending platforms have also operated in a grey area in many other countries. Often with limited or no reporting requirements. In recent years, many jurisdictions have, however, started to introduce dedicated regulation for crowdfunding institutions (see Havrylchyk (2018) for a recent review paper). There is, however, a substantial variation in regulatory frameworks, which is for instance reflected in the allocation of supervisory responsibility. In some jurisdictions the supervisory authority is located with the banking supervisor, but often other government agencies are responsible.

The focus of the current regulatory debate is mostly centred around consumer and investor protection with an emphasis on disclosure requirements. In an international comparison the disclosure requirements and the voluntary disclosure of information by online lending platforms are highest in the United States and in the United Kingdom. This includes the publication of detailed loan level origination data and of performance data. In other jurisdictions disclosure requirements tend to be more limited. Differences in regulation and in voluntary information disclosure give rise to considerable variation in the quality of information provided to investors. An example are difference in the disclosure of borrower characteristics when comparing the largest US online lending platform for uncollateralized consumer credit, LendingClub, to Auxmoney, the largest continental European platform in the same market segment. In contrast to LendingClub, Auxmoney does not supply investors with verified information on a number of important borrower characteristics, such as employment status, income or debt-to-income ratio. Another example is the publication of stress test results that inform investors about the expected loan portfolio performance in different macroeconomic scenarios. This type of disclosure has been pioneered by US and UK platforms, but it is largely absent in continental Europe.

In many jurisdictions existing regulation only captures some aspects of FinTech credit business models and it is, for instance, unclear whether platforms are allowed to offer automated investment services, to access institutional investors or to create loss provision funds. In some cases this can lead to a situation where a lack of clarity creates regulatory uncertainty, which can hamper the development of the FinTech industry. Such uncertainty can be addressed by modifying the existing regulatory regime in order to better capture the FinTech credit business, or by following a regulatory sandbox approach.

The UK Financial Conduct Authority (FCA) was first to implement a regulatory sandbox approach, which gained international attention. Thereby, the FCA provides a temporary licencing regime, which removes regulatory uncertainty and allows new business ideas and products to be tested for six months in a controlled environment and at a smaller scale. Importantly, the regulatory sandbox licencing ensures oversight by the FCA and allows for a collaborative approach in determining best practises and product design safeguards for consumer and investor protection going forward. A recent initiative by the Global Financial Innovation Network (GFIN), a group of 12 financial regulators that includes the FCA and the US Bureau of Consumer Financial Protection, seeks to create a ‘global sandbox’ that enables cross-border testing of new financial products following an FCA proposal.

Some other countries have chosen to address the regulatory uncertainty with the help of so-called innovation hubs or help desks that offer assistance to FinTech start-ups, as well as banks that want to introduce new FinTech products to the market. In this way regulators help FinTech players to navigate the existing regulation and create space for the experimentation with new business ideas.

3.2 Regulation in Sweden and in the European Union

In Sweden the Financial Supervisory Authority Finansinspektionen (FI) opened an Innovation Centre for FinTech firms in 2018. The aim is to support the development of the sector by providing a platform for dialogue, which can, for instance, assist market participants who seek clarification regarding the applicability of existing regulation and its interpretation. Moreover, FI's newly created Innovation Centre can facilitate the authorisation of new FinTech solutions, as well as the registration process.

Swedish online lending platforms are registered with FI as a payment institution ('betalningsinstitut') or as a financial institutions ('finansiellt institut'). Most platforms are payment institutions, which covers a broader range of activities. The payment institution license gives permission to broker credits and to execute payments. It also covers the provision of delegated investment services for debt products. Relative to credit institutions with a banking license, the regulatory burden for payment institutions is considerably lower and online lending platforms face comparably few reporting and disclosure requirements. Anti-money laundry regulation is applicable to both payment institutions and financial institutions. A key difference between the payment institute and financial institute registrations is that the latter only allows for direct matching of borrowers and investors. Regarding the protection of borrowers, the rules of the Consumer Credit Act (2010:1846) apply, which regulates aspects such as the information that has to be provided to loan applicants or to borrowers, rules for interest rate adjustments by the lender and guidelines for lenders to ensure that borrowers have the financial capacity to service the loan. For alternative mortgage credit additional rules from the Mortgage Business Act (2016:1024) apply, which regulates aspects such as the right of borrowers for early repayments and the right to keep the mortgage till maturity.

Consumer protection is high on the agenda of the Swedish Financial Supervisory Authority (Finansinspektionen 2018). One key concern is to protect vulnerable borrowers from over-indebtedness. This concern is also reflected in a recent Swedish government inquiry on crowdfunding (SOU 2018). Regarding the protection of investors, an important aspect is to assure that investors in alternative investment products can understand the risks involved. To this end, the government inquiry suggest improvements in investor protection and disclosure requirements.

Going forward, the trend of Swedish online lending platforms to access institutional investors with the help of balance sheet lending (i.e. to provide equity as a first loss buffer), as well as the increasing interest of Swedish banks in owning online lending platforms suggests that regulatory clarity will be an important component in the development of FinTech credit activities. An example is the recent recommendation of the Swedish financial supervisory authority on alternative mortgage credit brokered by online lending platforms and other alternative non-bank credit providers (Finansinspektionen 2019). FI is of the view that investors in mortgages should be (authorized) professional investors. This is to assure that investors understand the risks involved and have the ability to provide long-term funding. In addition, FI provides a set of guidelines for adequate management of liquidity risks.[24] Moreover, FI also addresses the exposure of banks to the alternative mortgage credit market by mandating that so called *peribank structures*, i.e. mortgage structures such as alternative investment funds outside the banking group that are directly or indirectly owned by the parent bank, have to be taken into account in the existing frameworks for bank capital and liquidity regulation.

The future regulatory landscape for the Swedish FinTech credit space is expected to be influenced by initiatives on the European level. To date, there is no European legal and regulatory framework for FinTech credit. In March 2018 the European Commission put

24 This includes contingency planning for alternative investment funds and funding maturities of at least ten years.

forward a proposal for the regulation of European crowdfunding platforms that provide funding for businesses.[25] The proposal is an initiative in the context of the European Capital Markets Union and refers to recent FinTech developments and the legal, as well as the regulatory fragmentation of the European market.

The European Commission proposal advocates a single set of rules and a single European Union-wide authorisation of crowdfunding platforms that provide funding for businesses. An important objective is to enable cross-border scaling of crowdfunding platforms and cross-border investing. The regulatory discussion in European policy circles includes questions regarding the registration, the supervision, the rules for governance and operations, as well as the rules for disclosure and financial conduct. It is noteworthy that crowdfunding platforms shall be banned to invest in projects or loans on the platform. Finally, an important decision to be taken concerns the allocation of regulatory and supervisory powers at the European or the national level.

Notably, the focus of the European Commission proposal is on investment-based and lending-based crowdfunding for businesses. This means that FinTech credit to consumers, the most important FinTech credit market segment in Sweden and internationally, is not covered. Nevertheless, it can be expected that a harmonization of the European legal and regulatory framework for crowdfunding platforms that provide funding for businesses would also have implications for the future regulation of FinTech credit to consumers on the national and European level.

3.3 Scandals and failures of online lending platforms

We conclude this section with a study of major scandals and failures of online lending platforms, which offer lessons on what can go wrong. Our discussion sheds light on issues concerning the transparency of the underwriting standards, as well as on the problematic practise of offering guaranteed returns. Besides the threat of fraud and uncertainty regarding the viability of online platforms, it turns out that the lack of dedicated resolution frameworks is a big risk for retail and institutional investors alike.

In Box 1 in the Appendix we describe the Trustbuddy bankruptcy in Sweden, which was an instance of outright fraud. The platform offered guaranteed returns to investors, a business model that has also been adopted by many Chinese platforms. For Trustbuddy, promising high returns to investors in the double-digits proved to be problematic from the start and opened the door to fraudulent business practises going forward. Due to the limited size of the platform and the small retail investor base, the platform's bankruptcy was a small event without any repercussions in the broader financial system. However, the scandal was an early demonstration of the new facets of financial fraud enabled by digital financial services, highlighting the importance of regulatory oversight for the growing FinTech credit market, including standards for reporting, investor protection and transparency.

Box 2 describes the market consolidation in China, which involved a drastic wave of platform closures. Due to numerous cases of fraud and failures of platforms, the Chinese online lending market has received increased regulatory scrutiny, especially after a second market turmoil erupted in summer 2018. Since 2016, more than 2,000 online platforms have been closed. This lead to a significant loss of confidence by investors, who also suffered from the lack of dedicated resolution frameworks to wind down collapsed platforms and to facilitate the continued servicing of loans. The implications were major disruptions, strategic borrower defaults and low recovery rates of investors. Given the relatively large size of the Chinese online lending sector, the market turmoil had a significant effect on credit availability to some sectors like SMEs. A lesson for financial regulators is that existing regulations for contingency planning may have to be adjusted to account for the particularities of online

25 See European Commission (2018a) for the proposal and European Commission (2018b) for the impact assessment.

lending platforms. In addition, minimum capital requirements may be a useful tool that can help to assure business continuity in adverse market scenarios. As said earlier, the Chinese government authorities intensified the clampdown on online lending platforms, prohibiting the pooling of funds by online lending platforms. In addition, new measures shall increase transparency and reduce the risk that platform owners abscond investor funds.

Finally, Box 3 in the Appendix describes the LendingClub scandal of May 2016, which involved the largest US online lending platform. The platform wrongly disclosed the allocation of loans in its funds and was not transparent about its own loan purchases, as well as its loan-pricing model. The lesson learnt is that funding from institutional investors is flighty, akin to wholesale funding of commercial banks. The trust in the underwriting standards of a platform can evaporate quickly and there is a risk of reputational spillovers to the wider FinTech credit sector. From a regulatory viewpoint, these observations matter provided the FinTech credit sector continues to gain in relevance. The LendingClub experience suggests that measures aimed at increasing transparency can also reduce the fragility of online lending platforms.

4 Financial stability implications

Financial innovations have the potential to offer substantial benefits and can improve the functioning of the financial system. However, new financial technologies can also pose new risks and challenges spanning from consumer and investor protection to financial stability considerations. When looking at the history of financial innovation, credit cards and mortgage-backed securities are two cases in point. The introduction of credit cards and their large-scale adoption in the 1980s and thereafter brought about clear benefits for consumers and merchants in terms of convenience, credit availability and security. However, the introduction of credit cards in the US also coincided with the explosion of US consumer debt and an increasing number of households becoming vulnerable to financial shocks and to increasing borrowing costs (see, for example Livshits et al. (2016)). Similarly, mortgage-backed securities have clear benefits for issuers (lower funding costs, increased liquidity) and for investors (safer assets, diversification benefits). But the financial innovation and its adoption by banks gave rise to substantial financial stability risks, as witnessed during the Great Financial Crisis where subprime mortgage-backed securities played a key role (see, for example Gorton and Metrick (2010)).

In this section we discuss how financial stability risks associated with FinTech credit innovations may appear and attempt to identify potential sources of risks with a focus on trends towards a reintermediation of FinTech credit, as well as on the growing exposure of commercial banks to alternative non-bank credit providers such as online lending platforms. A recent report by the Committee on the Global Financial System and the Financial Stability Board (CGFS-FSB 2017) provides one of the first discussions of the potential financial stability implications of FinTech credit. On the benefit side, FinTech credit promises efficiency gains from digital technologies, lean operations without costly legacy systems and less complexity relative to commercial banks. These factors can improve financial stability. In addition, disintermediation of credit and the matching of long-term investors with borrowers can lead to a reduction of structural liquidity risks vis-à-vis bank-based intermediation. Moreover, if online lending platforms fully transfer credit risk to investors with a high loss bearing capacity, the disintermediation of lending is likely to compare favourably with the cyclicality of lending by capital-constrained banks, resulting in a more steady credit supply. More broadly, financial stability benefits may arise from the diversification of the credit market landscape, as well as from a higher degree of competition and from the contestability of business models.

On the cost side, relevant concerns relate to the untested online lending platform business models and whether they can withstand a deep recession. This is because FinTech credit is a relatively recent financial innovation, implying that fragilities of platform business models and the soundness of algorithmic underwriting technologies warrant some caution. Potential problems are magnified by operational weaknesses and insufficient disclosure paired with potential conflicts of interest, as well as a lack of dedicated resolution frameworks and limited regulatory oversight.

Depending on the level of direct and indirect exposures of the traditional banking to the online lending sector, a key financial stability risk is the potential spill over of losses originating in the online lending sector to the broader financial system. The increased competition may also be a threat for traditional banking, with potential implications for the profitability and stability of banks. To this end, the banks' responses to competitive pressures and the growing linkages between online lending platforms and the banking sector are also a potential concern, especially in the context of the debate on shadow banking and non-bank financial intermediation in a broader sense.

We first turn in Section 4.1 to the growing exposure of the financial sector to FinTech credit, which suggests to be the most important avenue for a potential build-up in financial stability risks. We also connect to the broader debate on regulatory arbitrage, focusing on two aspects. First, banks may shift capital-intensive activities to online lending platforms and, second, online lending platforms may continue to gradually adopt services which are at the core of bank-based financial intermediation. Finally, Section 4.2 discusses in more detail sources of risks that stem from untested business models of online lending platforms, as well as magnifying factors.

4.1 Growing exposure of the financial sector to FinTech credit

Our focus is on the exposure of banks to the FinTech credit sector. However, we acknowledge that the exposure of non-bank institutional investors could also be a concern, for instance, if institutional investors have a limited loss-bearing capacity or if there is a strong search-for-yield motive paired with a lack of investment experience in the new FinTech credit market segments.[26] The discussion of financial stability risks is closely related to the broader debate on non-bank financial intermediation outside the perimeter of prudential regulation.

Relevant exposures of the banking sector can be direct or indirect. A direct exposure of the commercial banks to online lending platforms can arise through ownerships and partnerships or through purchases of shares in institutional investor loan pools that are originated on platforms. In addition, commercial banks also assist online lending platforms with asset packaging services (see Section 2.2), which can expose banks to credit and liquidity risk in case of disruptions. More concretely, the failure of an online lending platform that is owned by a commercial bank can lead to the transmission of losses and cause reputational risks for bank. In fact, it may be the case that a bank is willing to pay off investors and take loans originated by the failed platform on the bank balance sheet in order to mitigate reputational risks. If online lending platforms continue to grow in size, such exposures may become relevant for financial stability.

An example of a partnership between a large platform and bank is the referral arrangement between FundingCircle and Santander UK.[27] Regarding ownerships, there are several online lending platforms owned by European banks. In Belgium, the second largest bank KBC Group owns the platform BoleroCrowdfunding.be, which originates loans to small businesses. A Swedish example of a direct ownership link is Toborrow, which is owned by Marginalen Bank, a smaller Swedish bank.

26 Financial actors such as insurance companies and asset managers build up exposures to online lending platforms by investing in institutional investor loan pools.

27 See Funding Circle (2014).

Besides the direct exposures of the banking sector, there are also relevant indirect exposures. These include the competition channel and the confidence channel. Regarding the competition channel there is an extensive academic debate in the banking literature discussing the complex relationship between competition and financial stability. When applied to the FinTech credit setting, this literature suggests that the increase of competitive pressures due to the emergence of online lending platforms may affect the stability of incumbent banks. The increase in competitive pressures is likely to be particularly concentrated for lending activities based on hard information. Notably, larger banks tend to have a stronger focus on transactional lending based on hard information, while smaller banks tend to give more discretion to loan officers who also rely on soft information (Berger et al. 2005). An example of hard, or easily quantifiable, information is credit registry data. Instead, soft information, such as information regarding the soundness of a borrower's investment plans, is typically harder to quantify.

Regarding financial stability, the direction of the competition channel depends on factors such as the market structure, the relevance of different agency frictions and the effectiveness of banking supervision. In our context, one implication could be that negative financial stability effects arise due to a reduction in bank profits or due to adverse incentive effects on banks' risk-taking.[28] It is, however, questionable whether a lower probability to withstand adverse shocks due to lower bank profits is a relevant concern for the case of Sweden, where the bank profitability is relatively high and a large part of bank profits is paid out to shareholders (see article on 'New players in the mortgage market' in Sveriges Riksbank Financial Stability Report 2018:1 (2018)).

Regarding the confidence channel, consider a major disruption in the FinTech credit sector, for instance due to lax underwriting standards. Such a disruption may cause institutional investors to reassess not only the risks associated with online lending platforms, but also the risks of commercial banks who operate in the same market segments or are suspected to use similar lending practises or technologies. As a consequence, the failure of online lending platforms can be a wake-up call for investors, leading to a loss of confidence that may negatively affect the banking sector even absent direct exposures.[29]

A different set of concerns relates to regulatory arbitrage. More specifically, direct investments by banks in online lending platforms and the passing on of selected bank clients to platforms can raise red flags if regulatory arbitrage motives are at play. Such a situation arises if commercial banks pass on capital extensive lending activities without fully eliminating the banks' exposure to these loans. To give an example, commercial banks may operate or partner with online lending platforms and systematically refer borrowers with certain characteristics. Under the balance sheet lending model, online lending platforms hold an equity stake in the loan pools and in funds for institutional investors. This equity stake may, however, be lower than the equity needed for bank-based financial intermediation. As a result, banks owning online lending platforms may engage in regulatory arbitrage and reduce the total cost of capital by shifting credit activity outside the regulatory perimeter. The relevance of this concern is, for instance, reflected in the recent recommendation of the Financial Supervisory Authority (Finansinspektionen 2019). As discussed in Section 3.2, Finansinspektionen advocates to include so called peribank structures, which started to emerge in the Swedish alternative mortgage credit market, into the existing frameworks for bank capital and liquidity regulation.

28 Keeley (1990) found a positive empirical relationship between more competition and more risk-taking by banks. Later studies came, however, to mixed or even opposite results. From a theoretical viewpoint the relationship is also not clear-cut and it depends on whether the relevant risk-shifting problem is on the part of the banks (Wagner 2010) or on the part of its borrowers (Boyd and De Nicoló 2005). A non-linear relationship is possible with more competition being stability enhancing in an environment with low or intermediate levels of competition, while excessive competition undermines financial stability (Martinez-Miera and Repullo 2010; Jiménez et al. 2013). See, for example, Vives (2016) for a recent review of the literature.
29 See Acharya and Yorulmazer (2008) for information contagion due to asset commonality and Ahnert and Bertsch (2015) for wake-up call contagion.

