Financial Stability Report 2019:1

The Riksbank's Financial Stability Report

The Riksbank's Financial Stability Report is published twice a year. The Report describes the Riksbank's overall assessment of the risks and threats to the financial system and of the system's resilience to them. The stability analysis is therefore an instrument that is directly linked to the Riksbank's task of promoting a safe and efficient payment system. By publishing the results of its analysis, the Riksbank wishes to draw attention to, and warn of, risks and events that might pose a threat to the financial system, and to contribute to the debate on this subject.

The Executive Board of the Riksbank discussed the report on two occasions – on 8 and 20 May 2019. The report takes into account developments up to and including 17 May 2019. The report is available on Sveriges Riksbank's website, www.riksbank.se. It can be downloaded in PDF format. The Financial Stability Report 2018:1, which is also available from the Riksbank's website, includes a glossary.

The Riksbank and financial stability

- The Riksbank has a mandate from the Riksdag (the Swedish parliament) to promote a safe and efficient payment system. Achieving this requires a stable financial system in order to ensure that payments and the supply of capital function well. In practice, this task means that the Riksbank is responsible for promoting financial stability. The Riksbank defines financial stability as meaning that the financial system is able to maintain its basic functions – the mediation of payments, the conversion of savings into funding and risk management – and is also resilient to shocks that threaten these functions.
- The Riksbank is also the authority with the capacity to give liquidity support to individual institutions if problems arise that threaten financial stability. To be able to do this in the best possible way, the Riksbank needs to be well prepared for crises by having an efficient crisis organisation with good information channels and tools for analysis, as well as well-developed cooperation with other authorities.
- The Riksbank does not have the sole responsibility for promoting financial stability. It shares this responsibility with the Ministry of Finance, Finansinspektionen (FI, the Swedish financial supervisory authority), and the Swedish National Debt Office. The Ministry of Finance is responsible for the regulation of institutions, Finansinspektionen for the supervision of financial institutions and the Swedish National Debt Office for the government's management of banks in crisis. The interaction between the authorities is important both in the preventive work and in the event of crisis management. The same also applies internationally, as financial institutions increasingly operate across national borders.
- The financial system plays an important role in the economy. It is necessary to have a stable and smoothly running financial system for the economy to function and grow. A serious crisis in the financial system is liable to entail extensive economic and social costs.
- The financial system is sensitive. This sensitivity is due to the vulnerability of central parts of the system, such as banks and markets. Banks are vulnerable mainly because they fund their operations at short maturities but lend at longer maturities. This imbalance makes the banks dependent on the general public and the market having confidence in them. If the market agents' confidence in their counterparties or for the financial instruments traded on the market declines, trading may suddenly come to a halt. The various parts of the financial system are also closely interconnected, for instance in that financial institutions borrow from and trade with one another to such a large extent. This means that problems that arise in one institution or market can rapidly spread throughout the system. Contagion effects may also rise in that confidence will fall in general with regard to similar activities.
- The combination of the sensitivity of the financial system and the large potential costs of a financial crisis mean that the state has a particular interest in preventing threats to financial stability. This is because banks and other market agents do not have an incentive to give full consideration to the risks to financial stability to which they are contributing. This is because a part of the costs of a financial crisis fall to others both within and outside the financial system. If a crisis occurs, the government needs to be able to manage it at the lowest possible cost.
- The Riksbank analyses the stability of the financial system's on a continuous basis for the early detection of changes and vulnerabilities that could lead to a crisis. The main focus of the analysis is on the major banks in Sweden and on the markets and infrastructure that are important for their funding and risk management.
- In some cases the Riksbank recommends specific measures to counteract risks. These recommendations may be based on the current economic situation. But they may also relate to more structural circumstances and stem from current regulatory issues. The recommendations can be aimed at banks as well as at other market agents, legislators and other authorities.

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STABILITY ASSESSMENT SUMMARY AND RECOMMENDATIONS

Risks abroad may affect financial stability

The good economic activity in Sweden and abroad is holding up well but has now entered a phase with lower growth rates. The weaker economic outlook and inflation prospects have led central banks to signal more expansionary monetary policies after a period in which many of them started to raise their policy rates. A longer period of low interest rates may increase the risk for excessive risk-taking and over-valued asset prices, among other things. Such a development increases the probability of major price falls and problems for financial stability.

Indebtedness in the corporate sector has increased worldwide since the financial crisis. Loans to highly indebted companies with low credit ratings, so-called leveraged loans, have increased, especially in the United States. These companies are usually more sensitive to unexpected events, downturns in economic activity or deteriorating financial conditions than companies with lower indebtedness.

Uncertainty regarding the trade conflict between the United States and China has recently risen again. In addition, the structural problems in the European banking sector remain, as do the problems of weak public finances in several European countries, for example in Italy. The management of the economic and financial effects of the United Kingdom's withdrawal from the EU has thereby been postponed as the EU has given the United Kingdom more time to decide on a withdrawal agreement, but uncertainty persists.

High household indebtedness forms the greatest risk

The Riksbank deems that Swedish households' high indebtedness remains the greatest risk in the Swedish economy. However, since the autumn, the rate of increase in lending to households with housing as collateral has slowed down slightly. On the other hand, consumption loans are continuing to grow rapidly. All in all, debts with housing as collateral are now growing at about the same rate as household incomes, 5.6 and 5.3 per cent respectively in 2018. The lower housing prices and more stringent amortisation requirement introduced in March 2018 have contributed to new mortgage borrowers now amortising more of their mortgages and taking on less debt in relation to their incomes, compared to the year before.

However, household debt has increased for a long time and households are currently highly indebted, both from a historical perspective and in international comparisons. This means that households are sensitive to changes that affect their finances, such as rising interest rates, rising unemployment and falling housing prices. The development of household indebtedness has gone hand-in-hand with housing prices, which have risen for a long time.

Continued uncertainty on the housing market

Housing prices fell in the autumn of 2017, but have now recovered slightly. The fall in prices has affected housing construction, which has slowed down in 2018 and 2019. However, the supply of newly produced homes is expected to remain high as the construction of housing projects started earlier are completed. At the same time, the number of sales has decreased since the stricter amortisation requirements were introduced, which could indicate that demand is not high enough at the current price level. This could lead prices to fall further.

Structural problems on the housing market require measures in both housing and tax policy

Housing prices and household debt have been rising for a long time due to a poorly functioning housing market and the tax system not being well designed from a financial stability perspective. To address the fundamental causes of this high indebtedness, it is urgent that measures be taken in housing and tax policy.

In conjunction with the new Swedish Government entering power in January, a draft political agreement was published between the Swedish Social Democratic Party, the Centre Party, the Liberal Party and the Swedish Green Party. This agreement contained a number of proposed housing policy measures. In addition, it promised a larger tax reform, among other things with the aim of improving the functioning of the housing market. The proposals are a step in the right direction. But more comprehensive changes than those proposed under the framework of the political agreement are needed to handle the problems on the housing market and reduce the risks with household indebtedness. It is therefore important that the promised reforms are carried out promptly and that new proposed measures for a better functioning housing market are developed.

If housing and tax policy measures are not implemented to the extent necessary and debts again

start to increase at a faster rate, further macroprudential policy measures may become necessary. It is therefore important that Finansinspektionen (FI, the Swedish financial supervisory authority) regularly assesses the effects of its macroprudential policy measures and stands ready to introduce further measures if the situation develops in the wrong direction.

Banks may be affected by problems in the corporate sector

There are vulnerabilities and risks in the Swedish banking system, above all its size, concentration, interconnectedness, limited capital levels and, in some respects, low resilience to liquidity risks. In addition, the banks largely obtain funding on the international capital markets. A large part of which are short-term debts in foreign currencies, which contributes to increase their vulnerabilities.

Alongside lending to households for housing purposes, the banks have significant lending to the corporate sector. Corporate sector indebtedness as a proportion of GDP has increased in recent years and is formed largely of bank loans, although securities borrowing has also increased. The commercial real estate companies are a large share of this increase. At present, development is strong in this sector, but this could change, for example if interest rates increase. The banks extensive lending to the commercial real estate companies means that this sector is important from a stability point of view.

Money laundering affects confidence in the banks

In recent years, several Swedish and Nordic banks have been sanctioned and warned due to shortcomings in their routines against money laundering. At present, FI is investigating insufficient routines against money laundering in SEB and Swedbank. This could lead to sanctions being imposed.

Suspicions about money laundering may even lead to decreased confidence in the banks and a deterioration in their financing opportunities. It is important to survey and remedy any shortcomings in national and regional anti-money laundering activities, and that international actors such as the International Monetary Fund (IMF) are involved to provide analytical support and recommendations.

Vulnerabilities in the banking system require measures

The structural vulnerabilities in the banking system make it important that the banks have enough capital and liquidity. The Riksbank's stress tests of the banks' capital indicate that the banks' credit losses could be comprehensive in a scenario with a deep economic recession (see the article "Stress tests of banks' capital").

The Riksbank continues to consider that the banks need to increase their capital in relation to their total assets and FI should therefore introduce a leverage ratio requirement of 5 per cent.[1] It is also important that foreign supervisory authorities ensure that foreign banks with substantial operations in Sweden are subject to equally high requirements as the Swedish banks.

In addition, it is important that the banks strengthen their resilience to liquidity risks. The Riksbank therefore supports the requirement for a Liquidity Coverage Ratio (LCR) in individual significant currencies that FI plans to introduce. However, FI has not clearly motivated why 75 per cent is regarded as an appropriate level, compared with the 100 per cent that forms the starting point for the total LCR and for the levels in EUR and USD, and which also forms the international standard in this field. The Riksbank therefore thinks that the starting point should be 100 per cent for all significant currencies unless particular reasons suggest otherwise. The banks also need to reduce their structural liquidity risks and it is therefore important that they continue to attain at least 100 per cent in Net Stable Funding Ratio (NSFR).

The infrastructure needs more resilience to risks

The Riksbank's oversight shows that the financial infrastructure works well overall at present, but that there are risks that need to be managed. For the financial infrastructure to continue to be safe and efficient, it is important that the infrastructure systems continue their work of implementing and adopting measures (see the article "Measures needed for a safer and more efficient infrastructure").

In recent years, changes have been made to the financial infrastructure which have made the financial system faster and available over a greater part of the day than previously. At the same time, this is leading to new challenges (see the article "Financial infrastructure undergoing technological changes").

Cyber threats in the financial system

Cyber risks are currently seen as one of the greatest threats to the international financial system and its participants. It is of the greatest importance that authorities, banks and financial infrastructure companies work to prevent cyber threats in their systems. One way of increasing knowledge of threats and risks, and improving resilience, is to conduct tests simulating a cyberattack.

[1] Within the framework of the EU:s so called banking package, a minimum requirement of 3 per cent will be introduced (see the box "The banking package – on the way to Sweden"). The Riksbank's recommendation could take the form of a minimum requirement of 3 per cent with a national buffer requirement of 2 per cent.

Table 1. The Riksbank's recommendations

Household indebtedness
The Government and Riksdag should, as soon as possible, take further measures within housing and tax policy to reduce the risks in the household sector. Macroprudential policy measures adopted should be maintained and Finansinspektionen should stand prepared to adopt further measures.
The banks' capital levels
Finansinspektionen should introduce, as soon as possible, a leverage ratio requirement for the major Swedish banks of 5 per cent. Foreign supervisory authorities should ensure that foreign banks with significant activities in Sweden are subject to equally high requirements.
The banks' liquidity risks
Banks with significant operations in Sweden should continue to reduce their structural liquidity risks and continue to attain at least a Net Stable Funding Ratio (NSFR) minimum level of 100 per cent.
At least once a quarter, banks with significant operations in Sweden should report their LCRs in Swedish krona and other significant currencies, as well as their Net Stable Funding Ratios (NSFRs).

ARTICLE – Measures needed for a safer and more efficient infrastructure

The Riksbank's oversight of the financial infrastructure[2] is founded in the Sveriges Riksbank Act's mandate to promote a safe and efficient payment system and is based on CPMI-IOSCO's international principles.[3]

The financial infrastructure consists of systems that manage payments and transactions with financial instruments. If problems arise in the infrastructure, they can have serious negative consequences for the functioning of the financial system, with substantial costs to society as a result. A well-functioning infrastructure is thus crucial for the stability of the financial system. At the same time, the companies providing infrastructure systems are often alone in offering their services. All in all, this means that these companies and systems are very important for the financial system to function. The Riksbank's oversight involves analysing risks in the financial infrastructure and acting to reduce these risks. The Riksbank sees risks in several of the infrastructure systems and considers it important that the work on reducing these risks continues.

Nasdaq Clearing should, to a greater extent, include liquidation costs[4] when calculating requirements for the capital that must exist to cover losses

Nasdaq Clearing is the only Swedish central counterparty that clears derivatives and repos in Swedish kronor and thus plays an important role in various companies' risk management.[5] If Nasdaq Clearing sufficiently allows for liquidation costs to a greater extent, it will increase the likelihood that there will be enough money to cover the costs that could arise due to the default of a participant. Particularly when participants with large and concentrated portfolios default, liquidation costs can be considerable. It is important that participants contributing to the risk for major liquidation costs also contribute, in advance, capital corresponding to the risk. This will reduce the risk that other participants and the central counterparty itself will have to stand for the potential losses. After the participant default in the autumn of 2018, Nasdaq Clearing has adopted several measures to strengthen its resilience and it is important that this work continues.

Euroclear Sweden should continue implementing measures to modernise its platform for securities settlement

Euroclear Sweden is Sweden's only central securities depository and is thus decisive for trade in securities to work. Euroclear Sweden has adopted measures to reduce the risks associated with obsolete technology and complex structures in the system for securities settlement, for example via expanded processes for the development and testing of the system. It has also decided to modernise the system to achieve a higher degree of flexibility. However, continued risks remain, among other things associated with modernisation. It is therefore essential that Euroclear Sweden promptly pushes the work of modernising the system for securities settlement forwards via concrete measures that will further reduce the risks.

Internal governance and control of the RIX payment system needs to continue to be strengthened

The Riksbank's system for large-value payments, RIX, forms the hub of the Swedish payment infrastructure. RIX is run by the Riksbank as one among many of its activities.[6] It is important that RIX is organised and governed in such a way that there are well-documented routines and resources allocated for focused governance, control and risk management. The Riksbank has observed shortcomings within this area.[7] Work is under way in the Riksbank to mitigate these shortcomings and ensure that the governance and control of RIX are in line with the international standards applicable to systemically important financial infrastructure. It is important that the Riksbank promptly continues with this work.

[2] For more information, see Billborn, J. (2018), The Riksbank's oversight of the financial infrastructure, *Economic Commentaries* No. 7. Sveriges Riksbank.
[3] CPMI/IOSCO (2012), *Principles for financial market infrastructures*. Bank for International Settlements (BIS).
[4] Liquidation costs are costs for settling a defaulting participant's portfolio. Liquidation costs can arise in the form of a risk premium over and above the market price that must be paid when a defaulting participant's portfolio is sold off. When calculating liquidation costs, account must be taken of the financial instruments included in the portfolio.
[5] Clearing signifies all activities from the moment an agreement on a transaction is entered into until it is settled, and is, in practice, a summary of two or more parties' payment commitments.
[6] The part of the Riksbank's activities that is responsible for the operation of the RIX system is organisationally separate from the Riksbank's oversight of the system (see the box "The Riksbank's different roles in relation to the RIX system").
[7] See *Financial Stability Report* 2018:1. Sveriges Riksbank.

VULNERABILITIES AND RISKS IN THE FINANCIAL SYSTEM

The high level of household indebtedness, combined with the banks' substantial exposures to the housing market make the Swedish financial system sensitive to shocks. Moreover, the Swedish banking system is large, concentrated and interconnected, which could reinforce the negative consequences in the event of a shock. At the same time, financial stability in Sweden is affected by developments abroad, as the Swedish financial markets are closely interconnected with the international financial markets. There are also vulnerabilities in the financial infrastructure that can affect the stability of the Swedish financial system.

