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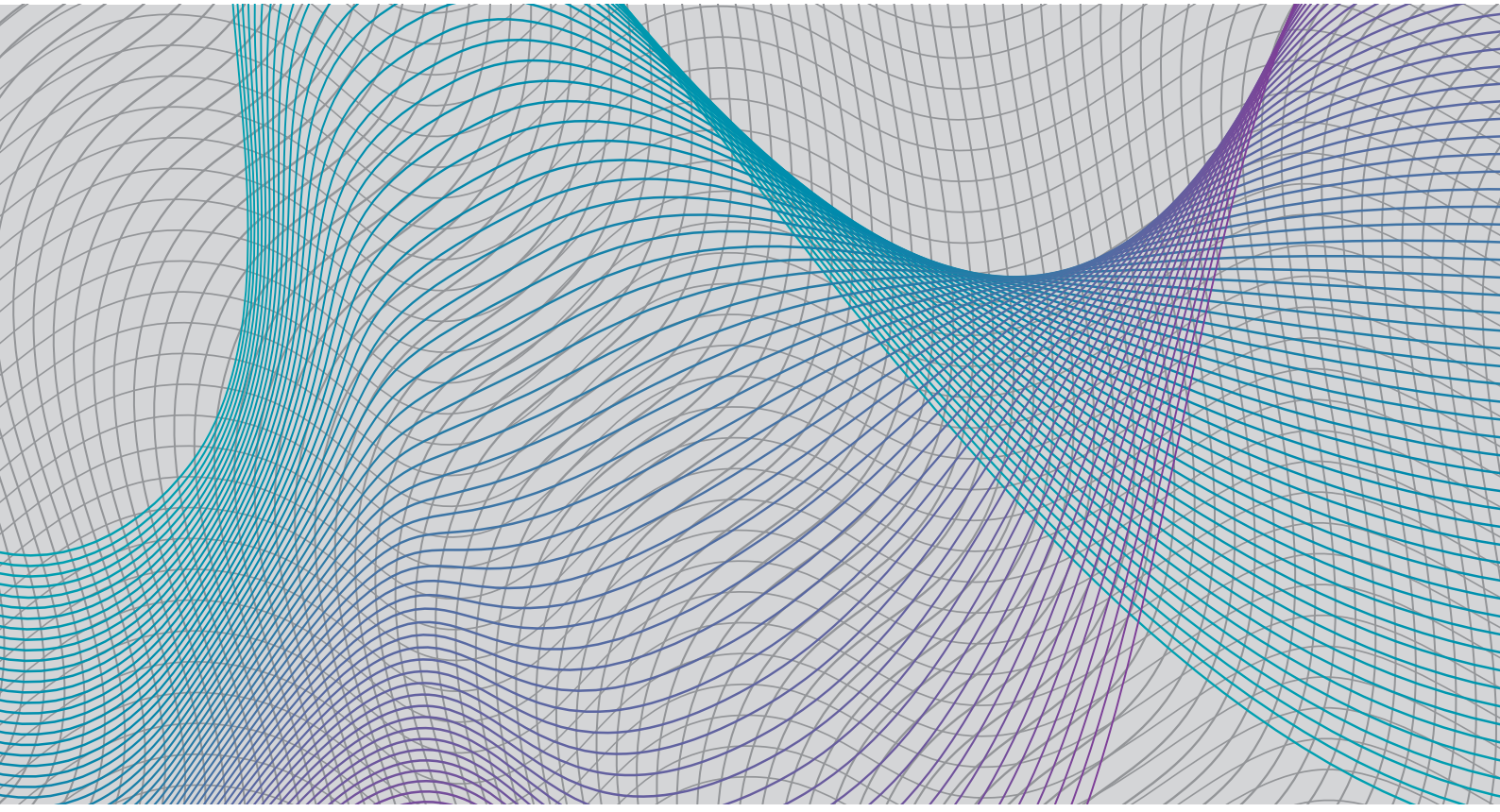
Financial Stability Review 2019



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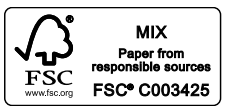


Financial Stability Review 2019

Boxes

Abbreviations and symbols

p	Provisional
e	Estimated
.	Data unknown, not to be published or not meaningful
–	Nil

Discrepancies in the totals are due to rounding.

Introduction

Under the Financial Stability Act *(Finanzstabilitätsgesetz),* the Bundesbank has extensive responsibility for monitoring the stability of the German financial system. It has the statutory mandate to identify and assess risks to financial stability. The analyses published in its Financial Stability Review document developments that are of relevance to financial stability and highlight risks to financial stability. They investigate the build-up of vulnerabilities in the financial system as well as the emergence of macroeconomic and financial imbalances. After all, imbalances harbour the risk of abrupt corrections, as they are not in line with the economic fundamentals. Vulnerabilities make the financial system more susceptible to such unexpected developments.

The functional viability of the financial system is of essential importance for the real economy. The financial system coordinates savings and investment, makes it possible to hedge against risks, and facilitates payments. The Bundesbank understands financial stability as a state in which the financial system is able to fulfil its functions at all times. This means that a stable financial system is in a position to absorb both financial and real economic shocks, especially when confronted with unforeseen events, in stress situations and in periods of structural adjustment. Adequate resilience in the financial system – that is, the ability to cushion even losses from unexpected developments – can prevent contagion and feedback effects. The financial system should neither cause nor add too much to a downturn in overall economic activity. Unlike microprudential supervision and regulation, which aim to ensure the stability of individual institutions, macroprudential oversight therefore focuses on the stability of the financial system as a whole.

Risks to financial stability arise from systemic risks. Systemic risks occur, for instance, when the distress of one or more market participants jeopardises the functioning of the entire system. This may be the case when the distressed market player is very large or closely interlinked with other market players. Interconnectedness may be a channel through which adverse developments are transmitted to the financial system as a whole, impairing its stability. Many market participants are connected to each other through a direct contractual relationship – banks, for instance, as a result of mutual claims in the interbank market. Besides this, indirect channels of contagion may exist – for example, if market participants conduct similar transactions and investors interpret negative developments at one market player as a signal that other market players could also be adversely affected. Systemic risks thus also exist if a large number of small market participants are exposed to similar risks or risks that are closely correlated with each other.

The Bundesbank contributes its analytical findings to the work of the German Financial Stability Committee, which is the central body for macroprudential oversight in Germany. It gives the Committee its assessment of the general risk situation and makes proposals to it for warnings and recommendations for addressing systemic risks as well as evaluating their implementation.

Account has been taken of developments up to the cut-off date of 13 November 2019.

Overview

Risks to financial stability have continued to build up in Germany over the course of 2019. Last year's Financial Stability Review already described the heightened cyclical systemic risk in the German financial system resulting from the systematic underestimation of risk by market participants. As recently as last year, robust economic growth and a gradual rise in interest rates were still expected, which would have strengthened financial stability. This did not come to pass, however. Not least in response to the ever-growing systemic risks, the German Financial Stability Committee *(Ausschuss für Finanzstabilität)* recommended in May 2019 that the countercyclical capital buffer be activated for the first time. The Federal Financial Supervisory Authority *(Bundesanstalt für Finanzdienstleistungsaufsicht,* or BaFin) followed this recommendation.

Some of the downside risks to the economy that existed last year have materialised. The economic situation in Germany has deteriorated markedly since the start of the year. Unfavourable external economic developments have played a large part in this, among them increasing trade tensions and weaker global investment. The economic outlook remains subject to a high level of (mainly political) uncertainty in the international environment (see the chapter entitled "The international environment" on p. 17).

Interest rate levels have fallen markedly as economic activity has slowed. In response to weaker economic growth, a dampened inflation outlook and growing downside risks, central banks have taken expansionary measures. Market participants now expect risk-free interest rates to remain low in the years to come. All in all, the scenario of an extended period of low interest rates has increasingly moved centre stage. As a result, the conditions that have encouraged cyclical risks to accumulate thus far are still in place.

Market participants expect an extended period of low interest rates.

Low interest rates are likely to be one of the key reasons why the German financial system shows no clearly visible signs of the economic slowdown. Banks continue to lend at a dynamic pace, prices for assets such as real estate are on the rise and indicators that measure stress in the financial markets are low. Alongside the lower interest rates, the fact that the economic slowdown has so far remained largely confined to the export-oriented industrial sector has probably been a supporting factor. Thanks to the upbeat labour market situation, rising wages and favourable financing conditions, domestic growth forces remain largely intact.

The vulnerabilities of the German financial system to unexpected macroeconomic developments thus continue to grow. The credit-to-GDP gap, which is used as an early warning indicator, is widening rapidly and suggests that the financial cycle is still in an expansionary phase, and banks' risk assessments and risk provisioning are at very low levels. Banks' lending to the corporate sector has tended to shift towards comparatively riskier borrowers. Overall, the recoverability of collateral such as real estate could be overestimated and credit risk underestimated. Moreover, interest rate risk in the German financial system is being exacerbated by the persistently low interest rate level. Many investors are focused on the search

Vulnerabilities to unexpected macroeconomic developments continue to grow.

for yield and could be tempted to take on greater risk.

Two developments, in particular, could expose the existing vulnerabilities. On the one hand, the current economic slowdown could turn into an unexpected economic downturn. For example, global economic activity could be much weaker than expected, or the current downturn in German industry could have a bigger impact than expected on the domestic economy. In a scenario such as this, credit defaults could increase and real estate prices could fall significantly. This would hit the German financial system hard.

On the other hand, an abrupt rise in interest rates could have negative repercussions. This is because interest rates are currently expected to remain low for an extended period of time and assets are thus valued at a high level. The interest rate level could rise abruptly if economic risks were to materialise and risk premia in the markets were to increase suddenly. With rates hovering around the zero lower bound, asset prices could react strongly to even small changes in interest rate premia. This could make asset prices more volatile.

Asset prices could react strongly to even small changes in interest rates.

There may be a danger to financial stability if these cyclical risks materialise at the same time and affect many market participants simultaneously, thus reinforcing each other. In this case, a large number of market participants would have to cope with losses and could react in similar ways, for instance by cutting back their lending, investment activity or consumption. This could then amplify an economic downturn.

Sufficient resilience can counteract systemic risks of this kind. Generally speaking, it is therefore in every market participant's interest to be properly protected against the risks and uncertainties of economic developments. To cushion losses stemming from unexpected developments, market participants should critically examine their risk management systems and strengthen their resilience. However, at the same time, it is difficult for individuals to gain a clear picture of the feedback and amplifying effects at work within the financial system. The countercyclical capital buffer activated by BaFin is therefore intended to make the banking system more resilient to cyclical systemic risks. The analyses in this year's Financial Stability Review highlight potential contagion channels and interdependencies and describe possible ways of strengthening the stability of the financial system.

The countercyclical capital buffer is intended to make the banking system more resilient to cyclical systemic risks.

Risks to the stability of the German financial system

Past editions of the Financial Stability Review have demonstrated that vulnerabilities have slowly but surely been building up in the German financial system. In a protracted spell of low interest rates coupled with favourable financing conditions and healthy economic activity, downside scenarios may have slipped out of focus. This creates a danger that risks are being systematically underestimated because market participants are "gazing into the rear-view mirror". They may be too optimistic in expecting the positive developments of the last few years to continue and may fail to sufficiently factor earlier crises or pronounced downturn periods into their risk assessments. The upshot is a potential underestimation of future credit risk and an overesti-

Participants could be too optimistic in expecting the positive developments of the last few years to continue.

mation of the recoverability of loan collateral such as real estate. Additional vulnerabilities stem from interest rate risk. Moreover, interconnectedness between market participants could amplify shocks.

Although the macroeconomic situation has deteriorated, the persistently low interest rates, in particular, provide ideal conditions for these vulnerabilities to grow further. This risk assessment is underscored by this year's analyses, which indicate that vulnerabilities have continued to increase over the course of the year.

Underestimation of credit risk

Despite the noticeable deceleration in the pace of economic activity in Germany, banks' lending activity, particularly to non-financial corporations, continues to record strong growth. The domestic economy, which remains robust, and the further decline in the level of interest rates are probably boosting demand for loans. At just under 5% at present, nominal annual growth in lending to the private sector is at a 15-year high.

Given the exceptionally favourable macroeconomic developments over the last nine years, there is a danger that economic downturns tend to be underrepresented in banks' risk assessments at the moment.[1] This is particularly true of banks that use internal risk models to estimate their credit risk. Risk weights have decreased significantly over the last few years and remain very low.

Economic downturns tend to be underrepresented in banks' risk assessments at the moment.

Due to the sound situation in the corporate sector, credit risk has tended to decline on average. However, there are signs that banks' lending portfolios now include a higher share of loans to enterprises whose credit ratings could deteriorate the most in the event of an economic downturn. Loans to relatively riskier enterprises within the portfolio have grown more strongly than loans to less risky enterprises.

Loans to relatively riskier enterprises have grown more strongly.

Overvaluation of assets

The assessment of credit risk also depends on the recoverability of loan collateral. In the event of a loan default, the value of the collateral determines the amount of lenders' losses. Low interest rates are a key reason why valuations in the global bond markets, and in some cases the equity markets, are high, historically speaking.

Over half of all the outstanding bank loans to domestic households and enterprises are loans for house purchase. Furthermore, at 80%, real estate makes up the lion's share of fixed assets in Germany.[2] Prices in the German housing market continued to grow sharply last year at around 8%.[3] The Bundesbank estimates that house prices in German towns and cities were overvalued by between 15% and 30% in 2018. Since prices began to surge in 2010, banks have issued more loans for house purchase. In some cases, this has been accompanied by looser lending standards.

Furthermore, survey data suggest that households in Germany expect further increases in housing

Households in Germany expect further increases in housing prices.

1 See German Financial Stability Committee (2019b).
2 Buildings as a share of total net fixed assets.
3 The figure given for growth in residential real estate prices is based on Bundesbank calculations using data provided by bulwiengesa AG. See also the system of indicators for the German residential property market, available at: www.bundesbank.de/en/statistics/sets-of-indicators/system-of-indicators-for-the-german-residential-property-market

prices. Most banks, too, expect prices to increase further in the longer term. There is therefore a risk that market participants will spend too long "gazing into the rear-view mirror" and be overly optimistic in their expectations that the past trend will continue.

An unexpected economic downturn and the associated deterioration in the debt sustainability of enterprises and households could lead to an increase in loan defaults. A drop in real estate prices would additionally be accompanied by losses from the liquidation of loan collateral (see the chapter entitled "Risk situation of the German financial system" on p. 35).

In the scenario of an unexpected economic downturn, growing credit defaults and write-downs are likely to erode banks' equity capital. The root of the problem here is probably that risk provisioning has declined sharply as borrowers' creditworthiness has increased over the last few years. This would mean that losses from credit defaults would affect banks' equity capital sooner. In this kind of scenario, supervisory capital requirements would also rise and the market, too, would expect a stronger capital base (see the chapter entitled "Risks in the banking sector" on p. 61). However, in recent times, systemically important banks, in particular, have increased their unweighted capital ratio only slightly, meaning they have built up hardly any additional buffers to cushion against mounting losses in a crisis.

Lower risk provisioning would mean that losses from credit defaults would affect banks' equity capital sooner.

Risk of herding behaviour within the financial system

Overall, there is thus a greater risk that, in the event of an unexpected economic downturn, banks will follow the herd in order to meet the capital ratios required by regulators or expected by the markets. It is especially difficult to build up capital in a scenario such as this. Banks are thus likely to react by deleveraging. The banking system could reduce credit lines or curtail lending excessively. As a result, the banking system would amplify the effects of an unexpected economic downturn. Because agents in the financial system are interconnected via bilateral claims and liabilities, the impact could also be transmitted to other sectors of the financial system and be further intensified (see the chapter entitled "Interconnectedness in the German financial system" on p. 85).

In the event of an unexpected economic downturn, the banking system could curtail lending excessively.

Amplification via interest rate risk

Persistently low interest rates can tempt investors to take on greater risk in their search for yield. This may be why more loans have been granted to relatively riskier enterprises. In addition, banks may further expand their maturity transformation. Not least, in a prolonged environment of low interest rates, life insurers and pension funds, in particular, find it difficult to generate sufficient returns to honour the commitments from guaranteed returns on their liabilities, which are sometimes high (see the chapter entitled "Risk situation of the German financial system" on p. 35).

During periods of persistently low interest rates, life insurers can find themselves unable to pay out on expiring policies. In recent years, statutory and regulatory measures have been taken to strengthen life insurers' resilience. Most notably, the Regulation on the additional interest provision (*Verordnung zur*

Persistently low interest rates remain the main risk for life insurers.

Zinszusatzreserve) was revised in 2018, meaning that life insurers now have to build this precautionary balance sheet item more slowly. Taken by itself, this new regulation reduces the incentive to sell securities when times are worse in order to achieve capital gains. The risks associated with this type of herding behaviour are therefore also reduced.[4] That said, the relief afforded by the fact that fewer resources are needed for the additional interest provision has largely been cancelled out by the falling interest rate level. Persistently low interest rates remain the main risk for life insurers.

However, a sudden rise in interest rates also harbours risks for German life insurers. The market value of their asset holdings could then fall below their policies' surrender values, which are independent of the market interest rate. A sudden rise in interest rates gives life insurance policyholders an incentive to lapse their policies in favour of more attractive investments. This vulnerability could be tackled via regulation if surrender values were to be linked to interest rates.

An abrupt rise in interest rates would also put pressure on the banking sector. In response to falling interest rates, German banks have expanded their maturity transformation, notably by extending the interest rate lock-in periods of their assets. For instance, the share of new loans for house purchase with an interest rate lock-in period of more than ten years has risen from 45% in 2018 to its current level of 50%; at the start of 2010, it stood at 26%. A rise in interest rates would therefore not simply affect a few individual banks, but many institutions simultaneously. This would immediately drive up banks' funding costs, whereas their interest income would increase only gradually.

The share of new loans for house purchase with an interest rate lock-in period of more than ten years has now risen to 50%.

There is evidence to suggest that, in the environment of low interest rates, it is not only banks and life insurers that have extended the maturities of their assets, but also other sectors such as investment funds.[5] This probably means that asset prices in the entire financial system have become more sensitive to interest rates and would react more strongly to a rise in interest rates. Furthermore, a drop in asset prices may be intensified if investors such as funds respond simultaneously and sell off securities (see the chapter entitled "Interconnectedness in the German financial system" on p. 85).

A drop in asset prices may be intensified if investors such as funds simultaneously sell off securities.

Macroprudential policy

A stable financial system can cushion undesirable macroeconomic developments rather than intensifying them. Its ability to do so depends largely on how much equity capital is available in the financial system to absorb unexpected losses. As a result, equity capital not only makes individual banks and other market participants more robust and more resilient, but also protects the financial system – and therefore the real economy – from systemic crises.

Equity capital makes individual banks and the financial system more resilient.

The fact that German banks have increased their equity capital since the financial crisis is therefore to be welcomed. Numerous regulatory and supervisory

4 See Deutsche Bundesbank (2018), pp. 83-105.
5 See Deutsche Bundesbank (2017), pp. 83-101.

measures have played a part in this.[6] For instance, banks today must hold more capital, and of a better quality. This obligation is flanked by improvements to the supervisory regime and stricter risk management requirements.

Macroprudential capital buffers are also designed to ensure that, alongside banks' institution-specific risks, systemic risks are also addressed. Large, systemically important financial institutions thus have to meet additional capital requirements since these banks could jeopardise the stability of the entire financial system if they encounter problems.[7] The relevant supervisory authority can also activate the countercyclical capital buffer if cyclical systemic risks build up in the banking system. Here, the term "countercyclical" refers to the financial cycle rather than the economic cycle.

Macroprudential capital buffers are designed to ensure that systemic risks are addressed.

Macroprudential buffers such as the countercyclical capital buffer perform a function fundamentally different to that of microprudential minimum capital requirements. While minimum capital requirements need to be met at all times and undershooting these directly results in measures ranging from supervisory action to the withdrawal of banking licences, macroprudential buffers may be undershot under certain circumstances. Non-compliance with macroprudential buffers leads, first and foremost, to a limit on bonus payments and profit distribution – in the form of dividends, say. Therefore, banks can use macroprudential buffers to absorb losses on a going-concern basis. One of the special features of the countercyclical capital buffer is that the supervisory authorities can lower it with immediate effect, especially during periods of stress.

Macroprudential buffers can be used to absorb losses.

In the second quarter of 2019, the countercyclical capital buffer for German banks amounted to just under 0.1% of their risk-weighted assets.[8] This was the result of countercyclical capital buffers introduced abroad. Among the large, systemically important financial institutions, the buffers for global and other systemically important institutions correspond to around 1.2% of their risk-weighted assets. These buffers would be available to the German banking system in stress phases and amount to a total of 0.5% of the risk-weighted assets of all German banks.

Build up resilience against uncertainties and cyclical risks

In May 2019, the German Financial Stability Committee, Germany's chief macroprudential forum, recommended that BaFin activate the domestic countercyclical capital buffer in response to the cyclical systemic risks that had built up in the German financial system over the last few years. BaFin followed this recommendation and raised the buffer to 0.25% of risk-weighted domestic exposures with effect from the third quarter of 2019 with a 12-month phase-in period. This capital buffer applies to banks and is a preventive tool designed to increase resilience to cyclical risks that may endanger financial stability.[9]

The German Financial Stability Committee recommended activating the countercyclical capital buffer.

6 For more information about the microprudential measures and the completion of Basel III, see also the box entitled "International standards for regulating banks: the adoption of the final Basel III reforms" on p. 81.
7 There is a capital buffer for global systemically important institutions (G-SIIs) and a capital buffer for other systemically important institutions (O-SIIs).
8 Reports at the group level and individual bank level were analysed if no consolidated reports were available.
9 See German Financial Stability Committee (2019a).

In June 2019, BaFin therefore issued a general administrative act regarding the domestic countercyclical buffer rate.[10] On the whole, banks will probably be able to meet this requirement using the share of their existing equity capital that exceeds the supervisory requirements (see the chapter entitled "Risks in the banking sector" on p. 61). Even if the buffer were to be met entirely using excess capital, the resilience of the banking system would be improved because capital would be preserved for crises and not be distributed, for example. In the medium term, banks will have an incentive to rebuild their original excess capital in order to increase the flexibility of their business policy.

On the whole, banks will probably be able to meet additional requirements using excess capital.

Should cyclical systemic risks materialise, the buffer can be lowered straight away, thereby reducing the likelihood that the supply of credit will be curbed excessively in periods of stress and that the banking system will have a procyclical effect on the real economy.

Should cyclical systemic risks materialise, the buffer can be lowered straight away.

The recommendation makes allowances for uncertainty about economic developments going forward. Future adjustments to the countercyclical capital buffer will depend on whether and to what extent cyclical risks continue to build up, subside or materialise in the financial system. These financial cycle developments are not necessarily linked to the economic cycle.

Market participants should prepare for developments where the scope and potential impact are difficult to gauge.

However, uncertainties that cannot be captured clearly using risk models are not limited to economic developments. In addition, market participants should prepare for developments where the scope and potential impact are difficult to gauge, such as risks stemming from climate change (see the chapter entitled "Impact of climate-related risks on financial stability" on p. 107).

In this regard, the results of a special survey conducted by BaFin and the Bundesbank indicate that just under two-thirds of the responding institutions have not yet integrated climate-related risks into their risk analyses.[11] However, 22% of the institutions are currently planning to expand their risk management to include climate risk. When it comes to regulating the financial sector, the focus should remain on risk. For example, capital requirements – even those for environmentally friendly investments – should, as a general rule, be geared towards risk. Regulation should not be used as a tool to further other political goals, such as the transition to a sustainable economy.