The build-up of risks in the so-called 'shadow banking sector,' comprising non-bank financial intermediaries, was an important contributing factor to the Great Financial Crisis of 2007/2008 (see, for example, Gorton and Metrick (2010)). When seen in this light, the expansion of new alternative non-bank credit providers can play an important role for financial stability going forward. Prior to the Great Financial Crisis, key problems originated in the securitization process, which transformed pools of loans into liquid assets that were eventually transferred off the banks' balance sheets. With regard to the marketplace online lending model, where platforms offer delegated investment and asset packaging services, it is therefore instructive to discuss in more depth the intersections of the FinTech credit space with the broader debate on non-bank financial intermediation and regulatory arbitrage.

To clarify, online lending platforms that are pursuing the classical P2P crowdlending business model, as depicted in Figure 1, are not shadow banks since they merely match the loan demand of borrowers with the supply of funds from investors, without engaging in activities that are at the core of commercial banking. Under this model digital financial technologies are used to directly match the loan demand of borrowers with the supply of funds from the crowd of investors. However, in recent years many online lending platforms have transformed into marketplace lenders and taken various steps towards reintermediation.[30] More specifically, some platforms in Sweden and elsewhere started to offer services that are at the core of bank-based financial intermediation such as maturity transformation, liquidity transformation, guaranteed returns for investors or balance sheet lending (see discussion in Sections 2.2 and 2.3).

Besides the growing exposure of banks to online lending platforms, this tendency towards reintermediation constitutes another source of potential financial stability risks. First, online lending platforms started to develop their role as information providers and replaced auctions for the loan pricing with algorithms that allow to speed up loan origination. This was possible with the increasing availability of data, which facilitates automated credit scoring and loan pricing.

Next, online lending platforms broadened their investor base, adopting the marketplace lending model depicted in Figure 2. This included taking a more active role as a middleman in the allocation of funds, both on the retail investor side where marketplace lending entails automated investment services and on the institutional investor side where platforms allocate loans across different loan pools and funds. Taken together, online lending platforms became information and investment intermediaries.

More recently, online lending platforms also started to engage in balance sheet lending. Under this model platforms do not only have reputational skin in the game, but also direct financial investments in the loan pools. This gives platforms a credit risk management function, which is not dissimilar to the one of commercial banks. In addition, some platforms assumed additional roles of a financial intermediary such as the provision of liquidity services and guaranteed returns.

From the viewpoint of financial regulators, the expansion of FinTech credit can be a potential concern if a significant share of credit activity migrates outside the regulatory perimeter, due to the absence of a comprehensive regulatory framework for FinTech credit. Given the trend towards an increasing share of passive institutional investors, the platforms play a key role in screening loans. Platforms are at the same time rating agencies and providers of delegated investment services. This constellation is prone to confidence shocks in the case of unexpected losses, similar to what we experienced in the securitization market during the Great Financial Crisis. The problem can be amplified by a lack of transparency and opaque lending standards of online lending platforms.

The existence of a lightly regulated FinTech credit sector can lead to regulatory leakage, with commercial banks shifting capital-intensive lending activities to online lending

30 Bayluk and Davydenko (2018) gives a good review, taking the example of Prosper.

platforms. In principle, the migration of risky credit activity to the FinTech sector may reduce the fragility of the banking sector and improve financial stability. This is the case if the re-allocation of credit is associated with a full transfer of credit risk to investors with a high loss bearing capacity. Such a situation may arise if banks refer their riskiest borrowers to online lending platforms which receive the majority of funding from non-levered long-term oriented investors such as insurance companies. Another aspect that may contribute to banking sector stability is that FinTech credit tends to be junior to bank credit (for example longer maturity and less use of loan covenants). As a result, banks are less likely to suffer a credit loss if the same borrowers are also taking a credit from an online lending platform, which takes the first losses. However, the overall financial stability implications are likely to be less favourable if levered institutional investors such as commercial banks are taking large exposures to online lending platforms. In addition, the previously discussed trends towards a reintermediation of FinTech credit raise questions regarding the fragility of platforms and the potential build up hidden risks in a new branch of the shadow banking sector.

Chinese online lending platforms already comprise a significant part of non-bank financial intermediation in China. Since the Chinese FinTech credit market is by far the largest in size, its development may be informative for other jurisdictions. This is because many platforms have adopted business models that incorporate features which are at the core of banking, such as the possibility to withdraw funds or guaranteed returns that are often backed up by in-transparent arrangements, including platform loss insurance funds and third-party guarantees from insurance companies. From a financial stability viewpoint a major risk is the connectedness of non-bank financial intermediaries with the rest of the financial sector. Going forward, an increasing number of Chinese online lending platforms is expected to be partially or fully owned by financial institutions such as insurance companies and banks.

4.2 Untested business models

This section discusses in more detail sources of risk that stem from untested business models of online lending platforms, as well as magnifying factors. In contrast to commercial banks, online lending platforms do not face the risk of runs as long as they don't offer investors the possibility to withdraw their funds prematurely, thereby creating a maturity mismatch. However, platforms are exposed to the risk of a sudden dry-up in origination volumes, which can have profound implications. As described in Section 2.2, platforms typically rely on income from loan origination fees, loan- servicing fees and other fees charged for the platform's investment services. For most platforms the main source of income are loan origination fees that accrue at the point of issuance. This sharply differs from commercial banks who typically earn most of their income from the spread between lending and borrowing rates. To date, most platforms are loss-making and invest in growing their businesses with the desire to achieve economies of scale and network effects. As a result, a sudden dry-up in loan origination volumes can quickly endanger the solvency of online lending platforms. The risk of such a scenario is highest during an economic downturn. Hence, an important question is: Are the business models of online lending platforms able to weather a severe economic downturn?

Besides the reliance of platforms on fee income from loan originations, other destabilizing factors include the heavy reliance on algorithmic credit risk assessment models, potential operational weaknesses and the focus of many platforms towards riskier borrower segments. In the scenario of an economic downturn, the loan performance is expected to take a hit and investors may respond by ceasing to re-invest funds or even by withdrawing invested funds if platforms allow them to do so. To prevent investor withdrawals, platforms will need to tighten their lending standards by reassessing the calibration of their credit and loan pricing models. Such a tightening of lending standards is likely to result in a reduction in origination volumes, especially for online lending platforms that have been growing

strongest in riskier borrower categories. Since a large part of the platforms' income is tied to loan origination activity, it remains to be seen how well online lending platforms can cope with a prolonged downturn.

The previously described risk of dry-ups in online lending platform origination volumes is amplified for online lending platform operating a balance sheet lending model. Here online lending platforms take the first losses in the funds created for institutional investors, thereby further worsening the platform's financial position. At the same time, platforms need the resources to deal with a high number of non-performing loans. In the event of an economic downturn, especially unsecured consumer credit and unsecured credit to SMEs are prone to a sharp drop in loan performance. Cost-cutting measures are one avenue to contain losses stemming from cyclical fee income and from the write-downs on equity shares in institutional investor funds. Another avenue is to merge with other platforms or to partner with commercial banks that can provide funding. From a financial stability perspective, a sharp contraction of FinTech credit has negative implications for the credit availability in the market segments where online lending platforms have gained a significant market share. In addition, the growing exposure of the banking sector can be a concern, as discussed in Section 4.1.

Regarding the use of algorithmic credit risk assessment models, potential risks stem from the calibration of these models on data that has been generated during a decade-long economic expansion. Of course, also commercial banks are prone to these types of risks. However, online lending platform with their emphasis on fully automated credit risk assessment are to a considerable larger extend dependent on the soundness of models. Only few platforms publish stress tests of their loan books that try to gauge how severely loan performance will be hit in an economic downturn. As a result, investors and regulators have very limited information on how the platforms' underwriting standards, as well as its business models are coping with a recession. This uncertainty about the platform viability increases the risk of a loss of investor confidence.

Online lending platforms that offer liquidity services to investors by allowing them to withdraw their investments are likely to be especially prone to drops in loan performance. Typically, such platforms have loss provision funds that can be used to cover the first losses, or the platforms offer guaranteed returns that are backed by other financial institutions. Either way, investors purchase claims that are perceived as relatively safe, with the caveat that investors are potentially exposed to substantial credit or counterparty risk if the market experiences a negative shock. In the case of a severe economic downturn, loss provision funds are likely to be insufficient to withstand the losses.[31] Similarly, the loss-bearing capacity of financial institutions insuring platforms may be limited and unknown to investors.[32] As a result, platforms may find themselves in a situation where they have to suspend the possibility to withdraw funds. This has two implications akin to the well-known bank run problem. First, the suspension of the possibility to withdraw funds triggers a shock to investor confidence and, second, the anticipation of a potential suspension of withdrawals increases the incentives of individual investors to withdraw their funds early on at the first sight of a worsening in the loan performance. As a result, offering liquidity services can have profound implications for the stability of an online lending platform. A similar problem emerges if online lending platforms have many repeated borrowers who rely on rolling over their debt. In this case a reduction of funds from investors can abruptly end the

31 In an international comparison UK based online lending platforms are transparent regarding the size of their loss provision funds. For example a leading UK platform Ratesetter reports an interest coverage ratio of 117 per cent and capital coverage ratio of 231 per cent in March 2019. This means that investor returns are guaranteed, as long as market developments only moderately deviate from expected future loss scenarios. Instead, investor rates start to be negatively affected if realized losses exceed 117 per cent of expected future losses and the principal starts to be at risk if realized losses exceed 231 per cent. Such deviations from expected future losses are not unusual in an economic downturn, especially when many borrowers are in the riskier market segments.

32 A similar situation arose with AIG during the Great Financial Crisis.

repeated borrowing and trigger defaults by a larger number of borrowers who cannot access alternative sources of finance.

Another magnifying factor is the lack of dedicated resolution frameworks for online lending platforms, which can accelerate the loss of investor confidence. In fact, the closure of a platform is likely to significantly undermine the value of investors' claims. This is because the value of loans relies on the continuation of loan servicing which may be impaired when a platform goes bankrupt. During the financial crisis we experienced that non-bank financial firms have the potential to cause serious disruptions with implications for financial stability. A case in point is GE Capital, which put the entire General Electric corporation at risk in 2008. Bankruptcies of non-banks can be disruptive due to knock on effects for suppliers and customers. There are several factors which are likely to make bankruptcies of online lending platforms particularly disruptive. One factor is the aforementioned lack of resolution frameworks, which endangers a continued loan servicing. Another factor is that some loans originated on online lending platforms may be harder to sell off due to the lack of well-established funding markets in conjunction with a lack of understanding of the new business models and underwriting technologies. In addition, the experience of the Trustbuddy bankruptcy and the market turmoil in China have shown that guaranteed returns and an ambiguous allocation of ownership of loans can further complicate bankruptcies.

Other potential risks can stem from operational weaknesses and governance problems paired with insufficient oversight. The lessons we can draw from the scandals and platform failures discussed in Section 3.3 are a case in point. Governance problems span from transparency about the underwriting standards to conflicts of interest in the discretionary allocation of loans to different pools. The confidence in the underwriting standards of online lending platforms relies to large extend in the platforms reputation and track record. Unlike banks, online lending platforms have only very limited skin in the game besides their reputation. Potential operational weaknesses span from IT security to insufficient compliance with anti-terrorist and anti-money laundering regulations.[33] These operational weaknesses are likely to be magnified by the rapid growth of online lending platforms.

Finally, with a view to the macroeconomic perspective, the targeting of riskier market segments may fuel household over-indebtedness. Related concerns are typically discussed in the context of consumer protection (see Section 3.2). Ultimately they are, however, also relevant from the monetary policy and macro-prudential policy provided FinTech credit continues to grow in importance (see, for example discussion on the risks of household indebtedness in Sveriges Riksbank Financial Stability Report 2018:1 (2018)).

5 Concluding remarks

New financial technologies, which are commonly referred to as FinTech, have the potential to transform established business models in banking and finance. The focus of this article is on credit originated by online lending platforms, which use digital technologies to match borrowers and lenders without the need of a bank or other financial institutions to act as a middleman. We analyse how online lending platforms differ from commercial banks and study the main trends regarding the evolution of business models in the largest FinTech credit markets in China, the United States and the United Kingdom. Moreover, this article is the first to map the development of the Swedish FinTech credit sector.

With an origination volume of more than SEK 2bn new loans in 2018, the market share captured by Swedish online lending platforms is still small relative to total bank lending.

33 A report by the European Banking Authority provides an overview of the risk drivers (EBA 2015). An example of problems with anti-terrorist finance regulations is Prosper, which originated a loan that was used to purchase weapons and explosives by one of the 2015 San Bernardino terror attack shooters.

However, the Swedish online lending market has expanded rapidly in recent years. Judging from the developments in more mature online lending markets, the expansion of FinTech credit in Sweden is likely to continue and it is plausible to expect that commercial banks will seek to play an active role in the FinTech credit market, be it via ownerships of online lending platforms, via partnerships or as institutional investors.

From a financial stability perspective, the most relevant aspects are the growing exposure of commercial banks to alternative non-bank credit providers such as online lending platforms, as well as the trends towards a reintermediation of FinTech credit. The analysis in this article does not provide evidence suggesting that online lending platforms could, at the current market size, pose any significant risk to the broader financial system. However, we see that changes in the rapidly expanding FinTech credit space can happen fast and new FinTech-enabled structures can evolve in a way that in the future may necessitate further analysis to understand emerging risks.

Going forward, much can be learned about the viability of the different FinTech credit business models and the banking sector's response to the new developments. We regard our article as a first step in this direction and see merits in more research. The available data for the Swedish FinTech credit market is limited. Granular loan-level information would allow to better understand the drivers of the expansion of online lending specific to the Swedish market and to analyse the borrower and investor segments targeted by online lending platforms.

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Appendix

Box 1. Trustbuddy scandal in Sweden

Sweden experienced one of the first cases of a fraudulent bankruptcy of an online lending platform. In October 2015 the platform Trustbuddy closed due to heavy losses and proven misconduct. Trustbuddy was listed on the NASDAQ OMX Nordic exchange since 2014. The platform pursued a questionable business model from the start that could hardly be viable. Trustbuddy promised returns in the double digits paired with a non-existent or insufficient insurance fund to cover losses from bad loans. In addition, lenders could withdraw up to 90 per cent of their investments, provided the loans could be matched with other investors. Subsequently, loan losses lead to fraudulent conduct starting in June 2010.[34] To cover the losses from bad loans, the platform raised additional capital from new investors. The new investors were promised that their funds are invested in new loans. Instead, their funds were diverted to pay off other investors. In fact, Trustbuddy transferred loans that have gone to debt collection between investors. Such conduct contrasts with a proper assignment of ownership of investor shares in the loans originated on the platform, as depicted in Figure 1.

During its operations from 2010 to 2015 around 23 per cent of the total investments brokered by the platform were assigned to bad loans, totaling SEK 244m. Moreover, investor claims amounting to a value of approximately SEK 37m have not been assigned to borrowers. Additionally, there was a discrepancy of SEK 44m between the funds from borrowers that were repaid and the claims of investors. Eventually, the platform filed for bankruptcy in October 2015 after Finansinspektionen ordered it to terminate operations. At the point of closure loans amounting to a total of SEK 302m were outstanding with 3,500 investors affected. The bankruptcy procedure was complicated by the unclear ownership of claims against borrowers and due to a lack of a dedicated resolution framework for online lending platforms. One contentious question was whether to sell off the debts immediately, or to engage a collection agency to pursue the outstanding loans.

In retrospect, the scandal may have slowed down the expansion of the Swedish online lending sector.

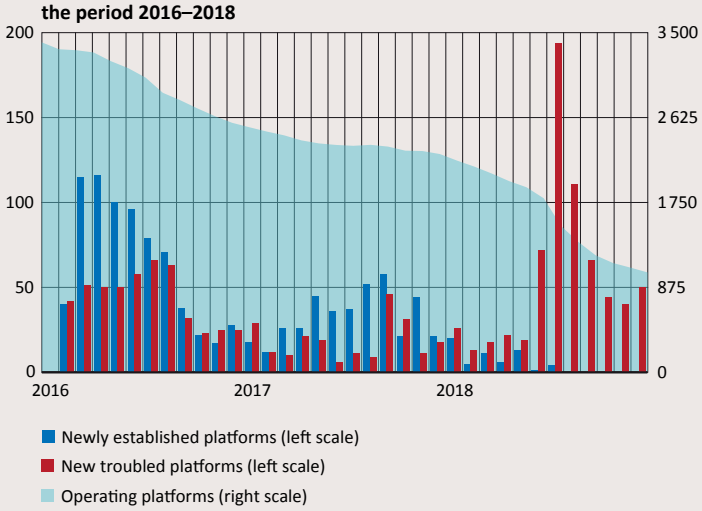
34 See Lindahl (2016) for a press release by the law firm Lindahl, which managed the liquidation.

Box 2. Market consolidation and market turmoil in China

China has the by far largest FinTech credit sector with thousands of online lending platforms. The market is very diverse and there has been a sustained trend towards market consolidation. The Chinese online lending market has received increased regulatory scrutiny, especially after the market turmoil erupting in summer 2018 featuring numerous cases of fraud and failures of platforms.

As mentioned earlier, the availability of bank-based consumer credit in China is only limited. Unregulated online lending platforms seized the opportunity to capture a large underserved market. The strong growth of platforms is facilitated by their ability to attract high funding volumes by offering a significantly higher return to investors than bank deposits. Due to the lack of a centralized credit registry the borrower information tends to be of a considerably worse quality relative to the US or UK markets. Moreover, the lack of experience in lending to risky consumer credit market segments, together with a strong drive for rapid expansion resulted in a large number of unsound business models and failures of online lending platforms.

Figure A.1. Consolidation in the Chinese FinTech credit market over the period 2016–2018



Source: Home of Online Lending (wdzj.com)

Figure A.1 shows the consolidation in the Chinese FinTech credit market. The total number of operating platforms more than halved during the last two years dropping form 3,401 platforms in January 2016 to 1,207 platforms in October 2018. The high number of exiting platforms is also reflected in the large number of platforms that have been identified by the Chinese P2P data provider Home of Online Lending as 'troubled'. Home of Online Lending classifies platforms as troubled if they are either subject to a fraud related investigation from authorities, when investors face difficulties withdrawing cash, when it is revealed that managers absconded money or when the website is closed. There are two major waves of exit; in the spring and summer of 2016 and in the summer of 2018. The consolidation of the industry is also reflected in the number of newly established platforms, which collapsed from an average of 65 in 2016 to an average of 5 in 2018.