Vulnerabilities and risks associated with international developments

Sweden is a small, open economy with considerable foreign trade and a financial system that is dependent on international financial markets. Among other things, the banks in Sweden obtain funding on these markets. Economic and political uncertainty abroad may affect economic activity in Sweden and result in the banks finding it difficult to obtain funding if the uncertainty spreads to the international financial markets. This, in turn, could lead to the banks' customers facing higher lending rates or finding it harder to raise loans, which could negatively affect the economic situation in Sweden.

High uncertainty abroad may thus also entail risks for Swedish financial stability. In addition, there are other global phenomena that could affect financial stability in Sweden, including risks of cyberattacks and risks linked to climate change.

The international risk outlook is unchanged

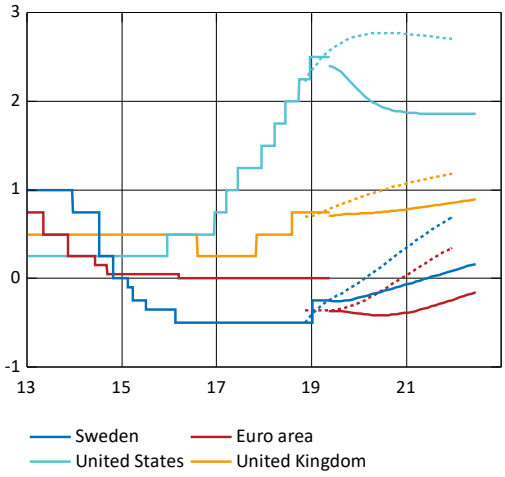
As in Sweden, global economic activity continues to be good, even if growth is expected to slow down in the period ahead.[8] Central banks' communication, together with a slightly more restrained economic outlook and inflation prospects, has contributed towards expectations of low interest rates for a longer period ahead (see chart 1). Partly as a consequence of this, the stock markets recovered over the start of the year after having fallen last year (see chart 2).

The stock markets have, however, fallen during the last weeks, partly as the ongoing trade conflict between the United States and several other countries is continuing to create uncertainty for the prospects for world trade. In the euro area, uncertainty linked to structural problems persists in several countries. Among other things, this includes problems concerning low profitability in the banking sector

[8] See *Monetary Policy Report*, April 2019. Sveriges Riksbank.

Chart 1. Policy rates and rate expectations according to forward rates

Per cent

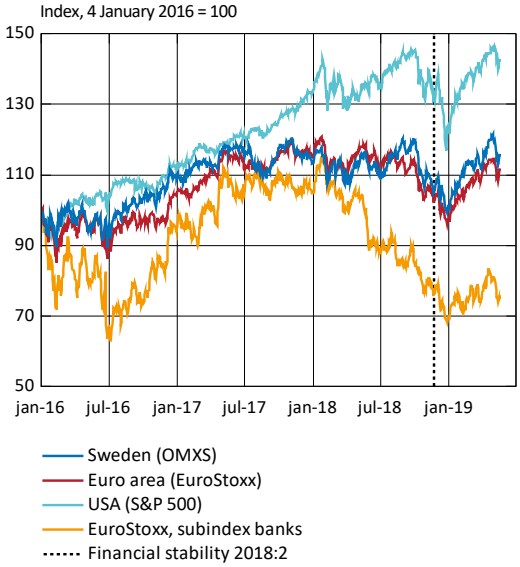


Note. Forward rates describe the expected overnight rate, which does not always correspond to the policy rate (the main refinancing rate for the euro area). Unbroken lines refer to 17 May 2019, broken lines refer to 21 November 2018.

Sources: Macrobond, the national central banks and the Riksbank

Chart 2. Stock market movements

Index, 4 January 2016 = 100



Sources: Macrobond and Thomson Reuters

and weak public finances. In addition, several banks in both the euro area and Sweden are being investigated for insufficient routines against money laundering.

The EU has given the United Kingdom more time to decide on a withdrawal agreement. The handling of the economic and financial effects of the United Kingdom's withdrawal from the EU has thereby been postponed, but uncertainty persists. As far as Sweden is concerned, it has been important that Swedish banks also continue to have access to UK infrastructure as a large part of their interest rate derivatives are cleared in the UK. Consequently, it is positive that British and European authorities have adopted measures so that financial institutions in the EU will have continued access to clearing services in the UK, at least over the short term.

Compared with the situation last autumn, the international risks that could threaten financial stability in Sweden are deemed to be relatively unchanged.

Risks inherent in low interest rates over a long period of time

The financial conditions have long been expansionary in many parts of the world, among other things due to an expansionary monetary policy. A long period of low interest rates may lead actors on the financial markets to search for yield by investing in financial products with a higher risk. Excessive risk-taking among market participants and overvalued assets could lead to risks in the financial system. Such a development would lead to a greater probability of major price falls and risks to financial stability.[12] Policy areas such as macroprudential policy are aimed at adopting measures to increase the resilience of the financial system and thereby make it less vulnerable to major price falls.

One sign of increased risk-taking on the financial markets is that the volume of loans to companies with low credit ratings and/or high indebtedness, so-called leveraged loans, has grown rapidly in recent years, especially in the United States.[13] As demand has grown for assets with higher yields, investor protection for these products has also deteriorated.[14] In general, companies receiving these loans pay a higher interest rate. Investors can either invest directly in the loans and access ongoing interest payments or in the bonds issued,

Climate-related risk is a source of financial risk

Since December 2018, the Riksbank has been a member of the international network for central banks and supervisory authorities in the area of climate risk and financial markets, the Network for Greening the Financial System (NGFS). The NGFS was created in December 2017 and consists of 35 central banks and supervisory authorities from five continents. In its first report, the NGFS established that climate-related risk is a source of financial risk.[9] The network thereby considers that it is one of the tasks of central banks and supervisory authorities to ensure that the financial system is resilient towards climate-related risks.

In April, the NGFS published its second report, which included six recommendations to central banks, supervisory authorities, decision-makers and financial institutions.[10] The recommendations reflect the best practice that the NGFS members have identified to support the financial system to meet the targets of the 2016 Paris agreement. The Paris agreements' long-term goal is to limit global warming to below 2 degrees, but preferably to below 1.5 degrees.

Among other things, the recommendations of the NGFS include integrating climate-related risks into the supervision of financial institutions and oversight of financial stability and achieving a robust and consistent reporting of climate and environment-related information on an international level. In its recommendations, NGFS calls on companies in the financial sector to report climate- and environment-related information in line with the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD).[11] NGFS also encourages decision-makers to develop systems to classify financial assets to help assess which economic activities contribute to the transition to a green and low carbon economy, as well as exposures to climate-related risks.

[9] See *NGFS First Progress Report*, October 2018. Network for greening the financial system (NGFS).
[10] See *A call for action - Climate change as a source of financial risk*, April 2019. NGFS.
[11] See *Recommendations of the Task Force on Climate-related Financial Disclosures*, June 2017. Task Force on Climate-related Financial Disclosures.
[12] Giordani, P. et al. (2015). Asset valuation and financial stability, *Economic Commentaries* no. 15. Sveriges Riksbank.
[13] There is no clear-cut definition of what forms a leveraged loan. It is common to base it on a company's credit rating or indebtedness in relation to earnings before interest, taxes, depreciation and amortisation (EBITDA). A loan can also be classed as leveraged if the yield differential in relation to government lending rates or an average bank lending rate, for example, is high.
[14] This means that fewer conditions are attached to the loans, which is known as covenant light. For a comparison of the characteristics of the US leveraged loan market in 2007 and 2018, see, for example, *Global Financial Stability Report*, April 2019. IMF.

with loans that have been packaged as collateral, so-called Collateral Loan Obligations (CLOs). The investor base for these bonds is, above all, banks and insurance companies, for parts with higher credit ratings, and different types of funds, for parts with lower credit ratings.[15] A number of participants, including the Financial Stability Board (FSB) and the International Monetary Fund (IMF) have expressed unease over the increase of leveraged loans.

Cyber threats and climate change entail risks for the global financial system

Cyber risks are currently seen as one of the greatest risks to the global financial system and its participants. A cyberattack on one participant can rapidly be spread further and have serious consequences for the entire financial system, for example if a virus spreads between different systems.[16]

Another overall threat to the international financial system is climate-related risks, which can affect both insurance companies and banks negatively. Insufficient resilience to these risks may have consequences for financial stability. It is therefore important to include climate-related risks in the supervision of financial institutions and oversight of financial stability (see the box "Climate-related risk is a source of financial risk").

Vulnerabilities and risks linked to household indebtedness

The Riksbank considers that households' high indebtedness continues to form a major vulnerability of the Swedish financial system and is the primary threat to financial and macroeconomic stability. This high indebtedness can be illustrated by the debt-to-income ratio, which is household debt as a proportion of disposable income (see chart 3), and means that households are sensitive to changes that affect their economies, for example rising interest rates, increased unemployment and sharply falling housing prices.

There is broad consensus in Sweden regarding this vulnerability, which has also been highlighted by international bodies such as the IMF, the Organisation for Economic Co-operation and Development (OECD), the European Commission and the European Systemic Risk Board (ESRB).[17]

The high and rising indebtedness is due, among other things, to steeply rising housing prices. These price developments are due to several factors, but above all to an

Structural problems on the housing market

For a long time, increased indebtedness among households has gone hand-in-hand with the strong development of prices on the housing market and is due, in part, to a poorly functioning housing market and to the tax system not being well designed from a financial stability perspective.

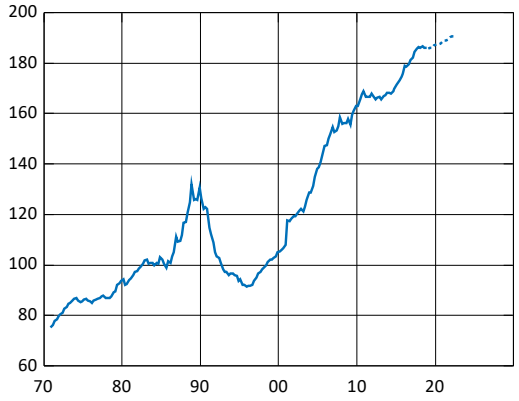
For example, tax deductions for interest payments and low property taxes are contributing towards lower housing costs for home-owners, which is increasing the incentive for households to take on debt. Long queues for rental housing, above all in the major cities, may be contributing towards households feeling forced to purchase homes, which almost always requires taking on debt.

There are also factors that are contributing towards the housing stock not being utilised more efficiently and the supply of housing thereby being limited. The current rent-setting system means low rents for existing tenants while reducing their incentive to move. Stamp duties, such as registration of title and mortgage deeds, and the taxation of capital gains on housing sales, make it more expensive to move and therefore do not promote mobility on the housing market either.

In addition, weak competition in the construction sector, an insufficient supply of land for new construction, and comprehensive and complicated planning processes have long impeded housing construction. The limited supply of housing over a longer period has contributed to higher housing prices and thereby also to higher indebtedness among households.

Chart 3. Household debt

Per cent of annual disposable income



Note. Households' total debt as a share of their disposable income totalled over the past four quarters. The dashed line represents the Riksbank's forecast.

Sources: Statistics Sweden and the Riksbank

[15] *Financial Stability Report,* November 2018. Bank of England.

[16] Some examples include the cyberattacks to which the companies Norsk Hydro and Maersk were subjected. Maersk was affected in 2017, when terminals in several countries were knocked out, causing interruptions and delays for several weeks. In 2019, Norsk Hydro was affected by a cyberattack which resulted in individual operations in the company being stopped entirely, which is calculated to have cost the company about SEK 500 million. Attacks against financial agents, for example banks or infrastructure systems, could also be very costly and problematic to manage.

[17] See, among others, *Country Report Sweden,* February 2019, European Commission and *Financial System Stability Assessment Sweden*, October 2016. IMF.

imbalance between supply and demand for housing. The Riksbank has long warned of the consequences of the poorly functioning housing market, and has pointed out the need for structural measures in housing and tax policy to reduce the risks linked to household debt (see the box "Structural problems on the housing market").

Dampened price development and lower housing construction

Housing prices fell in the autumn of 2017, but have subsequently recovered somewhat (see chart 4). Since the Financial Stability Report in November, prices for both tenant-owned apartments and detached houses have been unchanged in principle. According to the Riksbank's forecast, prices will rise slightly, but uncertainty is high regarding price developments in the period ahead.[18]

The more restrained development of housing prices seen recently has affected housing construction, which had been high in recent years. The number of housing starts has decreased from about 63,000 housing starts in 2017 to about 53,000 housing starts in 2018 (see chart 5). The greatest decline has been in multi-dwelling blocks, where the number of tenant-owned apartment starts has clearly decreased, while the new construction of rented accommodation is relatively unchanged. The development of Stockholm County is of great significance in this context. Construction there decreased by about 6,600 homes, above 34 per cent, between 2017 and 2018. In some other counties, such as Skåne and Västra Götaland, construction has not decreased at all yet (see chart 6). The clear decrease in Stockholm is probably connected with the facts that construction in the county in recent years has largely been concentrated on tenant-owned apartments and that housing developers with Stockholm as primary market are now having problems starting new projects. In the Riksbank's forecast, construction will fall further to about 45,000 homes per year over the next few years. But even if housing construction is expected to decrease in the period ahead, the current rate of construction is high from a historical perspective.

Developments in the housing market are continuing to be uncertain

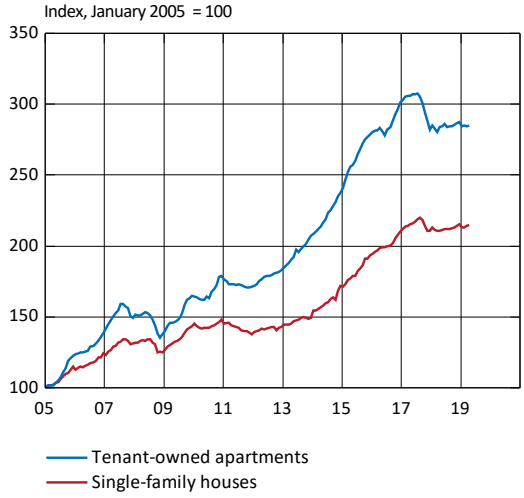
The rapid increase in the construction of multi-dwelling blocks in recent years has led to a rapid increase in the supply of tenant-owned apartments for sale (see chart 7). Supply is expected to remain high as more homes are completed, which will probably contribute to price development continuing to be restrained in the period ahead.

Even if the good growth in households' disposable incomes and continued low interest rates is contributing to maintaining demand for housing, the number of sales, above

[18] See *Monetary Policy Report*, April 2019. Sveriges Riksbank.

Chart 4. Housing prices in Sweden

Index, January 2005 = 100

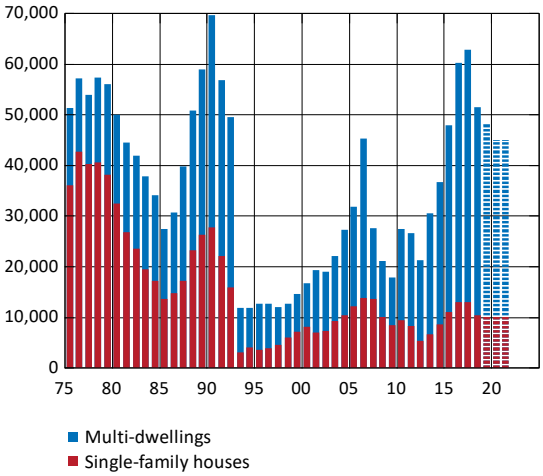


Note. Housing prices are seasonally adjusted.