Two-thirds of the responding institutions have not yet integrated climate-related risks into their risk management.

Improve framework conditions for structural change in the financial sector

Substantial challenges are on the horizon for the financial sector – digitalisation, demographic change and an evolving international environment. For instance, the emergence of new financial service providers, such as fintech and bigtech firms, may call into question existing business strategies and struc-

10 See Federal Financial Supervisory Authority (2019).
11 The Survey on the Profitability and Resilience of German Financial Institutions in a Low-Interest-Rate Environment, which was undertaken by BaFin and the Bundesbank, focused on 1,400 small and medium-sized credit institutions. It included questions about lending standards, the significance of climate risk and interest on deposits. Details can be found at https://www.bundesbank.de/en/press/press-releases/results-of-the-2019-lsi-stress-test-807624

tures.[12] Positive framework conditions are thus imperative to enable structural change in the financial sector without hindering innovation or placing financial stability in jeopardy. This also means letting banks – just like firms in other economic sectors – withdraw from the market if their business strategies are no longer sustainable.

Positive framework conditions are imperative to enable structural change in the financial sector.

An effective resolution and restructuring regime can help market mechanisms to function properly. The objective of such a regime is to allow even systemically important banks to exit the market without endangering financial stability and exposing taxpayers to loss.[13] If a bank runs into difficulties, by applying the bail-in tool, losses are borne not only by the institution's shareholders and subordinated creditors but also by senior creditors. A sufficient amount of liable capital has to be available for a bail-in of this nature.

A sufficient amount of liable capital has to be available for a bail-in.

It is thus a welcome development that the banking package recently adopted by the EU contains a revised minimum requirement for own funds and eligible liabilities (MREL), bringing it into line with international standards. Another crucial issue is the point in time at which to decide whether a bank should be resolved or restructured. If this decision is made too late, there is a risk that further losses may accumulate and that, ultimately, a sufficient amount of liable capital is no longer available. Moreover, contagion effects may arise as, under the currently applicable EU rules, there are no limits for banks investing in MREL instruments of other institutions. This kind of interconnectedness between banks means that losses can be directly transferred in the case of a bail-in (see the box entitled "Regulation on the resolution of systemically important banks: status and outstanding issues" on p. 73).

Close data gaps in the housing market and create income-based instruments

The available data suggest that the risks pertaining to residential real estate loans may have increased in some instances. With prices still rising perceptibly and houses overvalued in some regions, there is a danger that risks associated with residential real estate loans are being underestimated. This is contributing to the cyclical vulnerabilities in the German financial system. These factors were behind the German Financial Stability Committee's recommendation to BaFin to activate the countercyclical capital buffer.

There is, as yet, no evidence of a spiral resulting from sharp rises in house prices, an excessive expansion in residential real estate loans and an erosion of lending standards. Should such a spiral emerge, macroprudential policy could counter this, for instance, by stabilising lending standards.

Germany has, since 2017, had in place two borrower-based macroprudential instruments which can be used to set minimum lending standards should financial stability be at risk in this way. These are a ceiling for the loan-to-value (LTV) ratio and an amortisation requirement. The prerequisites for activating these instruments are not met at present. However, looking ahead, this situation could change unexpectedly and rapidly in the event of an erosion

The prerequisites for activating the borrower-based instruments are not met at present.

12 See, inter alia, Deutsche Bundesbank (2016), pp. 67-77. See also https://www.bundesbank.de/en/press/speeches/digitalization-competition-and-financial-stability-799792
13 See Deutsche Bundesbank (2017), pp. 34-36.

of lending standards and an excessive rise in loans for house purchase, for example. The framework conditions for macroprudential policy for the housing market should thus be improved in terms of the availability of both data and macroprudential instruments.

Macroprudential supervisors still do not have robust, systematic and timely information on lending standards. These data gaps should be closed. The regular and standardised collection of such data would allow potential risks to financial stability to be recognised more clearly and at an early stage. This is very important from a macroprudential perspective in order to be able to act in a forward-looking manner. Currently, Germany is significantly worse off in terms of the regular availability of relevant data than other EU countries. The European Systemic Risk Board (ESRB), too, has identified the need for macroprudential action in the German housing sector in this year's evaluation of the European housing markets. In a warning to Germany, it underscored the need to close the data gaps on lending standards (see the section entitled "Monitoring risks from residential real estate loans" on p. 56).[14]

Macroprudential supervisors still do not have robust and systematic information on lending standards.

Moreover, two income-based instruments recommended by the German Financial Stability Committee as long ago as 2015 should be created for the housing market in addition to the LTV ceiling and the amortisation requirement.[15] Both instruments are based on measures of creditworthiness that lenders regularly use for credit assessments when granting loans. These are a cap on the debt-to-income ratio (DTI) and a cap on the debt-service-to-income ratio (DSTI). Both these instruments would supplement the borrower-based macroprudential instruments already available in Germany (see the section entitled "Monitoring risks from residential real estate loans" on p. 56).[16] Both also feature in the ESRB's recommendations for the German housing market.

Two income-based instruments should be created for the housing market.

List of references

Deutsche Bundesbank (2016), Financial Stability Review.

Deutsche Bundesbank (2017), Financial Stability Review.

Deutsche Bundesbank (2018), Financial Stability Review.

European Systemic Risk Board (2019), Warning on Medium-term Vulnerabilities in the Residential Real Estate Sector in Germany, June 2019.

Federal Financial Supervisory Authority (2019), General Administrative Act governing the rate for the domestic countercyclical capital buffer under section 10d of the KWG, June 2019.

German Financial Stability Committee (2015), Empfehlung zu neuen Instrumenten für die Regulierung der Darlehensvergabe zum Bau und Erwerb von Wohnimmobilien, AFS/2015/1, June 2015.

German Financial Stability Committee (2019a), Empfehlung zur Erhöhung des antizyklischen Kapitalpuffers, AFS/2019/1, May 2019.

14 See European Systemic Risk Board (2019).
15 See German Financial Stability Committee (2015).
16 See Deutsche Bundesbank (2017), pp. 54-56.

German Financial Stability Committee (2019b), Sechster Bericht an den Deutschen Bundestag zur Finanzstabilität in Deutschland.

The international environment

Global economic growth has slowed considerably, and risks to the economy are predominantly tilted to the downside. Trade disputes, Brexit and geopolitical risk are dominating the political and economic landscape and contributing to uncertainty going forward.

Despite much weaker growth in corporate profits, valuations in the global bond markets and, in some cases, the equity markets are still high, historically speaking. A key driver of these valuations is the expectation that risk-free interest rates will remain at low levels over the coming years.

Low interest rates, favourable financial conditions and a high risk appetite among investors pose the threat of risks being systematically underestimated and vulnerabilities continuing to build up. Corporate debt in a number of countries has risen significantly over the past few years, for instance. The United States, in particular, has seen large-scale lending to enterprises with low credit quality. These leveraged loans tend to be associated with higher default risk. They are often securitised and then sold on to investors around the world. A number of systemically important German banks have significant exposures to leveraged loans.

Global macroeconomic and financial environment

The German financial system is closely interconnected with the rest of the world. Germany's economy is integrated into global value chains. An increase in global financial stress therefore has the potential to worsen financial conditions in Germany and depress economic activity (see the box entitled "Transmission of a global financial shock to Germany" on p. 20). Unexpectedly weak demand from abroad may place a strain on Germany's export-oriented industry. An abrupt rise in risk premia or an unexpected economic downturn abroad may affect the German financial system through direct linkages. Moreover, shocks could also have an impact via indirect channels – even from countries with which Germany has only few links.

An abrupt rise in risk premia or an unexpected economic downturn abroad may affect the German financial system.

When assessing the risk situation of a financial system with strong international ties, therefore, not only domestic risks but also risks in the international environment should be taken into account. It is of special interest to open economies in particular that reforms aiming to boost the resilience of the financial system are closely coordinated at the international level, and that a structured process is in place to assess their impact (see the box entitled "Policy evaluation in the international context" on p. 30).

However, not every negative development outside Germany has to have an adverse effect on the German financial system. For example, negative shocks in other countries might indirectly give another economy a competitive edge if, say, its government bonds are deemed to be especially safe (safe havens).

The current global economic setting and financial conditions are discussed below, focusing on the slower global economic growth and ongoing low interest rate environment. In this context, the valuation level on the financial markets is touched upon, after which the global financial system's vulnerabilities to shocks are analysed. Key factors are the debt levels and risk appetite of enterprises as well as vulnerabilities on the markets for corporate bonds and residential real estate.

Global economic growth has slowed considerably this year. The high level of political uncertainty is also clouding the economic outlook worldwide. Against this backdrop, capital market rates have fallen, and market participants now expect interest rates to stay low for longer than previously anticipated. Thus, a scenario in which interest rates are low, or even negative, for much longer than expected has become more likely. This could, in turn, incentivise financial market participants to take on more risk in order to generate higher returns. Financial market participants targeting nominal returns, such as life insurers, would be particularly susceptible to this.

A protracted low interest rate scenario has become more likely.

Slower global growth

The underlying cyclical trend in 2019 is weaker than had been expected last year. The International Monetary Fund (IMF) is expecting the global economy to grow by 3.0% this year compared to 3.6% last year, which would be the lowest rate since the global financial crisis. At the root of this development is weaker impetus from the advanced economies and certain emerging market economies. Some of the downside risks that were already relevant last year materialised this year and have shaped economic de-

velopments.[1] The trade dispute between the United States and China intensified, for example. The associated political uncertainty is likely to have played a particular role in the weaker investment dynamics. This, in turn, is having a negative effect on global industrial output and world trade.[2]

The growth outlook is also subdued: current IMF projections envisage growth of 3.4% in 2020. The moderate recovery next year is based primarily on the expectation that the economic situation in the emerging market economies that are currently facing stress will improve. The advanced economies will not expand any faster than they did this year, according to the forecasts. Growth in this group of countries will also be dampened by lower potential growth from a longer-term perspective.[3]

On the whole, the forecasts reflect the prevailing uncertainty at the global level, with multiple downward revisions to forecasts of global economic growth over the course of the year. The outlook remains dogged by considerable downside risk going forward as well.

The outlook remains dogged by considerable downside risk.

Key interest rates low and market players expecting further decrease

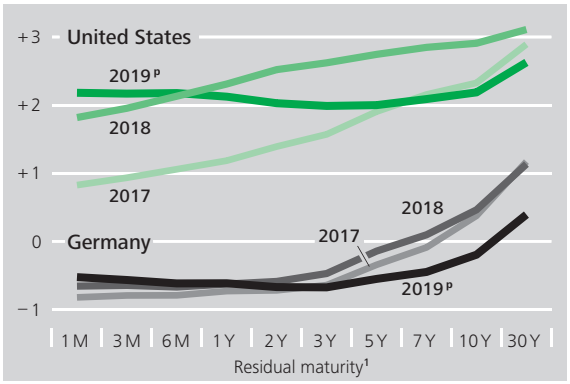
In response to the weaker economic growth, dampened inflation outlook and elevated downside risks, the major central banks have taken additional expansionary measures. The US Federal Reserve System cut its benchmark rates in July for the first time since December 2008. In the euro area, the Governing Council of the European Central Bank (ECB) reiterated the need for an accommodative stance of monetary policy for a prolonged period of time.[4]

As a result, market participants have revised their expectations of future key interest rate movements downwards. At the same time, the yields on benchmark bonds, such as longer-dated German and US government bonds, have fallen markedly (see Chart 2.1).

Market participants have revised their expectations of future key interest rate movements downwards.

Yield curves of government bonds Chart 2.1

Yield in % p.a., annual averages



Source: Bloomberg. **1** Maturity buckets are not evenly distributed.
Deutsche Bundesbank

Higher volume of bonds with negative yield

Compared with last year, the global volume of outstanding bonds with a negative yield has grown sig-

1 For example, the United States and China once again hiked their tariffs markedly this year. Before the trade dispute began in early 2018, the average tariff for Chinese imports to the United States was 3%, and for US imports to China, 8%. There are plans to raise the tariffs further in December 2019, to an average of just under 24% and 25%, respectively. See Bown (2019a, 2019b).
2 See Deutsche Bundesbank (2019) and Organisation for Economic Co-operation and Development (2019).
3 See International Monetary Fund (2019a, 2019c and 2019d) and European Central Bank (2019d).
4 The Governing Council of the ECB expects the key interest rates to remain at their present or lower levels until it has seen the inflation outlook robustly converge to a level sufficiently close to, but below, 2% within its projection horizon, and such convergence has been reflected in core inflation dynamics; see European Central Bank (2019c).

Transmission of a global financial shock to Germany

Dynamic factor models can be employed to identify how an unexpected rise in global financial stress could affect the German financial system and the real economy.[1]

A shock is defined here as an exogenous change in a financial stress index (FSI) in the United States, the dominant economy in the global financial and monetary system. The FSI used here is an indicator that summarises stress among financial intermediaries as well as in the US equity markets and bond markets.[2]

The impact of a global shock is considered below.[3] A dynamic factor model (factor-augmented vector autoregressive model) is estimated. The underlying quarterly dataset contains a total of around 2,000 macroeconomic and financial market time series for 40 advanced and emerging market economies for the period from 1996 to 2018.

The assumed shock increases the FSI in the United States itself for approximately one year; US equity prices fall by around 3%, while volatility rises by 6%. By comparison, in the 2007-08 global financial crisis, stock market volatility increased by a factor of 13 and the financial stress index by a factor of 18 compared to this scenario.

The results of the empirical study indicate that an unexpected rise in global financial stress would have had a significant impact on the German financial system (see the chart).[4] The shock causes share prices in Germany to fall immediately, while stock market volatility goes up. Corporate bond market spreads widen.[5] The shock also influences a broader index of financial conditions in Germany covering a large number of financial indicators such as asset prices, risk premia and credit aggregates. The result suggests that the financial conditions in Germany would deteriorate, at times considerably.

Outstanding corporate credit climbs slightly in the short run. The initial rise in credit could be attributable to enterprises resorting less strongly to internal sources of funding[6] and credit lines that were already approved prior to the shock's occurrence.[7] Additionally, shifts in foreign banks' portfolios could contribute to higher lending to Germany than lending from Germany. This means that foreign banks' lending to Germany increases in the short run, while German banks' lending to non-residents decreases.[8] After two

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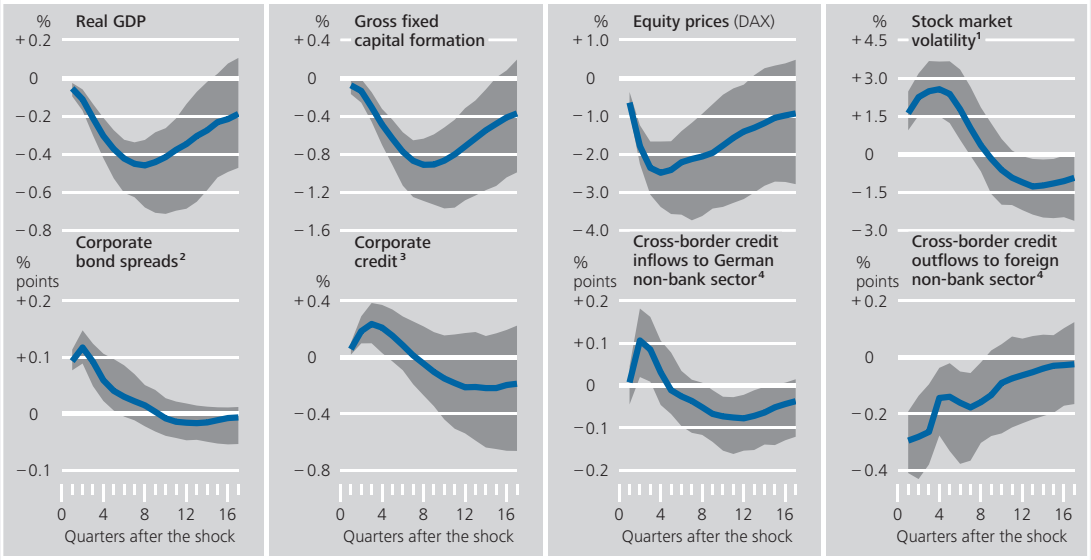
1 See Eickmeier and Tanneberger (2019).
2 The Federal Reserve Bank of Kansas City's financial stress index (FSI) is based on eleven variables (spreads and second moments) that depict different aspects of financial stress.
3 The effects of an exogenous one standard deviation change in global financial stress are estimated. The results are similar even if a broader index of US financial conditions and more narrowly defined financial market indicators (such as interest rate spreads) are used instead of the financial stress indicator.
4 The latent international factors summarising the movements of these data are modelled together with the variables for the United States (GDP, consumer price index, fed funds rate and FSI) in a vector autoregressive model. Financial shocks are identified by combining contemporaneous zero restrictions and sign restrictions on the impulse responses.
5 Euro area corporate bond spreads are considered here, as no such data exist for Germany. The results for the interest rate spreads on German corporate credit (the difference between the lending rate and the risk-free interest rate of the corresponding maturity) are similar.
6 The global financial shock could result in a decrease in internal funding (retained earnings) and thus push up demand for external financing; see, inter alia, Haan, Sumner and Yamashiro (2009).
7 See Ivashina and Scharfstein (2009). This study demonstrates that there was a clear rise in corporate lending during the financial crisis because borrowers drew down credit lines that had already been approved. This increase was not caused by newly issued loans, however.
8 Home bias (i.e. the tendency of investors to overweight financial investment in their domestic market) and safe haven (capital investment where investors assume that it has a stable value) motives are likely to be at play here. For more information on the reasons for home bias in international capital markets, see Coeurdacier and Rey (2013).

Effects of a global financial shock in Germany*

Median and 90% confidence interval



Sources: BIS, Bloomberg, Haver Analytics, ICE Data and Bundesbank calculations. * Impulse responses for a one standard deviation shock to the global financial markets. **1** DAX 90-day realised volatility. **2** Risk premia on euro-denominated bonds issued by non-financial corporations compared with government bonds. **3** Outstanding credit volume of all sectors to non-financial corporations. **4** Changes in the external claims on the non-bank sector of banks reporting to the BIS as a percentage of GDP, after adjustment for exchange rate movements.

Deutsche Bundesbank

years, the volume of corporate credit drops below the pre-shock level, but this decline is not statistically significant.

A rise in global financial stress could have an impact beyond the German financial system and even reach the German real economy. Poorer financial conditions mean that enterprises invest less,[9] causing real economic activity in Germany to slow down. After the shock occurs, German gross domestic product (GDP) drops by just over 0.4% within eight quarters. This effect lasts around three years and is thus relatively persistent.

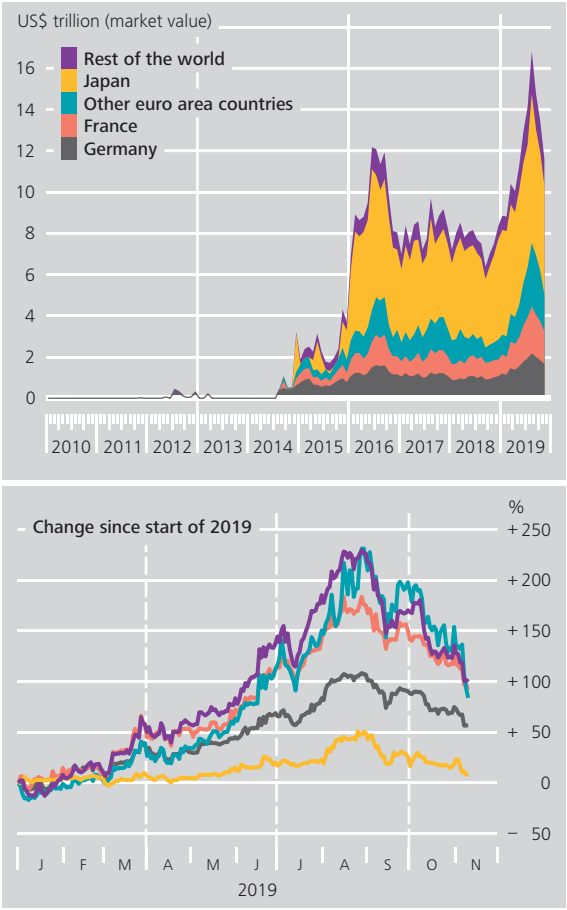
By international standards, the global financial shock also has a marked adverse impact on most of the other countries in the sample. Stock market volatility rises sharply in all of the economic regions considered. GDP falls in most countries, and only in Asia is the effect unclear. When compared directly with other euro area countries, the decline in Germany's GDP tends to be somewhat more pronounced.

A cross-country regression analysis examined which of a country's structural features increases its vulnerability to a global financial shock. The results indicate that a higher degree of financial openness and greater significance of the financial sector are associated with stronger responses to a shock.[10] However, greater exchange rate flexibility and larger international reserves seem to serve as a buffer against a shock.

9 Households in Germany are not substantially affected by the financial shock under consideration. Consumption and its most important determinants barely show any significant changes. These determinants include house prices, loans to households and the labour market situation as measured by the unemployment rate.

10 The effects on real GDP and stock market volatility were considered here.

Bonds with negative yields* Chart 2.2



Sources: Bloomberg Barclays and Bundesbank calculations. * Outstanding volumes of bonds from issuers across all sectors.
Deutsche Bundesbank

nificantly (see Chart 2.2). This is largely attributable to euro area government bonds. Overall, euro area bonds now make up 43% of the outstanding volume of bonds with negative yields worldwide, representing an increase of 9 percentage points since the beginning of the year. The share of German bonds offering negative yields currently comes to 14%.[5] Yields on German Federal bonds (Bunds) are now in negative territory out to long maturities.

The global volume of outstanding bonds with a negative yield has grown significantly.

On the one hand, there may be structural reasons for this development. For example, demographic change or slower technological progress may be changing the propensity to save and invest.[6] The decline in bond yields may also be due to demand for safe assets outstripping supply.[7] Additionally, many institutional investors are required to invest in bonds denominated in certain currencies and with very good credit quality, even if they bear negative yields.[8]

On the other hand, the increase in negative-yielding bonds may reflect a change in the expectations and preferences of market players and an expectation that the yields on safe assets will decline further in future. Investors may, for example, be expecting the international trade disputes to have long-term negative consequences.[9] However, negative yields on safe bonds also create an incentive for yield-seeking market participants to take on greater risk.

Low interest rate level supporting high valuations

The deterioration in the macroeconomic environment is reflected in weaker growth in corporate profits. Listed European enterprises have reported declining profits throughout 2019; in the United

Despite slower growth in corporate profits, valuations are still high.

5 Based on the following index: Bloomberg Barclays Global Aggregate Negative Yielding Debt.
6 See Bean, Broda, Ito and Krozner (2015).
7 In connection with the balanced Federal budget, the supply of Bunds stagnated in the past few years or declined slightly, whereas demand for safe securities has tended to increase in recent years; see Committee on the Global Financial System (2016).
8 See Jung (2019).
9 See Deutsche Bundesbank (2018a), pp. 33-37.