Many platform closures are related to fraud or unsound business models. Incidences of fraud span from alleged Ponzi schemes to absconding of funds by managers. A prominent platform failure during the first wave of exit in early 2016 was Ezubao, which closed after it became public that the platform fabricated non-existing projects. The Ponzi scheme collected USD 7.6bn from around 900,000 individual investors. During the market turmoil erupting in summer 2018, investor confidence in online lending platforms was shattered by media reporting about egregious fraud and the inability of platforms to pay the high guaranteed returns that had been promised to investors. According to Kiff and Monroe (2019), the nationwide total losses could reach hundreds of billions of RMB, affecting millions of Chinese investors.

Another factor driving the large numbers of platform closures is a regulatory tightening starting in 2016, which intensified in the second half of 2018. In 2016 the Chinese authorities started to roll out 'Interim Measures on the Administration of Business Activities of Online Lending Information Intermediaries', which involved the mandatory registration of platforms, as well as custody accounts with banks.[35] The China Banking and Insurance Regulatory Commission (CBIRC) has taken over responsibilities of regulation and oversight in November 2018 and it is said that the CBIRC requires all platforms to complete a comprehensive licensing process by the end of June 2019. Moreover, online lending platforms are instructed to improve transparency about their ownership structure and about the transactions and investments.

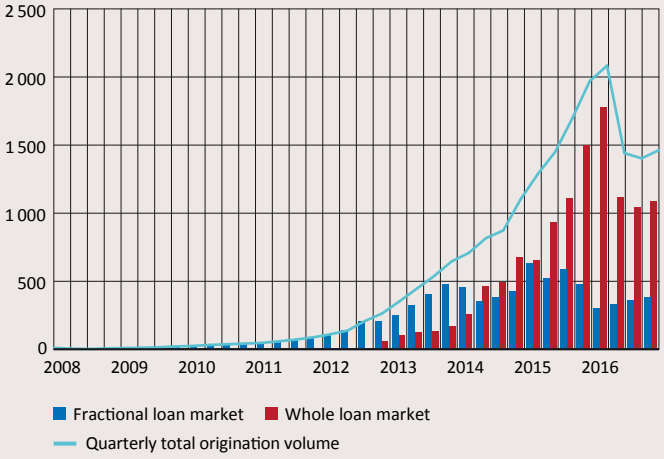
From a financial stability viewpoint the contagious loss of confidence in the soundness of online lending platforms and their underwriting standards are an important concern, which the regulatory initiative seeks to address. The market turmoil of 2018 also demonstrated that the lack of dedicated resolution frameworks poses a significant obstacle in winding down collapsed platforms and in facilitating the continued servicing of loans. The implications can be severe disruptions affecting the broader financial system, strategic borrower defaults and low recovery rates for investors.

35 See the Financial Times article by Suya (2019) on 'China's Renrendai sees future in SMEs as P2P industry reels', as well as the TechCrunch article by Liu (2018) on 'The dramatic rise and fall of online P2P lending in China'.

Box 3. LendingClub scandal in the US

The LendingClub scandal of May 2016 involved the largest US online lending platform, which disclosed wrong information to institutional investors on the platform and failed to disclose ownership interests of senior management in a fund that invests on the platform. As a consequence, Renaud Laplanche, the chief executive and chairman, stepped down on May 9, 2016 when an internal review was published and LendingClub's share price slid by more than 15 per cent in pre-market trading after the news was released. In the aftermath, the US Securities and Exchange commission (SEC) charged LendingClub Asset Management (LCAM) and Renaud Laplanche with fraud, accusing LCAM of misallocation of loans in its funds, undisclosed loan purchases to smooth out swings in investor demand, and undisclosed adjustments to the loan-pricing model. As part of a settlement, LCAM and senior management paid fines and Renaud Laplanche has been banned from the securities industry.

Figure A.2. Evolution of the LendingClub funding flows from retail investors (fractional loan market) and institutional investors (whole loan market) over the period 2008–2016
Million USD



Sources: LendingClub loan book and 424B3 filings from the SEC's Edgar database; authors' calculations

An interesting aspect of the LendingClub scandal is that it allows us to study the effect of the shock on the platform itself and on the FinTech credit industry. Recall that the LendingClub platform caters to both retail and institutional investors as explained in Section 2.2. When the scandal erupted in May 2016, funding from institutional investors evaporated rapidly as can be seen in Figure A.2. The whole loan market volume experienced a sharp drop in the second quarter of 2016. At the same time, retail funding continued to be fairly stable and even increased in the second and third quarter of 2016. Part of the explanation is that most of the retail funding is channeled through LendingClub's automated investment service for retail clients that continuously re-invests the available funds from loan repayments.

This feature of relatively less stable funds from institutional investors is similar for commercial banks, who typically have a funding mix comprising relatively stable deposit funding and wholesale debt by flighty institutional investors. Given the low profitability of online lending platforms and their reliance on a continuous stream of fee income from originating loans, reputational shocks may lead to a platform closure and thereby endanger the loan servicing and investor returns. In the case of LendingClub, the platform suffered a prolonged reduction in origination volumes for several quarters. A timely corporate response during the unfolding scandal and improvements in the transparency and underwriting standards helped LendingClub to recover to previous levels of origination volumes in 2017. It remains to note that there have been moderate spillover effects to other platforms such as Prosper.

How can various structural changes in the economy affect wages and inflation?

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This article contains a review of the research literature on various structural changes that may have affected wage and price formation over the past 25 years. During that period, there have been extensive changes both in Sweden and abroad that have affected the Swedish labour market. First, significant reforms have been carried out on the Swedish labour market; for example, the unemployment compensation level has been considerably lowered. Second, increases in foreign trade appears to have had effects on producer prices. Third, trade has also had some effects on wages, although it is primarily technological developments benefitting highly educated workers that seems to have had an impact on wage formation. Fourth and finally, migration has risen sharply over the period, affecting labour force composition, for example in terms of education level. Somewhat surprisingly, it is suggested in the literature that the increases in migration and labour market integration within the EU in the past few decades have had limited effects on wages in general. However, this does not rule out that the effects potentially have been greater for certain sectors, for instance the construction sector.

1 Introduction

In this article, a review is performed of the theoretical and empirical literature that concerns structural factors on the labour market and the effects of changes therein on wages and inflation. The labour market has been affected by considerable structural changes both in Sweden and abroad.

In Sweden, extensive labour market reforms have been carried out that may have affected wage formation. Unemployment compensation levels have fallen relatively sharply in Sweden in the past 25 years, although this does not seem to have had any great effects on wages, see Gottfries et al. (2008) and Jonsson and Theobald (2019). Substantial changes to, for instance, the pension system, have also been made – which can affect labour supply – for example the possibility of working until the age of 67.

Other structural factors might also have affected the labour market. For example, trade with low-wage countries has increased, leading to firms in Sweden closing down and their employees having to seek new employment that might pay less. However, this also causes the least productive Swedish firms to disappear, while at the same time the more productive Swedish export firms grow, leading to increased productivity and higher wages for workers in the export industry. On the whole, the increase in trade does not seem to have had any significant effects on wage formation. However, there is support for it having lead to declining producer prices, although this has not affected aggregate inflation dynamics to any great extent.

* I wish to thank Iida Häkkinen Skans, Magnus Jonsson, Jesper Lindé and Åsa Olli Segendorf for their comments, input and other assistance. The interpretations in this paper are the author's own and should not be taken as the Riksbank's opinions or positions.

Major demographic changes have also taken place in the past 25 years, which might have affected wages and inflation. For example, migration can bring about an increase in labour supply which, in turn, affects wage formation. It seems, however, that the high level of migration in the past few decades has had relatively small effects on wages, see for example Engdahl (2016). The increase in wage dispersion in many countries appears instead to have been caused by technological developments, which have benefited highly educated workers. In Sweden, wage dispersion has been relatively unchanged since the turn of the millennium. Migration seems however to have affected prices in sectors that employ a high percentage of workers with low education. Considerable improvements in human health over time also seem to have lead to an increase in labour supply, which in turn might have affected wages.

Section 2 provides a brief description of wage formation, while section 3 discusses possible effects of changes in unemployment compensation systems and rigid wages. Section 4 offers an overwiev of what the literature says about possible effects of the increase in world trade. How the altered demographics, migration and an increasingly integrated European labour market affect wage and price formation is discussed in section 5, while section 6 looks at the effects that other structural changes have on wage and price formation. Finally, the main messages are summarised in section 7.

2 Wage formation in brief

Wages are normally determined in negotiations between the labour market parties. In order to gain an understanding of what affects wage formation, it can be useful to study how wages are determined in simple models.

A common method for analysing the labour market and wage formation is to use search and matching models. When workers and firms negotiate wages, they also take into account what would happen if they fail to agree. For example, the worker might leave the firm, and in that case the firm looses the value of the production that the worker would have provided until a replacement could be found. The worker's alternatives are affected by how many other workers are searching for a job, and the intensity of their job search. How intense unemployed workers look for work is affected by how much they receive in unemployment compensation, how high a probability they have of finding a job, and how costly it is to look for one. The wage negotiated between the firm and worker thus depends on the compensation level, unemployment and the firm's productivity.

Changes in the labour force will affect unemployment and hence also wages. If the labour force increases, unemployment rises, which in turn pushes down wages. Changes in demand can also affect wages. If firms demand less labour, for instance due to a drop in demand abroad for goods, or due to the relocation of firms to other countries, this reduces the probability that workers find new jobs, which in turn lead to lower wages.

Ultimately, inflation is affected since inflation depends on how the marginal costs of firms change. Marginal costs depend on wages, labour productivity and the price of capital and other input goods. Under certain conditions, the marginal costs in the period t, MC_t, are closely related to the unit labour cost.

$$(1) \qquad MC_t = k\frac{w_t N_t}{Y_t} = k\frac{w_t}{A_t}$$

where k is a constant, w_t is nominal wages, N_t is employment or hours worked, Y_t is production and $A_t = Y_t/N_t$ is productivity. How wages and productivity develop in relation to each other will then be important for inflation.

2.1 Productivity

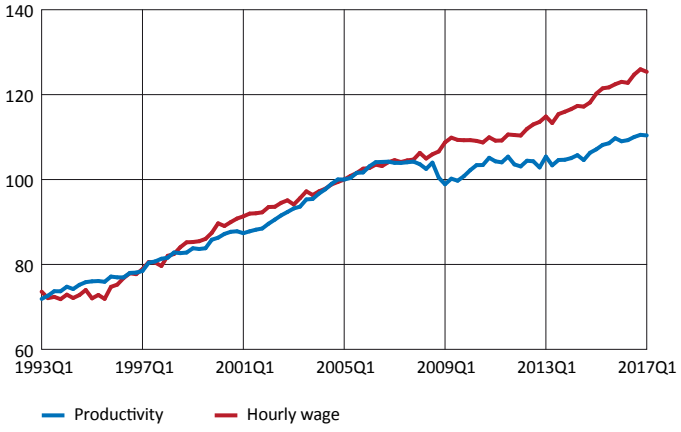
Productivity growth, measured as GDP per hour worked, slowed down in the mid-1970s and grew relatively slowly until the mid-1990s. In the United States, productivity growth took off around 1995 and grew at a faster rate for around a decade. A few years before the financial crisis in 2008, productivity growth slowed down once more, and the growth rate has also been low after the crisis. Fernald (2014) studies the reasons for why growth took off and then slowed down, and finds that it appears to be driven by IT-related sectors. In Sweden, the slowdown seems to have occurred just before the financial crisis, that is to say somewhat later than in the United States, see National Institute of Economic Research (2017). The reason for the rapid productivity growth before the financial crisis seems to be related to IT sectors in Sweden as well, see Calmfors et al. (2019).

2.2 Wages

Wage growth in Sweden, measured as average hourly wage, has been relatively good since the crisis of the 1990s. In the years following the 2008 financial crisis, however, nominal wage changes has fallen.[1] This pattern partially differs from wage growth in other countries – wages in the United States rose for example in the 1990s, but have developed weakly since the turn of the millennium. Another important international trend has been that wage dispersion, measured for example as the difference between the wage of the highest-paid 10 per cent and that of the lowest-paid 10 per cent, has widened relatively sharply since the mid-1990s, see OECD (2012). In Sweden wage dispersion increased up until the turn of the millennium, but has subsequently been relatively constant, see Carlsson et al. (2017).

Figure 1 shows real wages and productivity from 1993 to 2017. Wages grew at more or less the same rate as productivity until the financial crisis in 2008. After the crisis, productivity has grown somewhat slower than real wages.

Figure 1. Productivity and real hourly wage 1993Q1–2017Q1
The wage and productivity level is indexed at 100 for the first quarter of 2005



Note. Productivity is calculated as GDP per hour worked.
Source: Own calculations from the National Accounts (via DORIS)

Westermark (2019) estimates wage equations in order to get an idea about what factors affect for example aggregate industrial wages in Sweden. The results indicate that productivity and competitor prices affect Swedish industrial wages, but also wages in competing countries.

1 National Mediation Office, short-term wage statistics.

3 Change in the unemployment compensation level

The level of unemployment compensation affects wage formation through the negotiations between workers and firms. For example, lower unemployment compensation means that an unemployed worker earns relatively more by working, and therefore searches for employment more intensively. At the same time, this makes it more difficult for an employed worker to find a new job, because of the greater competition for new jobs. Then it will also be more difficult for an employed worker to negotiate a higher wage by threatening to switch jobs, which leads to wages dropping or at least rising less than they would have done had the benefit level not declined.[2] If the drop in benefit levels affects large groups, the change will in turn cause a drop in unemployment, because the lower wages make it more profitable for firms to hire, making it easier to find a new job. This in turn then affects wage negotiations and job search behaviour. These general equilibrium effects can cause the total effect of a change in the compensation system to differ substantially from the effect for an individual person in isolation.

The unemployment compensation system has undergone major changes since the beginning of the 1990s. How the system is devised, for example with a cap on benefits, leads to variation in the replacement rate for different income groups. For a middle-income earner, for whom the benefit cap usually tends to limit compensation, the replacement rate at the end of the 1980s was at around 90 per cent, and then dropped to 65 per cent in 2006. The new government that took office in 2006 then carried out reforms that led to the replacement rate dropping further to below 50 per cent. In recent years, changes in the benefit system have led to a rise in the replacement rate to over 50 per cent again. For workers with a low income, for whom the cap in the compensation system is not binding, the drop has been less drastic.[3]

The effects of these changes have been analysed in several studies. Roughly, these can be divided up into two categories – studies based on microdata and studies based on aggregate data. An example of a study that looks at microdata is Bennmarker et al. (2011). Therein, the authors find that the changed compensation levels between 2007 and 2009 led to a drop in wages of 2.5 to 5.2 per cent.

A problem with studies based on microdata is that they do not usually take account of the general equilibrium effects described above. A drop in wages caused by a lower unemployment compensation level leads to a rise in the profits of firms, which makes them want to hire more workers, and the improved job prospects tend in turn to push up wages. These effects moderate the initial wage drop. A paper that studies this problem by looking at macrodata is Forslund et al. (2008), in which the authors look at how changes in the compensation system from the 1960s to 1997 have affected wage formation in the Nordic countries. They find that the partial effect on wages, that is to say the effect of a changed replacement rate at a given unemployment level, is in line with the findings in Bennmarker et al. (2011): Wages drop by at least 3.8 per cent if the replacement rate drops by 10 per cent (that is to say that the replacement rate drops from 0.6 to 0.54). They also quantify the general equilibrium effects and find that they differ substantially from the direct effect. The effects of an altered replacement rate largely operates through quantity adjustment, that is to say changes in employment and unemployment, and the effects on wages are small when general equilibrium effects are taken into account. Specifically, wages drop by 1.1 per cent and unemployment by 22 per cent if the replacement rate is cut by 10 per cent; that is

2 If the alternative for the worker is unemployment, the replacement rate has a more direct impact on negotiation. If the replacement rate decreases, the alternative to working at the firm, that is to say unemployment, will be worse for the worker, and this causes wages to drop.

3 Because workers also might have private insurance, the drop in the benefit level can be smaller. A drop in benefits from unemployment benefit funds gives workers a greater incentive to take out private insurance.

to say, if unemployment is 6 per cent initially, it will drop to just below 5 per cent. When unemployment changes, this has indirect effects on wages causing the total impact on wages to be much smaller than the direct effect.[4]

Zhang (2017) studies a new Keynesian DSGE model in which the replacement rate is subject to shocks. The model is estimated on American data and the results are in line with those for Sweden. A shock leading to a drop in the replacement rate by 10 per cent causes a drop in wages of 1 per cent at most. Jonsson and Theobald (2019) also find relatively small effects when they study the effects of an altered replacement rate in a new Keynesian model that is calibrated for the Swedish economy: If the replacement rate drops by 21 per cent, wages fall by 1 per cent at most.