Sources: Valueguard and the Riksbank

Chart 5. Housing starts

Number

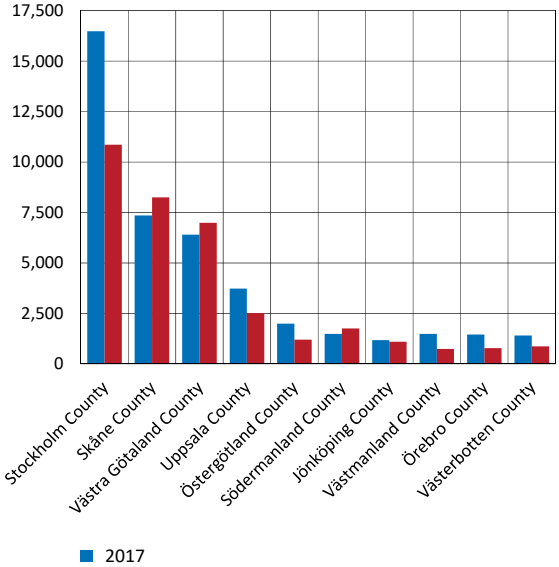


Note. Dashed bars represents the Riksbank's forecast. The outcome for 2018 has not been adjusted for the time delay in reporting.

Sources: Statistics Sweden and the Riksbank

Chart 6. Housing starts by county

Number



Note. The selection signifies the ten counties with the highest number of housing starts in 2017. The outcome for 2018 has not been adjusted for the time delay in reporting.

Source: Statistics Sweden

all in Stockholm, has decreased slightly since March 2018, when the stricter amortisation requirement was introduced. This could indicate that demand is insufficient to meet the increased supply at current price levels, which risks leading to prices falling further.

The continued weak sales figures among most housing developers suggest that households have become more cautious about signing pre-sale agreements to buy newly-produced homes. In several cases, this has led companies to cut prices and to start to offer different forms of discounts. If uncertainty persists on the market for new production and leads to continued price cuts, this, in turn, risks spilling over onto the secondary market in the form of lower prices.

Housing prices are also closely linked to the banks' funding, as the major banks fund their mortgage lending by issuing covered bonds with mortgages as collateral. A larger fall in housing prices would impact the value of the collateral that guarantees these covered bonds. It could also affect confidence in the banks in Sweden which could then be forced to renew their funding at a higher price. However, the fall in prices in the autumn of 2017 and the subsequent slower development of prices have not affected the banks' funding costs to any great extent.

Slower rate of increase but household debt remains high

The development of the housing market has resulted in lending to households with housing as collateral increasing more slowly. On the other hand, consumption loans are continuing to grow rapidly (see chart 8). All in all, this has contributed to the debt-to-income ratio, household debt as a proportion of disposable income, having been relatively unchanged over the last year. The debt-to-income ratio for the entire household sector is currently over 186 per cent (see chart 3) and, if debts through housing cooperatives are included, it increases to just under 206 per cent. This is a high level from a historical perspective. Debt levels are also high in comparison with other countries (see chart 9).

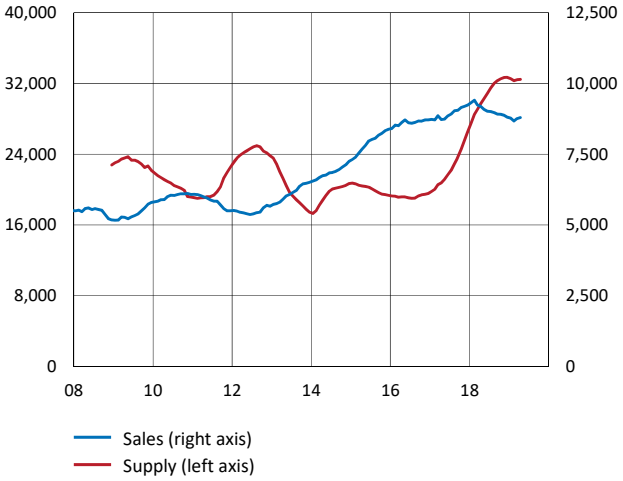
According to the sample from 2018 upon which FI's latest mortgage survey is based, the average debt-to-income ratio among new mortgage borrowers is 398 per cent, which is slightly lower than in the previous year.[19] The proportion of new mortgage borrowers with mortgages exceeding 450 per cent of gross income also fell between 2017 and 2018 (see chart 10). The fact that many new mortgage borrowers are choosing to borrow amounts just below the stricter amortisation requirement indicates that this has affected households' propensity to take out very large loans in relation their incomes.

It is positive, from a stability perspective, that new mortgage borrowers are now borrowing slightly less in relation to their incomes. However, it will take a long time for

[19] *The Swedish mortgage market 2019*. Finansinspektionen.

Chart 7. Turnover and supply of tenant-owned apartments

Twelve-month moving average

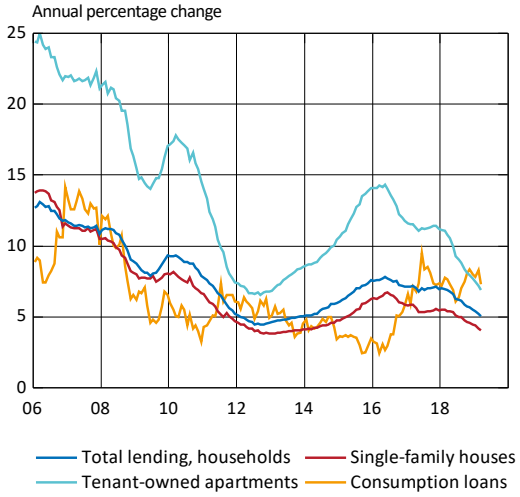


Note. Sales refers to the number of transactions and supply refers to the number of active advertisements on the online residential property trading website, Hemnet.

Sources: Hemnet and Mäklarstatistik

Chart 8. Loans to households per type of collateral in Sweden

Annual percentage change

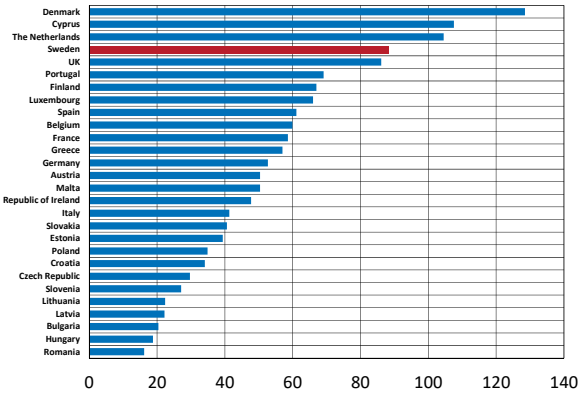


Note. Refers to loans from monetary financial institutions (MFI).

Sources: Statistics Sweden and the Riksbank

Chart 9. Household indebtedness in various countries

Per cent of GDP



Note. Refers to data from 2017.

Source: Eurostat

changes in debt among new mortgage borrowers to have an impact on aggregate indebtedness, as these only form a small portion of all mortgage borrowers. Many households are already highly indebted, while about 70 per cent of household mortgages have been taken out at variable interest rates. This means that rising mortgage rates quickly come to affect households' interest expenditure. Household interest expenditure as a proportion of disposable income is expected to increase over the next few years, albeit from low levels (see chart 11).

High household indebtedness entails great risks

The severity of the consequences of a serious economic slowdown or steeply rising interest rates for households largely depends on the scale of their economic buffers. The household sector presently has large assets and households' total savings are historically high. However, the value of real and financial assets can fall in times of economic unease, while the size of debts remains unchanged. The way that assets and savings are distributed between highly and lowly indebted households is of great significance for risk assessment. It is not possible, however, to analyse this at present, as data on households' assets is not gathered at the individual and household levels. Nevertheless, there is reason to believe that savings are unevenly distributed among households.[20]

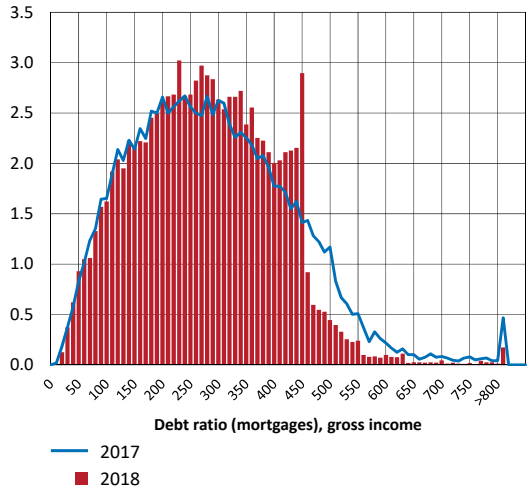
Within the framework of its mortgage survey, FI conducts stress tests for new mortgage borrowers and investigates whether households will have deficits in their finances in various stress scenarios. The results indicate that households continue to have a good capacity to cope with rising interest rates and loss of income due to unemployment. However, the stress tests do not analyse the effects on household consumption. Even if households do not have deficits in their finances, the risk exists that, in a macroeconomic scenario with rising unemployment and falling housing prices, they may heavily reduce their consumption. This applies in particular to those households that are heavily indebted or unprepared for changing economic prospects. If consumption falls rapidly it could, in turn, impair the profitability of Swedish companies and ultimately bring about increased loan losses for the banks. Confidence in the banks could weaken in such a situation, which could negatively affect the banks' access to, and cost of, funding.

The indicator developed by the Riksbank to measure vulnerability in the financial system shows heightened vulnerabilities from a historical perspective, partly due to rising indebtedness and rising real housing prices (see chart 12).

[20] See Sweden selected issues. *IMF Country Report No.17/351.*

Chart 10. Distribution of debt ratios among new mortgage borrowers

Per cent

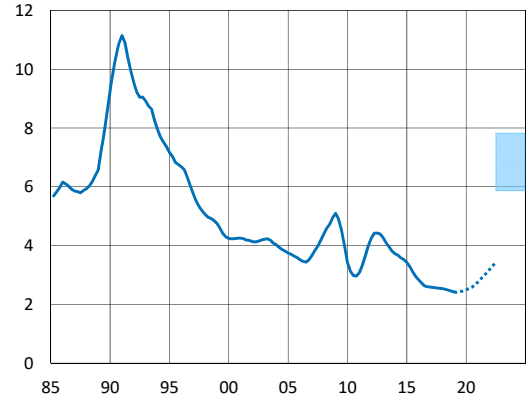


Note. The bars and line show the proportions of new mortgage borrowers within an interval that is 10 percentage points broad. The bar at 450 thereby reflects the proportion of new mortgage borrowers with mortgage debts over 440 but below 450 per cent of income. The clear increase at 800 per cent is due to the interval here including all new mortgage borrowers with a debt-to-income ratio over 800 per cent of income.

Sources: Finansinspektionen and the Riksbank

Chart 11. Households' interest expenditure

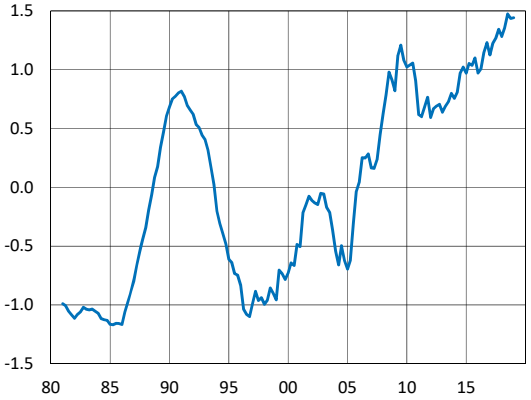
Percentage of annual disposable income



Note. Four-quarter moving average. The broken line represents the Riksbank's forecast. The blue field illustrates an interval for interest expenditure that is calculated on the current debt-to-income ratio, a long-term interval for the repo rate of 2.5–4 per cent and an assumption of a 2 per cent margin between the repo rate and the interest rate faced by households. Interest expenses have been adjusted for tax deductions for interest expenditure.

Sources: Statistics Sweden and the Riksbank

Chart 12. Indicator of financial vulnerability



Note. The indicator is based on deviations from trend in three underlying variables: Lending to households and companies in relation to GDP, real house prices and the relationship between non-stable and stable financing sources for the Swedish banking sector. For more information, see Giordani, P., Spector, E. and Zhang, X. (2017), A new early warning indicator of financial fragility in Sweden, *Economic Commentaries* no. 1. Sveriges Riksbank.

Sources: Statistics Sweden and the Riksbank

Vulnerabilities and risks linked to the corporate sector

Historically high debts in the corporate sector

Good demand and favourable funding conditions both in Sweden and abroad have led to credit growth being high in the Swedish non-financial corporate sector. This has contributed to Swedish companies' debts in relation to GDP having increased and being high from a historical perspective (see chart 13).

It is above all securities borrowing through certificates and bonds that is increasing rapidly, with growth rates of up to 20 per cent in recent years. Just over one-tenth of the bonds were issued with high yields or with no credit ratings. The international trend towards loans to highly indebted companies with low credit ratings, so-called leveraged loans, also occurs in Sweden, albeit on a small scale (see chart 14).

It is fundamentally positive that companies are combining bank loans with other sources of funding, as this spreads risks. At the same time, however, when indebtedness increases, companies become vulnerable to shocks, such as increased funding costs or difficulties in renewing funding. A greater borrowing volume from companies with low credit ratings may also increase the vulnerability of the financial system, as such companies, as a rule, have weak resilience to shocks.

Corporate debts have generally increased slightly less than their assets, which has led to a decrease in loan-to-value ratios in most sectors. Low interest rates are also holding corporate interest rate costs down, which, in combination with good domestic demand, is contributing to favourable conditions for companies. This is also reflected by bankruptcies being few, even if there has been some increase in recent months.

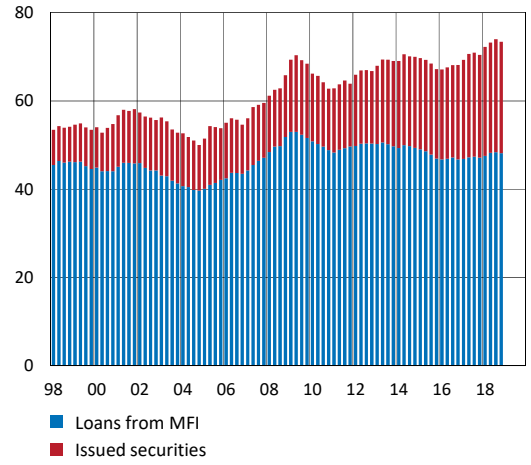
Continued unease in the construction sector

The development of the housing market has led to uncertainty in the construction sector and some companies' equity prices have fallen steeply since the summer of 2017. For example, several of the smaller housing developers are having problems with profitability and difficulties in starting new projects. This is largely connected with households having become more cautious about entering pre-sale agreements to buy newly-produced homes. A number of companies may also encounter problems in renewing their securities borrowing. Some of the companies may also encounter problems in continuing their operations at all. However, as the companies are small, this need not entail any major risks for the Swedish economy as a whole.[21]

Households' increased caution about entering pre-sale agreements has also affected the larger housing developers'

Chart 13. Corporate borrowing

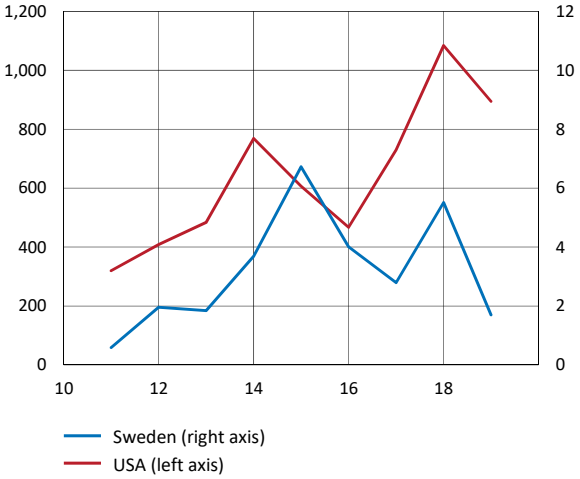
Per cent of GDP



Source: Statistics Sweden

Chart 14. Issued volumes of leveraged loans

USD, billions



Note. In this chart, leveraged loans refers to loans to companies with credit ratings corresponding to BB+ or below. For companies without credit ratings, collateral and type of instrument, among other factors, have been considered when determining the status of loans.