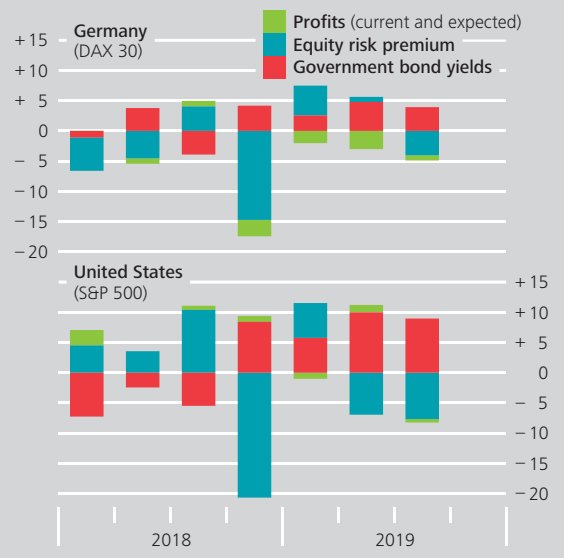
States, corporate profits are growing at a much slower pace than last year. Generally speaking, a less favourable profit outlook can be a factor which increases the likelihood of an insolvency. There would thus be an increase in the risk premia demanded by the market and in the enterprises' funding costs. Despite slower growth in corporate profits, valuations in the global bond markets, and in some cases the equity markets, are still high, however. The reduced interest rate level and the discounting of future payments at lower rates are likely to have been major factors in this. Low interest rates also reduce enterprises' debt service, thereby making insolvencies less likely. At present, market observations show that the interest burden for new borrowing by some enterprises has even dropped to zero.

Changes in risk premia are another important driver of securities prices. These fluctuated considerably over the course of the year, not least in response to developments in the trade dispute and the uncertainty surrounding a no-deal Brexit. Generally speaking, a decline in the equity risk premium would indicate a greater willingness to take on risk and growing importance of profitability motives ("search for yield").[10]

The effect of the persistent low interest rate level on equity prices can be demonstrated by decomposing the explanatory factors behind price performance. The explanatory factors considered are current and expected corporate profits, government bond yields as an approximation of the risk-free interest rate, and the equity risk premium (see Chart 2.3).[11] For Germany's DAX 30 stock index, the drop in profits since the start of the year is a negative explanatory factor behind price performance. However, this is overcompensated for by the contribution of the risk-free interest rate. For the US S&P 500, too, the risk-free interest rate appears to have been a positive explanatory factor since the beginning of the year. The explanatory contribution of the equity risk premium fluctuates for both indices.

Explanatory factors* in stock market performance Chart 2.3

%



Sources: Bloomberg, Consensus Economics Inc. and Bundesbank calculations. * Based on residual income valuation formula. A positive contribution (e.g. falling government bond yields or equity risk premia, or increasing corporate profits) results in rising equity prices.

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Risk premia could rise abruptly

The risks to the future path of the global economy are predominantly tilted to the downside. These include a possible renewed escalation of the trade dispute between the United States and China, the spread of the dispute to other regions, and a

If political risks were to materialise, they would place a further strain on the already weak world trade dynamics.

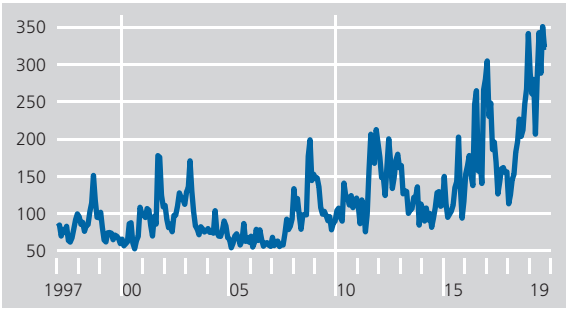
10 See Hau and Lai (2016). For an analysis of low interest rates and bond markets, see Abbassi and Schmidt (2019).

11 Explanatory factors are derived from the residual income formula. The inputs for this formula are as follows: residual income ((return on equity minus cost of equity) × book value of equity in the previous period), book value of equity, stock market index price, and what are considered to be the risk-free yields on the benchmark government bond curve of the respective home country. The implied equity risk premium is calculated as the difference between the market-implied return and the yield on government bonds.

Global Economic Policy Uncertainty Index*

Chart 2.4

Monthly data



Sources: Bloomberg and https://www.policyuncertainty.com/global_monthly.html. * Weighted index on the basis of PPP-adjusted GDP for countries that together account for around two-thirds of global GDP.

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no-deal Brexit (see the box entitled "Brexit" on p. 25). If these risks were to materialise, they would place a further strain on the already weak world trade dynamics. Restrained investment and consumption decisions could contribute to an unexpected economic downturn and lead to losses and hence rising default rates among enterprises in the affected countries.[12] Financial conditions for enterprises could deteriorate abruptly as a result.

Economic policy uncertainty is very high at present – the global Economic Policy Uncertainty Index (EPU) peaked in August 2019 (see Chart 2.4).[13] In light of this, market players might not be pricing in risk correctly at the current juncture. A reassessment of risk could thus result in an increase in volatility and an abrupt adjustment of asset prices.[14]

Asset prices could fall abruptly if market participants reassess risk.

Owing to the current low interest rate level, financial assets with long maturities would be especially susceptible to sharp price fluctuations. This is due to the discount effect: the value of a security stems from the sum of the discounted future payments. The further in the future those payments lie, the more heavily they are discounted. Thus, when interest rates are low, even small rate hikes can lead to relatively strong price drops, particularly for long-dated securities.

Vulnerabilities in the global environment

In the current setting, financial conditions are favourable and interest rates are low. This increases the incentives to take out additional loans. High asset prices widen the scope to take on more debt and collateralise it with assets. An unexpected economic downturn or deterioration in financial conditions could result in funding difficulties and an increasing number of credit defaults among enterprises. The paramount issues in the international environment are the mounting debt levels and risk appetite of enterprises as well as vulnerabilities on the markets for corporate bonds and residential real estate.

Higher debt levels among enterprises

The non-financial corporate sector has significantly increased its leverage over the past few years in many countries, especially the United States, China and a number of emerging market economies.[15] In some cases, debt is rising at a much faster pace than GDP, as shown by widening credit-to-GDP gaps (see Chart 2.5 on p. 27). Given the currently favourable conditions for debt financing, vulnerabilities could

12 See European Central Bank (2019b). For a macroeconomic simulation of an escalating trade dispute between the United States and China, see Deutsche Bundesbank (2018c), pp. 11-13.
13 See Baker, Bloom and Davis (2016). The EPU Index captures the frequency with which uncertainty is discussed in newspapers by counting the mentions of certain keywords. For information on the constraints of the EPU Index as a measure of uncertainty, see Deutsche Bundesbank (2018b), pp. 49-53.
14 See, inter alia, Deutsche Bundesbank (2017), pp. 26-28.
15 See International Monetary Fund (2019a).

Brexit

Following the rejection on 29 March 2019 by the UK House of Commons of the Withdrawal Agreement (WA)[1] negotiated with the EU in November 2018, the date for leaving the EU was moved from end-March to end-October 2019. In October, the United Kingdom submitted a formal request to the EU for a further extension of the deadline, which was granted until end-January 2020. Uncertainty still exists at present concerning the further decision-making process and the future relationship between the United Kingdom and the remaining EU countries. A risk scenario involving abrupt changes in the legal basis for economic and financial relations, in particular, currently still cannot be ruled out.

Market participants, central banks and supervisory authorities had already readied themselves for the possibility of the UK leaving the EU without a deal on the initial exit date in March. In principle, it is predominantly the task of the private sector to make the necessary preparations for specific business lines, such as adapting contracts with customers and inventories.

Preparations already made by public authorities include the following:

– The United Kingdom has adopted legislation which would allow European Economic Area (EEA) firms to continue to provide financial and financial market infrastructure services in the United Kingdom for a transition period of at least three years.

– In the event of a no-deal Brexit, the European Commission has announced contingency measures, a large part of which it has already implemented. This includes a measure in connection with central counterparties (CCPs) based in the United Kingdom which, if they lost EU recognition, could no longer be used directly by EU market participants as third-country CCPs. In addition, exposures to these CCPs would likewise be affected by regulatory capital charges at short notice. These risks have been temporarily reduced by a December 2018 decision by the European Commission that the legal and supervisory arrangements governing UK CCPs in the event of a disorderly Brexit will be regarded as equivalent to those in the EU until 30 March 2020.[2] On this basis, the European Securities and Markets Authority (ESMA) has decided to recognise three UK CCPs – LCH Limited, ICE Clear Europe Limited and LME Clear Limited – as third-country CCPs under Article 25 of EMIR in the event of a no-deal Brexit. This would ensure that EU market participants would have continued but temporary access to UK CCPs if the United Kingdom were to leave the EU in a disorderly fashion.[3]

– The German Tax Act relating to Brexit (*Brexit-Steuerbegleitgesetz*) of 25 March 2019 gives the Federal Financial Supervisory Authority (BaFin) scope for action in order to accommodate the settlement of current contracts and contracts dated beyond the date of Brexit, if necessary, for a transition period of up to 21 months.

– The European supervisory authorities and EEA national supervisors have concluded Memorandums of Understanding (MoUs) with the UK Prudential Regulatory Authority (PRA) and

1 See European Commission (2019).
2 See European Commission (2018).
3 See European Securities and Markets Authority (2019a).

Financial Conduct Authority (FCA) which will come into force in the event of a no-deal Brexit:

- European Banking Authority (EBA): The MoU serves as a template for bilateral MoUs being negotiated between the EU and UK competent authorities. It outlines provisions for maintaining information exchange and supervisory cooperation.[4]

- European Securities and Markets Authority (ESMA): A multilateral MoU has been reached concerning the exchange of information between national securities regulators and the FCA on topics such as market surveillance, investment services and asset management activities. ESMA and the FCA have concluded a bilateral MoU in order to ensure the exchange of information in relation to the supervision of credit rating agencies (CRAs) and trade repositories (TRs).[5]

- European Insurance and Occupational Pensions Authority (EIOPA): A multilateral MoU on supervisory cooperation, enforcement and information exchange and a bilateral MoU on information exchange and mutual assistance in the field of insurance regulation and supervision have been agreed.[6]

- In addition, on 5 March 2019, the Bank of England and the European Central Bank (ECB) activated a currency swap arrangement for the possible provision of euro to UK banks. Under this arrangement, the Eurosystem would additionally stand ready to lend pound sterling to euro area banks, if the need arises. In preparation for Brexit, the Bank of England, for its part, launched a Liquidity Facility in Euros (LiFE) under which it will offer to lend euro to UK banks on a weekly basis.[7]

4 See European Banking Authority (2019).
5 See European Securities and Markets Authority (2019b).
6 See European Insurance and Occupational Pensions Authority (2019).
7 See European Central Bank (2019a) and Bank of England (2019b).

continue to build up, particularly for highly leveraged enterprises with low profits. Independently of acute default risk, further negative effects could arise due to inefficient allocation of capital in an economy.[16] The advantageous financial conditions may ease the pressure on less profitable enterprises to restructure or to exit the market, thereby crowding out investment by more productive firms, for example.[17]

Vulnerabilities could continue to build up, particularly for highly leveraged enterprises with low profits.

Enterprises tapping increasingly risky funding sources

In the United States, the debt level of non-financial corporations stood at just under 75% of GDP in the first quarter of 2019, which was higher than the level in 2008. There has been especially strong growth in syndicated loans to enterprises in the non-investment-grade segment; these are known as leveraged loans.[18] At the same time, the quality of these loans has declined, as measured by the ratings and leverage of the enterprises. Lending standards and investor protection clauses have been relaxed considerably.

Leveraged loans have grown particularly strongly.

Similar developments can be observed in Europe. The market for leveraged loans grew by 44% between the end of 2016 and November 2019. However, with an outstanding volume of US$483 billion, it is much smaller than the US market, which is worth US$1,837 billion (see Chart 2.6). Non-financial corporations resident in Germany barely used leveraged loans as a source of funding (1.2% of GDP). Traditional bank loans are predominant here.

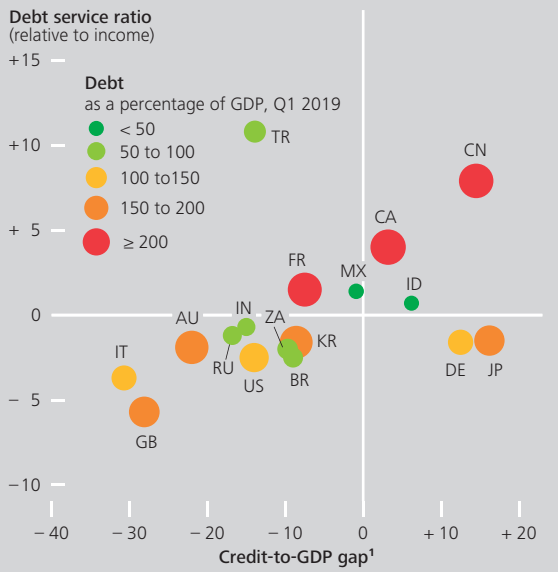
The default risk of leveraged loans has increased worldwide as a result of a decelerating economy and deterioration in credit quality. Furthermore, in the event of default, recovery rates may be lower than in previous credit cycles. Over the past few years, non-bank financial intermediaries such as funds, asset managers and insurers have been investing more heavily in leveraged loans. Investment funds, in particular, may behave procyclically in stressed periods.[19] Thus, funds might in-

Over the past few years, funds and insurers have been investing more heavily in leveraged loans.

Debt metrics in the private non-financial sector of G20 countries*

Chart 2.5

Q1 2019 versus Q4 2008, percentage points



Sources: BIS and Bundesbank calculations. * Where country data for G20 countries are available. **1** Deviation of credit-to-GDP ratio from its long-term trend. Country abbreviations according to ISO 3166-1.

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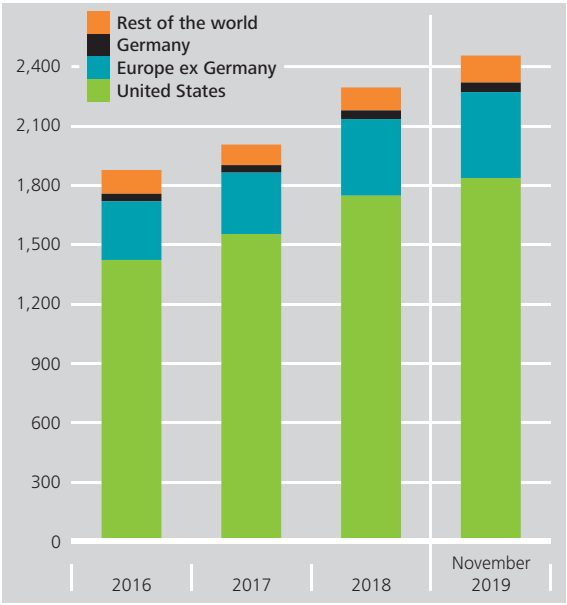
16 See Andrews and Petroulakis (2019).
17 See Banerjee and Hofmann (2018), and Borio and Hofmann (2017).
18 As yet, there is no internationally harmonised definition of the leveraged loan market. It is often understood to include loans to enterprises with a non-investment-grade rating or with a wide spread over a reference rate. In its "Guidance on leveraged transactions", the ECB includes loans to enterprises with a total debt-to-EBITDA ratio greater than 4 and loans where the borrower is majority-owned by one or more financial sponsors.
19 See Timmer (2018).

Leveraged loans* by origin of borrower Chart 2.6

Outstanding volumes in US$ billion, year-end data



Source: Bloomberg. * Loans (term loans and revolving credit facilities) to enterprises with elevated default risk.
Deutsche Bundesbank

creasingly sell off financial assets in response to sizeable redemptions of fund shares by investors (see the section entitled "Investment funds could amplify shocks" on p. 100).

Additionally, a large proportion of leveraged loans have been securitised as collateralised loan obligations (CLOs) and are widely distributed over sectors and geographical areas. Consequently, there is limited transparency concerning the ultimate holders of these potentially risky securitisations. Uncertainty surrounding holders and their loss-absorbing capacity may exacerbate price slumps.

According to estimates, banks hold the biggest share of leveraged loans worldwide.[20] A number of large, systemically important German banks also hold sizeable portfolios of leveraged loans and CLOs.[21] In addition, market data show that in some cases, these banks have a strong market position when it comes to passing on syndicated loans to other banks and investors in Europe and the United States. The Single Supervisory Mechanism (SSM) therefore monitors euro area banks' activities in this regard and is able to address institution-specific vulnerabilities where necessary.

Banks hold the biggest share of leveraged loans.

Higher default rates may directly result in losses for banks. Aside from this, risks may emerge for German banks as a result of spillover and negative confidence effects. Elevated rates of default may be triggered by an economic downturn or sudden deterioration in financial conditions. Furthermore, if the transaction and issue volumes in the leveraged loan market begin to flag, the earnings of those banks which are particularly active in this market segment may also decline.

Increasing vulnerabilities in the corporate bond markets

Increased vulnerabilities are revealed not only by lending behaviour. Indeed, overall borrowing on the markets has risen since the global financial crisis. For example, corporate bonds as a share of bank loans to enterprises in the euro area rose from 11% to 18% between 2008 and 2018.[22]

Moreover, it is striking that the segment of corporate bonds with a BBB rating, i.e. the lowest investment grade notch, has grown significantly.[23] Examining euro-denominated bonds issued by non-financial corporations from the EU, the share made up by BBB-rated bonds has increased from 35% in 2008 to

20 See Bank of England (2019a).
21 The large, systemically important German banks include the 13 other systemically important institutions (O-SIIs).
22 Data source: ECB, Non-financial corporations (NFCs) – statistics on financial assets and liabilities on a consolidated basis.
23 See Bank for International Settlements (2019).

47% in June 2019. A substantial proportion of the outstanding volume of such bonds was issued by enterprises domiciled in France or Germany (see Chart 2.7). The rating is particularly important to institutional investors, as they are bound to certain investment criteria on account of their mandates. In the event of an economic downturn, many corporate bonds may be downgraded to the non-investment-grade segment. This would force many institutional investors to offload them simultaneously.

The segment of corporate bonds with the lowest investment grade notch has grown significantly.

The market segment for non-investment-grade bonds is relatively small, only receptive to a limited extent and thus characterised by low liquidity. Accordingly, risk premia may increase rapidly and significantly if extensive downgrades occur, subsequently causing tensions to spill over to other market segments. On account of the close relationship between market risk premia and risk premia in banks' lending activity, implications for financial conditions may also be transmitted through this channel. In extreme cases, corporate funding may be jeopardised.

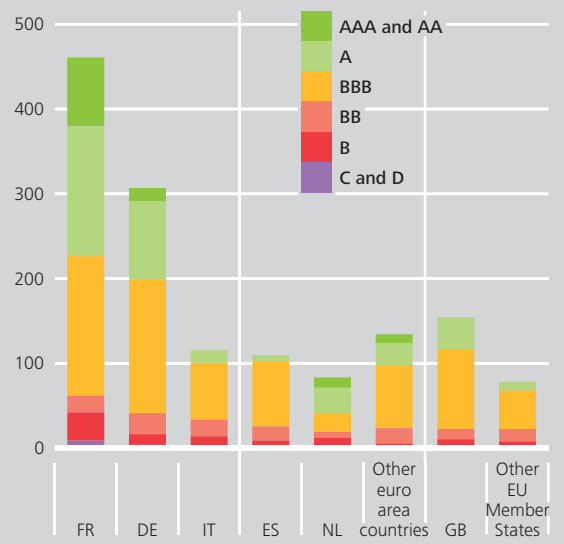
Vulnerabilities from household debt

In the past, high levels of household debt in conjunction with increasing debt service payments were often early warning indicators of future disruptions.[24] In an economic slump, macrofinancial vulnerabilities are exacerbated. Rising unemployment rates, in particular, could deprive households of the ability to service their debt. The macroeconomic situation would then worsen further due to the second-round effect of debtor households hit particularly hard by the downturn cutting back on their consumption.

Euro-denominated bonds of EU non-financial corporations by rating and country of domicile*

Chart 2.7

Outstanding nominal amounts in € billion as at 30 June 2019



Sources: Centralised Securities Database (CSDB), ICE Data and Bundesbank calculations. * Only rated bonds with a nominal volume of at least €10 million are included.

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Residential real estate borrowing also has a bearing on household debt. Such borrowing continues to be driven by favourable financial conditions. In most countries, the real estate markets have recovered since the global financial crisis (see Chart 2.8).[25] In spite of similar trends, country-specific market developments are more pronounced here than in other investment categories such as equities or bonds.[26]

Residential real estate borrowing continues to be driven by favourable financial conditions.

24 See Alter, Xiaochen Feng and Valckx (2018).
25 See European Central Bank (2018) and International Monetary Fund (2019b).
26 See Mandler and Scharnagl (2019). One reason for this stronger heterogeneity is that the structures of residential real estate markets often differ considerably in terms of, for example, rental market regulations, building land designation, tax conditions or credit market setup; see Andrews, Sánchez and Johansson (2011).

Policy evaluation in the international context

In response to the global financial crisis, the Financial Stability Board (FSB) was tasked with coordinating the preparation and implementation of the G20 financial market reforms. The execution of these reforms is making progress:[1] Basel III has been finalised, while systemically important financial institutions have been identified and must fulfil additional prudential requirements. Resolution regimes are currently underway, although the internationally agreed standards have not yet been fully implemented in all countries.[2] A number of reforms can now be reviewed in terms of whether the regulatory objectives have been achieved, whether any side effects have emerged, and whether the right balance has been struck for society between the costs of regulation and the benefits associated with more stable financial markets.

The results of the study "Evaluation of the effects of financial regulatory reforms on small and medium-sized enterprise (SME) financing" will be published at the end of November 2019. The study examines whether the implementation of the initial Basel III reform package on banking regulation, which was passed in November 2010, had an impact on lending to SMEs. This question is particularly relevant to the German economy, as roughly 60% of all employees work in small and medium-sized enterprises, whilst around 50% of aggregate value added comes from SMEs. Credit financing from banks is especially important for SMEs as their access to sources of funding such as the bond market is limited in comparison to large enterprises.[3] That said, lending to SMEs is also a key business area for German banks, which issue around 60% of their corporate loans to SMEs on average.

The most important finding of the evaluation project is that – taking account of macroeconomic and monetary policy factors – aggregate lending to SMEs has not been negatively affected by Basel III in the long term. This result is based on a comprehensive data analysis and is in line with the feedback from market participants surveyed during the project. Most of them stated that SME financing was predominantly driven by positive economic developments and the low interest rate environment.

In addition, the analysis for Germany shows that the introduction of a leverage ratio and higher risk-weighted capital requirements for banks with low capitalisation was accompanied by a temporary decline in the market share of such banks' lending – a shift that may contribute positively to the financial system's resilience.[4] These banks cut back their lending to SMEs in the short run and increased their collateral requirements for loans. By contrast, there are no signs that the introduction of the liquidity coverage ratio (LCR) has affected lending to SMEs. The results of the analyses of the entire corporate sector do not differ substantially from the results of SMEs specifically. Hence, there is no evidence that Basel III has put SMEs at a disadvantage in terms of credit financing. These results are largely consistent with those of other countries that participated in the evaluation project.

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1 See Financial Stability Board (2019).
2 These are the "Key Attributes" (KA), which define the essential features of resolution regimes.
3 See, inter alia, Beck and Demirgüç-Kunt (2006).
4 The study by Imbierowicz, Löffler and Vogel (2019) comes to a similar conclusion (see the box entitled "Effect of higher capital requirements on lending to enterprises" on p. 79).