When the replacement rate changes, this can also have implications in terms of how different shocks affect wages and unemployment. A higher replacement rate also causes wages to rise. This means that the surplus that a worker generates in a firm will be lower, as wages rise in relation to the worker's productivity. In the event of a negative shick, the surplus decreases more and the value of hiring a worker falls more if the replacement rate is higher, which in turn leads to fewer vacancies when the replacement rate is high. Workers who are employed will also generate a lower surplus in the event of a negative shock, leading to more workers losing their jobs. A negative shock thus leads to higher unemployment if the replacement rate is high, while the effects on wages will be smaller, because the replacement rate limits how much they can fall. Similarly, a positive shock leads to employment increasing more if the replacement rate is high. Unemployment will thus be more volatile while wages will be less volatile, the higher the replacement rate, see Hagedorn and Manovskii (2008) and Pissarides (2009) for details. For low replacement rates, however, this relationship need not hold because a low replacement rate leads to precautionary saving potentially varying more over the business cycle, see den Haan et al., (2017).[5] This counteracts the traditional effects that changes in replacement rates have on the labour market.[6]

3.1 Effects caused by rigid wages

In the 2008 financial crisis, production and employment dropped sharply in several countries, but the effects on nominal wages do not seem to have been large. A reason for this is that if wages are downwardly rigid, that is to say they are difficult to adjust downwards, wages do not fall much in a deep recession. The relationship between wage inflation and unemployment will in that case be weaker than in normal times. After the economy has recovered from the deep recession, wage growth can be weak for some time, due to the same sluggishness in wage formation that stopped them from falling much in the recession. Because wages have not fallen much, the scope for increasing wages is smaller during the recovery. Another factor that can add to this is that firms that know that lowering wages in a recession might be difficult, are not as inclined to raise them so much when the economy is in a boom, see Daly and Hobijn (2014 and 2015), and Elsby (2009). Elsby et al. (2014) find however that downwardly rigid nominal wages were perhaps not such an important factor for wages and employment in the United States and the United Kingdom during the Great Recession. One reason for this is that the drop in employment was relatively similar to that in other recessions when inflation was high and hence nominal downward rigidity not so

4 It is worth noting that the changes that the centre-right government carried out may have had effects on labour supply that differ from the effects of a traditional cut in replacement rates. A drop in the replacement rate makes unemployment less attractive, which in turn makes it less attractive to participate in the labour force (for a certain wage level) On the other hand, a tax cut that only targets individuals in employment makes it more attractive to have a job (for a given wage level), which in turn ought to increase labour force participation.

5 Compensation ratios below approx. 0.55.

6 In a model with precautionary saving and incomplete markets, a recession will increase precautionary saving, which in turn leads to a drop in demand and prices. If wages are rigid, profits fall, which leads to a rise in unemployment. In that case, demand falls even more, which pushes unemployment up further. Because of this self-generating process, a shock can have major effects on unemployment. The reason for why these effects are small when the replacement rate is high is that a high replacement rate causes precautionary saving to be low, and the self-generating process is subdued.

important, for example the recession at the beginning of the 1980s. They also claim that relatively flexible wages for new employees mean that downwardly rigid salaries in existing jobs do not matter so much for job creation.

4 Increases in trade

In the past few decades, the growth and increased international trade of China have been a major and important factor that has affected international trading patterns. The political changes and the liberalisation of the economies in Eastern Europe have also had major effects on international trade, as has the enlargement of the EU. How this affects inflation, prices and wages is described below.

4.1 Effects on inflation and prices

Increased imports of goods from low-wage countries should affect inflation and prices if the goods are cheaper, compared with the products they replace. The size of the effects has however been questioned by for instance Ball (2006), who claims that they have not been so significant. Auer and Fischer (2010) find on the other hand that the effects on prices are economically significant when they study the consequences of increased imports from low-wage countries to the United States.[7] They find that if the volume of imported products increases by 1 percentage point in a manufacturing sector, producer prices in the sector fall 2.35 per cent.[8] Auer et al. (2013) conduct a similar study for a number of European countries.[9] For Sweden, they find that if imports increase by one percentage point in a sector in a manufacturing sector, prices in the sector fall by 2.6 per cent. They also study how wages are affected and find that the effect is much smaller than for prices. Wages only fall by 0.57 per cent if imports increase by 1 per cent. Because imports increased by 4 percentage points between 1995 and 2007, wages fell by 2.3 per cent over the same period. Auer et al. (2012) perform an equivalent analysis of increased imports from China to the Nordic countries for the period 1995 to 2008 and find similar effects – if imports increase by 1 percentage point, producer prices fall by 2 per cent.[10] In total, producer prices fell by 14 per cent during the period.

The effects on sectoral prices will thus be relatively large when imports increase in these studies. However, at the aggregate level the results can be different, for example because the increased imports can, through general equilibrium effects, affect other parts of the economy. In simple macroeconomic models of open economies, consumers will demand products produced both in Sweden and abroad. The prices are affected by marginal costs which, through wage formation, depend on both domestic and international factors, for example domestic and international resource utilisation. Prices and inflation are then also affected by both domestic and international factors. If imports increase international factors will have larger effects. Milani (2009) studies this in a small new Keynesian model on US data but finds that the increased trade only has small effects on inflation.

From a theoretical angle, increases in trade also implies that import prices have larger effects on inflation, besides international resource utilization. Ihrig et al. (2010) study whether globalisation has led to international factors having larger effects on inflation dynamics in 11 OECD countries, including Sweden, in a model based on a Phillips curve with adaptive expectations. They find however that the effect of import prices have not increased

7 Low-wage countries are China, Brazil, Indonesia, India, Malaysia, Mexico, the Philippines, Thailand and Vietnam. 'Low-wage country' means countries with a GDP per capita that is lower than 20 per cent of GDP per capita in the United States. Also, the countries may not have a export share of commodities exceeding 30 per cent in trade with the United States, and the country's exports must account for at least 0.4 per cent of imports to the United States.

8 They assume that the effects of changes in import shares do not differ between sectors.

9 Low-wage countries are China, India, Malaysia, Mexico, the Philippines and Thailand.

10 In terms of volume the effect is smaller – if the percentage of imports increases by 1 percentage point, producer prices fall by 0.8 per cent.

over time. Bianchi and Civelli (2015) also find that globalisation has not led to any substantial changes in how inflation is affected by international factors.[11]

4.2 Effects on wages

4.2.1 Effects in models

In recent decades, the OECD countries have extended their trade with countries with a less-educated labour force. The theoretical effects of this on wages has been analysed by Stolper and Samuelsson (1941). The model they use consists of a small open economy with perfect competition on goods markets and several different sectors. Several production factors are used, the sectors differ in terms of the importance of highly educated labour, and the supply of production factors is fixed. In sectors with technology that requires more highly educated labour, the share of highly educated workers will be higher than in other sectors. Increased trade in goods for which workers with low education are important causes a drop in the relative price of such goods, which in turn means that the cost of producing them in richer countries also decreases. Wages for workers with low education will thus drop, while wages for highly educated workers rise.[12]

One problem with the approach described above is that wages rise for highly educated labour while at the same time employment is unchanged. However, this is not consistent with how wages and employment have developed empirically. There, both wages and demand have risen. A reason for this could be that highly educated workers are complements (or is complement to firms with high productivity), which could give results more in line with data. Exporting firms are also larger, more productive and pay higher wages than non-exporting firms. Melitz (2003) analyses this in a model in which it is costly to export. Firms with sufficiently high productivity will therefore both export and produce for the domestic market, while firms with lower productivity will only produce for the domestic market. Exporting firms are larger than those that only produce for the domestic market. If trade increases, more firms choose to export while at the same time the least productive ones close down. Productivity hence increases, which tends to push up average wages. This mechanism can give results that are more consistent with empirical data. Helpman et al. (2010) also find that the average wage rises when trade increases, when they analyse the effect on wages and wage dispersion. This is because exporting firms are more productive than non-exporting firms. But, the relationship between wage dispersion and trade is not linear. Both when no foreign trade occurs (autarchy) and in the case of all firms exporting, the firms are identical – in the one case no firms export and in the other all of them do. Because the firms are identical in terms of exports, wage dispersion in the economy will be low. However if an economy opens up for trade, inequality will increase, because some workers now work at firms that export that have higher productivity and wages, compared with in an autarchy.[13] In a situation where all firms export, a change to less openness will lead some firms to cease exporting.[14] This leads to a drop in the productivity and wages of these firms, which widens wage dispersion. Wage dispersion will be largest when the economy trades with other countries but is not too open. In that case, the firms differ, with some exporting and paying high wages while others only producing for the domestic market and having a lower wage level.

11 They estimate a vector autoregression in which they study whether the dependence of inflation on international factors has been affected over time.

12 The marginal costs do not change for the commodity to which highly educated labour is important because the price is unchanged. If one wage drops, the other must rise in order for marginal costs to be unchanged.

13 Highly productive workers tend to work at exporting firms, which also pushes up wages.

14 Modelled through the cost of exports increasing.

4.2.2 Empirical findings

Most of the studies described below analyse the effects that increases in trade has on wage dispersion. Although wage dispersion is not of primary interest if we want to find out the effects on average wages and inflation, we might still get an idea about the importance of the trade mechanism. If increases in trade only has small effects on wage dispersion, it is not unreasonable to think that the effects on the average wage, and hence inflation, also might be small. Wage dispersion in Sweden has not changed so much since the turn of the millennium, which means that the trade mechanism has perhaps not had such a great impact on wages in Sweden.

The way in which increases in trade affects the economy empirically has been studied using both macro- and microdata. A panel study by the OECD based on 22 countries finds that increases in trade does not cause wage dispersion to increase, apart from in countries with weak job security, see Cahuc et al. (2014).Burstein et al. (2016) study whether it is technological developments or trade that have driven increases in wage dispersion in the United States. They find that it is primarily driven by technological change and that globalisation only explains a relatively low share of the widened wage gap between highly paid and low-paid workers, see also Helpman (2016). Trade is affected by free-trade blocs, for instance the EU internal market. Another example is MERCOSUR, which was formed in 1991 and includes Brazil, Argentina and Uruguay. Helpman et al. (2017) have studied how this has affected wages for workers and firms using Brazilian microdata during the period 1986 to 1998. Although MERCOSUR does not have a direct bearing on Sweden, an indication of the effects of free-trade areas on wages can perhaps nevertheless be obtained by studying the effects of MERCOSUR. Helpman et al. find that increased trade causes wage dispersion to increase. The increase in wage dispersion is chiefly driven by differences in wages between exporting firms and firms that only operate on the domestic market, which is in line with their model from 2010. Akerman et al. (2013) examine Swedish data for the period 2001 to 2007 and find that the share of wage dispersion caused by differences between firms is much smaller, which is an indication that the effects of increases in trade are perhaps not so large in Sweden. This could be due to differences in wage formation and regulation on the labour market between Sweden and Brazil, and could imply that the effects of trade on wages are smaller in Sweden than in Brazil. If wages respond less in Sweden compared with Brazil, the adjustment could instead occur on the employment margin.

Autor et al. (2013) analyse effects of increased competition from China on the American labour market. They find that employment declines more on local labour markets, which are more exposed to competition from China, and that wages only fall slightly on these labour markets. By comparing local labour markets with varying degrees of import increases from China, they find that the effects on employment are relatively large – employment drops by 4.5 per cent more on the labour market that is more exposed to competition. Specifically, they compare two local labour markets at the 25th and 75th percentiles in the breakdown of import growth from China, that is to say labour markets with import growth that is relatively low and high, respectively. Import growth was approximately double for the region at the 75th percentile (3.1 per cent) compared with the region at the 25th percentile (1.6 per cent) during the period 2000 to 2007. Employment in other sectors does not seem to have been affected to any considerable extent, although unemployment increases more in the sector exposed to competition. Also, wages fall 0.8 per cent more on the labour market that is more exposed to competition.

Helpman's (2016) conclusion is also that the effects on wages from increases in trade are not so substantial in a literature review of papers that have studied the effects of growing trade on wages. The increase in wage dispersion of the past few decades is mainly explained, according to Helpman, by technological developments that have benefited highly educated workers.

4.3 Offshoring

Globalisation and increased trade can also affect wage formation due to the offshoring of operations to other countries. The mechanisms are relatively similar to those when trade increases. If firms offshore operations with a low content of qualified labour, this could lead to that wages for low-skilled workers decline compared with those of high-skilled, see for instance Feenstra and Hanson (1997).[15] Just as in the models describing the consequences of altered trade patterns, offshoring operations can also cause higher average productivity, because the firms offshore the operations with relatively low productivity. This can in turn push up the average wage, see Grossman and Rossi-Hansberg (2008).

A number of empirical studies have been conducted to study the effects of offshoring on wages. A study that might be of interest to Sweden is described in a study by Hummels et al. (2014) which looks at effects of offshoring in Denmark during the period 1995 to 2006. They use Danish microdata and can follow workers in Denmark who remain at the same firm following the offshoring. They find that, for highly educated workers who remain at the firm, offshoring causes wages to rise, while they drop for workers with low education who remain. The effects can be considerable – a worker with low education at the firm that doubles its offshored operations has a drop in wages equalling one-and-a-half years of professional experience. For highly educated workers, the effects are the opposite and they receive substantial wage increases as an effect of the offshoring. Hummels et al. also study what happens when the workers who lose their jobs or change jobs are also included, and find that the effects on wages for highly educated workers are not statistically significant, while the effects for workers with low education are negative. A handful of studies also analyse general equilibrium effects of increased offshoring, but the available results indicate that the effects can be small, see Hummels et al. (2018).

5 Demographic changes

5.1 Effects of changes in the age structure

Changes in the population structure, caused for instance by longer life expectancy, or increased migration, will affect labour supply, which can in turn affect wages. If the labour supply decreases, for example if fewer young persons start working, this causes a drop in the supply of labour in relation to capital, which pushes up real wages and prompts a decline in the real interest rate. However, fewer young persons on the labour market also leads to lower savings, which can counteract the effect on capital formation. Krueger and Ludwig (2006) find that the first effect dominates. Demographic changes thus tend to drive wages and real interest rates in different directions. Gagnon et al. (2016) study which effects demographic changes have on the economy in a general equilibrium model, with a focus on the real interest rate. They find that the growing share of the elderly, through lower labour supply, causes higher real wages and a drop in the real interest rate in line with the findings in Krueger and Ludwig. Empirically, real interest rates have fallen while at the same time real wages have shown weak growth in the past few decades in many countries, which is not in line with the effects in demographic models. There is therefore reason to doubt that demographic factors are important in explaining the development of real wages in the past few decades.

Juselius and Takats (2016) study the relationship between age structure and inflation in a panel estimation for a number of different countries. They find that when the working-age population increases, this tends to push inflation down. They therefore claim that increased retirement in the next few decades will, conversely, substantially push up inflation.

15 In the paper, a low-skilled worker is one who works in production, while a high-skilled worker is employed in other operations at the company.

A problem with the findings is that demographic changes largely drive long-term trends in inflation, for example it appears that the higher inflation rate in the 1970s and 1980s was driven by demographic changes. Clearly, other explanations for the high inflation rate are possible, such as altered monetary policy regimes. The Bretton Woods system, with relatively stable fixed exchange rates, was abandoned at the beginning of the 1970s and replaced by a system with greater instability.

The findings described above mainly refer to how demographic changes affect the size of the labour force in relation to the population. However, another way in which the age structure can affect inflation is through changes in the composition of the employed. If the firms' cost of producing a commodity varies with the age of workers, the age structure for workers in the economy will affect firms' prices, and hence inflation. The correlation between age, wage and productivity has been studied by for instance van Ours and Stoeldraijer (2010) and Aubert and Crespon (2006) on Dutch and French microdata, respectively. In both studies, the authors find that wages and productivity are affected about the same by age. An effect of this is that the cost of producing a commodity does not depend on the age structure of the employed, which in turn means that prices and inflation are not affected either. Other studies find however that wages and productivity are not affected in the same way, which could mean that the age structure among workers actually does affect firms' costs and hence inflation.

5.2 Effects of migration

Migration to Sweden has been high in recent decades, and from low- and middle-income countries in particular (Engdahl, 2016). In 1985 more than half of the foreign-born had a Nordic background and, out of the rest, the share who came from other high-income countries, and from low- and middle-income countries, was more or less equal. In 2010 picture was completely different. Out of the foreign-born, the share from low- and middle-income countries was then at around two thirds, while the last third consisted of around as many from the Nordics as from other high-income countries.[16] Also in terms of the distribution across different categories of education, the composition has changed over time. A significant change is that the share of foreign-born lacking upper-secondary education has increased relatively sharply. However, the share with a long post-secondary education has also increased.

5.2.1 Effects in models

Bentolila et al. (2008) study the effects that migration has on inflation in a DSGE model in Spain for the period 1982 to 2006. The percentage of migrants increased sharply during the period, primarily from the turn of the century when it rose from around 3 per cent to 14 per cent. They find that the effects have been significant: The annual inflation rate would have been 2.2 percentage points higher during the period 1999 to 2006 had migration not increased. They estimate this in a simple model however and it could be the case that migration is correlated with other inflation-driving variables. Spain introduced the euro in the same period, for example. The results should therefore be interpreted with caution.

The effects of migration on wages are not clear-cut. In a simple model for a small open economy that produces one commodity and has two types of labour, and in which capital is mobile, the average real wage need not be affected by migration in the longer term, because the capital stock is adjusted to the increased labour supply. In the short term however increased migration can cause wages to decrease, because the capital stock per

16 Olli Segendorf and Theobald (2019) convey a similar picture for 2017, although their breakdown of countries is not entirely consistent with Engdahl's.

worker falls, which in turn causes a decline in labour productivity.[17] Wage dispersion can also be affected, if the relative supply of workers with low and high education changes. If the migrants' composition differs from that of the domestic population, wages will drop for jobs (or qualifications) for which the number of migrants exceeds the domestic share, and rise when the share of migrants is lower than that of the domestic population. For example, the relative wages of cleaners and physicians decrease in the event of immigration with an over-representation of cleaners and physicians in relation to the domestic population. If the migrants' qualifications, for example in terms of education, are similar to those of the domestic population and they have the same ability to be integrated into the labour market, then migration has no effect on wages, at least not in the long run when the capital stock has adjusted. If the migrants are a complement to domestic-born, that is to say if the firm has a domestic-born worker, the value of hiring a foreign-born worker is relatively high, in which case increased migration can lead to higher productivity, see for example Jaumotte et al. (2016). Increased migration of highly educated workers can also prompt more innovation, which can push up productivity. A mitigating effect on productivity over time in Sweden is however that the share with a low education among foreign-born has increased, which ought to have a directly negative impact on productivity. However, the share with a lengthy post-secondary education has also increased among foreign-born. The quality of education also varies between countries, and some groups of migrants tend to have a much poorer education quality than domestic-born with the same education, see Olli Segendorf and Theobald (2019). Also, the complementarity mechanism works through employment, and the employment rate among foreign-born has fallen from being on a par with or higher than that of domestic-born in the 1950s, 1960s and 1970s, to being around 80 per cent in the 2000s (Ekberg 2009), which implies that effects of migration on wages via this mechanism may have decreased over time.