Source: Dealogic

[21] See New production of housing and financial stability. *Financial Stability Report* 2018:2. Sveriges Riksbank.

possibilities of starting new projects. However, unlike the smaller developers, they have been able to maintain a relatively high production volume. They have done this by accepting a lower proportion of pre-sold housing, which means that the companies are exposing themselves to a greater risk if housing prices should fall during the production process.[22] Major price falls on the housing market could thus lead to greater problems in the sector and have a negative impact on the rest of the economy.

Developments on the commercial property market entail risks

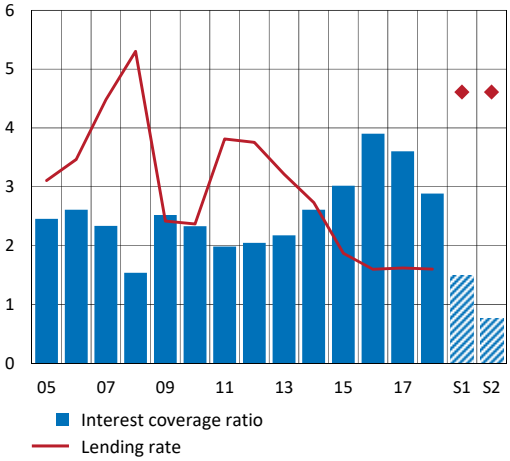
The property companies, which is to say those companies that primarily own and manage properties, have a large proportion of borrowed capital and form the single largest corporate sector to which the major banks in Sweden lend. These companies are also responsible for a large proportion of securities borrowing. This means that they are exposed to interest rate and refinancing risks.

Growth in the commercial property market is currently strong. Rising rents, above all in Stockholm, and few vacancies are contributing to this. Low interest rates are also contributing to low funding costs. The value of the companies' property portfolios has also increased more rapidly than their liabilities, which has contributed to lower loan-to-value ratios. However, as a rule, the property companies have lower earnings in relation to their interest rate costs when compared to companies in other sectors. This makes them sensitive to interest rate rises. In a scenario in which the interest rate increases by 3 percentage points from today's level, for example due to rising risk premiums, with full impact on interest rate costs, the listed property companies' current earnings would not cover their interest rate costs (see chart 15). If vacancies increase or rents fall, their revenues could also be affected.

A structural transformation has been under way in the retail trade for several years. E-Commerce has increased competitiveness across the entire sector. A number of listed Swedish property companies have a relatively large proportion of retail properties in their property portfolios and may be affected negatively by this development. For example, vacancies in shopping centres have increased in recent years, even if they remain on low levels. Investor demand for retail properties has also decreased and the transaction volumes of shopping centres has halved since 2016. Those transactions carried out despite this primarily consist of retail properties in good locations in metropolitan areas and it is above all foreign property companies that have invested in these. A growing proportion of foreign investors could be positive from the perspective of diversification and could contribute to there being more liquidity on the market. But it may also lead to

[22] Blom, K., Frykström, N. and Katinic, G. (2019), Housing developers – how do the business model and revenue reporting work? *Economic Commentaries* No. 4. Sveriges Riksbank.

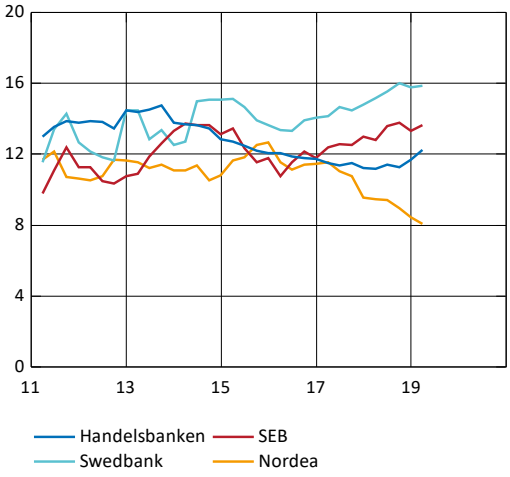
Chart 15. Interest-rate sensitivity of listed property companies
Ratio and percentage, respectively



Note. The lending rate refers to average lending rate to non-financial corporations according to Statistics Sweden's financial market statistics. The interest coverage ratio is calculated by dividing the companies' profits by their interest rate costs. S1 and S2 refer to two different stress scenarios in which the lending rate rises by 3 percentage points (see the rhombuses) and the impact of interest rate adjustments is 50 or 100 per cent, respectively. Revenues are assumed to be unchanged in both scenarios.

Sources: Bloomberg, Statistics Sweden and the Riksbank

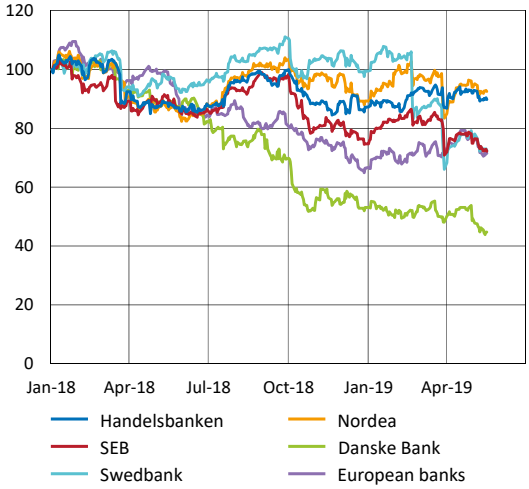
Chart 16. Return on equity for the major banks
Rolling four quarters, per cent



Note. Adjusted for nonrecurring items.

Sources: Bank reports and the Riksbank

Chart 17. Major banks' equity prices
Index, 2 January 2018 = 100



Source: Bloomberg

greater price movements across the entire property market if these investors were to leave the market at the same time.

Vulnerabilities and risks in the Swedish banking system

Since last autumn, the four major banks in Sweden[23] have continued to benefit from good economic growth and low credit losses, which, in turn, has led to low funding costs. In addition, the major banks in Sweden are more cost-efficient than many other banks in Europe (see the box "Structural problems in European banks"). The increased competition on the mortgage market has certainly reduced the banks' mortgage margins[24], but these continue to be high nevertheless. All in all, the four major banks in Sweden also continue to report good returns on equity (see chart 16).

At the same time, several Swedish banks are being investigated for insufficient routines in their work against money laundering, which has led their share prices to fall (see chart 17).

The banking system is large, concentrated and closely interlinked

The Swedish banking system is large compared to other countries in the EU and, including foreign banks' operations on the Swedish market, the banking system's total assets amount to just under 300 per cent of GDP.[25] Its size means that problems in the banking system can have a great impact on the Swedish economy and be very costly to manage.

The banking system is concentrated around four major banks that are closely interlinked. The major banks have the same type of exposure in the form of loans, both mortgages and corporate loans, on their balance sheets. Their borrowers largely pledge homes and other properties as collateral for these loans. Property-related loans amount to about 75 per cent of total lending. In addition, the major banks are among the largest owners of one another's covered bonds. Their exposures to each other in the form of securities amount to about SEK 150 billion, which corresponds to almost 30 per cent of their Common Equity Tier 1 (CET1) capital on average over the last three years (see chart 18). All in all, the banks' interconnectedness entails significant contagion risks in the event of disruptions.

The major banks are exposed to liquidity risks

To a large extent, banks in Sweden obtain funding on the financial markets and are exposed to both short-term and structural liquidity risks. One way of measuring short-term liquidity risks is in terms of liquidity coverage ratio (LCR). LCR

[23] The "major banks in Sweden" refers to Handelsbanken, Nordea, SEB and Swedbank.
[24] *The banks' margins on mortgages*, first quarter 2019. Finansinspektionen.
[25] Excluding foreign banks' operations in each country, the average in Europe is just over 130 per cent and in Sweden about 200 per cent. See Chart A49 in the chart appendix.

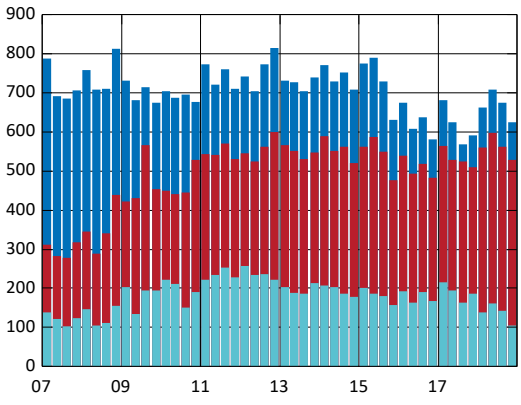
Structural problems in European banks

Since the financial crisis and the subsequent debt crisis, large parts of the European banking system have been characterised by poor profitability. One reason for this is that volumes of non-performing loans increased heavily in conjunction with the crisis periods. Non-performing loans negatively affect the banks' profitability as they give lower interest income when borrowers partly or entirely stop paying according to the agreement. As a rule, an increased proportion of non-performing loans also leads to greater credit losses. In addition, low profitability and uncertainty over the banks' asset quality lead to more expensive bank funding, which further impairs the banks' profitability. As more lending require more equity, unprofitable banks often find it more difficult to issue new credits to improve profitability. This means that banks with a large proportion of non-performing loans risk entering a downward spiral of worsening profitability.

In addition, structural problems exist that are also making it difficult for European banks to improve their profitability. One example is the fragmented German banking market. Private German banks are finding it difficult to compete with state-owned and member-owned local savings banks. These banks are not as heavily regulated, cannot be taken over by private actors and do not have the same profit-maximising interest. Another example is the Italian banking market, where many smaller banks have large volumes of non-performing loans, but not enough capital to be able to manage their problems and return to profitability.

Poor profitability may lead to the banks' supply of credit becoming restricted, which could have a negative impact on economic growth. One way of improving profitability is to consolidate the banking sector. For example, discussions have been held over a merger of the two German banks Deutsche Bank and Commerzbank. Both of these banks have had profitability problems since the financial crisis. The merger did not go ahead, however, because the risks and costs associated with a merger were considered to be too high, for example risks related to high investment costs for integrating the banks. Neither is it certain that a merger would have improved the banks' profitability.

Chart 18. The major banks' counterparty exposures through securities holdings
SEK billion



Note. The chart shows the breakdown of the major banks' total securities holdings on the basis of who issued the securities.

Source: The Riksbank

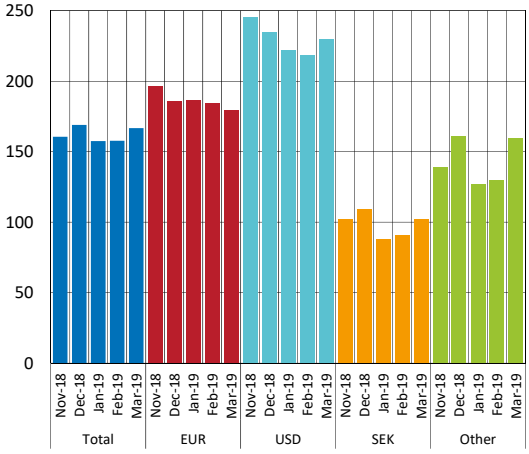
measures the banks' resilience over a short period of liquidity stress. An LCR of 100 per cent means, put simply, that one can manage stressed outflows for 30 days.

FI imposes requirements of 100 per cent LCR in total currencies, euros and US dollars and the four major banks still have high liquidity coverage ratios in these currencies (see Chart 19).[26] At the start of March, FI also proposed the introduction of an LCR requirement in Swedish kronor and other significant currencies[27] apart from the euro and US dollar. These other significant currencies, including the Swedish krona, account for more than half of the banks' liquidity outflows in a stressed scenario,[28] and around two-thirds of their deposits and short-term funding. Under the proposal, the LCR level of these currencies must not fall below 75 per cent.

Some of the major banks have previously had very low LCR in Swedish krona, at times around 10 per cent. However, since the end of last year, the average and lowest LCR level in Swedish kronor has been higher for all banks (see charts 19 and 20).

The banks can increase their LCR by increasing their liquid assets or by extending their funding. Swedish banks largely obtain funding in foreign currency for short maturities, primarily euros and US dollars. The banks exchange parts of this funding into kronor by entering currency swaps with insurance companies, among others, who, in turn, wish to protect their investments in foreign currencies. One way for the banks to increase their LCR in Swedish kronor is to extend the maturity of these currency swaps. In addition to the banks being able to achieve a higher LCR in Swedish kronor this way, it would also reduce the maturity risk in foreign currency for insurance companies. Seen over a longer time, even though, it has been cheaper for the insurance companies to have longer foreign exchange swaps, they have not demanded such agreements with the banks.[29] One reason they have not chosen to do this may be that insurance companies desire more flexibility in how they hedge investments in foreign currency.

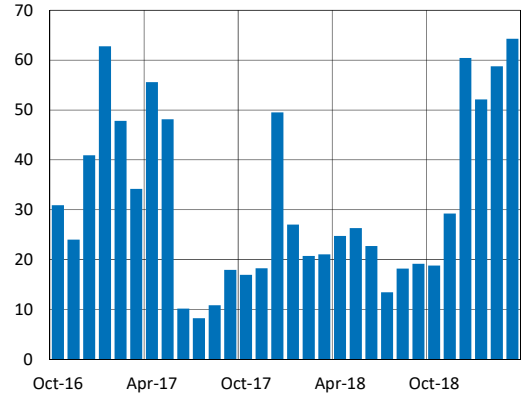
Chart 19. The major banks' LCRs in different currencies
Per cent



Note. Refers to a weighted average.

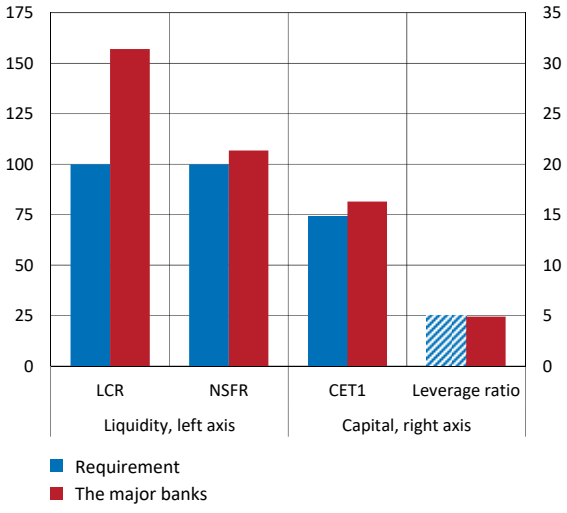
Source: Finansinspektionen

Chart 20. The major banks' daily LCR in SEK, single lowest observation
Per cent



Source: The Riksbank

Chart 21. The four Basel ratios
Per cent, December 2018



Note. CET1 is an abbreviation for Common Equity Tier 1 ratio. Minimum levels for CET1 and actual CET1 are calculated as weighted averages. The minimum level of the leverage ratio has not yet been determined, so the chart shows the level recommended by the Riksbank.

Sources: Bank reports, BIS and the Riksbank

[26] FI places LCR requirements on the Swedish banks Handelsbanken, SEB and Swedbank, among others. Following Nordea's relocation to Finland, the ECB is responsible for the supervision and regulation of Nordea. The Riksbank considers that foreign banks with significant operations in Sweden should be subject to the same requirements as the Swedish banks and therefore also monitors developments for Nordea.

[27] A significant currency is a currency that comprises more than five per cent of a bank's total debts, according to the Basel Accord and European Commission Delegated Regulation (EU) 2015/61 on LCR. The proportion of funding in a specific currency can vary over time and thereby the currencies classified as significant can also vary.

[28] For an example of a stylised stress scenario, see Short-term liquidity risks in the major Swedish banks. Article in *Financial Stability Report* 2017:2. Sveriges Riksbank.