The too-big-to-fail reforms are currently being evaluated in another project.[5] While the term "too big to fail" refers to the size of a bank in the stricter sense, it has a broader meaning in this context. Here, it refers to institutions that are systemically important on account of their size, complexity, interconnectedness, cross-border business activities or substitutability. The core of the too-big-to-fail issue is that if one such institution encounters difficulties, this may have negative effects on the stability of the financial system as well as on the real economy. This could put pressure on government bodies to prevent insolvencies by using public funds to pay for support schemes. The expectation of such a bailout can result in financing advantages and distorted incentives (moral hazard) for banks even under normal circumstances. These distorted incentives could affect banks' structures, e.g. their size and complexity, prompting them to take on greater risks. This, in turn, may cause an increase in the likelihood and magnitude of the distress of banks.

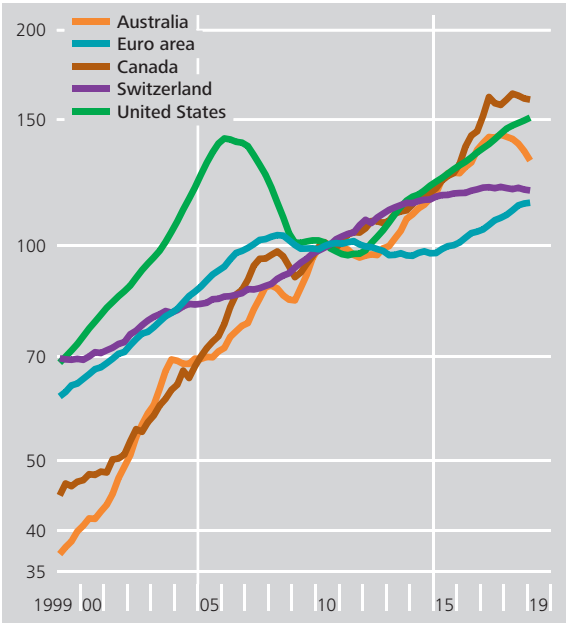
The G20 countries approved the too-big-to-fail reforms in order to reduce systemic risk and distorted incentives at systemically important institutions. These reforms apply to all institutions classified as systemically important, and include additional requirements for loss absorbency in the form of higher capital buffers and the total loss-absorbing capacity (TLAC) standard, a new resolution regime and more intense supervision.

An international working group is currently investigating whether the too-big-to-fail reforms have achieved their goal of reducing the likelihood and impact of a systemically important financial institution running into difficulties. This can, for example, be measured (indirectly) by the extent to which the financing advantages of such institutions have changed. The analysis likewise examines whether the reforms have led these banks to change their structures (e.g. their size and complexity), their business models or their risk profiles. Furthermore, the study looks at whether the new resolution regime has created adequate framework conditions for resolving systemically important institutions without thereby placing financial stability in jeopardy or burdening taxpayers. Finally, consideration is also given to the impact of this regime on the financial system's functioning and on the real economy. A consultative report is scheduled for publication in June 2020, and the project is set to finish by the end of 2020.

5 See Financial Stability Board (2019).

Residential property prices in selected countries Chart 2.8

2010 = 100, log scale, quarterly data



Sources: BIS and Haver Analytics.
Deutsche Bundesbank

The long-term upswing in the residential real estate markets, coupled with persistently low interest rates, may give rise to an accumulation of risk.[27] For example, real estate financing may be granted on the basis of overoptimistic expectations linked to an overestimation of the recoverability of collateral in the real estate lending business. Accordingly, lending standards are to be observed with particular care, because if they are eased significantly, this may result in higher credit default risk in the future.[28] Developments on the residential real estate markets thus represent a focal point of efforts to monitor potential risks to financial stability. At the European level, the European Systemic Risk Board (ESRB) recently issued warnings and recommendations to several countries concerning medium-term risks in their housing markets. The Czech Republic, France, Germany, Iceland and Norway received their first warnings (see the section entitled "Monitoring risks from residential real estate loans" on p. 56). The Member States Belgium, Denmark, Finland, Luxembourg, the Netherlands and Sweden, which had already been issued warnings in 2016, received recommendations.[29]

The ESRB has issued warnings and recommendations to several countries concerning medium-term risks in housing markets.

List of references

Abbassi, P. and M. Schmidt (2019), Financial Stability Effect of Yield-Oriented Investment Behaviour, mimeo.

Alter, A., A. Xiaochen Feng and N. Valckx (2018), Understanding the Macro-Financial Effects of Household Debt: A Global Perspective, IMF Working Paper No 18/76.

Andrews, D. and F. Petroulakis (2019), Breaking the Shackles: Zombie Firms, Weak Banks and Depressed Restructuring in Europe, ECB Working Paper No 2240.

Andrews, D., A. C. Sánchez and A. Johansson (2011), Housing Markets and Structural Policies in OECD Countries, OECD Economics Department Working Paper No 836.

Baker, S. R., N. Bloom and S. J. Davis (2016), Measuring Economic Policy Uncertainty, The Quarterly Journal of Economics, Vol. 131, No 4, pp. 1593-1636.

Banerjee, R. and B. Hofmann (2018), The Rise of Zombie Firms: Causes and Consequences, BIS Quarterly Review, September 2018.

27 See, inter alia, Chi Man Hui and Yim Yiu (2009).
28 See Gaudêncio, Mazany and Schwarz (2019).
29 See European Systemic Risk Board (2019).

Bank for International Settlements (2019), BIS Quarterly Review, March 2019.

Bank of England (2019a), Financial Stability Report, July 2019.

Bank of England (2019b), Liquidity Facility in Euros (LiFE): Market Notice, March 2019.

Bean, C., C. Broda, T. Ito and R. Krozner (2015), Low for Long? Causes and Consequences of Persistently Low Interest Rates, Geneva Reports on the World Economy 17.

Beck, T. and A. Demirgüç-Kunt (2006), Small and Medium-Size Enterprises: Access to Finance as a Growth Constraint, Journal of Banking & Finance, Vol. 30, No 11, pp. 2931-2943.

Borio, C. and B. Hofmann (2017), Is Monetary Policy Less Effective When Interest Rates Are Persistently Low?, BIS Working Paper No 628.

Bown, C. P. (2019a), US-China Trade War: The Guns of August, Peterson Institute for International Economics, August 2019.

Bown, C. P. (2019b), US-China Trade War Tariffs: An Up-to-Date Chart, Peterson Institute for International Economics, October 2019.

Chi Man Hui, E. and C. Yim Yiu (2009), Negative Real Interest Rate and Housing Bubble Implosion: An Empirical Study in Hong Kong, Journal of Financial Management of Property and Construction, Vol. 14, No 3, pp. 257-270.

Coeurdacier, N. and H. Rey (2013), Home Bias in Open Economy Financial Macroeconomics, Journal of Economic Literature, Vol. 51, No 1, pp. 63-115.

Committee on the Global Financial System (2016), Fixed Income Market Liquidity, CGFS Paper No 55.

Deutsche Bundesbank (2017), Financial Stability Review.

Deutsche Bundesbank (2018a), Monthly Report, July 2018.

Deutsche Bundesbank (2018b), Monthly Report, October 2018.

Deutsche Bundesbank (2018c), Monthly Report, November 2018.

Deutsche Bundesbank (2019), Monthly Report, May 2019.

Eickmeier, S. and S. Tanneberger (2019), Global Transmission of Financial Stress and Capital Flows, mimeo.

European Banking Authority (2019), EBA Board of Supervisors Agrees a Template for the MoU to Facilitate Supervisory Cooperation Between the EU and UK Supervisors in Case of a No-deal Brexit, press release, March 2019.

European Central Bank (2018), Economic Bulletin, July 2018.

European Central Bank (2019a), ECB and Bank of England Activate Currency Swap Arrangement for Possible Provision of Euro to UK Banks, press release, March 2019.

European Central Bank (2019b), Financial Stability Review, May 2019.

European Central Bank (2019c), Monetary Policy Decisions, 24 October 2019.

European Central Bank (2019d), The ECB Survey of Professional Forecasters: Second Quarter of 2019, April 2019.

European Commission (2018), Brexit: European Commission Implements "No-deal" Contingency Action Plan in Specific Sectors, press release, December 2018.

European Commission (2019), Draft Agreement on the Withdrawal of the United Kingdom of Great Britain and Northern Ireland from the European Union and the European Atomic Energy Community, November 2019.

European Insurance and Occupational Pensions Authority (2019), EIOPA and its Members Agree on No-deal Brexit Memoranda of Understanding with the Bank of England and the Financial Conduct Authority, press release, March 2019.

European Securities and Markets Authority (2019a), ESMA Agrees No-deal Brexit MOUs with the Bank of England for Recognition of UK CCPs and the UK CSD, press release, February 2019.

European Securities and Markets Authority (2019b), ESMA and EU Securities Regulators Agree No-deal Brexit MoUs with FCA, press release, February 2019.

European Systemic Risk Board (2019), Vulnerabilities in the Residential Real Estate Sectors of the EEA Countries, September 2019.

Financial Stability Board (2019), Progress in Implementation of G20 Financial Regulatory Reforms, June 2019.

Gaudêncio, J., A. Mazany and C. Schwarz (2019), The Impact of Lending Standards on Default Rates of Residential Real Estate Loans, ECB Working Paper No 220.

Haan, W. J. D., S. W. Sumner and G. M. Yamashiro (2009), Bank Loan Portfolios and the Canadian Monetary Transmission Mechanism, Canadian Journal of Economics, Vol. 42, No 3, pp. 1150-1175.

Hau, H. and S. Lai (2016), Asset Allocation and Monetary Policy: Evidence from the Eurozone, Journal of Financial Economics, Vol. 120, No 2, pp. 309-329.

Imbierowicz, B., A. Löffler and U. Vogel (2019), The Transmission of Bank Capital Requirements and Monetary Policy to Bank Lending, mimeo.

International Monetary Fund (2019a), Global Financial Stability Report: Lower for Longer, October 2019.

International Monetary Fund (2019b), Global Financial Stability Report: Vulnerabilities in a Maturing Cycle, April 2019.

International Monetary Fund (2019c), World Economic Outlook: Global Manufacturing Downturn, Rising Trade Barriers, October 2019.

International Monetary Fund (2019d), World Economic Outlook: Growth Slowdown, Precarious Recovery, April 2019.

Ivashina, V. and D. S. Scharfstein (2009), Bank Lending During the Financial Crisis of 2008, Journal of Financial Economics, Vol. 97, No 3, pp. 319-338.

Jung, K. M. (2019), Optimal Negative Interest Rate Under Uncertainty, International Journal of Central Banking, Vol. 15, No 3, pp. 1-25.

Mandler, M. and M. Scharnagl (2019), Financial Cycles Across G7 Economies: A View from Wavelet Analysis, Deutsche Bundesbank Discussion Paper No 22/2019.

Organisation for Economic Co-operation and Development (2019), Economic Outlook, May 2019.

Timmer, Y. (2018), Cyclical Investment Behaviour Across Financial Institutions, Journal of Financial Economics, Vol. 129, No 2, pp. 268-286.

Risk situation of the German financial system

Cyclical systemic risks in the German financial system have steadily built up in recent years. This trend continued over the course of the year, despite the deceleration in economic activity and the partial materialisation of various pre-existing external downside risks. So far, the economic slowdown has been confined to the export-driven industrial sector, with capacity utilisation in many domestically oriented sectors remaining high. This has prompted market participants to expect lower growth, but not a broad-based downturn. Against the backdrop of decelerating economic activity and the expansionary measures taken by central banks, the interest rate level fell markedly once again. Unlike last year, market participants now increasingly expect risk-free interest rates to remain low in the years to come.

Low interest rates and the still robust domestic economy are likely to be the key reasons why the German financial system shows no clear signs of the economic slowdown at present. Growth in lending and real estate prices remains dynamic. This environment is, however, conducive to a further build-up of cyclical risks. There is a danger that the recoverability of collateral is being overestimated and credit risks are being underestimated. Furthermore, for one thing, the financial system is vulnerable to an abrupt rise in interest rates. For another, persistently low interest rates would continue to put it under pressure.

In 2018, robust economic growth and a slow rise in interest rates were still expected, which would have strengthened financial stability. These expectations were not met, however. A scenario of persistently low interest rates has instead moved centre stage, and the German financial system remains vulnerable to an unexpected economic downturn – in an environment in which the economic outlook is characterised by major uncertainty. Based on this risk assessment, the countercyclical buffer was activated this year for the first time on the recommendation of Germany's Financial Stability Committee.

Risks in the German financial system

Cyclical risks in the German financial system have steadily built up in recent years. In the banking sector, there is a danger that credit risks are being underestimated. The positive economic development observed in the past was accompanied by low risk assessments and low levels of risk provisioning, rendering the financial system more vulnerable to a scenario in which credit risks suddenly increase again. Closely linked to this is a potential overestimation of the recoverability of loan collateral. A fall in the current high valuations of real estate coinciding with higher credit default rates could hit the German financial system hard. Furthermore, the entire German financial system is exposed to high interest rate risk, rendering it vulnerable to both abruptly rising interest rates and persistently low ones. These cyclical risks are strongly correlated and could materialise at the same time and reinforce each other. This results in risks to financial stability. Banks could be compelled to reduce their balance sheets substantially in order to meet regulatory capital requirements as well as market expectations of capital adequacy.

The build-up of cyclical risks in the German financial system continued over the course of the year. Last year's expectations of robust economic growth and slowly rising interest rates, which would have strengthened financial stability, were not met. As a result, greater focus has been put on one of the risk scenarios of the past year: persistently low interest rates. All in all, the low interest rate environment is likely to continue to put pressure on the financial system and foster the further build-up of existing vulnerabilities there. The financial system will probably become more vulnerable to an abrupt interest rate rise, in particular, as market participants expect low interest rates over the long term. Moreover, in an environment of high uncertainty, the financial system has become more vulnerable to another risk scenario of the past year: an unexpected economic downturn.

The build-up of cyclical risks in the German financial system continued.

The economic situation in Germany has deteriorated markedly, and external downside risks that existed last year partially materialised. Trade tensions and weaker global investment deserve special mention in this context. The economic slowdow is thus largely confined to the export-driven industrial sector. By contrast, capacity utilisation in many domestically oriented sectors, such as construction, remains high, and the overall labour market situation is still robust. Given this dichotomy within the German economy, market participants expect growth to be lower than last year, but do not anticipate a broad-based downturn.

The economic situation has deteriorated markedly.

The interest rate level fell markedly once again as economic activity slowed and expansionary measures were taken by central banks. Unlike in 2018, market participants now increasingly expect risk-free interest rates to remain low in the years ahead. Low interest rates and the still robust domestic economy are likely to be the key reasons why the financial system shows no clear signs of the economic slowdown at present. Banks continue to lend at a dynamic pace, prices for assets such as real estate are on the rise, and indicators that measure stress in the financial markets are low. This environment is still conducive to a further build-up of cyclical risks in the German financial system.

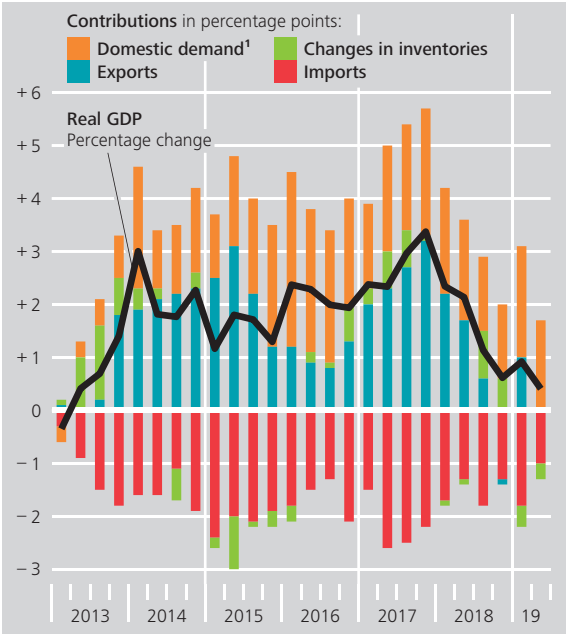
The financial system shows no clear signs of the economic slowdown at present.

This environment is still conducive to a further build-up of cyclical risks.

The analyses conducted this year suggest that the financial cycle is still in an expansionary phase, despite the weak economic situation. The credit-to-GDP gap is rapidly widening, for instance. In addition, there is mounting evidence that credit risks are being underestimated while the recoverability of residential real estate used as collateral for loans is being overestimated (see the section entitled "Real estate lending adds to systemic cyclical risks" on p. 46). The resulting vulnerabilities make the German financial system susceptible to unexpected events, such as an economic downturn involving rising credit default rates and a sharp drop in real estate prices. Such a scenario could engender large losses in the banking sector and cause lending to be curtailed excessively. In this way, the impact of an unexpected economic downturn could be amplified by the financial system. If interest rates remain low in line with market expectations over the coming years, market participants' risk appetite is likely to remain high. The stabilising effect of a slow rise in interest rates – as was expected last year – would fail to materialise (see the section entitled "Persistently low interest rates continue to put banks and life insurers under pressure" on p. 54).

Real GDP in Germany Chart 3.1

Year-on-year change, calendar-adjusted



Sources: Federal Statistical Office and Bundesbank calculations. **1** Excluding changes in inventories.

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Real economic and macrofinancial developments no longer in step

In Germany, economic growth slowed noticeably in the first half of 2019. This contraction was driven primarily by weak exports (see Chart 3.1). These are likely to be due, in part, to the materialisation of political risks (see the chapter entitled "The international environment" on p. 17). For instance, the trade dispute between the United States and China escalated further, not least in the form of raised tariffs. The uncertainty surrounding the United Kingdom's impending exit from the European Union may also have had a dampening impact on the real economy.

However, there are probably more reasons for the unexpected weakness in global trade observed since the fourth quarter of 2018. For example, the global investment cycle lost momentum following the unusually long period of expansion seen in previous years, and the underlying pace of economic growth is again slower. Against this backdrop, German companies' export prospects deteriorated significantly, and growth projections for the German economy were lowered considerably.[1]

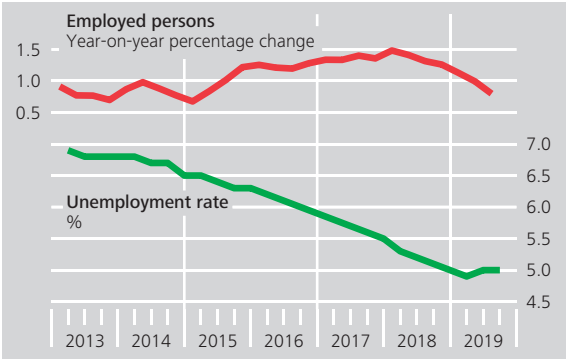
The economic slowdown has so far remained confined to Germany's export-oriented industrial sector.

Nevertheless, the economic slowdown has so far remained largely confined to Germany's export-oriented industrial sector. The domestic economy has scarcely been affected. Above all, the still boom-

1 See Deutsche Bundesbank (2019b); Joint Economic Forecast (2019); German Council of Economic Experts (2019).

Labour market in Germany Chart 3.2

Calendar and seasonally adjusted



Sources: Federal Employment Agency, Federal Statistical Office and Bundesbank calculations.
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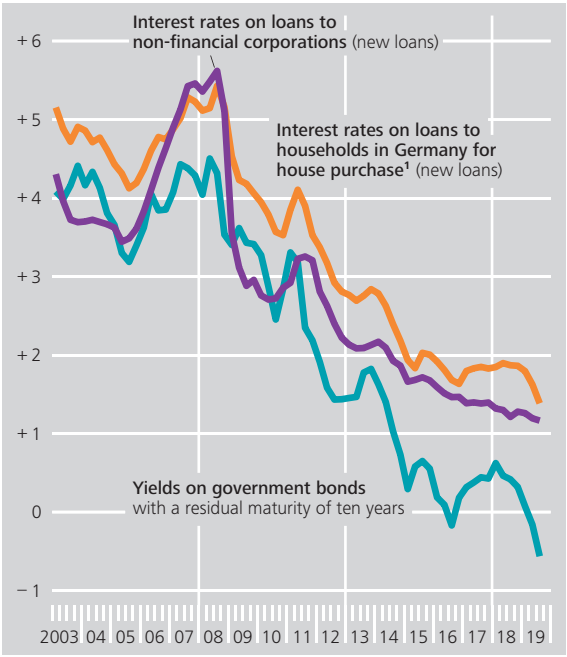
Selected interest rates in Germany Chart 3.3

% p.a., quarterly averages



1 Including non-profit institutions serving households.
Deutsche Bundesbank

ing construction sector as well as government and private consumption are making significant contributions to growth. Private consumption benefited not least from fiscal impulses and the still upbeat labour market situation. While job creation lost momentum, there has thus far been no rise in the unemployment rate (see Chart 3.2). At around 5%, it is at its lowest level since reunification. Overall, the domestic forces are thus intact. This is probably one of the key reasons why the majority of market participants currently expect a temporary economic slowdown in Germany and a return to higher growth in 2020. In line with this, households and banks expect further increases in house prices over the next few years (see the boxes entitled "Household expectations about the future development of real estate prices in Germany" on p. 47 and "Residential real estate financing and risks to financial stability" on p. 50). Against this backdrop, credit demand remains buoyant and real estate prices continue to rise (see the sections entitled "Cyclical vulnerabilities continue to build up in the banking system" on p. 41 and "Real estate lending adds to systemic cyclical risks" on p. 46).

Even though market participants assume that the domestic economy will remain stable and that the economic weakness is temporary, there are major downside risks for the German economy. These stem partly from the external environment and are largely political in nature (see the chapter entitled "The international environment" on p. 17). They are also a product of the dichotomous development of industry and the domestic economy. As a result, the possibility of the current slowdown spreading to other sectors and affecting the labour market cannot be ruled out.

There are major downside risks for the German economy.

As the economy has slowed, risk-free interest rates have fallen. The yield on German government bonds with a residual maturity of ten years again declined markedly and is in clearly negative territory (see Chart 3.3). Across the euro area, market participants now expect risk-free interest rates to remain low in

Greater attention has been focused on the scenario of persistently low interest rates.

the years to come. Greater attention has thus been focused on the scenario of persistently low interest rates, a risk scenario that was already a subject of discussion last year.[2]

Interest rate developments have made a significant contribution to ensuring that financing conditions in Germany remain favourable. Furthermore, the economic slowdown has not led to heightened stress in the financial markets. The financial stress indicator has actually declined since the start of the year and is currently below its average value (see Chart 3.4). This indicator brings together a variety of individual indicators that can reflect stress in the financial markets: risk premia, liquidity and volatility. At present, low volatility and risk premia are having a dampening effect on the indicator (see Chart 3.5).

Interest rate developments have likewise been a major factor supporting equity prices since the start of the year. On the whole, they have actually risen (see Chart 2.3 on p. 23). German enterprises' earnings expectations for the coming year dipped slightly, which, taken in isolation, pushed down stock market prices.

All in all, then, the factors that have promoted the build-up of cyclical risks in the German financial system in recent years remain in place. In addition to market participants' overall fairly optimistic expectations, these are, above all, the very low interest rates and the still robust domestic economy.