Besides capital adjustment, there are other possible margins in the economy that reduce the effects of migration on wages. The simple model described above has only one commodity, which means that there can be no changes in the composition of commodity production. In reality several commodities are of course produced, and increased immigration can give an inflow of labour that is more important to some sectors than others. If for example there is an inflow of labour with low education, this causes wages for workers with low education to decrease. This pushes up profits in sectors that employ a large proportion of workers with low education and production therefore increases. This prompts an increase in demand for labour that counteracts the initial drop in wages. Another moderating factor is that firms can choose technology endogenously.[18] If there is an inflow of migrants with low education, firms will endogenously select technologies that use workers with low education to a greater extent, when costs of these technologies fall. Demand for workers with low education then increases somewhat, which once more moderates the initial drop in wages.

5.2.2 Empirical findings

Most of the studies described below analyse the effects of migration on wages. We first describe studies that analyse effects on wages and then in Section 5.4 studies on how prices are affected.

Dustmann et al. (2013) study a general equilibrium model with different types of labour.[19] In the model, there are migration of all types of labour. They find that the effects on wages for a certain group depend on how many migrants belong to that group. Having numerous

17 How the capital stock reacts to migration is important to the size of the effects in the short and medium term. According to Dustmann et al. (2008) the effects on wages will be much smaller if the adjustment to the capital stock is taken into consideration. Given that 10 per cent of the deviation in the capital stock from the long-term level per worker caused by migration disappears per year, wages for workers with low education decline by 1.1 per cent in the medium term, compared with 3.6 per cent if capital adjustment is not taken into account.

18 The companies have several technologies to choose from, and choose the one that best suits the company.

19 Different types of labour are imperfectly substitutable.

migrants in a group leads to wages falling in the group, but they can rise for other groups. If the composition of migrants is identical to the domestic population, the average wage is not affected at all, at least not in the long run when capital has adjusted. They then study how migration has affected wages in the United Kingdom and find that the effects there differ between different income groups: Migration leads to wages increasing for workers with income over the 40th percentile, while they drop for workers below the 20th percentile. The effects on the average wage are slightly positive.

Ottaviano and Peri (2012) study what happens to wages in the United States during the period 1990 to 2006 in a structural approach. They find that the effects of increased migration are slightly positive irrespective of education level for workers born in the United States – wages increase by approximately 1 per cent. For certain groups, however, wages are negatively affected: For workers who migrated before 1990, wages fall by just over 6 per cent.

Blau and Kahn (2012) perform an accounting analysis of how the distribution of income has been affected by the increased share of foreign-born in the United States between 1980 and 2010. Specifically, they study how income dispersion has been affected for the entire population, and for domestic-born and foreign-born, respectively. They find that income dispersion has increased over the period, and that it has widened to around the same extent for domestic-born as for the entire population. The increase in the number of foreign-born thus seems only to have contributed only slightly to the increase in income dispersion. However, it can be indirectly affected via general equilibrium effects. It could for example be the case that the increase in wage dispersion among domestic-born is driven by migration via heightened competition for jobs within certain education and occupation categories, which pushes down wages for some groups of domestic-born too. However, it is once again worth noting that wage dispersion in Sweden has not changed so much from the turn of the millennium until 2013, which suggests that the mechanism via migration has perhaps not been so important for wages in Sweden, see Carlsson et al. (2017). One reason for this could be that a substantial share of migrants that have arrived in Sweden since the turn of the millennium have a relatively weak connection to the labour market, see also section 5.3.2 below.

Several studies of the effects that migration has on the wages of domestic-born have been carried out on microdata. They can be roughly divided into two types: a regional approach, in which variation in immigration between regions is used, and a national approach, in which variation in the share of immigrants across different categories of education or experience is used instead. The results in the regional approach are normally that the effects on wages are not particularly large. Card (1990) finds relatively small effects when studying the effects of migration from Cuba on the labour market in Miami.[20] A problem with this approach however is that it is difficult to deal with the fact that migration can cause workers who lose their jobs to move to other regions.[21] Borjas (2003) addresses this by looking at occupation categories instead of regions – the so-called national approach. He finds a somewhat larger effect for the United States, where migration caused average wages to fall by 3.2 per cent between 1980 and 2000.

A problem when measuring this is that migrants tend to want to move when conditions on the labour markets are good. An approach is therefore sometimes used in which exogenous variations are employed, so-called natural experiments, in which there is an attempt to tackle the problem by finding supply-driven migration. Hunt (1992) looks at the effects of repatriation of French Algerians after French colonial rule ended. In 1962 around

20 In the regional approach an equation is estimated of the type

(1) $\Delta w_{ijt} = a_t \Delta m_{ijt} + x_{it} b_t + e_{ijt}$

where Δw_{ijt} is the change in wages for workers i region j with education level i, Δm_{ijt} is the change in the number/percentage of migrants in region j with education level i, x_{it} control variables (for example age gender), a_t and b_t coefficients and e_{ijt} a disturbance term. Problems with endogeneity, for example that migrants move to regions where demand is high and wages rise, are addressed using instruments.

21 They are then not included in the wage and employment statistics of the region.

half a million individuals with a European background moved to France from Algeria – around 1.6 per cent of the French labour force.[22] The effects on both wages and unemployment were relatively modest, however. Wages fell by 1.3 per cent and unemployment rose by 0.3 percentage points for French nationals who did not belong to the repatriated group. The fall of the Soviet Union also caused several major waves of migration, because it became easier to leave the former communist states in Eastern Europe. Two examples of studies that look at this are Friedberg (2001), who studies migration to Israel, and Glitz (2012), who analyses immigration into Germany from Eastern Europe.[23] Migration to Israel was considerable – between 1989 and 1995 Israel's population increased by 13.6 per cent. Nonetheless, migration does not seem to have had any negative effect on wages. Migration to Germany was also substantial – over a 15-year period after the fall of the Berlin Wall, 2.8 million ethnic Germans moved to Germany. Here too, the effects on wages were relatively small and in most cases not significant, while unemployment for individuals living in Germany before the migration seems to have been affected more. For 10 migrants who found work, 3.1 workers residing in Germany before the migration became unemployed.[24]

Engdahl (2016) analyses the effects of migration on wages in Sweden. He finds that an increase in the share of immigrants of 1 percentage point within a certain education and experience group causes the monthly wage to decrease by around 0.3 per cent. It is worth noting however that the effects on wages are mainly driven by migrants with a Nordic background, and that there is no statistically significant effect on wages of migration from other countries. Engdahl also makes comparisons with results for other countries and finds that the effects in Sweden are smaller than in for example the United States and Canada, but more or less on a par with Norway. The construction industry seems to be affected more than other industries, however. In Norway estimations for the construction industry give more or less twice the wage elasticity as for the private sector as a whole.

The studies above mainly deal with the effects of migration on wages for domestic-born workers. However, there are considerable wage differences between foreign-born and domestic-born. Wages for foreign-born are often lower than those of domestic-born, see Pekkala Kerr and Kerr (2011). The results for Sweden vary over time, and average income from employment appears to have been higher or on a par with domestic-born in the 1960s and 1970s, but has subsequently fallen back and is now much lower, see Ekberg (2009) and also section 5.3.[25]

5.3 Specific waves of migration

In the past decade, two important waves of migration have often been discussed. The first concerns the effects of the enlargement of the EU in 2004 and 2007, respectively, and is mainly labour-market-driven migration. The other concerns the increase in refugee immigration, which is not labour-market-driven in the same way as migration within EU.

5.3.1 The enlargement of the EU

The internal market considerably facilitates cross-border labour mobility within the EU. This has gained significance mainly since the Eastern European countries became EU members, because the large wage differences between Western and Eastern Europe give Eastern Europeans substantial incentives to move.

22 Hunt (1992) cannot distinguish the wages of the repatriated group from those already residing in France, so the wage effect is estimated as the effect on average wage for both groups.

23 Glitz (2012) studies immigration to what was West Germany before 1990, from Eastern Europe, excluding East Germany (DDR).

24 The estimation might also be affected by the emigration of individuals who were already residing in the region. These effects seem to have been small however.

25 Ekberg studies income from employment, which is income from an employer and income from self-employment. The studies in section 5.3 that discuss Sweden use earned income.

Bratsberg et al. (2017) study the effect of the enlargement of the EU on wages in Norway in different sectors, and find that the effects are relatively large. They break down the sectors according to the percentage of migrants they contain, and find that the difference in wage increase between sectors with a low and high share of migrants, respectively (sectors in the 10th and 90th migrant share percentiles, respectively), is around 7 per cent during the period 2004–2013, with the wage increase being greater in the sector with a low share of migrants.[26] Over the same period, average wages increased by 40 per cent, so the difference between the sectors with a low and high share of migrants, respectively, is not negligible, but neither is it of the same magnitude as total wage increases. The fact that an increased share of migrants causes lower wages within an industry does not mean that the total effects on wages are negative, as Bratsberg et al. can only identify relative wage effects and not general equilibrium effects.[27]

Ruist (2017) studies income for migrants who immigrated to Sweden when the EU was enlarged. Because Ruist looks at earned income and not wages, the levels are also affected by the employment rate. He finds that income is much lower when the migrants arrive in Sweden, particularly for women, but reach levels close to that of the of the domestic population relatively quickly. An important reason for the low income for women is a low employment level in the initial years following immigration. Because the migrants differ from the population as a whole, Ruist devises comparable age groups for the domestic population. He finds that the median income for men is initially approximately 80 per cent of the median income for the equivalent domestic group, while women's income is at 20–30 per cent when they arrive in Sweden. After around eight years, the median income of both men and women is around 90 per cent of that of the domestic group.

5.3.2 Refugee immigration

The studies that look at refugee immigration normally look at earned income and not wages. Just as in Ruist's study, this does not give a good measure of the monthly wage of refugee immigrants, because earned income is also affected by how much the individual works.

Earned income for refugee immigrants is much lower than for domestic-born, especially soon after they have arrived in Sweden. However, even after a relatively long time in Sweden, earned income is far below that of domestic-born people. After around 10 years in Sweden, earned income is between 40 and 75 per cent of the comparable level of domestic-born, and after 25 years in Sweden it is approximately 65–80 per cent of the level of domestic-born, see Forslund et al. (2017).[28] A reason for the worse outcomes for refugee immigration than for migration caused by the enlargement of the EU could be that the latter has mainly been labour-market-driven and that EU migrants therefore move if there is a high probability of getting a job, which does not apply to refugee immigration to the same extent. Lewis and Swannell (2019) find in a study of 35 countries for the period 1990–2013 that, under free movement, migration reacts more strongly to variables that are related to the wage level (GDP per capita) and the state of the economy (expected growth). More individuals will thus be willing to move to a country with high wages or with a booming economy if there is free movement, compared with when mobility is limited.

26 The sectors are ranked according to how high a share of migrants work in the sector. If there are 100 sectors for example, the one with the lowest share is chosen first, then the one with the next-lowest share, and so on. The sector with the 10th migrant share percentile is thus the tenth sector in the ranking, and the sector with the 90th migrant share percentile is the ninetieth sector in the ranking.

27 Dustmann et al. (2013) is an example of a model in which migration can give a higher average wage.

28 They compare migrants of a certain age and gender with the equivalent domestic-born group. Note that education level and quality of education can differ between migrants and domestic-born of the same age and gender.

5.4 Effects on prices

Cortez (2008) and Frattini (2008) study migration effects on prices in the United States, Israel and the United Kingdom. Both find results that are in line with the results for wages: an increase in migration appears to lead to a drop in prices in service sectors that employ a high share of workers in low-wage occupations. In the United States an increase in the share of migrants with low education of 10 per cent causes prices to drop by 2 per cent in sectors with a high share of migrants. Frattini also finds similar effects in the United Kingdom.

6 Other structural reforms and changes

Substantial reforms in areas other than those described above have been carried out in the past 25 years that could have affected the labour market. The pension reform, which was carried out after the crisis of the 1990s, strengthened incentives to work longer, for example. Laun and Wallenius (2015) find in a calibrated model that the average age of retirement increases by just over two years from 62.4 to 64.7. Laun (2012) has studied the effects of the tax relief initiatives carried out between 2007 and 2009 for the over-65s, and finds that the changes appear to have caused more persons over the age of 65 to work. Employment appears to have increased by 1.5 percentage points in the year after the individuals turn 65. The effects on employment thus appear to be somewhat smaller than those brought about by the changes to the pension system in the 1990s. In recent times too, labour supply in Sweden appears to have increased, see Flodberg and Löf (2017). Although the studies do not look at the effects on wages, increased labour supply tends to lead to wages increasing slower than they would have done without the reforms.

Another substantial change is that the health of both pensioners and the working population has improved over a long period of time. Combined with for instance altered rules in the pension system, this could have considerable effects on the labour force. Johansson et al. (2016) study this by using two different approaches: one based on mortality and one based on self-reported health. Here, only the results from the first approach are described – the results for self-reported health are similar. In the approach based on mortality, they compare individuals in the 55–69 age range in 2009 with individuals with the same mortality in 1985. A potential labour force participation rate is then constructed for individuals in the 55–69 age group in 2009 that are assumed to have the same probability of working as a person active in 1985 with the same mortality.[29] The potential labour supply in 2009 can be viewed as follows: the age group with the same mortality as a younger group in 1985 is assumed to have the same labour force participation as the younger age group had in 1985. Potential labour force participation in 2009 is 8 per cent higher than the actual level for 55-year-olds, 9 per cent higher for 60-year-olds, 33 per cent higher for 65-year-olds and 39 per cent higher for 69-year-olds. The effects are thus substantial for individuals close to or over national pension age. Changes in the regulatory system that affect, for example, the national pension age can thus have major effects on labour supply. The stricter rules for obtaining national sickness benefit may also have resulted in a higher labour supply, see Forslund (2019). Jonsson and Theobald (2019) study the effects of poorer matching efficiency and changes in bargaining power. They show that changes in bargaining power may have caused slower wage growth.

29 In 1985 the age of individuals with the same mortality as those in the 59–69 age range in 2009 was below the statutory retirement age. A picture can hence be obtained of how labour supply changes if the retirement age is increased and labour supply is used for those who were not limited by the statutory retirement age on the labour market in 1985, in order to gain an understanding of how individuals today with the same health in the 65–69 age range are affected by a higher retirement age.

7 Concluding remarks

In the past 25 years, extensive structural changes have occurred both in Sweden and abroad that have affected the Swedish labour market. In this article, various structural changes have been studied which, via the labour market, might have affected wages, prices and inflation. Several studies only focus on wages however and not on inflation, which is also affected by cost pressure.

A number of reforms have been carried out that have affected the Swedish labour market, for instance the unemployment replacement rate has been considerably reduced, see Jonsson and Theobald (2019). Available empirical studies indicate however that this does not appear to have had any substantial effects on wages, although it may have had greater effects on employment, see e.g. Forslund et al. (2008). Earned tax credits may have increased labour supply, as well as a high migration level, changes to the pension system, stricter application of sickness benefits and sharp improvements in human health over time. Increased labour supply in turn tends to lead to slower wage increases. Weaker bargaining power for workers may also have caused slower wage growth.

Other structural changes have also been significant. Increased foreign trade during the period seems for example to have had effects on producer prices in studies based on microdata (see for example Auer et al., 2012, and Auer et al., 2013), while the effects in analyses based on aggregate data are more ambiguous. Trade has also affected wages, but is not the most important explanation for changes in wage formation in the past 25 years. Instead, it seems that technological developments benefiting highly educated workers have been the main driver. Demographic changes that affect factors like the share of the population that is of working age might have impacted inflation, although the results ought to be interpreted with caution. The increase in migration and the integrated European labour market in the last few decades have had some effect on wages, according to Bratsberg et al. (2017), although the results in Engdahl's study from 2016 suggest that the effects on wages have probably been limited, with the exception of migration from the Nordic countries. The effects might also have been greater for certain sectors, such as the construction sector.

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Is Germany a compass for wage formation in Sweden?

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In this article, wage formation in Sweden since the Industrial Agreement was reached at the end of the 1990s is studied. Using wage-setting equations, wage determination in various sectors in Sweden is analyzed. The results confirm that the Industrial Agreement sets a mark for other sectors and that industrial wages provide a significant and strong explanatory value for wages in both the construction and service sector. Industry is export-dependent and wages in the sector shall ensure its long-term competitiveness, distribute the surplus between employers and employees and be in line with the Riksbank's inflation target in the long run. In Sweden, it has been debated whether wages in Germany have a direct impact on wages in Swedish industry, besides the effects from other channels, such as competitor prices. I find that Swedish industrial wages could have such a link with German industrial wages by using German wages in a wage-setting equation similar to how Swedish industrial wages are used to explain wages in the construction and service sectors, even though the relationship is not as strong. However, there is a much stronger link between Swedish industrial wages and industrial wages in the Euro area.

1 Introduction

In the 1970s and 1980s, nominal wage increases in Sweden were high, which in turn led to repeated devaluations and high inflation. This further drove up wages and the economy ended up in a wage–exchange-rate spiral, see Calmfors et al. (2019). As a result of the crisis in the early 1990s, several institutional changes were implemented. One of these was the switch to a floating exchange rate, combined with an inflation target for monetary policy, which had implications for wage formation. Another was the introduction of a new fiscal policy framework to reinforce budgetary discipline and bring government finances in order (see Molander and Paulsson, 2008).

A few years after these reforms, the Industrial Agreement was signed in 1997 with the aim to ensure that wage formation took long-term competitiveness of industry into account. The Industrial Agreement has become the norm and the wage agreements sets a mark for other sectors, see for example Gottfries (2019) and Calmfors et al. (2019). Compared with the 1970s and 1980s, there has also been a slowdown in wage increases and inflation. The slowdown in nominal wage and price changes has however not caused real wages to fall. Until the 2008 financial crisis, nominal wage growth in Sweden was relatively high, but wage increases have subsequently declined somewhat. There are several possible reasons for why wages are increasing more slowly. Growth in productivity has been lower, but competitor prices have also shown slower growth and inflation has fallen. The higher unemployment

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that resulted from the financial crisis and the drop in the unemployment compensation level might also have caused wage increases to ease off, see Jonsson and Theobald (2019), and Westermark (2019) for a further discussion about the significance of these and other factors.

This article studies what has affected Swedish wage formation since the Industrial Agreement was reached. Because the Industrial Agreement sets the norm for other sectors, the focus is on wage formation in the industrial sector. Industry is exposed to international competition and wages will therefore depend on the prices set by firms in competing countries, but also on the exchange rate and productivity. The state of the labour market and unemployment compensation levels can also affect wages.