[29] For more information on currency swaps see Eklund, J., Milton, J. and Rydén, A. (2012), Swedish banks' use of currency swaps to convert borrowing in foreign currencies to Swedish kronor, *Economic Review* 2012:2. Sveriges Riksbank and Hilander, I. (2014), Short-term funding in foreign currency by major Swedish banks and their use of the short-term currency swap market, *Economic Review*, 2014:1. Sveriges Riksbank.

Major mismatches in maturity between the banks' assets and liabilities

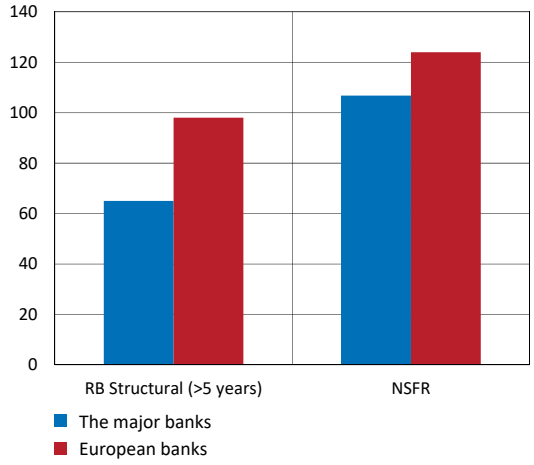
The major banks' structural liquidity risks concern mismatches in maturity between assets and liabilities on the balance sheet. There is no single measure that fully captures the risk inherent in the banks' maturity transformation. Instead, the liquidity risks need to be measured in several different ways. Using these measures, it then becomes possible to compare the Swedish banks' development against each other, as well as against other comparable European banks.

The Basel Committee's method for calculating structural liquidity risks is called the Net Stable Funding Ratio (NSFR). The NSFR places the part of the banks' funding that is deemed to be stable in relation to their illiquid assets. NSFR is currently 105 per cent, on average, for the four major banks, which is above the level recommended by the Basel Committee (see chart 21).[30] The major banks have improved their results according to NSFR in recent years but, at the same time, are below the average for comparable European banks (see chart 22).[31]

However, the Riksbank does not consider that the NSFR fully captures the large mismatch in maturities that exists between the banks' assets and liabilities. This is because the NSFR does not capture the difference in maturity for funding of more than one year. This means, for instance, that funding with a 13-month maturity is regarded in the regulatory framework as equally stable as funding with maturities of longer than 10 years. This has previously been illustrated in a study by the Riksbank that highlighted other measures of structural liquidity risk.[32] If liquidity risks are measured using these alternative measures, the banks' liquidity situation is worse than the NSFR shows (see chart 23). For some of these measures, however, the banks have improved their results over time, but, at the same time, levels remain low (see chart 22).

The major banks in Sweden get worse results than comparable European banks for several reasons. On the asset side, the major banks in Sweden have a greater proportion of loans than many other European banks which, usually, own a greater proportion of securities. Loans often have long maturities, which means that it takes a long time before the bank gets its money back. A large share of loans issued by the major banks, moreover, comprised of mortgages, which usually have a very long maturity, of 30–50 years. On the liability side, the major banks have a comparatively small share of deposits. Instead, they use wholesale funding to a greater extent. For example, the remaining average maturity

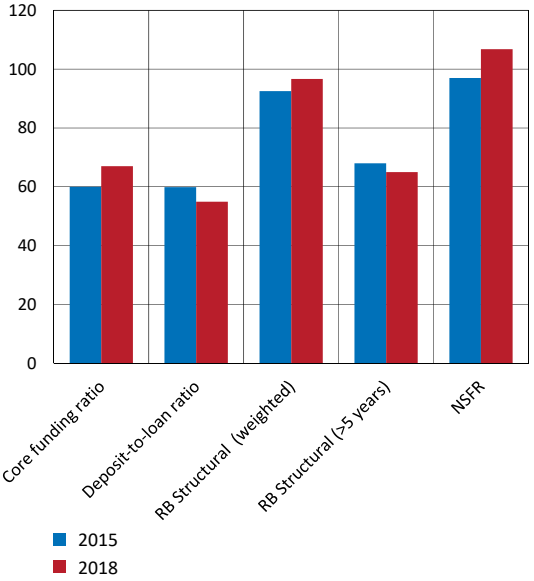
Chart 22. Measures of major banks' and European banks' structural liquidity risk
Per cent, December 2018



Note. A higher level of the measures showed in the chart indicates lower structural liquidity risks. For more information on the measures, see Swedish banks' structural liquidity risks, *Riksbank Studies*, November 2016. Sveriges Riksbank.

Sources: Liquidatum and the Riksbank

Chart 23. The major banks' liquidity measures over time
Per cent, December 2018 compared with December 2015



Note. See note to Chart 22.

Sources: Liquidatum, SNL and the Riksbank

[30] According to the Basel Committee for Banking Supervision, banks shall fulfil 100 per cent in NSFR as of 1 January 2018.
[31] The reference banks are BBVA, Banco Santander, Barclays, BNP Paribas, Commerzbank, Crédit Agricole, Credit Suisse, Danske Bank, DNB, Erste Bank, BPCE, HSBC, Intesa Sanpaolo, KBC, Lloyds, Raiffeisen, RBS, Société Générale, UBS and UniCredit.
[32] The major Swedish banks' structural liquidity risks, *Riksbank Studies*, November 2016. Sveriges Riksbank.

for Swedish covered bonds is about three years, which has not changed to any great extent over the last decade.

All in all, it is important that the banks reinforce their liquidity situation by increasing their liquidity buffers in the currencies where they have lower levels, such as Swedish kronor, and by limiting their maturity transformation to a greater extent.

The banks' capital has not changed significantly

The banks' capital in relation to their risk-weighted assets (Common Equity Tier 1 capital ratio or CET1) has decreased since last autumn due to the risk-weight floor for Swedish mortgages being moved from Pillar 2 to Pillar 1.[33] Capital in relation to risk-weighted assets (Common Equity Tier 1 capital ratio or CET1) amounted to 16.3 per cent at the end of December 2018 in comparison with the requirement[34] of 14.8 per cent (see chart 21).

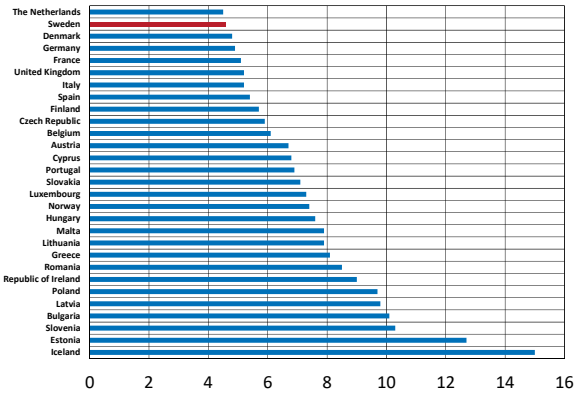
The Riksbank has previously pointed out the importance of introducing a supplementary requirement that is not dependent on risk weights, which is to say a requirement for the leverage ratio, which has also been proposed within the framework for the banking package (see the box "What is the banking package?"). The leverage ratio measured in the major banks was largely unchanged in the first quarter of 2019 in relation to the last six months of 2018, and varies roughly between 4 and 5 per cent between the banks. Compared with many other European countries, the banks in Sweden on average have low leverage ratios (see chart 24). The results of the Riksbank's stress tests show that the major banks' credit losses could be significant in a stressed scenario (see the article "Stress tests of banks' capital"). With a higher leverage ratio in the banking sector, the banks' resilience would increase. An earlier study by the Riksbank, which takes into consideration both social benefit and costs for capital requirements, indicates that a well-balanced leverage ratio for Swedish banks could be in the interval of 5–12 per cent.[36]

Nordic banks under investigation for money laundering

In the summer of 2018, it was discovered that Danske Bank's routines against money laundering had failed in the bank's Estonian branch in the period 2007–2015. At present, FI is investigating SEB and Swedbank for insufficient routines against money laundering. At the same time, other European banks[37] are being investigated for such lack of routines. The

Chart 24. The leverage ratio in various countries

Per cent, December 2018



Note. Refers to weighted average per country.

Source: European Banking Authority (EBA)

What is the banking package?

The banking package is the collective name for several coming changes to the European regulations that must be met by banks wishing to operate in the EU. These regulations primarily affect rules for the banks' capital and liquidity levels, as well as the proportion of eligible liabilities, but other parts of European banking regulations are also covered.

The banking package will primarily implement global agreements in the EU, such as parts of Basel III, but some changes that will only affect banks active in the EU will also be made.

The banking package includes regulatory amendments to strengthen the banking sector's resilience to financial stress. For example, a European leverage ratio requirement is being introduced, as is a requirement for banks, in certain circumstances, to be able to convert a part of their liabilities to capital. The banking package also includes new requirements for the maturities of the banks' funding to correspond to a greater degree with the maturities of their lending, which will strengthen the financial stability of the EU.[35]

For Sweden's part, this involves measures such as the introduction of a leverage ratio requirement of at least 3 per cent of the major banks' exposures, new regulations for the maturities of the banks' funding (NSFR) and a new lowest level for the banks' loss-absorbing capital.

The final contents of the reform package have recently been adopted after just over two years of negotiation. The banking package will now be implemented in stages in the EU member states over the next two years. Some parts will be directly binding in the member states, while other parts must first be implemented in each country's national legislation.

[33] See Risk-weight floor for Swedish mortgages will become a Pillar 1 requirement. Fact box in *Financial Stability Report* 2018:2. Sveriges Riksbank.

[34] The level of the requirement refers to a weighted average, based on the amount of equity, of the requirements for Handelsbanken, SEB and Swedbank. Nordea's capital requirement is now set by the ECB.

[35] For more details, see Edlund, T. and Ferenius, C. (2019), The banking package – on the way to Sweden, *Economic commentaries* No. 3. Sveriges Riksbank.

[36] See Almenberg, J. et al. (2017), Suitable capital ratios in major Swedish banks – new perspectives, *Staff Memo*, May 2017. Sveriges Riksbank.

[37] In Europe, several banks have come under investigation for inadequate routines against money laundering, including ING Groep, ABN Amro, Raiffeisen, Rabobank and several others active in Eastern Europe.

investigations may lead to comprehensive sanctions against the banks. Problems with money laundering may even lead to decreased confidence in the banks and a deterioration in their financing opportunities. It is therefore important that the banks have good routines to prevent and report suspect transactions.

At the same time, the Swedish banks' operations are cross-border and they have large market shares in the Baltic countries. These countries are thus also exposed to problems in Swedish banks, for example if these would have consequences on the banks' credit supply in the countries.

Oversight of money laundering is a particularly large challenge in countries such as Sweden, where the banking sector is comprehensive and cross-border. It is therefore important that the responsible authorities in Sweden have sufficient resources to be able to ensure good and extensive supervision.[38] It is also important that international cooperation works well (see the box "Authorities plan to strengthen international cooperation against money laundering").

The banks to have access to important financial infrastructure in the United Kingdom even after a British withdrawal from the EU

A large percentage of the bonds the banks use to finance themselves have fixed interest rates at the same time as a large part of their lending is at a variable interest rate, for instance household mortgages. This imbalance in interest rate flows entails an interest rate risk that the banks manage by entering into derivative agreements, usually in the form of so-called interest rate swaps. As the Swedish banks clear a large proportion of these interest rate derivatives in the United Kingdom, it is important that they continue to have access to the financial infrastructure of the United Kingdom after the UK withdraws from the EU.

British and European authorities have adopted measures to ensure that EU banks will have continued access to clearing via the central counterparty London Clearing House Ltd (LCH) and the settlement system Continuous Linked Settlement (CLS) in the United Kingdom. This means that UK central counterparties and central securities depositories may provide their services to the EU even if the United Kingdom leaves the EU without a withdrawal agreement. Swedish financial market infrastructures, such as Nasdaq Clearing, Euroclear Sweden and RIX have also taken measures so that their services will not be affected by the United Kingdom's withdrawal from the EU.

Authorities plan to strengthen international cooperation against money laundering

Money laundering is a global problem for the financial system and is also often linked to other serious crimes such as the funding of terrorism, for example. By laundering money, criminal agents want to convert money deriving from criminal activities into assets that can be reported openly. Over the last six months, a number of banks in Europe, not only in the Nordic region but also in Austria, the Netherlands and elsewhere, have been accused of having insufficient routines for the prevention of money laundering.

Due to this, FI is investigating SEB and Swedbank for inadequate routines against money laundering. This issue is also of utmost importance to the Baltic countries as Swedbank and SEB have large market shares in the region.

Banks without sufficient routines for preventing money laundering risk sanctions, fines and confidence problems that can have serious consequences for themselves and for the financial system. Among other things, problems of confidence can make it more expensive for the bank to borrow money or make counterparties unwilling to enter transactions with the bank at all.

It is therefore important that measures are continually adopted to combat money laundering. Legislation has developed over the years and places higher demands on the banks today than it did a few years ago. For example, the banks are required to have good knowledge of their customers and their transactions so as to impede and preferably entirely prevent their operations from being abused for money laundering purposes.

Both supervision and investigations of money laundering crimes mainly take place at a national level. This is an aggravating factor for a country like Sweden, with cross-border banks and transaction flows, as the actors engaged in money laundering often have international networks in which money is moved around to be 'laundered' clean. Stronger cooperation between countries is consequently needed.

Earlier in the spring, FI announced its plans to strengthen the Nordic-Baltic collaboration between authorities concerning money laundering issues. In this work, international actors such as the IMF should be consulted for analytical support and recommendations, for example under the framework of the evaluation and oversight activities conducted by the IMF in its member states. Initiatives are also under way on the EU level to facilitate increased collaboration in this area.

[38] The IMF has previously pointed out the need for further resources for work against money laundering. Sweden: *Financial System Stability Assessment*, November 2016. IMF.

Increased competition and new operations on the banking market

In recent years, changes have taken place on the traditional Swedish banking market. Legal amendments and technological developments have made it easier for new companies, with types of funding and technical platforms other than the traditional banks, to enter different loan markets.

One example is the mortgage market. New players have started to create and manage investment products on behalf of institutional investors.[39] These players are not subject to the same capital requirements as the banks, which reduces their costs for lending to households. The high margins on mortgages have also made it profitable for them to enter the mortgage market. In addition to this, several actors have created new business models to reduce costs linked to traditional bank lending.[40] This means that they sell portfolios with mortgages directly to institutional investors, such as insurance companies, either via a fund structure or in the form of bonds. Institutional investors, with a long investment horizon, may see these products as advantageous as they can both obtain higher returns and reduce the maturity imbalances between assets and liabilities. All in all, this means that the new actors on the mortgage market can offer both lower lending rates to their customers and higher returns to those who invest. As yet, however, this is a matter of small lending volumes.

Fintech credit is another new phenomenon within lending which has appeared over the last few years in Sweden.[41] This involves fintech companies using new technology, such as so-called matching algorithms, to mediate loans to consumers, small businesses or property projects. Unlike the banks, these companies do not use their own balance sheets. Instead, they connect lenders, such as savers, to borrowers via a platform. However, lending volumes from these operations also continue to be low.

A further type of business that has developed in recent years is credit companies, for example banks or non-financial corporations, that purchase portfolios of non-performing loans, often from other European countries. Some of the largest actors in Europe are based in Sweden. These companies purchase the portfolios at a lower price than the loans' original amounts and attempt to regain a larger part of the loans' value by improving the processes for recovering loans. They thus benefit from banks who need to improve their financial positions preferring to sell loans on than to

[39] For more information, see New players on the mortgage market. *Financial Stability Report* 2018:1. Sveriges Riksbank.

[40] New actors on the mortgage market generally invest in more automated processes for lending with the aim of keeping costs down.

[41] No clear-cut definition exists, but many other terms are used such as peer-to-peer lending, marketplace lending and online lending platforms. One broad definition that is used by the BIS and FSB is that fintech credit is credit granting enabled via the fintech sector. See CGFS and FSB (2017), *FinTech credit - Market structure, business models and financial stability implications*.

invest in better processes for recovering the loans. It is important to follow these developments and ensure that these companies have good risk management.