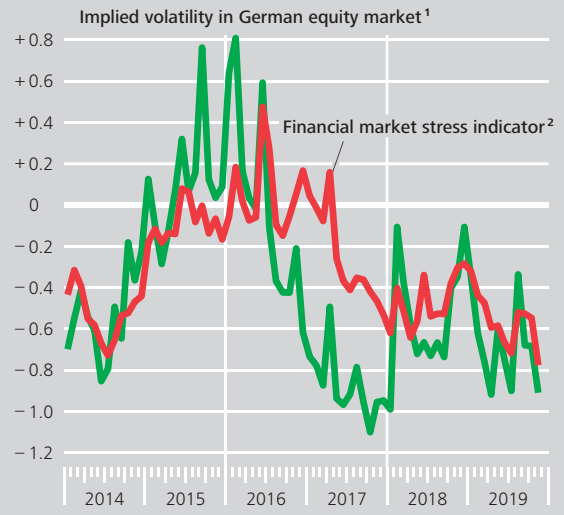
Optimistic expectations and low interest rates promote the build-up of cyclical risks.

Early warning indicator signals further build-up of cyclical systemic risks

The extent to which cyclical risks are building up in the German financial system can be gauged by a variety of macroeconomic indicators (see the box entitled "Measures of cyclical risks in the financial system" on p. 42). Two indicators that are of particular importance are the Bundesbank's early warn-

Financial market stress and financial market volatility in Germany Chart 3.4

Standardised values



Sources: Bloomberg, Markit, Refinitiv and Bundesbank calculations. **1** Expected volatility in the DAX, derived from option prices (VDAX). **2** The indicator is the first principal component of a total of 11 variables in a principal component analysis. The variables comprise a range of interest rate spreads as well as various measures of liquidity and volatility in the financial market.

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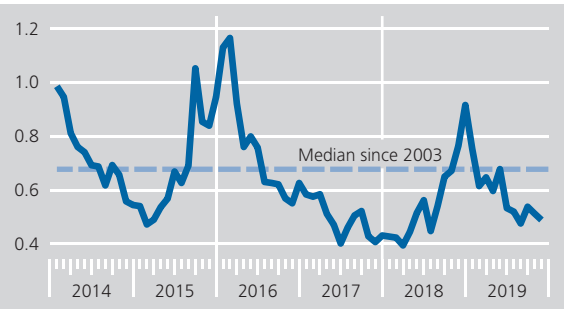
Spread-per-leverage ratio of non-financial corporations in Germany* Chart 3.5



Sources: Bloomberg, Markit and Bundesbank calculations. * Median of the ratios of five-year credit default swap premia to leverage of the enterprises contained in the DAX.

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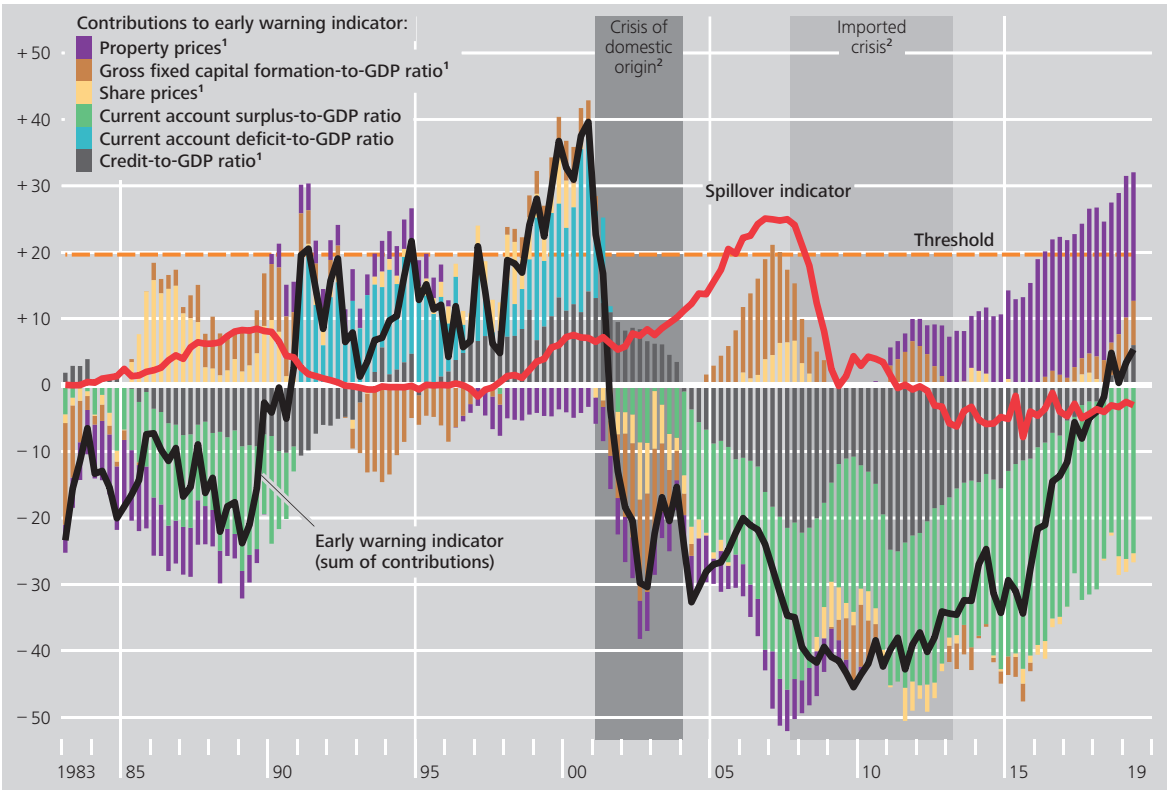
2 See Deutsche Bundesbank (2018).

Early warning indicator and spillover indicator for Germany*

Chart 3.6

Normalisation: early warning indicator in the United States in Q1 2006 = 100



Sources: BIS, Bloomberg, ECB, Eurostat, IMF, OECD, Refinitiv, Bundesbank statistics and Bundesbank calculations. * The early warning indicator shows the extent to which current developments in the German financial system exhibit similarities with developments that characterised the lead-ups to past crises. A value of 100 would correspond to the level of the early warning indicator for the United States in Q1 2006. The spillover indicator weights the early warning indicators of several major economies that are linked to the German financial system. These consist of the United States, Japan, Norway, and the 13 major economies of the EU. The weighting is based, first, on the relative significance of the German banking sector's external assets vis-à-vis each particular country and, second, on the relative significance of the German banking sector's total external assets. **1** Cyclical deviation from the long-term trend, based on the Hodrick-Prescott (HP) filter. **2** According to the European crises database; see M. Lo Duca et al., A New Database for Financial Crises in European Countries – ECB/ESRB EU Crises Database, ECB Occasional Paper Series 194, July 2017.

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ing indicator and the credit-to-GDP gap. These indicators point strongly to a build-up of cyclical risks in Germany.

The early warning indicator condenses an array of domestic data on cyclical risks, e.g. on real estate prices and lending, into a single figure.[3] In this way, it shows the extent to which the current risk situation is comparable to the developments that typically preceded previous financial crises. The financial interconnectedness of the German financial system with the systems of other countries is not taken into account. The early warning indicator has been rising sharply for several years already, primarily because the credit-to-GDP gap has been narrowing and prices in the German housing market have been increasing markedly (see Chart 3.6).

The early warning indicator has been rising sharply for several years.

The level of the early warning indicator is currently being dampened by Germany's high current account

3 For details on the early warning indicator, see Deutsche Bundesbank (2018), pp. 47-49; Beutel, List and von Schweinitz (2019).

surplus. The latter reflects the high domestic rate of saving and thus, implicitly, also the lower level of debt among the individual sectors in Germany. Net lending/net borrowing in the corporate sector has been almost consistently positive since 2002 and, as a result, the corporate sector's equity ratio has risen by around 10 percentage points to roughly 30%. During this period, the household sector even reduced its debt by more than 15 percentage points to around 54% of GDP. These developments have had a generally stabilising effect on financial stability, as the capital positions of both sectors improved as debt levels decreased.

Even so, the channels through which current account balances affect financial stability are the subject of heated debate in the academic literature, with special attention being paid to the destabilising effect of deficits.[4] Picking up on this issue, a variation of the early warning indicator was estimated that only factors in current account deficits. Recently, this variation has been indicating a considerably higher likelihood of crisis.

Alongside domestic developments, the extent to which cyclical risks to financial stability in other countries can build up and possibly affect Germany via financial ties is of particular importance for Germany. To estimate such potential contagion effects, a spillover indicator was calculated. To do this, the early warning indicators of major global economies are calculated in the same way as for Germany. The values for the early warning indicator determined in this manner are then weighted by the German banking system's external exposures to each country.[5] Consequently, any countries with which the German banking system is more closely interconnected receive a higher weight in the spillover indicator. At present, the spillover indicator is still hovering at a low level, particularly compared with the situation prior to the global financial crisis of 2008. Although the spillover indicator is low by historical standards, cyclical risks in several major economies have the potential to generate contagion effects (see the chapter entitled "The international environment" on p. 17).

Cyclical risks in several major economies have the potential to generate contagion effects.

Loans from monetary financial institutions* to the domestic private non-financial sector Chart 3.7

Nominal percentage change compared with same quarter a year earlier

* Domestic banks and money market funds, excluding the central bank. **1** Including non-profit institutions serving households.

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Cyclical vulnerabilities continue to build up in the banking system

Despite the economic slowdown, banks' lending activity continues to grow strongly (see Chart 3.7). Currently standing at around 5%, nominal growth in lending to the private sector is high compared with the values observed since the turn of the millennium. This development can be attributed to both the cor-

4 See Obstfeld (2012).
5 See Deutsche Bundesbank (2018).

Measures of cyclical risks in the financial system

Cyclical risks in the financial system can be measured using various indicators. A distinction can be made between individual indicators, such as the credit-to-GDP gap, and composite indicators, such as the Bundesbank's early warning indicator and growth-at-risk.[1]

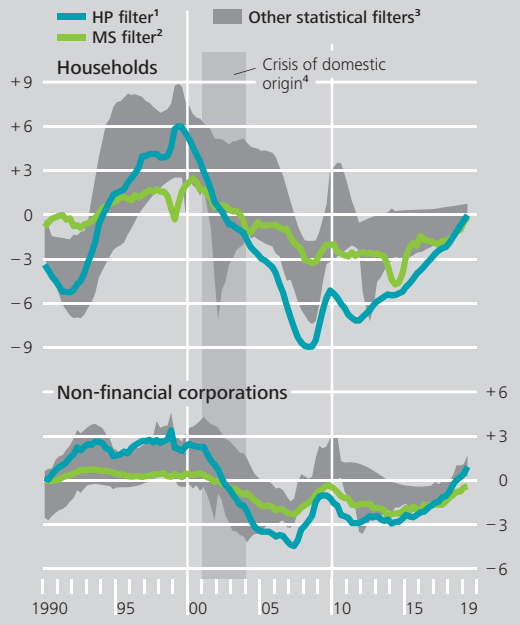
The credit-to-GDP gap measures how strongly the ratio of the aggregate credit volume to gross domestic product (GDP) deviates from its long-term trend. When the credit-to-GDP ratio stands well above its long-term trend, this is an indication of excessive credit growth. Historically, the credit-to-GDP gap has proved to be a good early warning indicator for banking crises[2] and is therefore given special attention when the countercyclical capital buffer is deployed.[3]

Various statistical filtering methods can be used to calculate the long-term trend. One frequently used method is the one-sided Hodrick-Prescott (HP) filter,[4] though it does exhibit some shortcomings. This means that, given a prolonged credit boom, the trend could be overestimated and the credit-to-GDP gap underestimated.[5] Moreover, as a purely statistical filter, the HP filter does not permit any economic interpretation of the gap or trend.

Alternative approaches address these points. First, additional statistical filtering methods can be used.[6] Second, a semi-structural approach can be adopted, whereby changes in the credit-to-GDP ratio are attributed to structural economic drivers.[7] The credit-to-GDP gap calculated in this way measures the contribution of economic drivers that are regarded as potential causes of excessive credit growth.

Credit-to-GDP gap for loans granted by German banks to selected sectors*

Percentage points, quarterly data



* Deviation of the credit-to-GDP ratio from its long-term trend for various calculation methods. **1** Cyclical deviation from the long-term trend, based on the Hodrick-Prescott filter (HP filter, one-sided). **2** Deviation from the level of borrowing justified by the fundamentals, based on the approach by F. Mokinski and M. Saß, Detecting excessive credit growth: An approach based on structural counterfactuals, mimeo, 2019. **3** HP filter (two-sided), Christiano-Fitzgerald filter (one-sided and two-sided), Hamilton filter (recursive and non-recursive) and three-year change. **4** According to the European crises database; see M. Lo Duca et al., A New Database for Financial Crises in European Countries – ECB/ESRB EU Crises Database, ECB Occasional Paper Series 194, July 2017.

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1 See Deutsche Bundesbank (2018), pp. 47-49; Beutel, List and von Schweinitz (2019).
2 See Drehmann, Borio and Tsatsaronis (2011).
3 See Tente, Stein, Silbermann and Deckers (2015).
4 See Hodrick and Prescott (1997). The Hodrick-Prescott filter is used here with a smoothing parameter of 400,000; see Basel Committee on Banking Supervision (2010).
5 See European Central Bank (2017).
6 Specifically, the following methods are applied: HP filter (one-sided and two-sided), Christiano-Fitzgerald filter (one-sided and two-sided), Hamilton filter (recursive and non-recursive) and three-year change. See Hodrick and Prescott (1997); Christiano and Fitzgerald (2003); Hamilton (2018).
7 See Mokinski and Saß (2019).

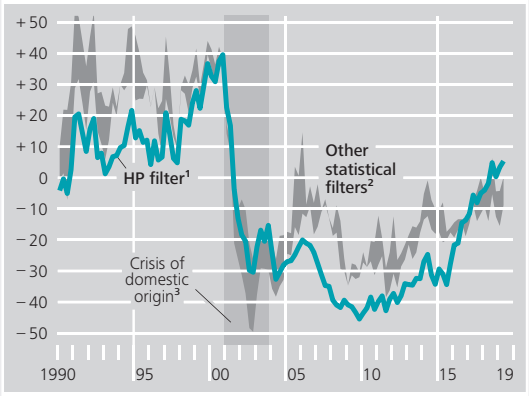
Irrespective of the method used, an increase in the credit-to-GDP gap has been observed in recent years for loans to both non-financial corporations and households (see the chart). Moreover, by historical standards, the range is currently narrow. This points to minimal uncertainty with regard to Germany's position in the cycle.[8]

Besides the credit-to-GDP gap, composite indicators can be calculated to estimate cyclical risks. These take account of credit developments as well as other individual indicators, such as asset prices and real economic variables. These individual indicators are incorporated into the calculation of the Bundesbank's early warning indicator as gaps. Here, too, the gap can be calculated based on various filtering methods, meaning that a range of early warning indicators can be calculated.[9] Again, a build-up of cyclical risks in recent years is evident across all variants (see the chart).

Compared with the indicators described, the growth-at-risk approach is focused on risks to real economic activity that go hand in hand with developments in the financial system. Among central banks and international institutions, this approach is a widely used measure of cyclical risks.[10] The aim of this approach is to forecast particularly sharp declines in GDP, such as the 5%

Early warning indicator for Germany* based on various statistical filters

Normalisation: early warning indicator in the United States in Q1 2006 = 100



Sources: BIS, Bloomberg, ECB, Eurostat, IMF, OECD, Refinitiv, Bundesbank statistics and Bundesbank calculations. * The early warning indicator shows the extent to which current developments in the German financial system exhibit similarities with developments that characterised the lead-ups to past crises. **1** Cyclical deviation from the long-term trend, based on the Hodrick-Prescott filter. **2** Hamilton filter (recursive) and three-year change. **3** According to the European crises database; see M. Lo Duca et al., A New Database for Financial Crises in European Countries – ECB/ESRB EU Crises Database, ECB Occasional Paper Series 194, July 2017.

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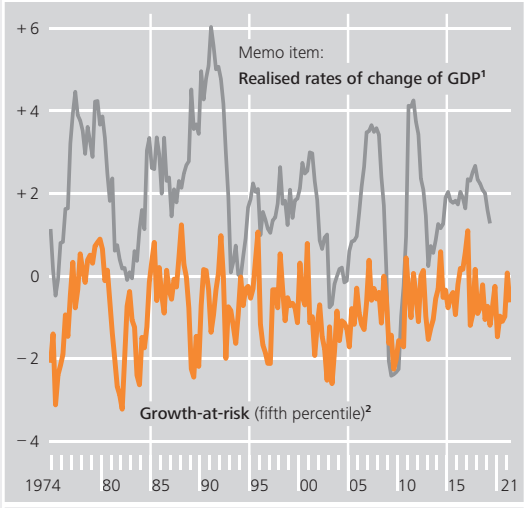
Growth-at-risk for Germany over a horizon of two years

%, quarterly data



Sources: BIS, Bloomberg, ECB, Eurostat, IMF, OECD, Refinitiv, Bundesbank statistics and Bundesbank calculations. **1** Average of the quarterly rates of change of GDP over the preceding eight quarters (annualised). **2** Fifth percentile of the distribution of the rates of change of GDP conditional on the development of the financial cycle.

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8 Given that both one-sided and two-sided filters are included in the calculation of the interval width, it is conceivable that this will be relatively narrow at the end of the observation period due to its design. In order to test this, the interval was alternatively calculated on the basis of the one-sided filter only (not shown). In this case, too, the interval width appears narrow at present compared to earlier periods. There are, therefore, no indications that the narrow range at the end of the observation period occurs due to its design.
9 For details on the early warning indicator, see Deutsche Bundesbank (2018), pp. 47-49; Beutel, List and von Schweinitz (2019).
10 See, inter alia, Prasad, Elekdag, Jeasakul, Lafarguette, Alter, Feng and Wang (2019).

largest drops in GDP. The fifth percentile of forecast GDP distribution is called growth-at-risk. It is apparent that both financial stress indicators and financial cycle indicators contain useful information for forecasting growth-at-risk.[11] This information can stem from the build-up of cyclical risks as well as from the forward-looking features of asset prices.

Growth-at-risk was estimated for a forecast horizon of two years on the basis of a panel quantile regression, conditional on the development of the financial cycle.[12] It shows a decline in the fifth percentile of the forecast GDP distribution for Germany over the past few years (see the chart on p. 43).[13] This means that the probability of much lower growth rates materialising has risen. For the first two quarters of 2021, the model shows that the fifth percentile has edged upwards in comparison with the previous year, but this is subject to a high degree of uncertainty. Overall, the growth-at-risk model therefore indicates an increase in cyclical risks to financial stability in recent years. Thus, all of the measures outlined here point to a rise in cyclical risks.

11 See Deutsche Bundesbank (2018), pp. 51-52.
12 For details on the approach used here, see Beutel (2019). The data used cover the period from the first quarter of 1970 to the second quarter of 2019 and the following countries: Belgium, Germany, Denmark, Spain, Finland, France, the United Kingdom, Italy, Japan, the Netherlands, Portugal, Sweden and the United States.
13 It should be noted that the growth-at-risk approach is not an economic forecast. Instead, it provides information on the build-up of cyclical risks in the financial system which are associated with real economic risks.

porate and household sectors, with lending to the corporate sector being particularly dynamic. Besides low lending rates, the still robust domestic economy is likely to be key in driving the demand for credit (see Charts 3.1 and 3.3).

Despite the economic slowdown, banks' lending activity continues to grow strongly.

As a result, growth in the credit-to-GDP gap is exceptionally dynamic, as in previous quarters, and is now clearly positive at around 1% (see Chart 3.8). The credit-to-GDP gap measures how strongly the ratio of the aggregate credit volume to gross domestic product (GDP) deviates from its long-term trend. When the credit-to-GDP ratio stands well above its long-term trend, this is an indication of excessive credit growth.

Growth in the credit-to-GDP gap is exceptionally dynamic.

Alternative methods of calculating the gap, such as other statistical filtering methods, confirm this picture. In addition, the range of results from alternative methods is currently narrow by historical standards. This points to minimal uncertainty with regard to Germany's position in the cycle (see the box entitled "Measures of cyclical risks in the financial system" on p. 42).

In terms of financial stability, it is important to know the extent to which credit risks associated with lending are potentially being underestimated. In such a scenario, the financial system would be more vulnerable to an unexpected economic downturn.

At present, banks consider their credit risks to be low. As a result, risk weights and provisioning for

credit risk have been reduced significantly in recent years. This is consistent with the improvement in debtors' creditworthiness. The low level of risk provisioning is predominantly attributable to the fact that the share of non-performing loans is low (see Chart 3.9). Since 2014, it has fallen by around 1.5 percentage points on aggregate to a level of approximately 3.5% at last count. In other words, the economic slowdown has so far not been reflected in a significant increase in loans with a heightened risk of default. The risk weights of banks that use their own risk models (internal ratings-based (IRB) approach) are likewise still low (see Chart 3.10).

At present, banks consider their credit risks to be low.

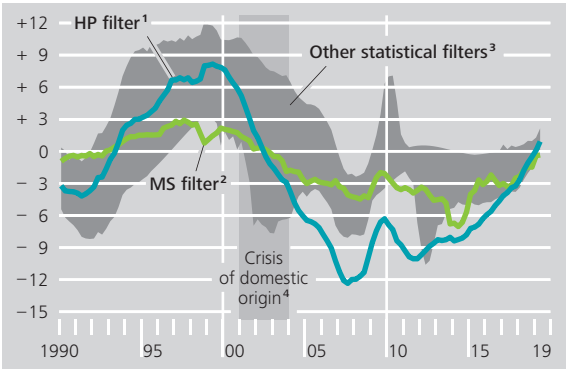
As already discussed in the last Financial Stability Review, there is thus a danger that the ramifications of an unexpected economic downturn are being underestimated.[6] In the event of an economic downturn, credit defaults could increase significantly. In such a scenario, the low level of risk provisioning – i.e. the low accounting provisions for losses given default – would reduce the time it takes for losses to have an effect on capital. Increasing credit defaults in the banking sector would also coincide with higher risk weights as well as rising capital requirements and put regulatory capital ratios under pressure. Ultimately, the probability of affected banks responding by at least partially reducing their assets in order to stabilise their tier 1 capital ratio would rise in such a scenario.[7] As vulnerabilities exist throughout the banking sector, this could cause herd behaviour among banks. It is possible that the banking sector might then curb lending to an excessive extent, with negative implications for the real economy.

In the event of an economic downturn, credit defaults could increase significantly.

Credit-to-GDP gap for loans granted by German banks to the private non-financial sector*

Chart 3.8

Percentage points, quarterly data



* Deviation of the credit-to-GDP ratio from its long-term trend for various calculation methods. **1** Cyclical deviation from the long-term trend, based on the Hodrick-Prescott (HP) filter (one-sided). **2** Deviation from the level of borrowing justified by the fundamentals, based on the approach by F. Mokinski and M. Saß, Detecting excessive credit growth: An approach based on structural counterfactuals, mimeo, 2019. **3** HP filter (two-sided), Christiano-Fitzgerald filter (one-sided and two-sided), Hamilton filter (recursive and non-recursive) and three-year change. **4** According to the European crises database; see M. Lo Duca et al., A New Database for Financial Crises in European Countries – ECB/ESRB EU Crises Database, ECB Occasional Paper Series 194, July 2017.