Competitor prices depend on the marginal costs of competing firms, which in turn are affected by nominal wages and productivity in the firms. According to the so-called competitiveness model ('konkurrenskraftsmodellen'), wages should (under certain conditions) increase by around as much as they do in our competitor countries.[1] The competitiveness model can thus be thought of as competitor countries setting the mark for Swedish industry, just as Swedish industry does for other Swedish sectors. Therefore, the extent to which wages in industry depend on competitor prices, the exchange rate, productivity, the state of the labour market, and the industrial wages of our most important competitor – Germany, is studied.

Simple correlations indicate that the relationship between Swedish and German industrial wages is relatively weak. Wage equations that include German wages are also estimated, and these provide some support for wages in Germany potentially affecting Swedish industrial wages, besides what is motivated by fundamental factors such as competitor pricing and the exchange rate. However, an increase in German contractual industrial wages of 1 per cent does not have as large effects on Swedish contractual industrial wages, which increase by 0.7 per cent, at least in the long run. The relationship between actual Swedish and German wages is stronger, and in the long run Swedish industrial wages increase by around 1 per cent when German industrial wages rise by 1 per cent. If it is the case that German wages have a strong direct impact, then the Industrial Agreement does not work as intended, because a direct link between industrial wages in Sweden and Germany does not necessarily take due account of the underlying factors that determine an appropriate wage level in Swedish industry, that is to say competitor pricing, productivity, the exchange rate, the compensation level and the state of the labour market. The wage level shall ensure the long-term competitiveness of industry, appropriately distribute profits between employees and employers, and give inflation that is in line with the Riksbank's inflation target. In the estimations, there is some, but not unequivocal, support for Germany actually having a unique position and direct influence over industrial wage-setting. However it cannot be ruled out that industrial wages are actually based on other relevant factors, discussed in the following section, rather than through nominal wages in Germany.[2] On the other hand, an equivalent empirical analysis for contractual wages for the euro area show that there is a strong and unequivocal link between these and contractual Swedish industrial wages. So, if anything, the dependence seems to be between Sweden and the euro area, and Germany does not necessarily have a unique position in wage-setting (apart from it representing a large share of the euro area).

Another way of getting an idea about dependence on other countries is to compare the effects of how German industrial wages affect Swedish industrial wages with how the Industrial Agreement affects wages in other Swedish sectors. In order to study the extent

1 This can hold if expected productivity growth in Sweden coincides with that abroad and if the exchange rate is expected to be unchanged.

2 Stronger conclusions can unfortunately not be drawn where Sweden is concerned, although in an equivalent analysis for Germany, one can easily reject the hypothesis that Swedish industrial wages have an equivalent explanatory power in a German industrial wage-setting regression, indicating that, if any dependence does exist, Sweden is dependent on Germany and not vice versa.

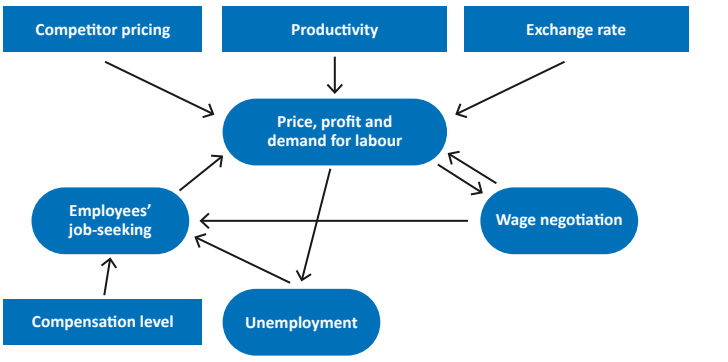
to which the Industrial Agreement affects the wages in other sectors, the relationship between industrial wages and wages in two other sectors is studied. Simple correlations indicate that the relationship is relatively strong, and the correlations are much higher than the correlation between German and Swedish industrial wages. Wage equations are then estimated for the construction and service sectors, with industrial wages included as an explanatory variable. When industrial wages are used to explain wages in the construction and service sectors, the coefficient of determination increases substantially and much more than when German wages are included in the wage equations for Swedish industry. An increase in industrial wages also leads to wages increasing about the same in both the construction and service sectors, at least in the long run. There are thus relatively clear indications that industrial wages set a mark for both the construction and service sector, and the link is stronger than that between Swedish and German industrial wages.

The article is structured as follows: In section 2 a simple wage formation model is discussed. In section 3 variables affecting wage formation over the period 1997 to 2017 are described, as well as the degree of synchronisation between Swedish and German wage agreements. Section 4 discusses the various wage formation models that are studied and empirical estimation results for contractual wages are presented. The results for actual wages are presented in section 5. In section 6, the extent to which the Industrial Agreement serves as a mark for other sectors is studied. Finally, the main findings and conclusions are summarised in section 7.

2 A wage formation model

Forslund et al. (2008) present an example of a wage formation model that describe the key factors that influence how wages are set, see also Westermark (2008). It has three theoretical mechanisms.[3] The first is a model for firm price-setting decisions, the second is a model for how wages are negotiated and the third is a model for how unemployment and compensation levels affect wage determination. Figure 1 provides a description of the three mechanisms.[4]

Figure 1. An overview of the mechanisms in wage formation



Source: The figure is adapted from Westermark (2008)

Wages will be affected by competitor prices, productivity and the exchange rate, as these factors affect the size of a firm's surplus. In wage negotiations between firms and workers, the surplus will be shared between the parties. The prices set by a firm depend on factors such as competitors' prices and the firm's own productivity. If for example competitors'

3 The model also has a mechanism for expectations and sluggishness in adaptation to shocks.
4 In an extension, we follow Bennmarker et al. (2011) and let nominal wages depend on the general price level in the economy, see Appendix A.

prices increase, demand will increase for the firm. The firm then hikes its prices and hence obtains a greater surplus. Similar effects arise if the exchange rate depreciates, that is to say there is a drop in the value of the currency. Productivity too affects both prices and surplus. As an example, an increase in productivity via lower marginal costs gives lower prices and a higher surplus. To sum up, increased competitor prices, a weaker exchange rate and higher productivity thus lead to an increase in the firm's surplus, and hence in wages as well.

Conditions on the labour market also affect wage formation. A common approach for analysing the labour market and wage formation is what is known as search and matching models. In these models, workers and firms take into account of what would happen if they do not agree when negotiating. If the worker leaves the firm, the firm could lose the production of the worker. The worker's alternatives to staying on at the firm are affected by how many other workers are searching for work, and the intensity of their job search. Workers who do not have a job are affected by the compensation they receive while unemployed, and by the probability of finding a job. They will probably look for work more intensively if the compensation level is lower and the chance of finding a new job is higher. The wage negotiated between the firm and worker thus also depends on the compensation level and state of the labour market.

To sum up, wage outcome depends on competitor pricing, the exchange rate, productivity, the state of the labour market and the unemployment compensation level.

An important determinant for competitor pricing is marginal costs at competing firms. Marginal costs are in turn affected by wages and productivity in these firms. There has been a discussion on the extent of dependence of wage formation in Sweden on wage formation in important competitor countries, such as Germany, see Kinnwall (2017). Via fundamental factors, that is to say competitor prices, German wages affect Swedish wages. It is possible, though, because Germany is an important export market, that German wages could also affect Swedish wage-setting beyond the fundamental channel via export prices.

3 Wages, productivity and competitor prices in data

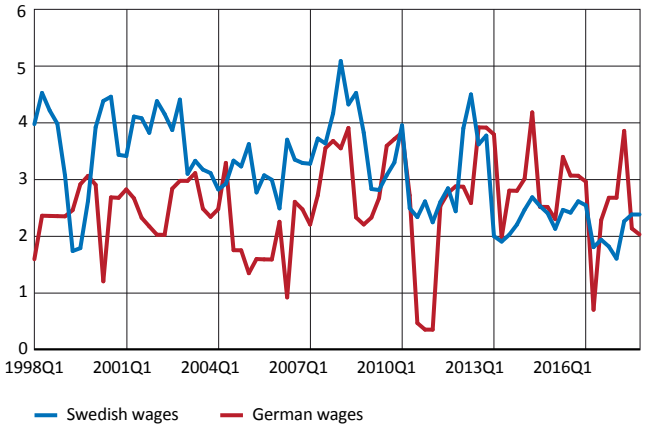
Figure 2 illustrates contractual nominal wage increases in Swedish and German industry between 1998 and 2017. The average increase in contractual wages have been roughly the same in the two countries, even though it appears to have been somewhat lower in Germany than in Sweden for a few years preceding the financial crisis in 2008, and subsequently somewhat higher. A reason for the lower wage increases in Germany before the financial crisis could be that Germany carried out substantial reforms of the labour market during the period, known as the Hartz reforms, see for example Krebs and Scheffel (2013). The correlation between the growth rate in Swedish and German contractual wages is however fairly low, around 0.31. In terms of actual wages, shown in Figure 3, the picture is somewhat different. Before the financial crisis, actual wages rose faster in Sweden than in Germany, but wage inflation has subsequently been on about the same level. The correlation between actual wages is 0.10, which is substantially lower than for contractual wages. This difference could possibly be explained by actual wages being affected by wage drift and changes in employee composition.[5]

5 If workers with lower wages lose their jobs to a greater extent in a recession, compared with in a boom, this mechanism causes the average wage to drop in a boom and rise in a recession, all else equal.

Figure 2. Industrial contractual wages in Sweden and Germany 1998Q1–2017Q4
Percentage change (4 quarters)

Sources: National Mediation Office and Bundesbank

Figure 3. Actual industrial wages in Sweden and Germany 1998Q1–2017Q4
Percentage change (4 quarters)



Sources: National Mediation Office, the Riksbank and Bundesbank

An important factor affecting both contractual and actual wages is the scope for wage increases in the negotiation. This can be defined as

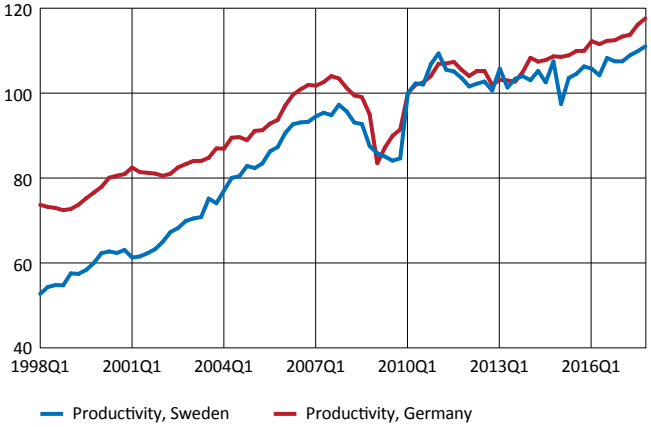
(1) $z_t + e_t + ppi_t$.

The scope for wage increases, or the value of what a worker produces, depends on the firm's productivity z_t, the nominal exchange rate e_t and the competitor price ppi_t. The competitor price is affected by the marginal costs of competing firms, which in turn depend on the firms' wages and productivity.

Figure 4 shows that productivity grew faster in Sweden than in Germany until the 2008 financial crisis. The growth rate then fell in both countries and has since developed in a relatively similar way. Competitor prices have shown a similar pattern, measured as competition-weighted producer prices in our competitor countries' industrial sectors. Figure 5 illustrates competitor prices, that is to say competition-weighted producer prices, and German producer prices.[6] Both grew faster up until the financial crisis, compared with the subsequent period.

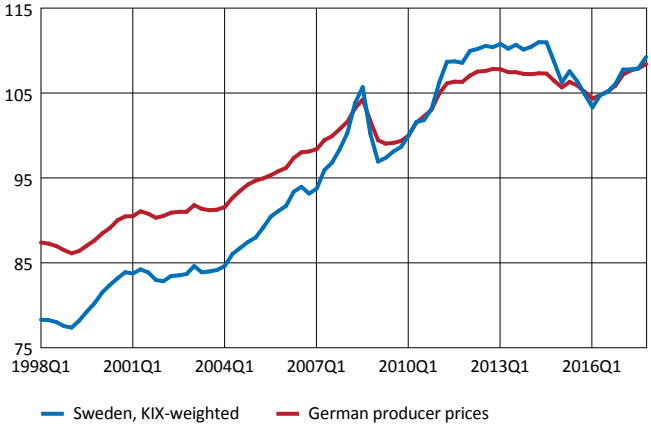
6 For the competition-weighted producer prices, 'KIX weights' are used. See Erlandsson and Markowski (2006) for a detailed description.

Figure 4. Industrial productivity in Sweden and Germany 1998Q1–2017Q4
Q1 2010 = 100



Sources: National Institute for Economic Research, Statistics Sweden and Bundesbank

Figure 5. KIX-weighted competitor prices for Sweden and German producer prices, industry 1998Q1–2017Q4
Q1 2010 = 100



Sources: Own calculations and OECD

Wage growth in relation to the scope for wage increases, that is to say the value of what the worker produces, indicates how much of the scope the employee obtains in the negotiation. Figure 6 shows wages in relation to the scope in Sweden and Germany during the period. We can see that, in both countries, wages fell in relation to the scope up until the financial crisis, but have since been relatively constant.

Figure 6. Wage/Scope for wage increases 1998Q1–2017Q4
Q1 2009 = 100

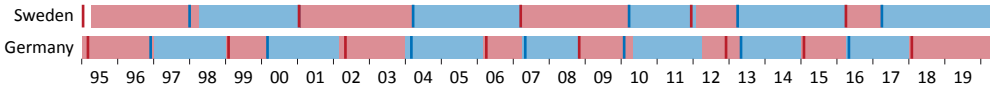
Note. Scope for wage increases is defined as $z_t + e_t + ppi_t$. Wages refers to actual wages
Source: Own calculations

3.1 How synchronised are Swedish and German wages?

Figures 2 and 3 indicate that there may be a relationship, albeit weak, between German and Swedish wages. One way of studying whether German wages affect those in Sweden is to look at the degree of coordination between German and Swedish agreements.

Figure 7 illustrates contract periods and contract dates for Swedish and German wage agreements. In general, it seems that German agreements often have a shorter duration than Swedish agreements. The average length of German agreements is around 20 months, and 30 months for Swedish agreements. There is not a full degree of synchronisation between contract dates. Out of the ten Swedish agreements, six are reached at a time close to when German agreements were reached. An even more important factor could be that, for these agreements, four of the Swedish agreements were reached before the German agreements, one in the same month and one afterwards. If the German agreements sets a mark for the Swedish ones, it is not unreasonable that Swedish industry waits until the German agreements have been signed, before reaching its own. However, it could also be the case that the Swedish parties can form a relatively precise estimate of the expected agreement level in German industry even before the German bargaining parties have finished negotiations.

Figure 7. Swedish and German wage contracts in industry
Time of agreement (red and blue lines) and agreement duration, alternating in red and blue blocks (the length shows the duration of the agreements) in the same colour as the agreement contract date



Source: See Appendix D

4 Estimated models

The two previous sections provide an overview of how wages and variables that are important for wage formation have developed since the mid-1990s. To gain more precise answers to what affects wage formation in Sweden, more advanced statistical analysis is needed, however. This section therefore describes how wage formation in Sweden is modelled and estimated, based on the theoretical model in section 2. The analysis closely follows Engle and Granger's (1987) method and estimates first of all a dynamic ordinary least square (DOLS) model with variables in levels to analyse the long-run relationship between

the different variables. If wages deviate from the long-run relationship, this will affect what happens to wages in the short run. If for example wages are too low in relation to the long-run relationship, wages ought to increase more than the long-run increase. In the analysis, the wage-setting relationship is then estimated in differences, with the deviation in the long-run relationship included. When the long-run relationship do not hold exactly at a certain point in time, for example because wages are too high in relation to the long-run relationship and the disturbance term is positive, wage increases are affected and wages ought to increase at a slower rate.[7] The deviation in the long-run relationship is thus corrected in the short-run relationship, a so-called error correction approach. The model is thus estimated first in levels:[8]

$$(2) \qquad w_t = \beta_c + \beta_z z_t + \beta_e e_t + \beta_p ppi_t + \beta_{ls} ls_t + \beta_{rr} rr_t + \beta_{wDE} w_t^{DE} + \varepsilon_t,$$

where w_t is Swedish industrial wages, z_t is labour productivity, e_t is the exchange rate, ppi_t is competitor prices, ls_t is a measure of labour shortage, rr_t is the nominal compensation level and w_t^{DE} denotes wages in German industry. The effect of German wages on Swedish wages will be the effects over and above those that go via competitor prices. The residual $\hat{\varepsilon}_t$ is then calculated in the long-run relationship and used in the following short-run regression:

$$(3) \qquad \Delta w_t = \alpha_c + \alpha_z \Delta z_t + \alpha_e \Delta e_t + \alpha_p \Delta ppi_t + \alpha_{ls} \Delta ls_t + \alpha_{rr} \Delta rr_t + \alpha_{wDE} \Delta w_t^{DE} + \alpha_{wlag} \Delta w_{t-4} + \alpha_\varepsilon \hat{\varepsilon}_{t-4} + v_t$$

where $\Delta x_t = x_t - x_{t-4}$ and v_t is a disturbance term. Models (2) and (3) will be estimated both with and without the German wages to study whether Germany has an influence on top of the fundamental factors. The estimations are performed for both contractual and actual wages, and in the estimations with Swedish contractual wages and actual wages, German contractual wages and actual wages, respectively, are used.[9]

Productivity is measured as hourly labour productivity and wages as hourly wage. The exchange rate is the KIX-weighted exchange rate and competitor prices are KIX-weighted producer prices in the industrial sector in our competitor countries. The labour shortage measure is the National Institute of Economic Research's measure of labour shortage in industry. Data for Germany has been obtained from Bundesbank.

4.1 Estimation results for contractual wages

The estimations for the long-run relationship for contractual wages are shown in Table 1 for the period 1997Q1–2017Q4.[10, 11] In the two columns in the middle of the table it can be seen that both the standard model without German wages and the model with German wages have a high explanatory power.

7 If the coefficient for the disturbance term is negative.

8 The DOLS approach also includes difference terms of the explanatory variables in the long-run relationship.

9 The agreements normally only cover wage changes. Based on these, a series for contractual wage levels can however be derived.