Vulnerabilities and risks linked to the financial infrastructure

The financial infrastructure is a central part of the financial system and consists of systems through which payments and transactions with financial instruments are made. The systems make it possible for individual households, companies and authorities to perform payments and transactions in a safe and efficient manner. In addition, the systems are interlinked in that they are often participants with each other and in that banks and other financial institutions are participants in the infrastructure systems. The systems are therefore often dependent on each other to be able to function without disruptions.

There are vulnerabilities in the financial infrastructure that can affect the stability of the financial system. As the functions that the infrastructure provides are vital for the markets to function well, it is important that they are stable and have a high level of availability.

The Riksbank deems that the financial systems overall have functioned well since last autumn. However, disruptions have occurred (see Chart 25). Apart from the disruptions, there are other risks that need to be managed and resilience needs to be strengthened (see the article "Measures needed for a safer and more efficient infrastructure").

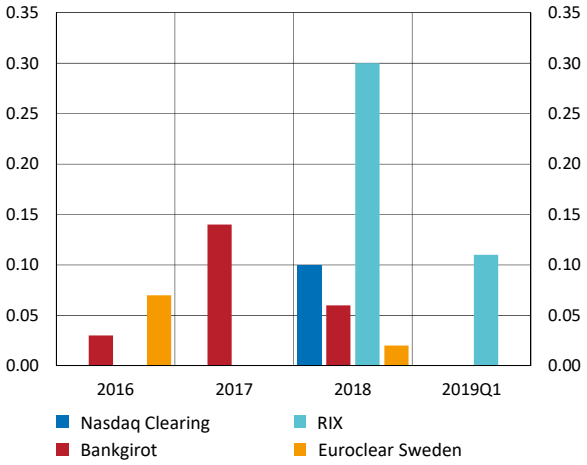
Important to have high availability in infrastructure systems

International standards and other regulations include requirements that infrastructure systems should be able to resume activities within two hours of an interruption. Interruptions create risks in the financial system and should therefore be remedied as soon as possible, assuming that this takes place in a safe and efficient way. Over the last two quarters, a number of interruptions have occurred in the RIX payment system (see light blue bars in Chart 25), two of which have exceeded two hours and entailed increased risks for participants in the system.

Risk management is vital in an infrastructure system and, to achieve good risk management, clarity is needed in governance, responsibility and control. In an organisation like the Riksbank, with several different activities, there is a risk that the RIX system will not get the clear governance ultimately needed to safeguard good resilience in the system (see the box "The Riksbank's different roles in relation to the

Chart 25. Interruptions to the Swedish infrastructure systems

Per cent



Note. 0 per cent shows that the system has been available the entire time without interruption. 0.2 per cent corresponds to an interruption of 5 hours over a period of one year. 0.2 per cent over one quarter corresponds to about 1 hour and 20 minutes. Outcome for 2019 refers to the first quarter.

Sources: Bankgirot, Euroclear Sweden, Nasdaq Clearing and the Riksbank

The Riksbank's different roles in relation to the RIX system

Oversight and the Riksbank's analysis of the financial infrastructure are based on CPMI-IOSCO's international principles for financial market infrastructures (PFMI). Among other things, PFMI includes requirements for how governance and control are to be formulated, as well as how financial and operational risks are to be managed in an infrastructure system. For some types of financial infrastructure, the international standards have largely been introduced into law, for example the EU regulations EMIR[42] for CCPs and CSDR[43] for central securities depositories.

The Swedish financial infrastructure systems that the Riksbank oversees are the Riksbank's own payment system RIX, the central securities depository Euroclear Sweden, the central counterparty Nasdaq Clearing and the clearing system Bankgirot. The Riksbank deems that it is important for financial stability in Sweden that these systems are safe and efficient and therefore considers that they should live up to the requirements of PFMI.

Unlike the other three systems, the RIX system does not come under the supervision of FI. Oversight is conducted by the Riksbank. However, the Riksbank has different roles in relation to RIX. Not only is the Riksbank owner and operator of RIX, it is also responsible for the oversight of the system. However, the part of the Riksbank's activities that is responsible for the operation of RIX is organisationally separate from the Riksbank's oversight of the system. This means that the Riksbank's Payments' Department is responsible for the operational activities of RIX, while the Financial Stability Department is responsible for oversight. On the other hand, the Executive Board of the Riksbank is principal for both the operational activities of RIX and the oversight of RIX.

[42] Regulation (EU) No 648/2012 of the European Parliament and of the Council of 4 July 2012 on OTC derivatives, central counterparties and trade repositories.
[43] Regulation (EU) No 909/2014 of the European Parliament and of the Council of 23 July 2014 on improving securities settlement in the European Union and on central securities depositories and amending Directives 98/26/EC and 2014/65/EU and Regulation (EU) No 236/2012.

RIX system"). The Riksbank has observed shortcomings in this area and work is therefore under way to review and improve the routines for governance, control and risk management within RIX (see the article "Measures needed for a safer and more efficient infrastructure").

The central securities depository Euroclear Sweden's system for securities settlement has been stable and reliable and has high availability, but there are also risks with the system. As the Riksbank has previously pointed out, the risks in Euroclear Sweden's system come from it being old,[44] inflexible and complex, which means that disruptions may arise when changes are made in the system.[45] A longer interruption to Euroclear's system would risk leading to it not being possible to settle securities transactions. This, in turn, could lead to disruptions to the banks' liquidity supply, as it would then become impossible to settle the securities transactions the banks make to pledge securities to the Riksbank for intraday loans in RIX.

Liquidation costs can give rise to major losses

Central counterparties (CCPs),[46] like the banks, are exposed to credit and liquidity risks. Participant default is a major risk for CCPs, as these can entail major losses for both the CCP and other participants and spread through the financial system. To manage these risks, it is important that CCPs have sufficient capital in the form of so-called pre-financed resources.[47]

In the autumn's Financial Stability Report, the Riksbank urged the Swedish CCP Nasdaq Clearing to carry out a review of its models to ensure it had enough pre-financed resources and also to review the models for calculating margins to be able to set higher requirements. Since then, Nasdaq Clearing has adopted several measures and is conducting a review of its models in the light of the participant default that occurred last autumn.

One further aspect of ensuring that the pre-financed resources are sufficient is linked to costs that can arise from a participant default. If a participant defaults, the CCP must close the defaulting participant's positions, which is to say sell off the participant's portfolio. In conjunction with this, there may arise costs, known as liquidation costs.[48] This particularly applies for portfolios that are large in relation to the market

[44] Several of the systems are from the end of the 1980s.
[45] See, for instance, *Financial Stability Report* 2018:1. Sveriges Riksbank.
[46] Central counterparties have an important role to play in the financial system and are considered systemically important. They act as intermediaries in financial transactions and undertake to supply payments and securities on behalf of their participants, even if the participant were to default. See also *Financial Stability Report* 2018:1. Sveriges Riksbank.
[47] The pre-financed resources are known as a "waterfall". This is called a waterfall because there is a pre-determined order in which the financial resources shall be used. First and foremost the defaulting participant's margins shall be used, secondly the defaulting participant's contribution to the default fund. If this is not enough, then thirdly the part of the CCP's own capital allocated to the waterfall is used and fourthly the other participants' contributions to the default fund. The waterfall must be dimensioned to manage the CCP's two largest participants defaulting at the same time.
[48] Liquidation costs are costs for settling a defaulting participant's portfolio. Liquidation costs can arise in the form of a risk premium over and above the market price that must be paid when a defaulting participant's portfolio is sold off.

they are traded on and when there are few actors in that market.

In its risk management, Nasdaq Clearing has not sufficiently considered that such costs may arise. This means that Nasdaq Clearing itself and other participants risk having to stand for part of the liquidation costs, which was also the case when a participant defaulted in the autumn of 2018. Unless a sufficient number of participants actively take part in the auction, it may be difficult to sell the defaulting participant's portfolio. This may lead to the costs of managing a participant default becoming higher than necessary.

Testing is a way of increasing resilience to cyber risks

Cyber risks are currently seen as one of the greatest threats to the international financial system and its participants, and they thereby also pose a threat to Swedish actors.

The Riksbank has previously carried out surveys among Swedish infrastructure companies to map their resilience to cyber threats, and regularly follows up how the companies are managing the risks. One way of increasing knowledge of current threats and risks, and of improving resilience for individual actors, is to conduct tests simulating a cyberattack. Such tests can be carried out in both a coordinated and standardised manner, and by the market participants (see the box "TIBER-EU tests resilience to cyber threats").

TIBER-EU tests resilience to cyber threats

TIBER-EU (Threat Intelligence-based Ethical Red Teaming) is a framework developed by the ECB that makes it possible to test, in a standardised way, resilience to cyber risks among systemically important infrastructure companies and banks. The test involves the simulation of a cyberattack against a company under controlled forms.

The ECB published the TIBER-EU framework in May 2018 and all relevant authorities in European countries have the possibility of using the framework, which can be adjusted for the country wishing to work with it. Each individual country develops guidelines for tests adjusted to country-specific conditions but based on the ECB framework. For Sweden, a TIBER-SE would then be created.

The main aims of the TIBER-EU framework are to strengthen resilience to cyber threats in the financial sector, standardise and harmonise the implementation of so-called red team testing within the EU, and provide support for cross-border tests. Red team tests involve simulating cyberattacks against organisations' employees, processes and technology. They are a form of penetration testing with a broad approach in which scenarios are developed comprising attacks against an entire organisation.

TIBER-EU can be seen as a complement to other tools that are already used to analyse and strengthen resilience to cyber threats in the financial sector, for example via other forms of penetration tests and cyber surveys.

ARTICLE – Stress tests of banks' capital

Stress tests of banks' capital are important tools for assessing banks' resilience to financial and economic unease. Different authorities use different methods. The Riksbank has also long used various forms of capital stress tests to assess the major banks' resilience and has also continuously developed the methods. However, there are many ways of conducting stress tests and each one has its strengths and weaknesses. This article provides an overall description of the Riksbank's current method and compares it with the stress test carried out by the European Banking Authority (EBA) in 2018. Given the same scenario, the results from the two stress tests differ, with significantly greater negative effects in the Riksbank's stress test. The results thereby clearly illustrate that different methods and approaches can lead to major differences in results. It is not obvious in advance which stress test method will result in the best description of what would happen in a stressed scenario. Different types of stress tests complement each other and it is therefore important to stress test banks using several methods.

The Riksbank conducts stress tests for several reasons

Using stress tests makes it possible to estimate how a bank's economic situation, and thus the bank's resilience, would be affected in a high-stress scenario. For example, it becomes possible to investigate how a bank's capital ratios would be affected during periods of financial and economic unease.

For many years, the Riksbank has conducted different types of stress tests to assess the resilience of individual banks and the banking system as a whole, and it has also continually developed the methods used. As the Riksbank is responsible for ensuring that the payment system is safe and efficient, such tests fulfil an important function. The banks are important participants in the payment system and also have a central role in the financial system in that they provide credit, accept deposits, mediate payments and help customers manage risk. Shocks to the banking system can lead to problems for these functions and in the payment system. At the same time, there are vulnerabilities in the Swedish banking system, and problems in one bank can rapidly spread to other banks (see "Vulnerabilities and risks in the financial system"). All in all, this can affect both financial stability and the conditions for monetary policy. The Riksbank therefore continually analyses the development of the banking system to discover threats and vulnerabilities at an early stage. The stress tests are part of this work.

The Riksbank can provide liquidity support to the banks in a financial crisis. One legal precondition, however, is that the bank receiving liquidity support has enough capital to be able to repay its debts, not just at the moment but also after a longer period of financial stress. In this context, also stress tests are important tools for assessing an individual bank's resilience.

There are different types of stress tests

Stress tests are based on a negative scenario

In most cases, a stress test is based on a scenario that describes a severe but plausible, development for different macroeconomic and financial variables. The idea is that the scenario describes a deep economic recession and/or financial crisis.

When authorities conduct stress tests, the stressed scenario usually assumes that no economic policy measures are adopted and that the banks do not make any changes to their business models. The banks' current ability to manage economic and financial problems without public support measures is thereby tested.

The type of stress test that the Riksbank conducts is known as a top-down stress test, which means that all calculations are made by the Riksbank. This differs from so-called bottom-up stress tests in which the banks themselves make the calculations under the monitoring of the supervisory authority. One example of the latter type of exercise is the EBA stress test implemented in 2018.

Second-round effects can be captured in top-down stress tests

In a top-down stress test, the same method is applied to all banks, making it easier to compare them. It can also be compared to the banks' own calculations. In addition, in a top-down stress test, it is possible to include mechanisms that take account of systemic risks that can arise due to for example second-round effects between banks. It is difficult to take account of this in bottom-up stress tests, as each bank makes its own calculations without considering the results of the other banks. One disadvantage of top-down stress tests is that they are usually based on less detailed data than bottom-up stress tests, which means that some characteristics of the risks in the credit portfolio are not captured to the same degree.

Bottom-up stress tests are based on loan portfolios
A bottom-up stress test can be conducted in many different ways. Internally, the banks work with various loan portfolios, for example the portfolio for mortgages. They also divide the loans into various risk classes. This division is usually made using internal models. Following this, the banks use the internal models to calculate what happens to the various loan portfolios in the stressed scenario. In addition, various restrictions for how the banks may calculate may be added, as is the case in the EBA stress test. Even though the stress tests are described as bottom-up, this does not mean that all calculations are based on each individual loan and every detail in the loan contracts, but rather from different loan portfolios. A bottom-up stress test is thus not as in-depth as the type of due diligence that normally takes place ahead the acquisition of a company, for instance.

Market-based measures are a good complement to stress tests
There may be reason to complement the stress tests that the banks themselves or the authorities conduct with various market-based measures. These measures provide an indication of market participants' confidence in the bank. The reason for this is that market information contains different participant' forward-looking assessment of the bank, such as expected credit losses. When the measures are based on market information, it is also possible to frequently update this type of assessment of the bank's repayment capacity and resilience. The market value of the shares in comparison with the book value of equity (price to book or P/B) and the expected probability of default (Expected Default Frequency or EDF[49]) are examples of such measures. These take consideration of the market participants' expectations of such things as a bank's future earnings and credit losses and can thus give an indication of a bank's capital strength or risks in its operations. The Riksbank also analyses measures of this type, even if these are not part of this article.

The Riksbank's stress test is based on models for both revenues and costs
The Riksbank's stress test of capital consists of a number of models that describe various parts of the banks' income statements and balance sheets and how these would be affected under stress. On the cost side, models are used for the banks' credit losses and for losses arising due to second-round effects. On the revenue side, models are used for the banks' net interest income and net commission income. All in all, the models make it possible to calculate the banks' capital ratios in different scenarios. A brief description of the models for credit losses, earnings and contagion effects is presented below.

The banks included in the stress test are Handelsbanken, Nordea, SEB and Swedbank.

Credit losses are an important variable in the stress test
The Riksbank's method for estimating credit losses is based on a model in which the level of earlier credit losses (credit losses as a proportion of lending to the general public) depends on the development of house prices, unemployment, interest rates,[50] corporate and household debt as a proportion of GDP, and the proportion of lending to non-financial corporations. In the model, housing prices, above all, play a decisive role.

The major banks' credit losses have historically been very small over long periods, before increasing heavily in crisis periods. This makes it difficult to estimate a model for credit losses that accurately captures the relationship between the level of credit losses and changes in factors such as GDP and house prices in both normal periods and crisis periods. The Riksbank's method for estimating credit losses in the stress test has therefore been developed to consider that levels in normal periods are close to zero but significantly higher in crisis periods.