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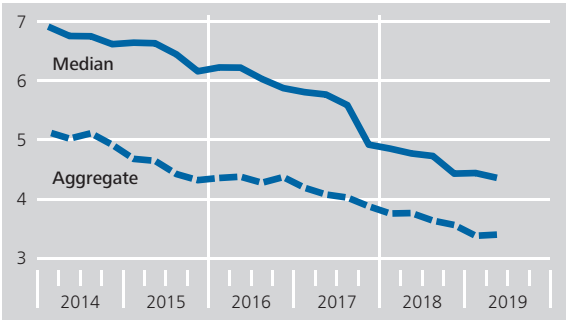
Loans with increased default risk*

Chart 3.9

As a percentage of the gross loan volume[1] of German banks[2]



* Loans with a heightened probability of default, loans past due and loans with specific loan loss provisions prior to deduction of specific loan loss provisions. **1** Including interbank loans. **2** Excluding foreign subsidiaries and foreign branches.

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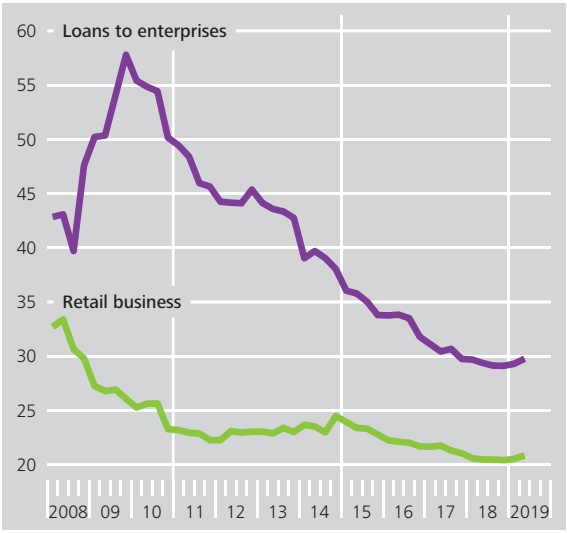
The banking sector's vulnerability to an unexpected economic downturn could be even more pronounced given that the expansion of lending has

6 See Deutsche Bundesbank (2018).
7 See Deutsche Bundesbank (2018), p. 80.

IRBA RWA densities* of German banks for loans to enterprises and in retail business Chart 3.10

Aggregate of German banks as a percentage



* The RWA density is determined as the ratio of risk-weighted assets (RWAs) to the respective gross exposures. In addition, it is taken into account that, in the internal ratings-based approach (IRBA), regulatory provisioning adjustments are made to the capital that must be held.

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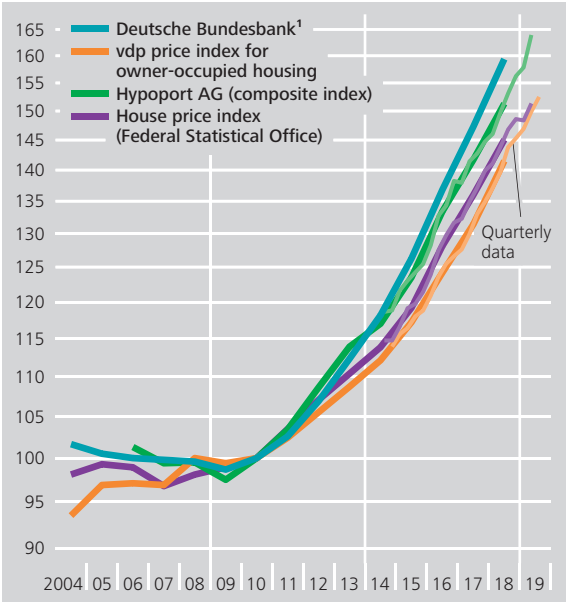
Residential property prices in Germany Chart 3.11

2010 = 100, log scale



1 Transaction-weighted. Bundesbank calculations based on price data provided by bulwiengesa AG.

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been associated with allocation risks in recent years (see the chapter entitled "Risks in the banking sector" on p. 61). These are risks stemming from the composition of banks' loan portfolios. New analyses provide clear indications of such allocation risks: with allocation risks on the rise, banks' loan portfolios now include a higher share of enterprises whose credit ratings could potentially deteriorate the most in the event of an economic downturn.

The expansion of lending has been associated with allocation risks in recent years.

Real estate lending adds to cyclical systemic risks

Experience with crises in the residential real estate markets which threatened financial stability in other countries highlights the fact that risks to financial stability are especially likely to build up if a strong rise in house prices is accompanied by excessive growth in lending and an erosion of lending standards.[8] In particular, there exists a danger that market participants will systematically underestimate the potential risks associated with loans for house purchase. For example, amidst a sharp upturn on the housing market, borrowers and creditors could become overly optimistic in assuming that these house price developments will persist in the future and overestimate the recoverability of residential real estate used as loan collateral. This could cause borrowers' future debt sustainability to be overestimated, forming the basis for a spiral in the house market that could endanger financial

Borrowers and creditors could become overly optimistic in assuming that house price developments will persist in the future.

8 See, inter alia, Demyanyk and van Hemert (2011), Dell'Ariccia, Igan and Laeven (2012); Jordà, Schularick and Taylor (2015).

Household expectations about the future development of real estate prices in Germany

In the second quarter of 2019, the Bundesbank carried out a representative survey of households in Germany: the Bundesbank Online Pilot Survey on Consumer Expectations. This study provides insights into how households perceive the future development of real estate prices in Germany.[1] For households, such expectations are a significant factor in deciding whether to buy a property or live in rented accommodation. In addition to expectations, financing conditions and available capital are also important to households (see the box entitled "Residential real estate financing and risks to financial stability" on p. 50). One caveat to be noted is the limited scope of this online pilot survey (just over 2,000 respondents each month between the end of April and the beginning of July 2019).

One core objective of the survey is to investigate whether there is evidence of excessively optimistic expectations in the German real estate market. In the past, such expectations have contributed to asset price booms, such as the housing bubble observed in the United States until 2008 or the dot-com boom until 2000.[2]

Households were asked what level of price and rent growth they expect in their region (district) in the future. In median terms across all households, annual expected nominal real estate price growth amounts to 4.4% over the coming 12 months and 2.9% over the next five years. This corresponds to overall growth of 15.6% over the next five years. By contrast, annual expected rent growth amounts to 7.1% over the next 12 months and 4.1% over the next five years. This corresponds to overall growth of 22.2% over the next five years. Households therefore expect real estate price and rent growth to exceed the expected inflation rate within the coming year.[3] This phenomenon is more pronounced in districts with a higher number of inhabitants.

In addition, expected rent growth considerably exceeds expected real estate price growth. Households therefore assume that the current high valuation level could fall somewhat – specifically, the median perceived price-to-rent ratio would decline slightly from 25 at present to 24 in five years. Expectations – with respect to both rent growth and price growth – are significantly lower in the long term (five years) than in the short term (12 months).

Data on house price expectations can also be examined in terms of the degree to which households extrapolate from past price developments. In the current environment of rising real estate prices and rents, expectations could be overly optimistic if households extrapolate from past price or rent growth to a far greater extent than

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1 For details on the evaluation outlined here and in-depth econometric analyses, see Abbassi and Beutel (2019). The questions were formulated based in part on the Survey of Consumer Expectations (SCE), © 2013-2017 Federal Reserve Bank of New York (FRBNY). The SCE questions and a comprehensive disclaimer from the FRBNY can be found at: http://www.newyorkfed.org/microeconomics/sce. The Bundesbank's PHF study contains one question asking for a qualitative assessment of real estate price growth in the next 12 months. The survey used here makes it possible to take a much closer look at expectations. The pilot survey website can be found at: https://www.bundesbank.de/en/bundesbank/research/pilot-survey-on-consumer-expectations/bundesbank-online-pilot-survey-on-consumer-expectations-794568. The analysis of expectations from the pilot survey presented here is based on a cross-section of the respondents at a single point in time.

2 For evidence on expectations as a cause of and amplification mechanism for asset price booms, see Adam, Marcet and Beutel (2017); Hoffmann (2016); Gelain, Lansing and Mendicino (2013); Towbin and Weber (2016).

3 The pilot survey does not include any data on long-term inflation expectations.

Household expectations about the future development of real estate prices and rents in their geographical region in Germany

Survey of roughly 2,000 persons from 30 April to 8 May 2019

Item	Total (median)	By number of inhabitants of respective district				
		<50,000	50,000-100,000	100,000-200,000	200,000-500,000	>500,000
Median expectations about						
Real estate price growth for the next 12 months (% p.a.)	4.4	3.7	3.6	4.4	5.0	6.7
Real estate price growth for the next five years (% p.a.)	2.9	2.5	2.4	3.0	2.9	3.7
Rent growth for the next 12 months (% p.a.)	7.1	6.7	6.7	6.7	7.1	7.1
Rent growth for the next five years (% p.a.)	4.1	3.7	4.1	3.7	4.1	5.0
Implied expectations about						
Price-to-rent ratio, current	25	25	24	25	25	28
Price-to-rent ratio in one year	25	25	23	25	24	28
Price-to-rent ratio in five years	24	24	23	24	24	27
Expected gross return for the next 12 months (% p.a.)[1]	8.7	7.9	8.0	8.7	9.3	10.5
Expected gross return for the next five years (% p.a.)[1]	7.1	6.7	6.7	7.2	7.1	7.5

Sources: Bundesbank Online Pilot Survey on Consumer Expectations, regional database of Germany and Bundesbank calculations. **1** Expected gross price growth added to the product of expected gross rent growth and the current rent-to-price ratio.

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would be justified based on the underlying, albeit unobserved price formation process.[4] In the case of real estate prices, there are no signs that German households' expectations are excessively optimistic. They extrapolate no more than around 5% from price growth over the previous one-year period and roughly 7% from price growth over the previous five years.[5] Historical data on real estate price growth show that the estimated temporal relationship between the one-year growth rates is significantly stronger. Hence, households' extrapolation of one-year growth rates is unremarkable. Extrapolation of five-year price growth expectations is unremarkable as well. Extrapolated one-year rent growth amounts to roughly 20%, whilst extrapolation of five-year rent growth is about 11%. Households extrapolate five-year rent growth to a greater extent than the past temporal relationship between the rent growth rates observed would suggest.

In a risk scenario, real estate prices could develop less dynamically than expected, for instance if the economy experiences an unexpected downturn. Valuation levels in the real estate market could also drop if expectations deteriorate or financing conditions worsen. Households and financial intermediaries should therefore also be prepared for a scenario in which price growth slows or even reverses. For instance, they could, when making financing decisions, factor in sufficient buffers to be able to shoulder unexpected losses.

4 The test used to measure the extrapolation of expectations is based on Armona, Fuster and Zafar (2019). The study finds that price growth expectations in the United States are excessively affected by past price developments.
5 This is evident in both the correlations and the regressions at district and household level. The regression analyses take account of expected rent growth, characteristics of households and unobserved, constant effects at district level, amongst other things. The findings are robust to various estimation variants.

stability – a spiral in which the upward pressure on house prices would be compounded by a significant easing of lending standards and an excessive expansion of lending. In order to be able to identify such a build-up of risk in a timely manner and, if necessary, mitigate said build-up, macroprudential oversight of the housing market focuses primarily on changes in three factors: house prices, loans for house purchase and lending standards.

House prices in Germany rose again markedly so far in 2019 (see Chart 3.11), continuing the positive pattern observed since 2010. According to Bundesbank estimates, house price overvaluations in urban areas were persistently high in 2018.[9] Representative survey data from the Bundesbank on price expectations furthermore suggest that households in Germany expect house prices to keep rising in the years to come (see the box entitled "Household expectations about the future development of real estate prices in Germany" on p. 47). On average, the households surveyed anticipate price increases of 4.4% over a one-year horizon and price increases averaging 2.9% per year over a five-year horizon. According to the results of two special surveys conducted this year – one by the Federal Financial Supervisory Authority (BaFin) together with the Bundesbank, the other by the European Central Bank (ECB) – the majority of lending banks also expect house prices to continue rising in the long term (see the box entitled "Residential real estate financing and risks to financial stability" on p. 50).[10]

House prices have continued to rise markedly.

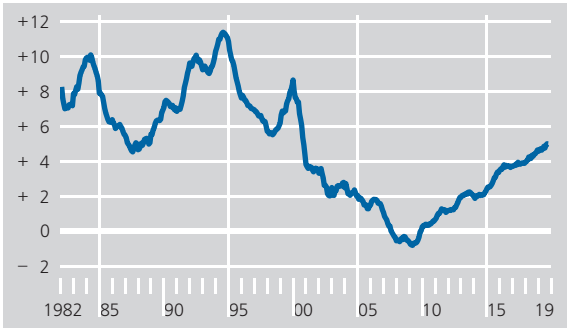
There has been dynamic growth in loans for house purchase since 2010 (see Chart 3.12). The low interest rates on loans for house purchase and the hitherto robust labour market situation are likely to give an additional boost to demand (see Charts 3.2 and 3.3 on p. 38). The stronger momentum in lending is evident in the house purchase loan-to-GDP gap.[11] While the house purchase loan-to-GDP gap is currently close to 0%, it has been rising vigorously for some time (see the chart in the box entitled "Residential real estate financing and risks to financial stability" on p. 50). What ist more, the majority of German banks plan to expand their lending for house purchase in the years ahead. This is borne out by the two special surveys conducted this year by BaFin together with the Bundesbank as well as by the ECB.

The house purchase loan-to-GDP gap has been rising for some time.

With regard to the German banking system's credit standards for loans for house purchase in recent

German banks' lending to domestic households for house purchase* Chart 3.12

Year-on-year percentage change, seasonally adjusted, month-end data



* Including non-profit institutions serving households. Up until 1991, data only for West Germany.

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9 See Deutsche Bundesbank (2019a).
10 The survey on the profitability and resilience of German financial institutions in a low interest rate environment, which was undertaken by BaFin and the Bundesbank, focused on 1,400 small and medium-sized credit institutions. Information was also gathered on lending standards, the significance of climate risks, and deposit interest rates. Details can be found at: https://www.bundesbank.de/en/press/press-releases/results-of-the-2019-lsi-stress-test-807624. The Bank Lending Survey (BLS) conducted by the ECB covers all significant institutions in the euro area. Amongst other things, the information collected from German institutions included details about the credit standards applied to loans for house purchase.
11 For the method used to calculate the credit-to-GDP gap, see the box entitled "Measures of cyclical risks in the financial system" on p. 42.

Residential real estate financing and risks to financial stability

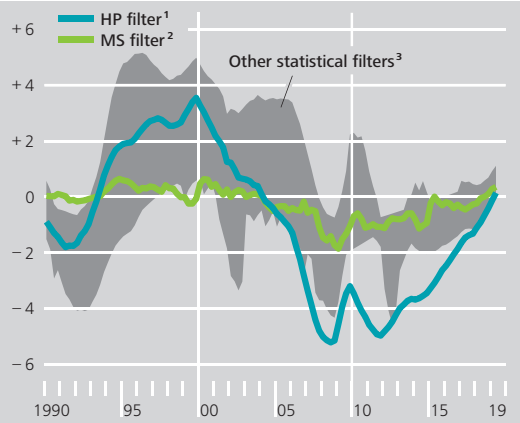
The rise in residential real estate prices that has been ongoing since 2010 has continued.[1] Although the upsurge in prices broadened in regional terms in 2018, the strongest price growth was still observed in towns and cities. According to current Bundesbank estimates, house prices in German towns and cities were overvalued by between 15% and 30% in 2018.[2] Overvaluation is calculated as the deviation from an estimated fundamental value, which is determined by the sustainable developments in economic and sociodemographic variables. In 2019 to date, prices have risen further, although price dynamics have moderated somewhat.

Survey data provide indications that households in Germany expect continued growth in house prices (see the box entitled "Household expectations about the future development of real estate prices in Germany" on p. 47). According to the results of special surveys conducted by the Federal Financial Supervisory Authority (BaFin) and the Bundesbank, as well as the European Central Bank (ECB), most lending banks also assume that prices will rise further in the long term.[3] According to these data, more than 80% (60%) of banks expect that residential property prices in the area they do business in will go up in the next three (ten) years.

Loans to households for house purchase represent more than 50% of all outstanding bank loans to the German non-financial private sector and consequently play a major role in the German banking system.[4] On aggregate, the volume of loans to domestic households for house purchase has increasingly been expanded since 2010 (see Chart 3.12 on p. 49). For example, the annual growth rate has increased continuously from just over 0% at the beginning of 2010 to

Credit-to-GDP gap for German banks' loans to households for house purchase*

Percentage points, quarterly data



* Deviation of the credit-to-GDP ratio from its long-term trend for various calculation methods. **1** Cyclical deviation from the long-term trend based on the Hodrick-Prescott (HP) filter (one-sided). **2** Deviation from the level of borrowing justified by the fundamentals, based on the approach used by F. Mokinski and M. Saß, Detecting excessive credit growth: An approach based on structural counterfactuals, mimeo, 2019. **3** HP filter (two-sided), Christiano-Fitzgerald filter (one-sided and two-sided), Hamilton filter (recursive and non-recursive) and three-year change.

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1 See Deutsche Bundesbank (2019a). Additional information may be found in the Bundesbank's system of indicators for the German residential property market, available at www.bundesbank.de/en/statistics/sets-of-indicators/system-of-indicators-for-the-german-residential-property-market

2 For more on the methodology, see Kajuth, Knetsch and Pinkwart (2016). For current estimations, see Deutsche Bundesbank (2019a).

3 The survey on the profitability and resilience of German financial institutions in a low interest rate environment, which was undertaken by BaFin and the Bundesbank, focused on 1,400 small and medium-sized credit institutions. Here questions were also posed on lending standards, the significance of climate risks and interest on deposits. Details can be found at https://www.bundesbank.de/en/press/press-releases/results-of-the-2019-lsi-stress-test-807624. The ECB's Bank Lending Survey covers all significant institutions in the euro area. German institutions were asked, amongst other things, for information on the lending standards that they apply to loans for house purchase.

4 At the end of the second quarter of 2019, just under 90% of all loans for house purchase were to households.

5% in the third quarter of 2019. The stronger momentum in lending is also evident in the house purchase credit-to-GDP gap (see the chart on p. 50). This recently still amounted to close to 0%, which is not worryingly high. It has, however, been rising sharply for some time now.

With regard to the credit standards that the banking system applies to new loans for house purchase, data are incomplete in Germany (see the section entitled "Monitoring risks from residential real estate loans" on p. 56).

Two special surveys conducted by BaFin, the Bundesbank and the ECB give some insight into current lending practices for new residential real estate financing. Particularly significant from a financial stability perspective is the development of the share of borrowed capital. This is defined as the ratio of the size of a loan to the market value of the mortgaged property (loan-to-value ratio, or LTV).[5] The higher the LTV, the greater the potential loss for the lender tends to be if a loan defaults and the property pledged as collateral is realised.[6] According to the survey results, the average LTV ratio increased slightly from 82% in 2016 to 84% in 2018. At individual bank level, developments in the LTV are very heterogeneous over time. The average LTV ratio in new business, for example, rose at around 60% of the surveyed institutions, but declined at 40%. When interpreting this information, it should be taken into account that banks partly use different methods to calculate LTVs. Caution should therefore be applied when interpreting the level of LTVs. The change in the LTV ratio over time is less strongly affected by the differences in the calculation.

The special surveys also provide further information on lending standards. This includes the initial repayment rate for residential real estate financing. On the one hand, a higher repayment rate means that the outstanding credit amount comes down more rapidly, thus reducing the potential loss from the lender's perspective. On the other hand, if credit conditions are otherwise identical, borrowers' regular debt service burden also rises the higher the repayment rate. From 2017 to 2018, the initial repayment rate declined only marginally from an average of 3.4% to 3.2% and was thus still at a fairly high level.[7]

Whether credit risk materialises in the form of higher default rates depends, crucially, on borrowing households' debt sustainability. The special surveys allow some conclusions about the debt sustainability of these households to be drawn with regard to loans for house purchase granted between 2016 and 2018. One indicator of this is the ability to service debt – in other words, the ratio of debt service payments to the borrower's income (debt-service-to-income ratio, or DSTI). Here qualitative survey results do not generally suggest that the ability to service debt has deteriorated. However, quantitative information from significant institutions indicates a slight increase in the burden of servicing residential real estate loans in relation to household income.

Aggregate household debt sustainability appears solid, with debt in relation to GDP of just above 54% fairly low in historical terms and by interna-

5 Alternatively, the share of borrowed capital can also be calculated as the German sustainable loan-to-value ratio (*Beleihungsauslauf*), i.e. the ratio of the loan amount to the sustainable mortgage lending value. The German sustainable loan-to-value ratio is generally higher than an LTV based on market value.
6 See Qi and Yang (2009).
7 According to information supplied by the Association of German Pfandbrief Banks *(Verband deutscher Pfandbriefbanken),* the average repayment rate increased from 1.9% in 2009 to 3.2% in 2017. See Association of German Pfandbrief Banks (2017).

Breakdown of residential real estate loans to households based on debt-service-to-income ratio and loan-to-value ratio

As a percentage of total outstanding real estate lending volume

Year	DSTI[1]	LTV[2] 0-60%	60-90%	>90%
2010	<20%	21	4	2
2014		21	6	3
2017		22	4	1
2010	20-40%	19	19	6
2014		19	16	11
2017		29	15	6
2010	>40%	10	10	10
2014		9	8	7
2017		13	4	5

Source: Bundesbank calculations based on its Panel on Household Finances (PHF). **1** Ratio of debt service to current net household income (debt-service-to-income ratio, or DSTI). **2** Ratio of outstanding debt to the market value of the property (loan-to-value-ratio, or LTV).

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tional standards. In the euro area, for example, aggregate household debt is currently just under 58% of GDP.[8] The disaggregated survey data taken from the Panel on Household Finances (PHF) provide further information on household debt.[9] On the whole, there is no indication in the data collected in the survey period between 2010 and 2017 of heightened credit risk for households with outstanding residential real estate loans. Within this period, there has been a decline in the share of borrowers in the loan portfolio presenting both a relatively high LTV (measured in terms of their outstanding housing loans relative to the current value of the property) and a high DSTI (see the table).

In addition, the PHF data can be used to estimate the effects of a rise in interest rates on individual households.[10] According to current calculations, interest rate risk is probably fairly low. In the short term, households would benefit from an interest rate rise on average, especially because they have large holdings of assets in the form of interest-bearing investment instruments, such as savings deposits, bonds or money market instruments. This also applies to households with residential real estate loans. This is mainly because long interest rate fixation periods mean that interest costs for these households would initially not rise in the event of an interest rate hike. The effect is negative only for a small group – around 5% of households – with high debt service and low savings deposits.

The still perceptible price dynamics – not least against the backdrop of market participants' fairly optimistic expectations – combined with regional overvaluations harbour the danger that the risks associated with residential real estate financing are being underestimated. Given that lending standards have, in some instances, been loosened between 2016 and 2018, it is therefore important that both borrowers and creditors give potential risks due consideration.

8 This information relates to statistics provided by the Bank for International Settlements (BIS) for the first quarter of 2019, which can be found under http://stats.bis.org/statx/srs/table/f3.1
9 The survey data were collected for the first time in 2010 and are currently available in three survey waves. Further information can be found under https://www.bundesbank.de/en/bundesbank/research/panel-on-household-finances/about-the-phf
10 See Tzamourani (2019).

years, the two special surveys do not point to an erosion of lending standards. However, the survey results do contain, in part, signs of some easing of lending standards.[12] During the observation period of 2016 to 2018, for instance, there is a slight tendency for loans to be backed by less collateral, on average, and for residential property to be funded with more debt. In addition, the survey data suggest that, for systemically important financial institutions' new residential real estate loans, borrowers' debt-service-to-income ratio has risen recently (see the box entitled "Residential real estate financing and risks to financial stability" on p. 50). All other things being equal, these developments are likely to have contributed to a build-up of vulnerabilities, as is evident from the latest stress test for German banks' portfolios of residential real estate loans (see the chapter entitled "Risks in the banking sector" on p. 61).