10 See Appendix A for estimations of wage equations where CPI is also included.

11 Because lags are included in (2) and (3) the estimations are carried out on a longer horizon, compared with the figures above.

Table 1. Estimation results for the long-run relationship in equation (2)
Refers to the period 1997Q1–2017Q4, contractual wages

Coefficient	Standard model	With German wages	With German wages, without producer prices
β_c	−4.210* (0.651)	−4.576* (0.255)	−4.452* (0.278)
β_z	−0.018 (0.072)	0.080* (0.030)	0.139* (0.020)
β_e	0.048 (0.079)	0.030 (0.032)	0.007 (0.033)
β_p	0.943* (0.118)	0.209* (0.093)	-
β_{ls}	0.016 (0.014)	0.006 (0.006)	0.010 (0.005)
β_{rr}	0.448* (0.062)	0.044 (0.052)	−0.047 (0.027)
β_{wDE}	-	0.704* (0.083)	0.834* (0.035)
F-test (p-value)		47.8 (0.00)	
Adjusted R^2	0.9909	0.9986	0.9983

Note. Engle and Granger (1987) regression, standard deviations in brackets.
* denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2.

In the standard model without German wages, the competitor price and the compensation level are significant, and an increase in competitor price or compensation level pushes up wages. When German wages are included as an explanatory variable, there is a sharp drop in coefficient β_p for competitor prices, while the coefficient for German wages is strongly positive and highly significant; if German wages increase by 1 per cent, Swedish wages rise by 0.7 per cent. A possible explanation is that, instead of studying competitor prices broadly, the parties in wage formation have an unjustifiably heavy focus on German wages. The relationship between Swedish wages and competitor prices will be weaker because the German wages capture part of the variation that normally goes via marginal costs.[12] If the competitor price increases by 1 per cent, wages increase by just over 0.2 per cent, and by just below 0.1 per cent if productivity increases by 1 per cent. In the column to the far right, a model is also shown without competitor prices, but with German wages. The explanatory value therein is essentially identical to the column that includes competitor prices. German wages have a somewhat stronger effect on the wages while the compensation level is insignificant.

We can use a simple statistical test, known as an F-test, to determine whether the model with German wages fits the data better than the model without German wages. Such a test indicates that German wage levels have significant effects in the long-run relationship.

Estimations for the short-run relationship in model (3) are shown in Table 2. The compensation level affects wage increases significantly in all models. The second column describes the results when German wages are also included. The coefficient for the change in German wages is not significantly different from zero, while an F-test indicates that German wages should be included in the relationship. In the column to the far right, a model is shown without competitor prices, and the coefficient of determination there is lower than for the model with both German wages and competitor prices.

12 The model is based on wages, productivity, exchange rate, competitor prices, compensation level, and state of the labour market covarying over time. In order for the results that are based on the theoretical model to be interpreted as indicating a relationship between the variables, they must covary in data. To use statistical vocabulary, the variables must be cointegrated. If this is the case, there is a long-term relationship between the variables, so-called cointegration. Tests (ADF test, with trend) show that there is cointegration at the 10 per cent level both with and without German wages in the relationship (test –3.31 with p-value 0.072 without German wages and –3.22 with p-value 0.088 with German wages). The tests thus weakly indicates cointegration.

Table 2. Estimation results for the short-run relationship in equation (3)
Refers to the period 1997Q1–2017Q4, contractual wages

Coefficient	Standard model	With German wages	With German wages. without producer prices
α_c	0.024* (0.003)	0.016* (0.004)	0.016* (0.004)
α_z	0.008 (0.015)	0.017 (0.015)	0.016 (0.015)
α_e	−0.019 (0.017)	−0.005 (0.016)	−0.014 (0.015)
α_p	0.038 (0.034)	0.055 (0.034)	-
α_{ls}	−0.003 (0.002)	−0.002 (0.002)	−0.001 (0.002)
α_{rr}	0.036* (0.016)	0.060* (0.015)	0.049* (0.013)
α_{wDE}	-	0.074 (0.105)	0.049 (0.105)
α_ε	0.219* (0.075)	−0.642* (0.178)	−0.618* (0.180)
α_{wlag}	−0.059 (0.111)	0.152 (0.104)	0.219* (0.097)
F-test (p-value)		3.98 (0.049)	
Adjusted R^2	0.199	0.231	0.213

Note. * denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2.

The results show that there are indications that German wages affect Swedish wages, even though the relationship does not appear to be entirely unequivocal. German wages are significant in the long-run relationship, but not in the short-run relationship, and F-tests indicate that the model with German wages is better than the model without for the long-run relationship and the short-run relationship.[13] Estimations with wages from the euro area gives a much stronger relationship, with a much higher coefficient of determination (0.521) in the short-run relationship (instead of 0.231 with German wages in the equivalent regression in Table 2), see Appendix B for these results.

4.2 Comparison with other models, and evaluation

An important component in wage formation, which is not explicitly modelled in models (2) and (3), is the formation of expectations. This is important because expectations about future productivity and prices affect the size of the expected surplus. In an alternative approach, one might assume that productivity will grow at its long-run average rates and the exchange rate will remain at its present level. If expectations about competitor prices are based on firms' marginal costs, they thus depend on expectations of productivity and wages abroad. In the alternative model, the wage outcome is determined by the upper and lower bound of the bargaining set, and the relative bargaining power of the parties. The upper bound of the bargaining set is closely linked to the change of the surplus in the negotiation over the term of the contract. The lower bound is instead determined by workers wanting unchanged real wages. The change in the surplus over time depends on the change of the exchange rate, productivity and competitor prices over time. The change in expected surplus will be $E\Delta z + E\Delta ppi + E\Delta e$ where E denotes expectations. Because the competitor price via marginal costs depends on wage and productivity in our competitor countries, the upper bound will be the expected change in the exchange rate plus the difference in expected productivity growth in Sweden and competitor countries (Δz^*) plus the change in our competitor countries' wages (Δw^*), i.e. $E\Delta z + E\Delta w^* - E\Delta z^* + E\Delta e$. If it is assumed for the sake of simplicity that the parties' expectations about the exchange rate are that it does not

13 Equivalent regressions have been estimated for Germany, in which Swedish industrial wages are used as explanatory variables. Swedish industrial wages are neither significant in the long-run relationship nor the short-run relationship and F-tests indicate that Swedish wages should not be included in either of the wage equations (2) or (3).

change over the term of the contract[14] ($E\Delta e = 0$) and that productivity is expected to grow at the same rate in Sweden as in competitor countries ($E\Delta z = E\Delta z^*$), then the upper bound equals expected wage growth in our competitor countries. The lower bound equals the change in expected price level ($E\Delta p$) during the period due to the desire of workers to have unchanged real wages. Bargaining power Υ is determined as a function of unemployment for workers in industry and labour shortage in industrial firms. Wages will then be $w = \Upsilon\,(E\Delta z + E\Delta w^* - E\Delta z^*) + (1 - \Upsilon)\,E\Delta p$. Table 3 below shows results from a model based on this approach (the Expectations model).[15]

In order to compare the above model with others, the mean square error (MSE) in the model is then studied. Let the estimated coefficients in the short-run relationship be denoted as $\hat{\alpha}_i$. Define

$$(4) \qquad \widehat{\Delta w}_t = \hat{\alpha}_c + \hat{\alpha}_z \Delta z_t + \hat{\alpha}_e \Delta e_t + \hat{\alpha}_p \Delta ppi_t + \hat{\alpha}_{ls} \Delta ls_t + \hat{\alpha}_{rr} \Delta rr_t + \hat{\alpha}_{wDE} \Delta w_t^{DE} + \hat{\alpha}_{wlag} \Delta w_{t-4} + \hat{\alpha}_\varepsilon \hat{\varepsilon}_t.$$

In order to calculate MSE, forecasts from (4) are then used, that is to say $\widehat{\Delta w}_t$, determined at the contract date, and if we let Δw_t^{avtal} be data for contractual wages and N the number of agreements, then

$$(5) \qquad MSE = \frac{1}{N} \Sigma_t (\widehat{\Delta w}_t - \Delta w_t^{avtal})^2$$

is a measure of how well the model on average manages to capture wage growth in the agreements. Note that the sum is over contract dates in the expression above.

Table 3 shows MSE for the two models described above, as well as the wage formation model of the National Institute of Economic Research, see National Institute of Economic Research (2018).

Table 3. Mean squared error (MSE) for certain models

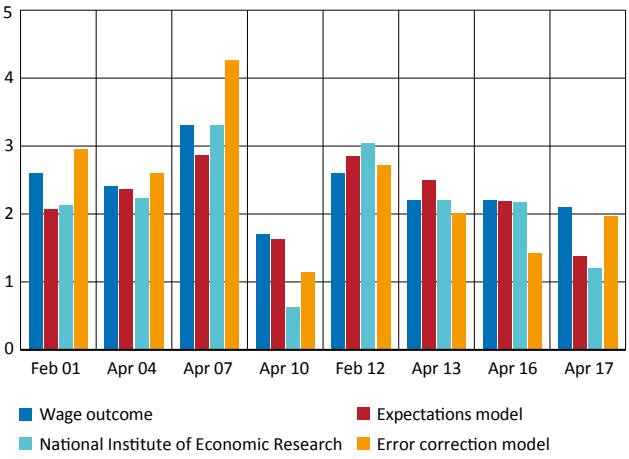
Model	MSE, 1998–2017	MSE, 2001–2017
Expectations model	0.128	0.145
National Institute of Economic Research	-	0.179
Error correction model with German agreements	0.562	0.262

Source: Own calculations

The National Institute of Economic Research's model and the expectations model are relatively comparable, while the error correction model appears to give somewhat poorer results. Alternatively, MSE can be calculated for all estimated observations and not just at the contract date. In the error correction model, we then obtain 0.214 and for the National Institute of Economic Research's model 0.052. Here too, the error correction model again performs worse than the National Institute of Economic Research's model. Figure 8 illustrates actual outcomes and forecasts for each agreement, that is to say Δw_t^{avtal} and $\widehat{\Delta w}_t$ for each contract in the three different models. The expectations model has large deviations for the first and last contract, while the National Institute of Economic Research's model works poorly for the fourth and last contract. The error correction model works poorly for the third, fourth and seventh contract, again indicating that the error correction model is somewhat worse than the other models, in line with the results in Table 3.

14 Holds if the exchange rate follows a random walk.
15 The model has been inspired by Henry Ohlsson, see also Ohlsson (2013).

Figure 8. Outcome and forecast for each agreement 2001–2017



Source: Own calculations

5 Analysis of actual wages

The results for actual wages are, in qualitative terms, relatively similar to the results for contractual wages, see Table 4 and 5. In the model without German wages, competitor price and compensation level are significant in the long-run relationship, and with German wages productivity and German wages are significant.[16] If German wages rise by 1 per cent, Swedish wages increase by about as much, and if productivity increases by 1 per cent, wages increase by around 0.2 per cent. In the column to the far right of the table, a model is also shown without competitor prices, but with German wages. The explanatory value is essentially identical to the column to the left, which includes competitor prices. German wages have more or less the same effect on the wages while productivity has a somewhat stronger effect.

Table 4. Estimation results for the long-run relationship in equation (2)
Refers to the period 1997Q1–2017Q4, actual wages

Coefficient	Standard model	With German wages	With German wages. without producer prices
β_c	−6.809* (1.050)	−6.113* (0.534)	−5.906* (0.527)
β_z	0.065 (0.116)	0.202* (0.062)	0.265* (0.039)
β_e	0.153 (0.128)	0.060 (0.065)	0.045 (0.066)
β_p	1.300* (0.190)	0.096 (0.194)	-
β_{ls}	0.014 (0.023)	−0.012 (0.013)	−0.001 (0.011)
β_{rr}	0.591* (0.100)	0.027 (0.093)	0.009 (0.052)
β_{wDE}	-	1.031* (0.142)	1.014* (0.057)
F-test (p-value)		26.5 (0.00)	
Adjusted R^2	0.9900	0.9975	0.9974

Note. Engle and Granger (1987) regression, standard deviations in brackets.
* denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2.

If, like before we apply a statistical F-test to compare the models with and without German wages, the results indicate that German wages seem to have significant effects in the long-run relationship.

16 For actual wages too, cointegration tests indicate only weak support for a long run relationship between the variables. Tests for cointegration indicate that there is cointegration for actual wages at the 5 per cent level when German wages are included in the cointegrated relationship (test–3.51, p-value 0.045). If German wages are excluded, there is cointegration at the 10 per cent level (test–3.25, p-value 0.082).

The results for the short-run relationship is shown in Table 5. Only lagged wages affect wage changes significantly in the model without German wages. In both the models with German wages, productivity, the compensation level and the lagged wage change affect Swedish wages significantly, while German wages do not have any significant effect on Swedish wages. An F-test indicates however that German wages should be present in the short-run relationship. The model without competitor prices has about the same coefficient of determination as the model with both German wages and competitor prices.

Table 5. Estimation results for the short-run relationship in equation (3)
Refers to the period 1997Q1–2017Q4, actual wages

Coefficient	Standard model	With German wages	With German wages. without producer prices
α_c	0.019* (0.005)	0.011 (0.006)	0.011 (0.006)
α_z	0.046 (0.025)	0.054* (0.023)	0.052* (0.022)
α_e	0.010 (0.028)	0.009 (0.024)	0.003 (0.022)
α_p	0.027 (0.055)	0.029 (0.049)	-
α_{ls}	−0.002 (0.003)	−0.002 (0.003)	−0.002 (0.003)
α_{rr}	0.038 (0.025)	0.059* (0.022)	0.053* (0.020)
α_{wDE}	-	0.124 (0.136)	0.113 (0.134)
α_ε	−0.013 (0.077)	−0.621* (0.129)	−0.620* (0.129)
α_{wlag}	0.382* (0.128)	0.511* (0.106)	0.536* (0.097)
F-test (p-value)		23.1 (0.00)	
Adjusted R^2	0.169	0.364	0.370

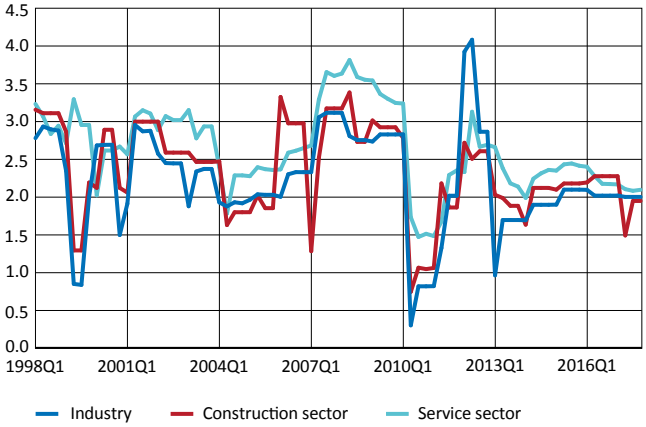
Note. * denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2.

The results for actual wages are thus relatively similar to the results for contractual wages. Even though there seems to be indications that German wages affect Swedish wages, the results are not unequivocal. At least in terms of the short-run relationship, German wages are not significant while a statistical F-test indicates that German wages should be included, similar to the results for contractual wages.

6 The impact of the Industrial Agreement on other sectors

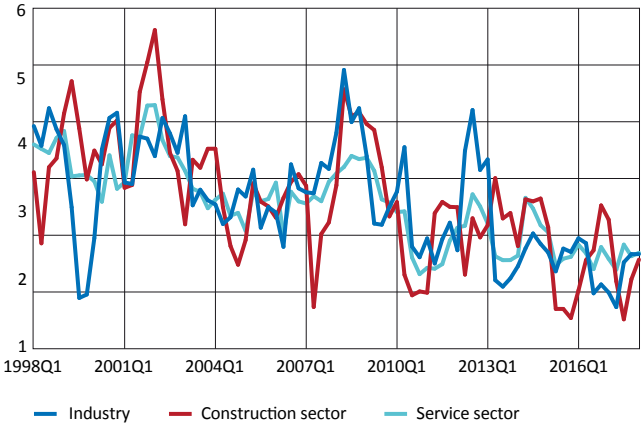
The results for how well German wages sets a norm for industrial wages in Sweden can be viewed in light of how well industrial wages sets a mark for other sectors in the Swedish economy. In this section, it is therefore studied how well the Industrial Agreement serves as a mark for certain other sectors. The sectors studied are the construction and service sectors, because limitations in access to data exclude other sectors. Figures 9 and 10 illustrate contractual and actual wage changes in the construction, service and industrial sectors over time. They show that both contractual and actual wages for the construction and service sectors follow industrial wages well, even though the average increase is higher for the service sector for contractual wages.

Figure 9. Contractual wages in the industrial, construction and service sectors 1998Q1–2017Q4
Growth in per cent



Source: National Mediation Office

Figure 10. Actual wages in the industrial, construction and service sectors 1998Q1–2017Q4
Growth in per cent



Source: National Mediation Office and the Riksbank

The correlation between wage changes in industry, and the construction and service sectors, is also much higher than the correlation between Swedish and German industrial wage changes. For contractual wages, the correlation is 0.79 for the construction sector and 0.64 for the service sector, and for actual wages the correlation is 0.49 for the construction sector and 0.74 for the service sector. The correlation thus falls when switching from contractual wages to actual wages for the construction sector, which indicates that wage drift and composition effects weaken the relationship with industrial wages.

In order to study the relationship statistically, a modification of the models in equation (2) and (3) is used. In the model for industry estimations, the competitor price ppi_t is used as an explanatory variable. Because Sweden is a small open economy, it is not unreasonable to assume that competitor prices for the industrial sector are taken as given by Swedish firms. They can therefore be treated as exogenous variables in the estimation. Because the construction and service sectors largely have their sales in Sweden, it is more difficult to treat competitor price as exogenous. Specifically, the prices are a function of wages and productivity via marginal costs, and we can therefore eliminate the prices from the estimated equations.[17] As in Forslund et al. (2005), we also make the simplified assumption that these

17 For example, a modification of the model in Trigari (2009) gives wage equations in which wage is a function of productivity, the state of the labour market and compensation level.

sectors only produce for the domestic market, which implies that the exchange rate does not affect the surplus in the sectors either.

In the estimated model – besides the state of the labour market, the compensation level and productivity – industrial wages are also used as an explanatory variable.[18] The Industrial Agreement's wages affect wages in the other sectors in the same way as German wages affect industrial wages in the wage equations for industry.