The estimated credit loss level in the Riksbank's model closely follows the previous actual credit losses in both normal periods and periods of crisis (see chart 26).[51]

Earnings are important as a protection against credit losses
A bank's earnings must cover the bank's normal operating costs and can act as a buffer if credit losses arise. The two largest sources of the banks' earnings are net interest income and net commission income, which together are responsible for over 85 per cent of total earnings. In the Riksbank's stress test, there are separate models for net interest income and net commission income. The models explain the net interest income and net commission income using various macro variables and bank-specific variables. In the model for the net interest income, it is also assumed that a bank's funding costs increase as its capital situation deteriorates, as it is likely that investors will then make the assessment that there is a higher risk involved in lending to the bank. The net commission income is also assumed to be negatively impacted by the

[49] EDF is a market-based measure used by rating agency Moody's. It is calculated as the likelihood that the market value of the company's assets will be lower than the size of its debts.
[50] Two measures of interest rates are included in the model. These are the difference between the corporate lending rate and the 6-month Treasury bill, and the 5-year government bond yield.
[51] For more details on the model for calculating credit losses, see Buncic, D., Li, J., van Santen, P., Wallin, P. and Winstrand, J. (2019), The Riksbank's method for stress testing banks' capital, *Staff Memo*. Sveriges Riksbank

deterioration of a bank's capital situation. Lower asset prices are another source of a deteriorated net commission income.

Second-round effects can exacerbate stress

The major banks in Sweden are closely interconnected. They are exposed to similar risks and often obtain funding on the same markets. In addition, they have significant exposures towards each other as they own each other's covered bonds. This means that problems in one bank can rapidly spread to another bank, which reinforces different shocks that may arise in the financial system.[52] In the Riksbank's stress test, there are two mechanisms that take account of such second-round effects, one which captures that the direct links between the major Swedish banks themselves can give rise to credit losses, and one which captures general stress in the European banking sector.[53]

Deep economic recession in the scenario

A scenario for a stress test should reflect a severe but plausible development for different macroeconomic and financial variables. To calculate the results presented in this article, the Riksbank applies the scenario in the stress test carried out by the EBA in 2018.[54]

The scenario stretches over three years. For Sweden, it involves, among other things, a total fall in real GDP over the period of more than 10 per cent and in housing prices of almost 50 per cent (see table 2). The macro scenario is thus very severe. Together with the Riksbank's methods, which place great emphasis on systemic risks and housing prices, the scenario entails a hard stress test for the banks' Swedish operations. The banks also have operations in other countries and the assumptions of the EBA scenario is also used for these.

The banks' capital ratios fall in the stress test

Major credit losses

The level of credit losses is one of the key variables in a stress test. With a combination of the EBA scenario and the Riksbank's methods, the credit losses for the four major banks over one year are, at highest, about 4.5 per cent of lending, which is approximately the same level as during the crisis of the 1990s (see chart 27). This can be compared with a credit loss level of less than 1 per cent during the global financial crisis. The EBA scenario, however, is based on an economic development that is significantly worse than that of the global financial crisis.[55]

Table 2. Parts of the Swedish macro scenario in the EBA stress test 2018

Per cent

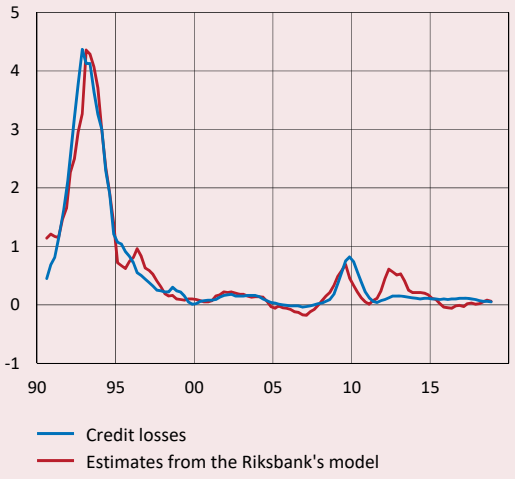
	Year 1	Year 2	Year 3
Real GDP	-3.1	-6.0	-1.7
House prices	-27.4	-28.0	-3.1
Prices of commercial properties	-23.8	-18.7	-7.7
Inflation	-1.4	-1.8	0.1
Unemployment	7.9	10.9	12.5
Equity prices	-26.4	3.1	6.6
Short-term interbank rate	0.3	0.8	1.2

Note. GDP, house prices, prices for commercial properties and equity prices are specified as annual percentage change. Inflation is specified as annual percentage change in the price index, and unemployment and the short (3-month) interbank rate are specified as percentages.

Source: EBA

Chart 26. The major banks' credit losses

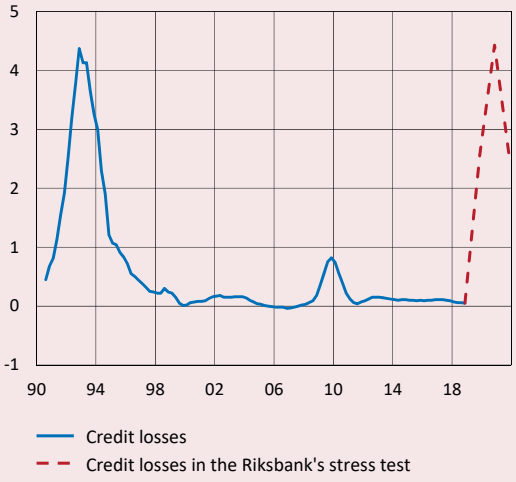
Percentage of lending to the public



Sources: Bank reports and the Riksbank

Chart 27. The major banks' credit losses in the Riksbank's stress test

Percentage of lending to the public



Sources: Bank reports and the Riksbank

[52] See the article Interconnectedness in the financial system. *Financial Stability Report* 2018:1 Sveriges Riksbank.

[53] For more information on the methods for capturing second-round effects, see Buncic, D., Li, J., van Santen, P., Wallin, P. and Winstrand, J. (2019), The Riksbank's method for stress testing banks' capital, *Staff Memo*. Sveriges Riksbank.

[54] For more information on the EBA's macroeconomic scenario, see *Adverse macro-financial scenario for the 2018 EU-wide banking sector stress test*, January 2018. European Systemic Risk Board (ESRB). For more information on the EBA's scenario for market risk, see *EU-wide Stress Test Market Risk Scenario,* January 2018. ESRB.

[55] During both the crisis of the 1990s and the global financial crisis, various support measures were adopted to mitigate the effects of the crises. This makes it difficult to compare the credit losses observed during these periods with the credit losses of the stressed scenario.

Most of the credit losses arising in the stressed scenario derive from lending to non-financial corporations (about 75 per cent of the credit losses). There are several factors that can explain why lending to companies in particular leads to such heavy credit losses in the scenario. Given the macroeconomic development in the scenario and the heavy fall in house prices, it is likely that households will significantly reduce their consumption and that demand for companies' goods and services will thereby fall heavily. At the same time, prices are falling for commercial properties, which affects property companies, who are major borrowers with the banks. All of this pushes up bankruptcies in the corporate sector and thereby also the banks' credit losses from lending to companies. In addition, losses arising as a consequence of second-round effects make up almost 12 per cent of credit losses.

Earnings fall

In the Riksbank's earnings model, the banks' earnings from net interest income and net commission income fall by 30 per cent over the three years of the scenario (see chart 28). The lower earnings mean that there is less scope for the banks to manage the credit losses.

One reason that earnings fall is that investors see a higher risk in lending to the banks when capital ratios are falling. This results in the banks' funding costs increasing, as investors demand compensation for the higher risk, and net interest income falling. In addition to this, lower asset prices also lead to the banks' net commission income falling.

The banks' capital situation deteriorates heavily

Chart 29 and chart 30 show how the banks' capital situation, measured using two different measurements, develops in the scenario, and how different parts of the stress test contribute towards the development. Chart 29 shows the banks' overall Common Equity Tier 1 ratio (CET1 ratio), which is to say their risk-weighted capital ratio measured as Common Equity Tier 1 (CET1) capital in relation to risk-weighted assets (see Equation 1).

Equation 1.

$$Common\ Equity\ Tier\ 1\ ratio = \frac{Common\ Equity\ Tier\ 1}{Risk\ weighted\ assets}$$

Chart 30 shows leverage ratio measured as Tier 1 capital in relation to total exposures (see Equation 2). Somewhat simplified, total exposures means total assets.

Equation 2.

$$Leverage\ ratio = \frac{Tier\ 1\ capital}{Total\ exposures}$$

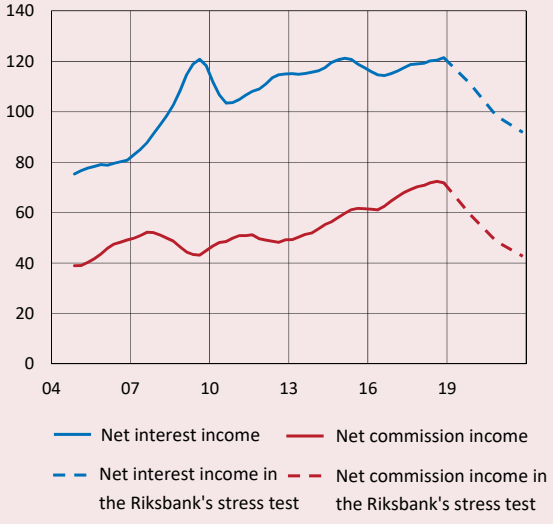
As the charts show, the banks' overall CET1 ratio is 16.3 per cent at the start of the scenario and the leverage ratio is 4.9 per cent. Due to the strongly negative development of the scenario, the banks' earnings deteriorate, but remain positive and thus make a positive contribution to the banks' capital ratios.

At the same time, the banks are making large credit losses, which affects the capital ratios negatively. In the stressed scenario, the credit losses become so large that the banks' earnings from net interest income and net commission income are not sufficient to cover the losses. This leads to the banks' operating earnings becoming negative over the entire scenario. The deteriorated economic conditions described in the scenario mean that parts of the banks' lending is deemed to be higher risk, with the consequence that the risk weights for this lending increase (so-called risk migration). All other factors being equal, this means that the risk-weighted assets increase and that the CET1 ratio thereby decreases. As the leverage ratio is not calculated using of risk-weighted assets, it is not affected by the risk in a bank's lending increasing.

A bank's Tier 1 capital (T1) consists of CET1 plus 'Additional Tier 1 capital' (AT1).[56] The part called Additional Tier 1 capital consists of debt instruments with long maturities and usually only makes up a small part of the bank's Tier 1 capital. When capital falls below a certain level, the debt instruments forming Additional Tier 1 capital are converted to CET1.[57] The conversion thereby

Chart 28. The major banks' earnings in the Riksbank's stress test

SEK billion

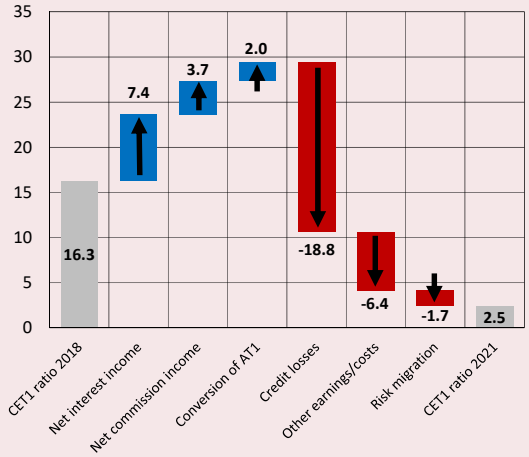


Sources: Bank reports and the Riksbank

[56] This means that T1 = CET1 + AT1.

[57] The terms for the debt instruments are designed so that they are converted to equity if the CET1 ratio falls below a certain level.

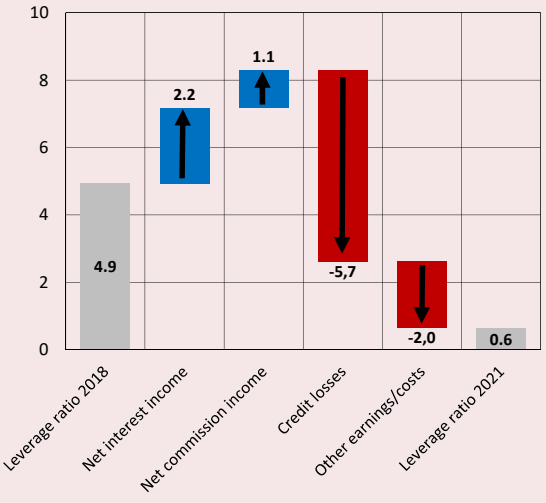
Chart 29. Change of the major banks' CET1 ratio in the Riksbank's stress test
Percentage points



Note. The credit losses affect the CET1 ratio both via CET1 and through a decrease in risk-weighted assets.

Sources: Bank reports and the Riksbank

Chart 30. Change of the major banks' leverage ratio in the Riksbank's stress test
Percentage points



Note. The credit losses affect the leverage ratio both via lower Tier 1 capital and through a decrease in total assets.

Sources: Bank reports and the Riksbank

has a positive effect on the banks' CET1, which increases the CET1 ratio.

The overall effect on the banks' capital situation in the stressed scenario is that the CET1 ratio falls from 16.3 per cent to 2.5 per cent and the leverage ratio from 4.9 per cent to 0.6 per cent.

Significant differences in results

As the stress tests of the Riksbank and EBA are based on the same macro scenario, it is interesting to compare the outcomes of the two exercises.

With the Riksbank's method, the credit loss level in the stress scenario reaches a maximum of about 4.5 per cent, which can be compared with just below 1 per cent in the EBA stress test. In total, over the three years, the banks' credit losses are SEK 771 billion using the Riksbank's method and SEK 155 billion with the banks' methods in the EBA stress test (see table 3).[58]

The Riksbank's method for estimating credit losses is sensitive to the variables included. The Riksbank has therefore made alternative calculations. The results of these show that the credit losses can be both higher and lower, depending on the variables included. The credit losses arising from different model specifications vary from being in the same magnitude as the credit losses for the Swedish banks in the EBA stress test to being just over SEK 1,000 billion. Models specified with house prices and short-term interest rates, but without variables indicating indebtedness in the economy, show credit losses in the lower part of the interval. Models specified so that indebtedness is included, or so that housing prices are given greater significance, show credit losses in the upper part of the interval. The selected credit loss model can explain historical credit losses well, at the same time as it gives a good balance between the number of variables and complexity. In addition, it takes consideration of risks that are significant to financial stability in Sweden. For example, the method attaches great weight to housing prices and indebtedness, which historically have played an important role in crises.

When it comes to net interest income and net commission income, the difference between the Riksbank and EBA stress tests is not quite as large. But the Riksbank's method cuts the net interest income and net commission income by a total of 30 per cent over the three years of the scenario, which can be compared to about 15 per cent in the EBA stress test. Over the three years of the scenario, the banks' earnings from net interest income and net commission income total about SEK 450 billion with the Riksbank's method while, in the EBA stress test, the corresponding figure is about SEK 500 billion.

The dates on which the stress tests start are different in the Riksbank and EBA stress tests, and thereby the starting values in the banks' capital ratios differ. However, both the stress tests run for the same length of time (three years), meaning that changes in capital ratios can be compared, despite the different starting values. The

[58] In the EBA stress test, the results are presented in EUR, and an exchange rate of SEK 10.3 to EUR 1 has been used here to convert the amount into SEK.

banks' operating earnings become heavily negative in the scenario using the Riksbank's methods, which results in the CET1 ratio falling by almost 14 percentage points and the leverage ratio by just over 4 percentage points (see charts 29 and 30). In the EBA stress test, the aggregate effect on the banks' CET1 ratios is relatively small, at the same time as the leverage ratio increases slightly.

Different methods affect the results

Even if the scenario in the Riksbank and EBA stress tests is the same, it is difficult to make direct comparisons of the results as there are relatively large differences in the methods used (see table 4).

In the Riksbank's stress test, all calculations are made by the Riksbank using mainly public data. In the EBA stress test, the banks carry out all calculations with the help of their internal models and largely non-public data. This means that both models and data are different in the Riksbank and EBA stress tests.