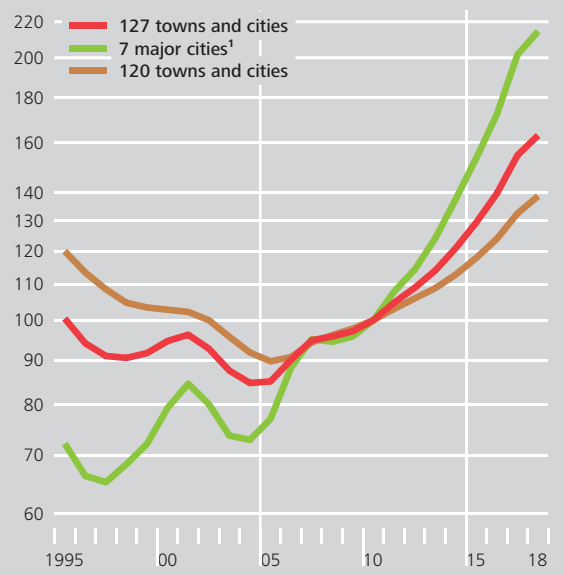
Special surveys do not suggest that lending standards are being eroded.

Given the lively price developments since the start of the upturn on the housing market and in view of regional overvaluations, the recoverability of the residential properties being used as loan collateral could be overestimated and potential credit risks could be underestimated. Banks' vulnerabilities resulting from their portfolios of residential real estate loans, which in turn also depend on developments in the housing market, consequently contribute to the cyclical vulnerabilities in the German financial system (see the box entitled "Residential real estate financing and risks to financial stability" on p. 50). However, based on the available information, there is, as yet, no evidence of a spiral of sharply rising house prices and residential real estate loans combined with an erosion of lending standards which would jeopardise financial stability. In the event of such a spiral occurring in future, policymakers have, since 2017, had at their disposal two macroprudential instruments with which to counter the risk to financial stability from an erosion of lending standards for new residential real estate loans (see the section entitled "Monitoring risks from residential real estate loans" on p. 56). However, as data on lending standards for new residential real estate loans are still patchy, there is a risk that such a spiral in the housing market might not be recognised until it is too late. A comprehensive assessment of credit standards for new loans as part of financial stability analysis therefore still requires an improvement in the available data through standardised and regular data collection (see the section entitled

The recoverability of the residential properties being used as loan collateral could be overestimated.

Prices of commercial real estate* in Germany by town category Chart 3.13

2010 = 100, log scale



Source: Bundesbank calculations based on data provided by bulwiengesa AG. * Office and retail (core properties). **1** Berlin, Cologne, Düsseldorf, Frankfurt am Main, Hamburg, Munich and Stuttgart.

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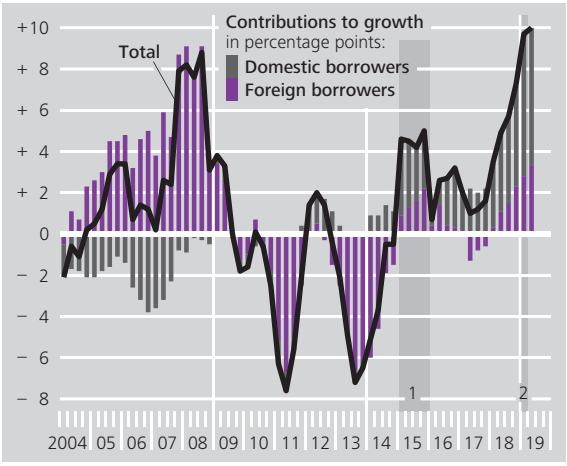
12 Information from the Eurosystem's Bank Lending Survey likewise suggests certain tendencies towards an easing of lending standards in the period since 2017.

Loans by domestic credit institutions entailing commercial property risk*

Chart 3.14

Year-on-year percentage change, quarter-end data



Source: Bundesbank calculations based on data from the Bundesbank's central credit register. * Comprising balance sheet items, off-balance-sheet items and derivatives. Approximate implementation of the classification put forward by the European Systemic Risk Board ((ESRB), 2016/14). **1** Reporting threshold lowered from 2015. **2** Definition of "credit" expanded from 2019. Total exposure adjusted for trading portfolio positions (debt securities and other interest-bearing securities, equities, equity interests and shares in enterprises) and for undrawn revocable and irrevocable lending commitments.

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"Monitoring risks from residential real estate loans" on p. 56).[13]

Developments in the commercial real estate market, too, are contributing to rising cyclical risks. Commercial real estate loans are significant for the German banking system, accounting for more than 16% of total claims on domestic households and enterprises. In recent years, strong growth in commercial real estate prices has been observed, although this has slowed of late (see Chart 3.13). Depending on the price indicator, the available data suggest that the slowdown in price growth relates more to retail properties than to office properties. The volume of domestic loans entailing commercial property risk is rising sharply, especially when compared with recent years (see Chart 3.14).[14] Small and medium-sized banks, in particular, but also several systemically important financial institutions, have strongly expanded commercial real estate loan financing for German borrowers.

Developments in the commercial real estate market, too, are contributing to rising cyclical risks.

The terms and conditions of commercial real estate loans render creditors susceptible to an unexpected economic downturn or an abrupt increase in interest rates. This is suggested by special surveys on lending practices for commercial real estate loans conducted by BaFin together with the Bundesbank, as well as the ECB. For instance, financing for special-purpose entities for commercial real estate where there is no, or limited, recourse is considerable, at some 41% of new business, and has risen slightly of late. In such transactions, there is no, or only limited, recourse to equity investors' assets, making dependence on rental income particularly high. In addition, more than one-quarter of the holdings of commercial real estate loans are subject to a floating interest rate.

The terms and conditions of commercial real estate loans render creditors susceptible to an unexpected economic downturn.

Persistently low interest rates continue to put banks and life insurers under pressure

Low interest rates have contributed to rising interest rate risk in the German financial system in recent

13 The Eurosystem's quarterly Bank Lending Survey, which is carried out among 34 German institutions, provides certain regular information. According to the survey, institutions still regarded credit standards for loans for house purchase to be comparatively tight in the first quarter of 2019, even though they were previously eased. For the purposes of financial stability analyses, the information from the BLS is insufficient, however, in terms of its detail and market coverage.

14 In line with the proposal from the European Systemic Risk Board (ESRB), developments in loans to housing enterprises, other real estate firms and enterprises involved in the construction and finishing trades are being observed.

years. Small and medium-sized German banks, in particular, are subject to high interest rate risk (see the chapter entitled "Risks in the banking sector" on p. 61).[15] Banks have steadily expanded maturity transformation and extended the interest rate lock-in period of their assets, especially for residential real estate loans. The percentage of residential real estate loans with an initial rate fixation of more than ten years, for instance, has risen by some 20 percentage points since 2014 to around 50% (see Chart 4.3 on p. 63). In addition, the percentage of short-term deposits has increased sharply. If interest rates remain low, there is an incentive for banks to take further risks and engage in even more maturity transformation.

Banks have steadily expanded maturity transformation and extended the interest rate lock-in period of their assets.

Current developments in interest rates mean that life insurers' capital adequacy has come down significantly compared with last year (see Chart 3.15). This is evident in the declining solvency ratios. In the market value-based Solvency II prudential regime, the solvency ratio is the key metric for measuring insurers' capital adequacy.[16] Market values fluctuate in line with interest rates because German life insurers invest a large proportion of their assets in long-dated fixed income paper and have promised their policyholders even longer-term guaranteed returns. Persistently low interest rates therefore are still the main risk for life insurers.

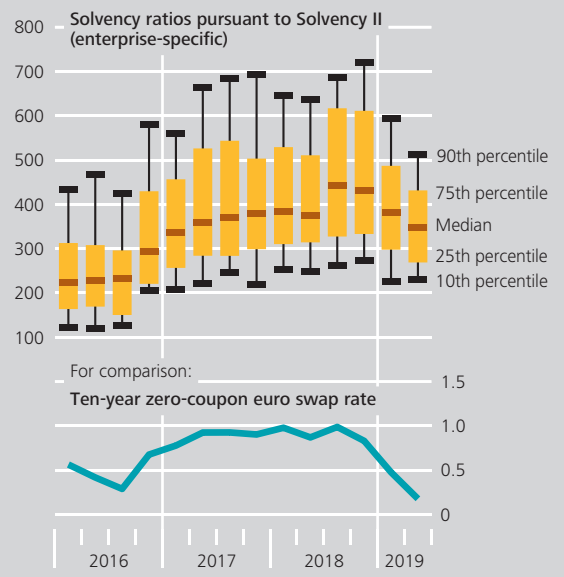
Persistently low interest rates are still the main risk for life insurers.

At present, solvency ratios are probably overestimating economic resilience, as most German life insurers are applying transitional regulatory measures under Solvency II. These allow insurers to report higher solvency ratios than if they applied full mark-to-market valuation. The objective of these transitional measures is to avoid the market turmoil that would ensue as a result of an abrupt switch to a mark-to-market valuation of assets and liabilities.[17] It should be noted that the new rule on the additional interest provision introduced in 2018 has reduced the funds required for this and bolstered solvency ratios.

Solvency ratios of German life insurers according to Solvency II*

Chart 3.15

%, quarter-end data



Sources: BaFin and Bundesbank calculations. * Shown here are the solvency ratios of the 66 life insurance companies for which quarterly reports are available throughout.

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15 See Deutsche Bundesbank (2017); Deutsche Bundesbank (2018).

16 The risk-based and market value-based Solvency II prudential regime defines the solvency ratio as the ratio of eligible regulatory own funds to regulatory own funds requirements.

17 Insurers have to apply for and obtain permission from BaFin to use transitional measures. Transitional measures may be applied until 2031, by which time they will have been gradually phased out. For a more detailed description of the transitional measures, see Federal Financial Supervisory Authority (2016).

Macroprudential policy

In recent years, cyclical systemic risks have built up in the German financial system. There is a danger that credit risks are being underestimated and the recoverability of collateral, especially real estate, is being overestimated. Furthermore, the entire financial system is exposed to high interest rate risk. On the one hand, the financial system is susceptible to an abrupt rise in interest rates, say as a result of higher risk premia. On the other hand, a continuation of the low interest rate environment would put the financial system under additional pressure. As the year has progressed, the risk scenario of an extended period of low interest rates has increasingly moved centre stage. In the low interest rate environment, the financial system's vulnerability, in particular to a sudden hike in interest rates, is likely to increase, as market participants expect interest rates to remain low in the long term. In addition, in an environment fraught with major uncertainty, the financial system has become more vulnerable to a further risk scenario: an unexpected economic downturn.

In recent years, cyclical systemic risks have built up in the German financial system.

Cyclical risks are strongly correlated and could materialise at the same time and reinforce each other. This generates risks to financial stability: an unexpectedly sharp economic downturn could, for instance, entail rising credit default rates and a steep drop in real estate prices. The large losses this would cause in the banking sector could result in lending being curtailed excessively. In this manner, the financial system would amplify an unexpected economic downturn.

Cyclical risks could materialise at the same time and reinforce each other.

Countercyclical capital buffer activated

Whether or not an economic downturn is amplified by the financial system depends on the vulnerabilities and resilience of the financial system. Sufficient resilience being available is in the interest of every single market participant. Nonetheless, individual market players are unable to fully factor in systemic risk. It therefore falls to macroprudential policy to identify systemic risks and, if necessary, to take measures to strengthen the resilience of the financial system, for instance by establishing macroprudential buffers. The objective is to enable the financial system to maintain functionality even in periods of stress and thus to avoid negative repercussions for the real economy.

In response to the cyclical systemic risks, the German Financial Stability Committee in May of this year recommended that BaFin should activate the domestic countercyclical capital buffer. BaFin followed this recommendation and raised the buffer to 0.25% of risk-weighted domestic exposures with effect from the third quarter of 2019 with a twelve-month phase-in (see the section entitled "Countercyclical capital buffer has stabilising impact in periods of stress" on p. 80).

The German Financial Stability Committee has recommended activating the countercyclical capital buffer.

Monitoring risks from residential real estate loans

International experience shows that the housing market can give rise to major financial stability risks in the event of an excessive expansion in residential mortgage lending, an erosion of lending standards and a sharp rise in house prices. Such developments may result in serious and protracted crises.

The available data suggest that the risks pertaining to residential mortgage loans may have increased in some instances (see the section entitled "Real estate lending adds to cyclical systemic risks" on p. 46). Overall, these risks result from the accelerated expansion of the residential real estate sector since prices started to rise in 2010. There is evidence in the latest special surveys to suggest that this development has been associated with a certain loosening of lending standards in the observation period of 2016 to 2018. At the same time, aggregate household debt relative to GDP remains comparatively low in Germany (see the box entitled "Residential real estate financing and risks to financial stability" on p. 50).

Risks pertaining to residential mortgage loans may have increased.

With prices still rising perceptibly and houses overvalued in some regions, there is a danger that risks associated with residential real estate loans in the banking sector are being underestimated. This is also true in light of market participants' fairly optimistic expectations regarding future price developments. Strengthening the banking system's resilience through the countercyclical capital buffer is therefore an appropriate macroprudential measure.[18]

There is currently no reliable evidence that lending standards have been lowered sharply. If, however, real estate prices rise rapidly over many years, as has been the case in Germany for the past nine years, there is a growing danger of borrowers and lenders alike assuming that this will continue. Borrowers and lenders may overestimate both the recoverability of the residential real estate used as loan collateral and developments in wealth as a result of rising prices. A broad-based and sharp lowering of lending standards for real estate loans would be an expression of such overly optimistic assumptions. This could set in motion a credit-driven spiral, potentially resulting in considerable risks to financial stability. Macroprudential policy could help prevent such a spiral by implementing minimum lending standards, known as borrower-based instruments.

There is currently no reliable evidence that lending standards have been lowered sharply.

These minimum standards should focus on key measures of creditworthiness. Metrics of this nature, which lenders regularly use to assess creditworthiness when granting loans, are, say: the downpayment that a borrower makes when taking out a loan to purchase a property, aggregate debt as a percentage of household income, or the percentage of household income needed to make interest and redemption payments. Germany has, since 2017, had in place two borrower-based macroprudential instruments which can be used to set minimum lending standards should financial stability be at risk. These are a ceiling for the loan-to-value (LTV) ratio and an amortisation requirement.[19] Contrary to the recommendation made by the German Financial Stability Committee in 2015, there was a failure to create instruments (which are just as important for lending standards) to bring debt or debt service into line with household income. These instruments are a ceiling for the debt-to-income, or DTI, ratio and the debt-service-to-income, or DSTI, ratio.[20]

Looking at all the available data and information, the prerequisites for activating the borrower-based macroprudential instruments are not met at present. However, data gaps make it difficult to assess, in a timely manner, whether the credit developments currently observed are associated with looser lending standards. With no

The prerequisites for activating borrower-based instruments are not met at present.

18 See German Financial Stability Committee (2019).
19 See German Financial Stability Committee (2015) and Section 48u of the German Banking Act (*Kreditwesengesetz*).
20 See, inter alia, Deutsche Bundesbank (2017).

robust systematic information on lending standards available, it is therefore not possible to assess how lending standards and consequently borrowers' debt sustainability are evolving. Creating a standardised and regular data survey is therefore of great importance from a macroprudential perspective in order to be able to act in a forward-looking manner. The results of this year's special surveys highlight that ad hoc surveys are no substitute for such standardised data collection (see the box entitled "Residential real estate financing and risks to financial stability" on p. 50).

Ad hoc surveys are no substitute for standardised data collection.

The European Systemic Risk Board (ESRB), too, has identified the need for macroprudential action in the German housing sector in this year's evaluation of the European housing markets.[21] In a warning to Germany, the ESRB identifies medium-term risks in relation to the German housing sector. The ESRB's view is based on the rapid house price dynamics and the overvaluation of house prices in urban areas, but also, notably, on the uncertainty surrounding lending standards for new housing loans as a result of data gaps. In its warning to Germany, the ESRB therefore underscores the need to close the relevant data gaps. Its recommendations also include the creation of income-based macroprudential instruments.

In a warning to Germany, the ESRB identifies medium-term risks in relation to the German housing sector.

List of references

Abbassi, P. and J. Beutel (2019), The Real Estate Valuation Puzzle: What Drives Local House Prices?, mimeo.

Adam, K., A. Marcet and J. Beutel (2017), Stock Price Booms and Expected Capital Gains, American Economic Review, Vol. 107 No 8, pp. 2352-2408.

Armona, L., A. Fuster and B. Zafar (2019), Home Price Expectations and Behaviour: Evidence from a Randomized Information Experiment, The Review of Economic Studies, Vol. 86 No 4, pp. 1371-1410.

Association of German Pfandbrief Banks (2017), Strukturen der Wohneigentumsfinanzierung 2017.

Basel Committee on Banking Supervision (2010), Guidance for National Authorities Operating the Countercyclical Capital Buffer, December 2010.

Beutel, J. (2019), Forecasting Growth at Risk, mimeo.

Beutel, J., S. List and G. von Schweinitz (2019), Does Machine Learning Help Us Predict Banking Crises?, Journal of Financial Stability, forthcoming.

Christiano, L. J. and T. J. Fitzgerald (2003), The Band Pass Filter, International Economic Review, Vol. 44 No 2, pp. 435-465.

Dell'Ariccia, G., D. Igan and L. Laeven (2012), Credit Booms and Lending Standards: Evidence from the Subprime Mortgage Market, Journal of Money, Credit and Banking, Vol. 44 No 2-3, pp. 367-384.

Demyanyk, Y. and O. van Hemert (2011), Understanding the Subprime Mortgage Crisis, The Review of Financial Studies, Vol. 24 No 6, pp. 1848-1880.

Deutsche Bundesbank (2017), Financial Stability Review.

Deutsche Bundesbank (2018), Financial Stability Review.

21 See European Systemic Risk Board (2019).

Deutsche Bundesbank (2019a), Monthly Report, February 2019.

Deutsche Bundesbank (2019b), Monthly Report, June 2019.

Drehmann, M., C. Borio and K. Tsatsaronis (2011), Anchoring Countercyclical Capital Buffers: The Role of Credit Aggregates, International Journal of Central Banking, Vol. 7 No 4, pp. 189-240.

European Central Bank (2017), Financial Stability Review, May 2017.

European Systemic Risk Board (2019), Warning on Medium-term Vulnerabilities in the Residential Real Estate Sector in Germany, June 2019.

Federal Financial Supervisory Authority (2016), Solvency II-Übergangsmassnahmen zur Rückstellungsbewertung: Eine erste Bestandsaufnahme, BaFin-Journal, March 2016.

Gelain, P., K. J. Lansing and C. Mendicino (2013), House Prices, Credit Growth, and Excess Volatility: Implications for Monetary and Macroprudential Policy, International Journal of Central Banking, Vol. 9 No 2, pp. 219-275.

German Council of Economic Experts (2019), Annual Report 2019/20.

German Financial Stability Committee (2015), Empfehlung zu neuen Instrumenten für die Regulierung der Darlehensvergabe zum Bau und Erwerb von Wohnimmobilien, AFS/2015/1, June 2015.

German Financial Stability Committee (2019), Empfehlung zur Erhöhung des antizyklischen Kapitalpuffers, AFS/2019/1, May 2019.

Hamilton, J. D. (2018), Why You Should Never Use the Hodrick-Prescott Filter, Review of Economics and Statistics, Vol. 100 No 5, pp. 831-843.

Hodrick, R. J. and E. C. Prescott (1997), Postwar US Business Cycles: An Empirical Investigation, Journal of Money, Credit and Banking, Vol. 29 No 1, pp. 1-16.

Hoffmann, W. (2016), What Drives the Volatility and Persistence of House Price Growth? In: Essays on House Price Formation and Household Leverage, Doctoral Dissertation, University of Mannheim.

Joint Economic Forecast (2019), Industrie in der Rezession – Wachstumskräfte schwinden, autumn 2019.

Jordà, Ò., M. Schularick and A. M. Taylor (2015), Leveraged bubbles, Journal of Monetary Economics, Vol. 76, S1-S20.

Kajuth, F., T. Knetsch and N. Pinkwart (2016), Assessing House Prices in Germany: Evidence from a Regional Data Set, Journal of European Real Estate Research, Vol. 9 No 3, pp. 286-307.

Mokinski, F. and M. Saß (2019), Detecting Excessive Credit Growth: An Approach Based on Structural Counterfactuals, mimeo.

Obstfeld, M. (2012), Does the Current Account Still Matter?, American Economic Review, Vol. 102 No 3, pp. 1-23.

Prasad, A., S. Elekdag, P. Jeasakul, R. Lafarguette, A. Alter, A. X. Feng and C. Wang (2019), Growth at Risk: Concept and Application in IMF Country Surveillance, IMF Working Paper No 19/36.

Qi, M. and X. Yang (2009), Loss Given Default of High Loan-to-Value Residential Mortgages, Journal of Banking and Finance, Vol. 33 No 5, pp. 788-799.

Tente, N., I. Stein, L. Silbermann and T. Deckers (2015), The countercyclical capital buffer in Germany, Analytical framework for the assessment of an appropriate domestic buffer rate, Deutsche Bundesbank.

Towbin, P. and S. Weber (2016), Price Expectations and the US Housing Boom, SNB Working Papers No 6/2016.

Tzamourani, P. (2019), The Interest Rate Exposure of Euro Area Households, Deutsche Bundesbank Discussion Paper No 01/2019.

Risks in the banking sector

In recent years, the economic environment in Germany has been shaped by a long period of economic expansion in conjunction with low interest rates. This has had a large impact on banks' balance sheets. Overall, lending has increased significantly, particularly in the residential real estate sector and the non-financial corporate sector. At the same time, in light of declining loan losses, risk provisioning at banks has been scaled back. For small and medium-sized institutions, in particular, the decline in impairment costs in the lending business has contributed to a build-up of capital. Furthermore, the average regulatory capital requirements in lending have fallen steadily on account of the good situation in the corporate sector and are currently at a low level. The capital requirements for market risk have also declined considerably, not least due to lower price volatility in the financial markets. Small and medium-sized banks, in particular, have benefited from a booming real estate market. However, the falling interest rate level has led to a narrowing of the net interest margin. Increased maturity transformation has helped institutions to stabilise their interest income.

These developments have made the German banking system vulnerable to cyclical systemic risks. While credit risk has receded overall, in recent years banks have stepped up lending to enterprises that appear to be comparatively risky. An unexpected economic downturn could lead to a significant increase in credit losses and rising capital requirements. This could force banks to shrink their balance sheets and curb their lending.

In order to counteract cyclical systemic risks, a macroprudential capital buffer was activated in Germany for the first time and raised to 0.25% of risk-weighted domestic exposures. This strengthens the resilience of the banking system along with other macroprudential buffers and has a stabilising effect on lending in periods of stress.

Impact of long period of economic expansion and low interest rates

The long period of buoyant economic conditions and low interest rates has left a lasting mark on banks' balance sheets in recent years. Lending has increased markedly, not least due to the high demand for residential property. As the good state of the economy has had a positive impact on enterprises and households, the default risks in banks' lending portfolios have fallen. For example, the number of corporate insolvencies per 1,000 firms stood at 6 in 2018 compared to 10 a decade ago. As a result, credit institutions' risk provisioning has fallen and their capital adequacy has improved.[1] Strong lending and increasing maturity transformation have bolstered interest income.