6.1 Estimation results for contractual wages

Estimations for the long-run relationship are shown in Table 6, with the construction sector in columns 1–2 and the service sector in columns 3–4. If industrial wages are used as an explanatory variable, the results change considerably in both sectors. For the construction sector, productivity is significant but with the wrong sign, in the model that does not include industrial wages. The compensation level is also significant. When industrial wages are included, productivity is significant and affects wages positively. Industrial wages affect wages in the construction sector about 1 to 1. The effects of increased productivity are small however and if productivity increases by 1 per cent, wages increase by 0.03 per cent. The coefficient of determination also increases sharply, much more than when German industrial wages are included in the long-run relationship for Swedish industrial wages (see Table 1). For the service sector, in the estimations without industrial wages, an increase in productivity leads to higher wages. If industrial wages are included in the relationship, the coefficient for productivity falls sharply, the coefficient for the compensation level is close to zero, while industrial wages have a strongly positive relationship with wages in the service sector.[19] An increase in industrial wages of 1 per cent leads to an increase in wages in the service sector by about as much, while the effects of increased productivity on wages is at more or less the same level as in the construction sector. The coefficient of determination increases substantially when industrial wages are included in the relationship, and here too much more than when German wages are used in the estimations for industry. An F-test indicates also that industrial wages appear to have significant effects in the long-run relationship.

Table 6. Estimation results for the long-run relationship (2)
Refers to the period 1997Q1–2017Q4 for the construction sector, 2003Q1-2017Q4 for the service sector, contractual wages

	Construction sector		Service sector	
Coefficient	**Standard model**	**With industrial wages**	**Standard model**	**With industrial wages**
β_c	3.728* (0.446)	−0.189* (0.084)	−16.357* (5.095)	−0.377* (0.098)
β_z	−0.549* (0.075)	0.027* (0.013)	2.759* (0.834)	0.062* (0.016)
β_{ls}	0.006 (0.012)	−0.003* (0.001)	−0.119 (0.085)	−0.001 (0.001)
β_{rr}	1.041* (0.083)	−0.035 (0.021)	−0.490 (0.610)	−0.056* (0.007)
β_{wInd}	-	1.085* (0.020)	-	1.191* (0.004)
F-test (p-value)		1 374.2 (0.00)		39 128 (0.00)
Adjusted R^2	0.9510	0.9996	0.6729	0.9999

Note. Engle and Granger (1987) regression, standard deviations in brackets.
* denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2, and 3 and 4, respectively.

18 The labour shortage measure is the National Institute of Economic Research's measure of labour shortage in the service sector and construction sector, respectively.

19 Cointegration test for contractual wages in the construction sector when industrial wages are included in the cointegrating relationship gives cointegration at the 5 per cent level (test–3.64, p-value 0.03); without industrial wages cointegration at the 5 per cent level (test–4.06, p-value 0.01). Cointegration tests for contractual wages in the service sector when industrial wages are included in the cointegrating relationship gives cointegration on the 1 per cent level (test–4.22, p-value 0.008); without industrial wages no cointegration (test–1.76, p-value 0.71). The cointegration tests indicate cointegration, apart from for the service sector when industrial wages are not included in the relationship.

In terms of the short-run relationship, industrial wages give qualitatively similar effects as in the long-run relationship, see Table 7. The coefficient of determination increases much more than when German industrial wages are included in the estimations for industry (see Table 2). Industrial wages affect wages in the construction and service sectors positively, unlike the estimations for industry in which German wages do not have any significant effects on Swedish industrial wages. An F-test indicates also that industrial wages have significant effects in the short-run relationship.

Table 7. Estimation results for the short-run dynamic regression (3)
Refers to the period 1997Q1–2017Q4 for the construction sector, 2003Q1–2017Q4 for the service sector, contractual wages

	Construction sector		Service sector	
Coefficient	**Standard model**	**With industrial wages**	**Standard model**	**With industrial wages**
α_c	0.016* (0.002)	0.0003 (0.001)	0.013* (0.004)	−0.004* (0.002)
α_z	−0.021 (0.014)	−0.004 (0.007)	0.027 (0.033)	−0.002 (0.012)
α_{ls}	0.002* (0.001)	0.0001 (0.0004)	0.001 (0.001)	0.0002 (0.001)
α_{rr}	0.020 (0.012)	−0.014* (0.006)	0.025 (0.015)	−0.010 (0.006)
α_{wlnd}	-	0.716* (0.044)	-	0.835* (0.045)
α_{ε}	−0.781* (0.238)	−0.899* (0.111)	−1.851 (1.187)	−1.231* (0.410)
α_{wlag}	0.335* (0.080)	0.301* (0.037)	0.493* (0.137)	0.430* (0.047)
F-test (p-value)		269.1 (0.00)		350.1 (0.00)
Adjusted R^2	0.284	0.845	0.192	0.904

Note. * denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2, and 3 and 4, respectively.

To sum up, the estimations strongly indicate that the Industrial Agreement sets a norm for the construction and service sectors. In Tables 6 and 7, industrial wages are always significant, and the models' explanatory value increases sharply if they are included. Results from statistical F- and t-tests also indicate that they should be present in the wage equations.

The results are similar for actual wages; see Appendix C. Industrial wages have effects both on contractual wages and the actual wages in the construction and service sector.

The effect of industrial contractual wages on other sectors in Sweden thus appears to be stronger than the effects of German industrial wages on Swedish industrial wages. The correlations for wage changes in Swedish industry and other sectors are much higher than the correlation between Swedish and German industrial wages. Swedish industrial wages affect wages in other sectors essentially on a one-to-one basis in the long run, while the effect of German industrial wages on those of Sweden is weaker. In the short run, industry wage changes have a strong impact on wage changes in other sectors, while the effects of changes in German industrial wages on Swedish industrial wage changes are small and not significant. The coefficient of determination also increases much more when industrial wages are included in both the long-run and short-run relationship for both the construction and service sectors, compared with the estimations for industry when German wages are included.

7 Summary and conclusions

This article studies wage formation in Sweden since the Industrial Agreement was reached in 1997. Wage equations are estimated to attempt to obtain an understanding of what determines wages different sectors. The Industrial Agreement has functioned as intended in that wages in other sectors are largely explained by industrial wages. Industrial wages thus provide a substantial increase in the explanatory power for wages in both the construction and service sectors, compared with models that are estimated without the inclusion of industrial wages. Industrial wages, which set the mark, depend on the surplus produced by firms. Because industry is export-dependent, this surplus depends on the exchange rate, competitor prices and productivity. There has been a debate about whether German industrial wages could have a direct impact on Swedish wages besides the effects via competitor price. In this article, the empirical support for such an assertion has been studied. The empirical analysis provides some but not unequivocal support for determining with certainty that German nominal wages have direct influence on Swedish nominal wages. An in-depth analysis is thus needed to examine whether this is the case. The empirical analysis however provides unambiguous support for there being a strong and statistically significant relationship between contractual Swedish industrial wages and contractual wages for the euro area. Contractual German industrial wages thus do not appear to have a unique position for Swedish contractual industrial wages; rather, the important factor appears to be the contractual wages for the entire euro area. By virtue of its size, however, Germany of course has great influence on contractual wages in the euro area.

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Appendix A – Estimations with CPI

In this section, estimations are described for a model in which the price level in terms of CPI is used as an explanatory variable in the equations (2) and (3). In the regression, the nominal compensation level is replaced by the replacement rate, because the price level captures nominal factors. The estimations for the long-run relationship for contractual wages are shown in Table A1 for the period 1997Q1–2017Q4. Both the model without German wages and the model with German wages have a high explanatory value. German wages also have a positive effect on Swedish wages.

Table A1. Estimation results for the long-run relationship (2)
Refers to the period 1997Q1–2017Q4, contractual wages

Coefficient	Standard model	With German wages
β_c	−7.725* (1.245)	−3.514* (0.448)
β_z	0.195* (0.070)	0.094* (0.020)
β_e	−0.034 (0.126)	0.008 (0.038)
β_p	−0.922* (0.428)	0.292 (0.162)
β_{kpi}	2.393* (0.399)	−0.503* (0.238)
β_{ls}	0.055* (0.015)	−0.005 (0.006)
β_{rr}	−0.194 (0.162)	0.001 (0.053)
β_{wDE}	-	0.913* (0.062)
F-test (p-value)		66.6 (0.00)
Adjusted R^2	0.989	0.999

Note. Engle and Granger (1987) regression, standard deviations in brackets.
* denotes significance at the 5 per cent level.

In the standard model, competitor prices have a sign that conflict with theory. German wages are significant, and affect Swedish wages at almost one to one. A statistical F-test indicates however that German wages should be present in the regression.

Estimations for the short-run relationship in (3) are shown in Table A2. The replacement rate affects wage changes significantly in both models. The second column describes the results when German wages are also included. Competitor prices also affect wages positively when German wages are included in the long-run relationship. However, the coefficient for the change in German wages is not significantly different from zero, and an F-test also indicates that German wages should not be included in the relationship.

Table A2. Estimation results for the short-run dynamic regression (3)
Refers to the period 1997Q1–2017Q4, contractual wages

Coefficient	Standard model	With German wages
α_c	0.021* (0.003)	0.021* (0.004)
α_z	0.019 (0.016)	0.014 (0.016)
α_e	−0.003 (0.017)	−0.013 (0.017)
α_p	0.073 (0.052)	0.107* (0.051)
α_{ls}	−0.003 (0.002)	−0.004 (0.002)
α_{rr}	0.042* (0.018)	0.046* (0.018)
α_{wDE}	-	−0.000 (0.112)
α_{kpi}	−0.155 (0.095)	−0.189* (0.095)
α_ε	−0.173* (0.066)	−0.628* (0.225)
α_{wlag}	0.146 (0.108)	0.143 (0.108)
F-test (p-value)		1.23 (0.27)
Adjusted R^2	0.127	0.130

Note. * denotes significance at the 5 per cent level.

Appendix B – Estimations with contractual wages for the euro area

In this section, estimations are described for a model in which German contractual wages are replaced by contractual EMU wages in equations (2) and (3).[20] Estimations for the long-run relationship in model (3) are shown in Table A3.

Table A3. Estimation results for the long-run relationship in equation (2)
Refers to the period 1997Q1–2017Q4, contractual wages

Coefficient	Standard model	With EMU wages
β_c	−4.210* (0.651)	−0.292 (0.214)
β_z	−0.018 (0.072)	−0.018 (0.013)
β_e	0.048 (0.079)	−0.009 (0.016)
β_p	0.943* (0.118)	0.105* (0.044)
β_{ls}	0.016 (0.014)	−0.008* (0.003)
β_{rr}	0.448* (0.062)	0.090* (0.019)
β_{wEMU}	–	0.873* (0.040)
F-test (p-value)		190.2 (0.00)
Adjusted R^2	0.9909	0.9996

Note. Engle and Granger (1987) regression, standard deviations in brackets.
* denotes significance at the 5 per cent level.

Just like for German wages, there is a sharp drop in coefficient β_p for competitive prices, while at the same time the coefficient for EMU wages is strongly positive and highly significant when wages for the euro area are included as an explanatory variable; if wages in the euro area increase by 1 per cent, those in Sweden rise by just shy of 0.9 per cent. The relationship is thus stronger than for German wages. The coefficient for competitor price also declines more when wages for the euro area are used, compared with when German wages are used. The F-test also clearly indicates that EMU wages should be included.[21]

Estimations for the short-run relationship in model (3) are shown in Table A4. The compensation level affect wage changes significantly in both models, and the coefficient increases when wages for the euro area are included. When wages for the euro area are included, the coefficient of determination increases much more than in the estimations with German wages in Table 2. Changes in wages for the euro area also have a strongly positive and significant effect on changes in Swedish contractual industrial wages. Also, the F-test indicates clearly that they should be in the regression.

To sum up, it appears that the relationship between Swedish contractual industrial wages and contractual wages for the euro area is much stronger than the relationship between Swedish and German industrial wages.

20 No series for the same geographical area for actual wages was available and therefore the estimation is only done for contractual wages.
21 Tests (ADF test, with trend) show that there is cointegration when wages for the euro area are included (at the 0.1 per cent level, critical value –4.83).

Table A4. Estimation results for the short-run relationship in equation (3)
Refers to the period 1997Q1–2017Q4, contractual wages

Coefficient	Standard model	With EMU wages
α_c	0.024* (0.003)	−0.003 (0.004)
α_z	0.008 (0.015)	0.004 (0.012)
α_e	−0.019 (0.017)	−0.009 (0.013)
α_p	0.038 (0.034)	0.033 (0.027)
α_{ls}	−0.003 (0.002)	−0.001 (0.002)
α_{rr}	0.036* (0.016)	0.059* (0.012)
α_{wEMU}	-	0.881* (0.118)
α_ε	0.219* (0.075)	−0.776* (0.264)
α_{wlag}	−0.059 (0.111)	0.183* (0.081)
F-test (p-value)		49.3 (0.00)
Adjusted R^2	0.199	0.521

Note. * denotes significance at the 5 per cent level.

Appendix C – The effect of the Industrial Agreement on other sectors – actual wages

Compared with the estimations for contractual wages, the results are qualitatively similar for both sectors, see Tables A5 and A6. Industrial wages give a sharp increase in the explanatory value and the coefficient is significantly different from zero, both in the long-run relationship and short-run relationship.[22]

Table A5. Estimation results for the long-run relationship (2)
Refers to the period 1997Q1–2017Q4 for the construction sector, 2003Q1–2017Q4 for the service sector, actual wages

	Construction sector		Service sector	
Coefficient	**Standard model**	**With industrial wages**	**Standard model**	**With industrial wages**
β_c	4.899* (0.648)	−0.093 (0.290)	−18.818* (5.960)	−0.352 (0.235)
β_z	−0.714* (0.109)	0.005 (0.044)	3.185* (0.976)	0.054 (0.038)
β_{ls}	0.006 (0.017)	−0.004 (0.004)	−0.136 (0.099)	−0.002 (0.002)
β_{rr}	1.479* (0.121)	−0.005 (0.075)	−0.607 (0.713)	−0.041* (0.013)
β_{wInd}	-	0.963* (0.047)	-	0.957* (0.005)
F-test (p-value)		222.2 (0.00)		15 437 (0.00)
Adjusted R^2	0.9456	0.9975	0.6564	0.9999

Note. Engle and Granger (1987) regression, standard deviations in brackets.
* denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2, and 3 and 4, respectively.

Table A6. Estimation results for the short-run dynamic regression (3)
Refers to the period 1997Q1–2017Q4 for the construction sector, 2003Q1–2017Q4 for the service sector, actual wages

	Construction sector		Service sector	
Coefficient	**Standard model**	**With industrial wages**	**Standard model**	**With industrial wages**
α_c	0.032* (0.003)	0.021* (0.003)	0.008* (0.004)	0.002 (0.002)
α_z	0.018 (0.021)	0.031 (0.018)	−0.005 (0.026)	−0.031* (0.015)
α_{ls}	−0.001 (0.001)	−0.002* (0.001)	−0.001 (0.001)	−0.0001 (0.001)
α_{rr}	−0.012 (0.017)	−0.031* (0.015)	0.019 (0.012)	−0.009 (0.007)
α_{wInd}	-	0.369* (0.068)	-	0.640* (0.063)
α_ε	−0.346* (0.101)	−0.383* (0.086)	−1.866* (0.510)	−1.376* (0.290)
α_{wlag}	0.078 (0.088)	0.016 (0.075)	0.732* (0.109)	0.292* (0.075)
F-test (p-value)		29.2 (0.00)		103.3 (0.00)
Adjusted R^2	0.140	0.378	0. 462	0.831

Note. * denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2, and 3 and 4, respectively.

22 Cointegration for actual wages in the construction sector when industrial wages are included in the cointegrating relationship gives cointegration on the 5 per cent level (test–3.88, p 0.02); without industrial wages in the cointegrating relationship cointegration at the 1 per cent level (test–4.14, p 0.008). Cointegration for actual wages in the service sector when industrial wages are included in the cointegrated relationship gives cointegration on the 1 per cent level (test–4.87, p 0.001); without industrial wages no cointegration (test–1.73, p 0.72). Just as for contractual wages, the variables appear to be cointegrated, apart from for the service sector when industrial wages are not included in the relationship.

F-tests for whether industrial wages should be included clearly indicate that this is the case. Just as for contractual wages, industrial wages seem to have significant effects in both the long-run relationship and short-run relationship.

Appendix D – Synchronisation of Swedish and German wages

Table A7 shows the contract date and term of Swedish and German wage contracts. The table contains the data that forms the basis for Figure 7 in the main text.

Table A7. Swedish and German wage contracts in industry
Time of agreement, contract length and start date

Sweden	Germany
Jan 95, 36 months, valid from 1 Apr 95	Mar 95, 24 months, valid from 1 Jan 95
	Dec 96, 24 months, valid from 1 Jan 97
Jan 98, 34 months, valid from 1 Apr 98	
	Feb 99, 14 months, valid from 1 Jan 99
	Mar 00, 24 months, valid from 1 Mar 00
16 Jan 01, 38 months, valid from 1 Feb 01	
	May 02, 22 months, valid from 1 Mar 02
18 Mar 04, 36 months, valid from 1 Apr 04	Mar 04, 26 months, valid from 1 Jan 04
	Apr 06, 13 months, valid from 1 Mar 06
15 Mar 07, 36 months, valid from 1 Apr 07	May 07, 19 months, valid from 1 Apr 07
	Nov 08, 18 months, valid from 1 Nov 08
20 Mar 10, 22 months, valid from 1 Apr 10	Feb 10, 23 months, valid from 1 May 10
12 Dec 11, 14 months, valid from 1 Feb 12	
	Dec 12, 13 months, valid from 1 Apr 12
27 Mar 13, 36 months, valid from 1 Apr 13	May 13, 20 months, valid from 1 May 13
	Feb 15, 15 months, valid from 1 Jan 15
31 Mar 16, 12 months, valid from 1 Apr 16	May 16, 21 months, valid from 1 Apr 16
31 Mar 17, 36 months, valid from 1 Apr 17	
	Feb 18, 27 months, valid from 1 Jan 18

Sources: National Mediation Office, own data and Bundesbank

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