The Riksbank's data on the banks' credit losses stretches back to the end of the 1980s and thus includes the banking crisis at the start of the 1990s. The 1990s was a period in which the banks made significant credit losses and the Swedish economy had major and protracted problems. However, the financial system looks different today, with a variable exchange rate and another target variable for monetary policy. The Riksbank's methods for estimating credit losses works well for explaining historical credit losses but does not take full consideration of changes in the banks' risk management. However, the model takes into consideration that the proportion of lending to non-financial corporations has decreased since the 1990s. In the Riksbank's credit loss model, this means that, for a scenario identical to the crisis of the 1990s, the estimated losses today would be slightly lower than those observed in the crisis of the 1990s.

The banks' internal models often use historical data that is adjusted to make it representative of the banks' current situation, for example by taking greater account of the banks' risk management having changed.[59] As in the Riksbank's stress tests, this means that, even if the banks were to use a scenario identical to the crisis of the 1990s, the estimated credit loss level would be lower than that observed in the crisis.

If the Riksbank's method were to be used with data that excludes the crisis of the 1990s, the credit losses in the scenario would be significantly lower than they would be if the crisis of the 1990s had been included.

[59] In those cases where the banks lack historical loss data from the 1990s for their present exposures, the models are complemented by expert judgements.

Table 3. The Riksbank and EBA stress tests

	Riksbank	EBA
Total credit losses (SEK billion)	771	155
Total earnings (SEK billion)	452	501
CET1 ratio, starting value (%)	16.3	20.7
CET1 ratio, final period of scenario (%)	2.5	17.9
Leverage ratio, starting value (%)	4.9	5.0
Leverage ratio, final period of scenario (%)	0.6	5.2

Note. FI implemented a new method for the application of the risk-weight floor for Swedish mortgages at the turn of 2018, meaning that risk-weighted assets increased for the banks. This means that the starting value of the CET1 ratio for the Riksbank's stress test is lower than in the EBA stress test.

Sources: Bank reports, EBA and the Riksbank

Table 4. Overall comparison between the Riksbank and EBA stress tests

	Riksbank	EBA
General approach	Top-down	Bottom-up
Static or dynamic balance sheet	Dynamic, but without credit growth	Static
Data	Mostly public data	Largely internal data
Effect of including crisis of 1990s	Great effect on credit losses	Varies
Significance of second-round effects	Considerable	Relatively little
Model for credit losses	Empirical time series models	Internal models for probability of default and loss given default *
Models for net interest income and net commission income	Empirical time series models	Internal models based on repricing of assets and market risk

*Usually termed PD and LGD.

In addition, the Riksbank's stress test is designed to capture risks in the banking system in general. This means that what happens in one bank can affect what happens in another bank. This link is not captured in the same way in the EBA stress test. All in all, this results in there being large differences between the credit loss levels that the Riksbank estimates and those the banks estimate.

Different stress tests complement each other

The banks' ability to manage an economic crisis can be evaluated in several different ways. This article describes how the Riksbank's stress test for capital can be used as a method to measure the banks' ability to handle a heavily negative economic and financial development.

The results of the stress test shows that the effects may be significant for the four major banks in Sweden if the scenario the test is based on were to materialise. However, it should be pointed out that the scenario describes a very severe macroeconomic development and that the stress test does not take account of the measures to increase resilience that could be adopted by both the banks themselves and the authorities at an early stage. In a situation such as that described, the banks could attempt to issue new capital, for example. In addition, the

banks have eligible liabilities that could be converted into equity.[60]

The Riksbank's exercise shows that the choice of method may have major effects on the results of a stress test. The Riksbank's method includes both bank-specific risks such as systemic risks and also includes data from the crisis of the 1990s. In most cases, therefore, it will have a more negative outcome than a stress test using the EBA's methods. In addition, the Riksbank's alternative estimates for credit losses show a large variation. It is difficult to know in advance which stress test method gives the best description but the EBA and Riksbank stress tests can be used as two starting points. It is important to stress test banks using several methods and the Riksbank's method can be seen as a complement to the EBA method.

[60] In the Riksbank's stress test, Additional Tier 1 capital is converted to equity. In addition, under the European Bank Recovery and Resolution Directive (BRRD) and as part of the resolution, authorities can allow other parts of banks' liabilities to bear the losses by using the so-called bail-in tool. This means that some of the banks' lenders will have their claims written-down or converted into shares in the bank.

ARTICLE – Financial infrastructure undergoing technological changes

The Swedish financial infrastructure, that is, the technical systems that enable financial transactions, is undergoing a technological shift.[61] This is due to new opportunities arising through technological advances, and also to changes in the behaviour and expectations of the population, as well as regulations that force financial agents to develop new functions, which in turn require the introduction of new technology. As the infrastructure forms the basis for the financial system these changes raise a number of important questions about the future of the financial system. The purpose of this article is to provide an overview of the changes in the Swedish infrastructure and describe the issues of principle that ensue.

Changes in the financial infrastructure enable increased digitalisation, speed and accessibility

The financial infrastructure consists of the systems that manage payments and transactions with financial instruments. For this reason, the financial infrastructure forms the base for the financial system. The technical changes that have occurred in the financial infrastructure in the last decades have enabled several clear trends in the financial system.

Firstly, the financial system is becoming ever more digital and fast-paced than before. Secondly, it is becoming accessible for a larger share of the day than before. One example is that a bank customer now primarily interacts with his/her bank via a computer or mobile phone. Another example is that instant payments, such as Swish, are being used to an increasing extent. Thirdly, the financial system is becoming increasingly cross-border. To ensure the financial system becomes more efficient and safe in the future, it is therefore assumed that the financial infrastructure will need to continue to develop in an appropriate and sustainable manner.

The driving forces behind the changes include technical innovations. Faster computers and more advanced means of communication have made it possible to rapidly transfer large volumes of information. These technical innovations have also changed the users' expectations of how long time a financial transaction should take. Transfer of an e-mail, for instance, is instant and can be done at any time of the day. This leads the general public to expect the same type of service from its financial services. Technological progress is enabling new companies, as well as public sector agents, to begin offering new solutions. The new fintech companies are an example of the former and the European Central Bank's (ECB) creation of several new common European infrastructures is an example of the latter.

Another driving force is new regulation, which leads to agents in the financial infrastructure needing to introduce new functions that require technical solutions. These regulations are aimed at making the financial infrastructure safer and more efficient. For Sweden's part it is mostly a question of adapting to the EU regulations. For instance, the EU's Central Security Depositories Regulation (CSDR) requires that so-called securities depositories must introduce partial delivery to reduce the risks and increase efficiency.[62] Another initiative within the EU that has a driving effect on technological developments is the Capital Markets Union, CMU.[63] The CMU aims to create a more uniform European financial system and to achieve this new regulations have been introduced with the aim of increasing competition between agents in different parts of Europe.

These changes raise several important questions regarding the future functioning of the financial system.

The relationship between the state's overall responsibility and private agents needs to be reviewed

Private and public sectors complement one another

The state has an overall responsibility to ensure there are robust and safe infrastructure systems and as part of this operates financial infrastructure. Operation of the financial infrastructure is thus based on a division of labour between public and private sector agents. For instance, the central bank in Sweden supplies a central

[61] New technology and new business models, so called fintech, can in the long run entail further changes, see Fintech – interaction between financial operations and technological innovation. *Financial Stability Report* 2017:1. Sveriges Riksbank.

[62] For more information on CSDR, see *Regulation on settlement and central securities depositories* (CSDR), https://ec.europa.eu/info/publications/regulation-settlement-and-central-securities-depositories-csdr_en.

[63] For further information on the CMU, see *Capital Markets Union – A plan to unlock funding for Europe's growth*, https://ec.europa.eu/info/business-economy-euro/growth-and-investment/capital-markets-union_en.

payments system for the banks, RIX, which complements those parts of the payments system that are managed privately by the banks and by Bankgirot. Other parts of the financial infrastructure, such as clearing and settlement of securities, are operated by private agents. This division of labour is based on a consensus that private and public sector operation both have advantages and disadvantages and complement one another. As private companies are sensitive to losses, they tend to be very willing to make their operations efficient. This efficiency advantage indicates that the financial infrastructure should to some extent be run privately. At the same time, there are disadvantages with private, profit-making operations, which means that this is not suitable from the perspective of society. When it comes to financial infrastructure it may be difficult, for instance, for a profit-making company to consider the total cost to society of a disruption. There is thus a risk that a company would invest too little in its operational resilience, from the point of view of society. Another risk of privately-run infrastructure concerns entrance barriers as existing structures which benefit established agents but hinder entrance for new agents. An operation run by the public sector, on the other hand, can take into consideration more factors and thus potentially make decisions that are better for society.

Global changes, for instance, technological advances, can lead to new analysis being required with regard to the future division of labour between public and private sector. One example is the decline in cash handling in Sweden, which is linked to the factors mentioned above. A cashless society with the means of payment that exist today would mean that the payment system offered to the general public would be in entirely private hands. The Riksbank has therefore begun to investigate the possibility of a state digital currency, a so-called e-krona, which would ensure that the krona continues to be issued by the public sector. An e-krona would either require a new financial infrastructure or that the existing infrastructure is expanded.

Trend towards more instant payments

In Sweden and internationally, there is also a trend towards more instant payments. As mentioned earlier, the most well-known example in Sweden is Swish. Instant payments mean that the payment is made instantaneously between payer and recipient and that it is possible to make payments around the clock, even at weekends and bank holidays. This can be compared with traditional payments, which put simply can only be completed during office hours when RIX is open.

As the volume of instant payments increases, the consequences of disruptions to the flow of payments become more serious for society. The infrastructure that manages the payments therefore becomes very important and needs to be designed to be as safe as possible. One question is thus whether Sweden may in the future need an infrastructure with greater elements of public sector management to ensure secure access to instant payments. The Riksbank is therefore looking into how instant payments will be supplied in the future. One possible solution is a private infrastructure that is linked to and overseen by the Riksbank. Another is for the Riksbank itself to offer instant payments around the clock to the general public. A further alternative would be for the Swedish krona to be linked to the ECB's infrastructure for instant payments, Target Instant Payments System (TIPS). This would enable instant payments in Swedish krona directly via a central bank. The Riksbank has begun a prestudy of a possible Swedish connection to TIPS. TIPS is also an example of another trend: the development of larger cross-border infrastructures that offer economies of scale and facilitate cross-border financial flows.

Cross-border infrastructures offer economies of scale but can make oversight and supervision more difficult

By building large, cross-border infrastructures a large number of agents can pool their resources. The potential gains of this from an efficiency point of view are economies of scale and an increased financial integration between countries. Large joint systems with uniform rules make it easier and cheaper to carry out cross-border financial transactions and operations.

Something that would promote the attainment of the ambitions of the Capital Market Union (CMU) is common European financial infrastructures. TIPS has been created to enable instant payments in Europe at a lower cost and with common rules and technical standards. The ECB has also, for the same reasons, launched T2S (Target 2 Securities), which is a common system for settling securities at a European level.[64] In 2011, the Riksbank and the Swedish financial market investigated whether Sweden should join T2S. As the market was then doubtful, the Riksbank refrained from joining. It is, however, possible that potential economies of scale in the future will make it appropriate for Sweden to join and the Riksbank has opened a dialogue with the Swedish financial market on the development of securities settlement in Sweden.

The economic advantages of harmonisation and larger infrastructures mean that private initiatives have also been started up. In the Nordic region, the banks have

[64] *What is TARGET2-Securities (T2S)?*, https://www.ecb.europa.eu/paym/target/t2s/html/index.en.html.

launched a project entitled P27, which aims to establish a pan-Nordic payment infrastructure for payments in Nordic currencies.[65] The purpose of the initiative is to harmonise the payment market, which looks different in different parts of the Nordic region, and thereby create economies of scale that can reduce the costs of making payments.

There are thus several advantages in cross-border infrastructure. But there may also be potential problems if significant parts of infrastructure are relocated beyond Sweden's borders. To some extent this has already happened in that private infrastructure companies have in some cases chosen to locate their IT operations abroad. The most evident and dramatic reason is from an emergency preparedness point of view that in a war Sweden could be cut off from financial functions important to society. But the financial infrastructure also needs to be under supervision and oversight during normal circumstances, to minimise the risks. In Sweden it is Finansinspektionen and the Riksbank who have responsibility for this.[66] In a future where there is a cross-border infrastructure several countries would therefore need to coordinate their supervision and oversight. This sets higher demands on cross-border cooperation between different national authorities and private agents. Nor is it possible to rule out the risk of Swedish influence declining in this case.

Old technology needs to be adapted, which entails risks

New technology also needs to interact with older, existing technology. In the financial sector, both in Sweden and abroad, IT operations are still reliant on so-called mainframe computers. These were developed in their current form in the 1950s, although they are now much more advanced.[67] Around 70 per cent of all of the financial transactions in the world are still processed by mainframe computers.[68]

Mainframe computers in themselves are considered stable, but problems can arise when new technology, such as mobile applications, are to interact with the older technology. The new regulations also entail new functions being built on already existing systems. The results can become a patchwork where it is difficult to assess the consequences of changes in certain parts of the system. Problems can then arise when updates are made in connection with the introduction of new functions. The British bank TBS experienced major disruptions in April 2018 because of this. The problems continued for more than a month and at worst almost two million customers were denied access to their accounts. In autumn 2018 two other British banks suffered similar problems.

From the Riksbank's perspective it is important that financial institutions and infrastructure companies maintain their role in the economy even when new technological functions are added. This means that they need to take an overall perspective of their IT systems and either replace certain technical systems or ensure that the older and newer technology is compatible. In Sweden the Riksbank has particularly drawn attention to the central securities depository Euroclear Sweden, where Swedish securities are settled and stored. This concerned in particular incorporating the functions required in the above CSDR regulation without causing disruptions.

The Riksbank's role in developing the future financial infrastructure

Technological advances entail new opportunities and challenges. For the Riksbank's part, this means that the central bank functions in the financial system must be updated to keep up with developments. It also means that the Riksbank must act to ensure the different parts of the infrastructure keep up with developments so that some parts do not lag behind. This is a question of reducing direct vulnerabilities and risks in the system, as well as seeing the opportunities offered by the new technology that can lead to a safer and more efficient financial system. It is therefore important that the central bank help to ensure that the development work proceeds smoothly. At the same time, the agents in the financial system must take an overall perspective of their technical systems and implement modernisation in a way that does not deteriorate the functionality of their systems.

This article has mentioned several initiatives the Riksbank has taken to bring about a safe and efficient future financial infrastructure. Firstly, the Riksbank is reviewing the relationship between public and private sector operation of the future financial infrastructure. The most high profile question here is a possible future state-issued digital currency, the e-krona. But there are also other questions, such as whether the infrastructure for instant payments should be operated by the public or private sector. Secondly, the Riksbank is analysing the advantages and disadvantages for Sweden of joining cross-border infrastructures. At present, this concerns whether to join TIPS and T2S. Finally, the Riksbank also

[65] *Sweden's future payment infrastructure*, https://www.swedishbankers.se/en-us/the-swedish-bankers-association-in-english/payment-infrastructure/sweden-s-future-payment-infrastructure/

[66] The difference between supervision, which is conducted by Finansinspektionen, and oversight, which is conducted by the Riksbank, can largely be expressed as the supervision being more formal. Among other things, supervision checks that specific regulations are observed and that there is a possibility to decide on sanctions against a company that does not meet the requirements. Oversight does not entail any possibility for sanctions but can take a broader perspective of operations and identify risks that are not yet covered by existing regulations.

[67] See Ceruzzi, P. (2003), *A History of Modern Computing*. MIT Press.

[68] See, for example, Ismael, N. (2017), https://www.information-age.com/legacy-systems-next-financial-crisis-123465888/

acts to ensure that systemically important infrastructures renew their technical systems at the right time and with maintained functionality, for instance through its requests to Euroclear Sweden.

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