Lending has increased markedly, not least due to the high demand for residential property.

Lending higher since the global financial crisis

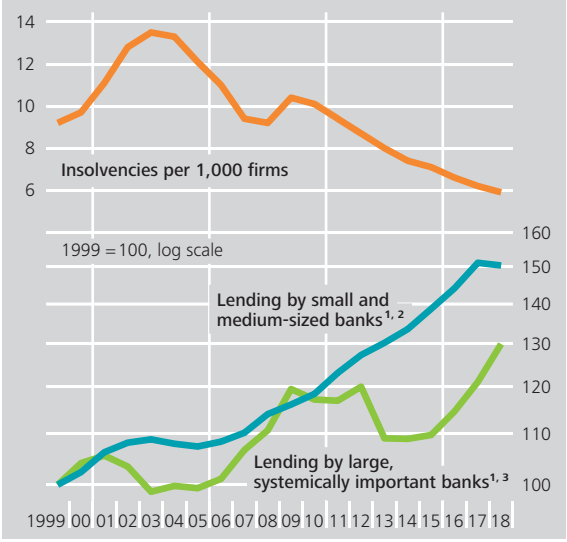
For a number of years, domestic non-financial corporations have recorded high profits, which they have used in part to reduce their leverage ratio. Enterprises' creditworthiness has thus improved; the insolvency ratio of domestic enterprises is currently at a historically low level. In conjunction with a heightened demand for credit, this has led to a significant increase in the loan portfolio in recent years, particularly at small and medium-sized banks (see Chart 4.1). However, lending by large, systemically important banks has also significantly increased since the global financial crisis.[2] With the ongoing upswing in the housing market, banks have additionally issued more loans for house purchase (see the section entitled "Real estate lending adds to cyclical systemic risks" on p. 46).

Insolvency ratio of enterprises is at a historically low level.

Lending portfolios have aligned

As a result of the dynamic growth in lending, concentration in the German lending business has increased (see Chart 4.2). As this trend can be seen across virtually all banks, balance sheets have become increasingly homogeneous overall. A more homogeneous banking system tends to be more susceptible to unexpected macroeconomic developments. If cyclical risks were to materialise in an unexpected economic downturn, this would have an impact on several banks simultaneously.

Corporate insolvencies and lending to the real economy Chart 4.1



Sources: Federal Statistical Office, Bundesbank statistics and Bundesbank calculations. **1** Lending to domestic enterprises and households. **2** Savings banks, credit cooperatives and small and medium-sized commercial banks. **3** Comprises the 13 other systemically important institutions (O-SIIs).

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1 See Deutsche Bundesbank (2018a), p. 70.
2 The large, systemically important banks comprise the 13 other systemically important institutions (O-SIIs).

Institutions have steadily expanded maturity transformation

The past decade has been characterised by a steady decline in interest rates. For example, the average yield on listed Federal securities fell from 4.2% to 0.3% between 2007 and 2018, and in 2019 even entered negative territory for the first time (-0.4% in July 2019). This development has had an impact, above all, on savings banks and credit cooperatives, for which interest income is particularly important. As longer-term investments are generally higher yielding than short-term investments, these institutions have increased the interest rate lock-in period on the assets side. However, this development has been partly attributable to increased demand for long-term loans. In this context, the expansion of maturity transformation has helped to stabilise the net interest margin. The lengthening of interest rate fixation periods for newly issued residential real estate loans is particularly pronounced (see Chart 4.3).

Savings banks and credit cooperatives have increased the interest rate lock-in period on the assets side.

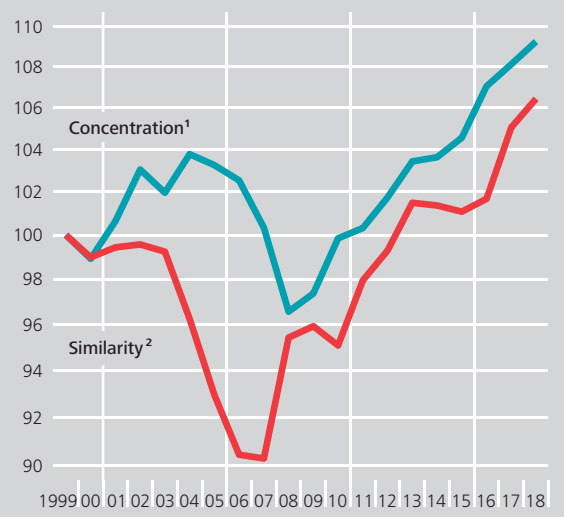
However, if the interest rate fixation periods of assets and liabilities are not aligned, this leads to interest rate risks. The degree of maturity transformation and thus the extent of interest rate risk can be determined indirectly based on reports from institutions for the Basel interest rate coefficient.[3] On the basis of the reported present values and present-value losses in the case of a hypothetical interest rate

3 In calculating the Basel interest rate coefficient, banks must determine the present value of their interest-bearing on-balance-sheet and interest rate-sensitive off-balance-sheet assets and liabilities in the banking book. The institutions must then calculate the change in the present value of the banking book that would occur if risk-free rates were to rise by 2 percentage points across all maturities. The present value loss in relation to overall regulatory capital defines the Basel interest rate coefficient. See Deutsche Bundesbank (2012).

Chart 4.2

Concentration and similarity of German banks' loan portfolios

Q1 1999 = 100, log scale



1 Concentration of domestic loan portfolios in various economic sectors of the private non-financial sector, measured by the Herfindahl-Hirschman Index. **2** The distance between two institutions is calculated using the standardised Euclidean distance between the respective loan portfolios. Similarity is based on the aggregate distances between all pairs of institutions.

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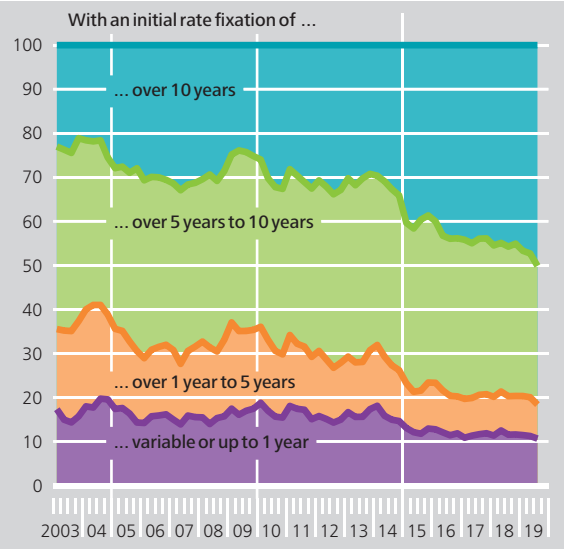
Chart 4.3

Interest rate lock-in periods for loans for house purchase issued to households in Germany*

%



* Calculated as domestic banks' volume of new business with respective rate fixation periods as a share of total new business (also including extensions).

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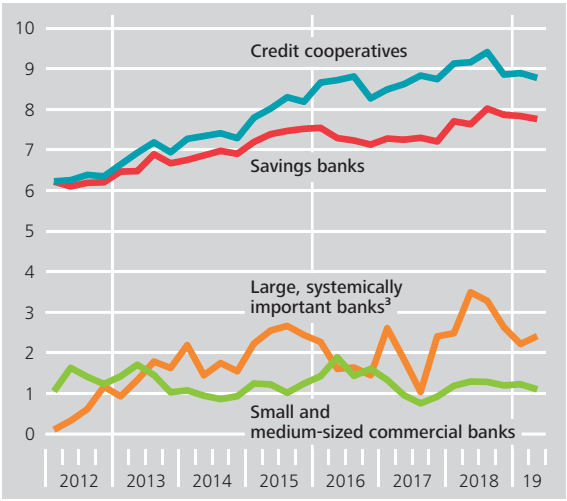
Interest rate risk in the German banking sector*

Chart 4.4

Duration of net assets (banking book[1])[2] in years, median values per category of banks



* Based on institutions' reports for the Basel interest rate coefficient. **1** Positions in the banking book exposed to interest rate risk. **2** Macaulay duration as a measure of the sensitivity of the present value of the interest book to the Basel interest rate shock (abrupt interest rate rise of 200 basis points across all maturities). **3** Comprises the 13 other systemically important institutions (O-SIIs).

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shock, the average commitment period of net assets, measured in years, can be approximated by the Macaulay duration.[4] A higher duration is associated with increased interest rate sensitivity of net assets, i.e. higher interest rate risk. The duration currently stands at around eight years for savings banks and around nine years for credit cooperatives (see Chart 4.4). In 2012, it stood at just over six years. For large, systemically important banks, the duration is considerably shorter, at 2.4 years. This is probably because these institutions make greater use of interest rate derivatives to hedge against interest rate risk. This shortens the duration. Nevertheless, the duration for these institutions has also lengthened considerably in this respect since 2012. If interest rates were to rise abruptly, banks' funding costs would typically rise to a greater extent than interest income, at least in the short term. If depositors were additionally to withdraw their funding unexpectedly, banks could face payment difficulties. The more maturity transformation is performed, the greater the interest rate risk.

Systemically important banks make greater use of interest rate derivatives to hedge against interest rate risk.

The interest rate risk of German banks is high due to the increased maturity transformation. Measured in terms of the Basel interest rate coefficient, mainly small and medium-sized banks display heightened interest rate risk. When calculating the Basel interest rate coefficient, banks have to determine the present value losses of their interest-bearing assets and liabilities given a shift in the yield curve of 200 basis points and set it in relation to total regulatory capital.[5] Supervisors assume heightened interest rate risk if the interest rate coefficient exceeds the threshold of 20%. Applying this, 57% of credit cooperatives and 38% of savings banks display heightened interest rate risk.[6]

Institutions have built up tier 1 capital

In recent years, credit institutions have improved their capital adequacy. The unweighted capital ratios, i.e.

4 The Macaulay duration is calculated using the formula Dmac = -∂V/∂r*1/V*(1+r), where V is the present value of the banking book and r is the yield. The following is derived through approximation: Dmac = -ΔV/V*1/Δr*(1+r). The negative change in the present value of the banking book represents the loss in present value in the Basel interest rate coefficient, and the change in interest rate represents the Basel interest rate shock of 200 basis points. The yield r can be disregarded, as it is currently close to 0. The value of the net interest rate lock-in period resulting from this approximated estimate should not be interpreted as a "duration gap" in the sense of a difference between the duration of assets and liabilities. However, the development over time can be used as an indicator of the actual dynamics of maturity transformation.
5 This refers to all interest-bearing on-balance-sheet and interest rate-sensitive off-balance-sheet assets and liabilities in the banking book.
6 With the entry into force of the new BaFin circular 6/2019 on 31 December 2019, an early warning indicator is being introduced in addition to this standard prudential test. This indicator identifies institutions that display a loss of more than 15% of their tier 1 capital in one of six interest rate scenarios.

tier 1 capital relative to total assets, of German institutions have increased significantly since the global financial crisis. In the second quarter of 2019, this ratio stood at 8.9% for small and medium-sized banks and 4.7% for large, systemically important banks (see Chart 4.5)

For small and medium-sized banks, the tier 1 capital ratio, i.e. tier 1 capital in relation to risk-weighted assets, stood at 16.3% in the second quarter of 2019. These banks were able to improve their capital adequacy not least by retaining earnings. While the net interest margin of these institutions trended downwards despite the strong demand for credit and expanded maturity transformation (see Chart 4.6), these institutions benefited from the decline in impairment costs in lending and thus from a significant rise in the valuation result. The return on assets in recent years has therefore been above average.

For the large, systemically important banks, the tier 1 capital ratio stood at 16.2% in the second quarter of 2019. These institutions primarily raised additional tier 1 capital on the capital market. In addition, they also improved their capital ratios by shrinking their balance sheets (deleveraging). However, losses in operating business and valuation adjustments placed tier 1 capital under strain.

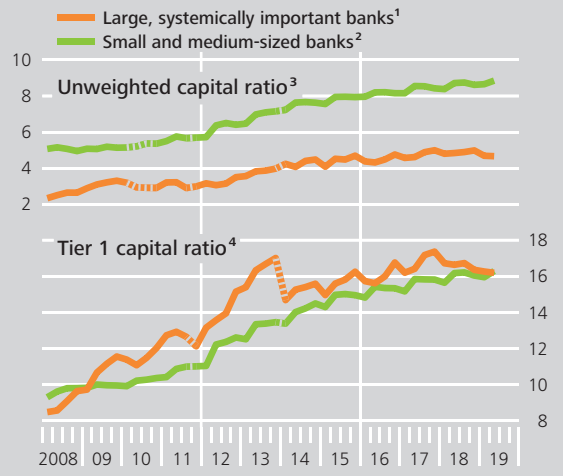
Systemically important banks also improved their capital ratios by shrinking their balance sheets.

The discrepancy between the unweighted capital ratios of both categories of banks is mainly attributable to the fact that risk density, i.e. risk-weighted assets relative to total assets, is lower for large, systemically important banks.

Capital adequacy of selected German banks*

Chart 4.5

%



* In 2011 and 2014, the valuations of tier 1 capital and risk-weighted assets changed as a result of Capital Requirements Directives CRD III and CRD IV. **1** Comprises the 13 other systemically important institutions (O-SIIs). **2** Savings banks, credit cooperatives and small and medium-sized commercial banks. **3** Tier 1 capital in relation to total assets; transitional period in 2010 pursuant to the Accounting Law Modernisation Act (*Bilanzrechtsmodernisierungsgesetz*). **4** Tier 1 capital in relation to risk-weighted assets.

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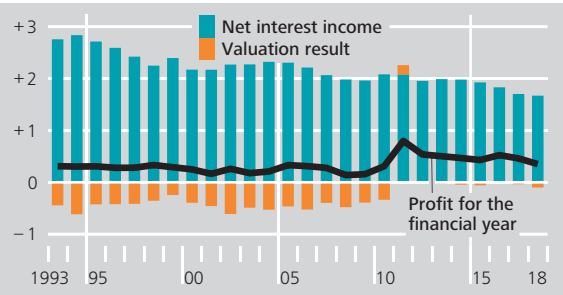
Selected components in the profit and loss account of small and medium-sized banks*

Chart 4.6

As a percentage of total assets



* Savings banks, credit cooperatives and small and medium-sized commercial banks.

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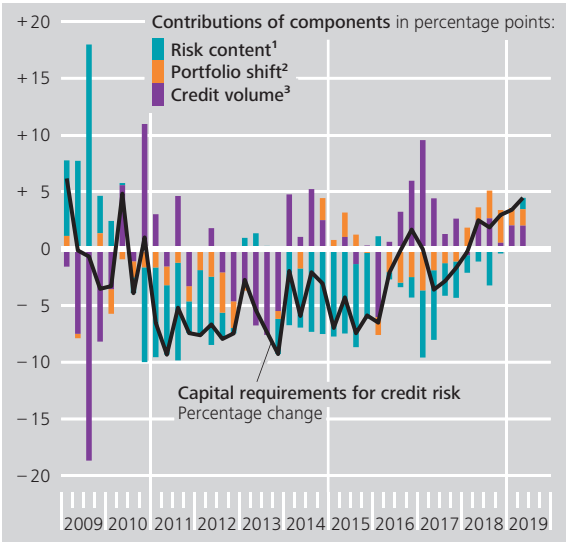
Capital ratios rise while risk weights fall

The capital requirements for credit risk fell significantly for large, systemically important banks until the end of 2015 (see Chart 4.7). Falling capital requirements have contributed to the rise in the regulatory

Capital requirements for credit risk at large, systemically important banks*

Chart 4.7

Year-on-year change



* Comprises the 13 other systemically important institutions (O-SIIs). **1** Change in the risk weights within the sub-portfolios. **2** Shifts between sub-portfolios with different risk weights. **3** Changes in the credit volume without a change in the composition of the loan portfolio.

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tier 1 capital ratio. An important factor in this is that these banks are allowed to use internal models to calculate their capital requirements. In principle, all banks can ask the supervisory authority for permission to use internal models (internal ratings-based approach: IRBA), but due to regulatory conditions it is usually only worthwhile for larger institutions. At the end of 2018, a mere 37 of around 1,500 institutions in Germany had such supervisory approval. Measured in terms of lending to the real economy, the IRBA portfolios of these institutions constitute roughly one-third of the German banking system.[7] However, most institutions do not use internal models to calculate own funds requirements, but instead use the standardised approach. Here, the risk parameters are largely predetermined by the supervisory authority. In contrast to the standardised approach, internal models react considerably faster to changes in economic conditions or the solvency of a borrower. Falling average risk weights in individual exposure classes have led to a drop in the risk density, i.e. the ratio of risk-weighted assets to total assets, at large, systemically important banks overall.

Falling capital requirements have contributed to the rise in the regulatory tier 1 capital ratio.

Banks have stepped up lending since 2016. Capital requirements at large, systemically important banks have been rising once again since 2018, not least due to their increased lending. Risk density has also gone up in recent quarters. This is chiefly attributable to banks altering the exposure class profile of their portfolios. In particular, loans to enterprises and residential real estate loans have grown disproportionately, causing their share of aggregate loans to rise. By contrast, exposure to the public sector has decreased. That said, the average risk weight of the individual exposure classes remained unchanged until the beginning of 2019. In the second quarter of 2019, the average risk weight edged up slightly.

Banks alter exposure class profile of portfolios.

Risk situation in the banking sector

In recent years, there have been mounting vulnerabilities in the balance sheets of German banks, which could be laid bare in an economic downturn. A common measure of this is the credit-to-GDP gap, which has been positive since the beginning of the

Credit-to-GDP gap has been positive since the beginning of the year.

7 It should be noted in this context that an institution which is authorised to use internal models does not have to assess all credit portfolios using internal models. A portion of the portfolios can also be assessed using the standardised approach.

year. However, the credit-to-GDP gap only captures some of the cyclical systemic risks that could, for example, materialise in the banking sector in the event of an unexpected economic downturn.

Medium-term cyclical risks are potentially insufficiently taken into account in the supervisory microprudential own funds requirements. In the standardised approach, which is used above all by small and medium-sized banks, risk weights hardly change over time. By contrast, internal models are in principle used to determine risk-adjusted, institution-specific capital requirements. However, cyclical systemic risks are likely to remain unconsidered to some extent. This is partly because the metrics usually used for borrowers tend to be time-lagged indicators, making it more difficult to carry out a projection of medium-term default risks. Furthermore, the rather atypical combination of low interest rates and prolonged economic growth may have contributed to enterprises' creditworthiness being overestimated. It should also be noted that the microprudential own funds requirements are added together: the overall own funds requirements in lending business are the sum of the own funds requirements for the individual loans. As a result, changes in the distribution of credit risks are not taken into account where the average level of credit risk remains unchanged. Monitoring these allocation risks is an important component of the macroprudential monitoring of cyclical risks in the banking sector (see the section "Allocation risks higher" on p. 68).

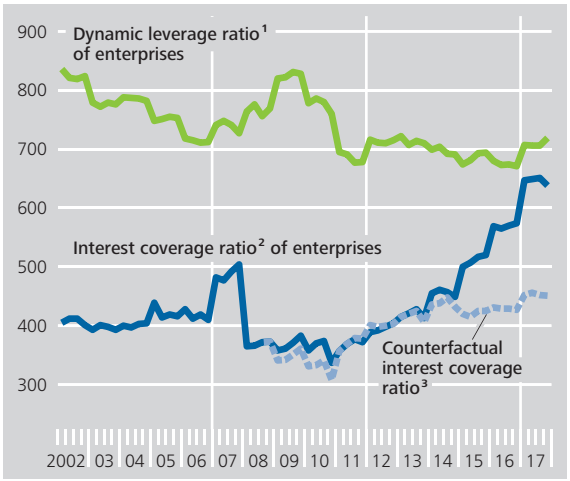
Where internal models are used, cyclical systemic risks are likely to remain unconsidered to some extent.

Aggregate credit risks lower

The favourable economic development means that aggregate credit risks on banks' balance sheets have decreased considerably in recent years. The institutions' risk provisioning has therefore fallen sharply and is currently at a historically low level. Although impairments have recently increased, a trend reversal cannot be derived from this.

Dynamic leverage ratio and interest coverage ratio of enterprises in German banks' domestic corporate loan portfolios Chart 4.8

Mean value weighted according to banks' total assets, %



1 Ratio of debt capital to EBITDA (earnings before interest, taxation, depreciation and amortisation). **2** Ratio of EBITDA to interest expenditure. **3** Calculation under the assumption that enterprises' interest on borrowed capital remained at the average level of the years 2000 to 2008.

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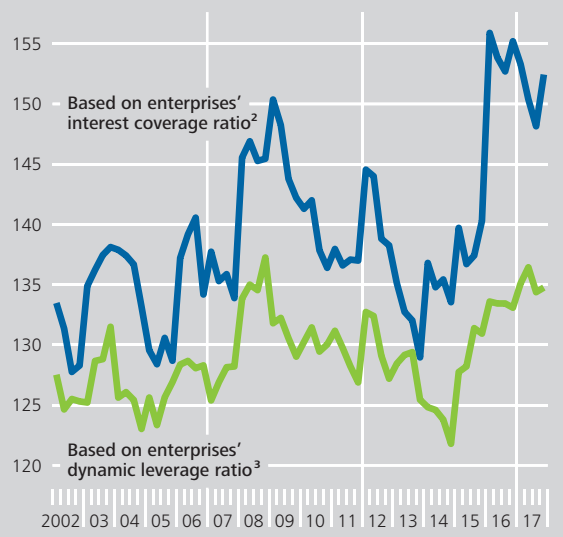
An important reason for the decline in default rates has likely been the considerable drop in enterprises' interest burden. For example, the interest coverage ratio, i.e. the ratio of operating profits to interest expenditure, has increased significantly (see Chart 4.8).[8] The interest coverage ratio would have been considerably worse if interest rates had been at their average level of the years 2000 to 2008. It is therefore questionable whether

Falling default rates among enterprises are probably attributable to the lower interest burden.

8 Earnings before interest, taxes, depreciation and amortisation: EBITDA.

Allocation risks in domestic credit exposure of German banks Chart 4.9

Ratio of riskier enterprises to less risky enterprises, %[1]



1 Relating to the respective median credit exposure. The allocation to riskier or less risky enterprises is decided on the basis of the median of the interest coverage ratio or of the dynamic leverage ratio. **2** Ratio of EBITDA (earnings before interest, taxation, depreciation and amortisation) to interest expenditure. **3** Ratio of debt capital to EBITDA.

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the low interest burden could continue to buttress the default rate and thus the creditworthiness of enterprises in the event of an unexpected economic downturn. Furthermore, enterprises' balance sheets have not improved in structural terms in recent years. This can be seen, amongst other things, in the development of enterprises' capital ratios and dynamic leverage ratios.[9]

Credit risk potentially underestimated

There are growing signs that institutions may be underestimating credit risk. An objective assessment of the risks is only possible if banks' risk models are based on sufficiently long time series covering at least one complete economic cycle. If, however, the credit scores and the default rates are marked by a trend, there is a danger of spurious correlations. The measured creditworthiness of borrowers could then be overstated. This danger is particularly acute for institutions that use internal risk models to estimate their credit risks and determine their capital requirements. These risk models are typically based on data from past years. Internal models for determining own funds requirements for credit risk have been permitted since 2007. Given the good macroeconomic development by historical standards, the scenario of an economic downturn tends to be underrepresented in the risk assessments of these institutions.[10] Furthermore, due to economic policy measures, even the economic downturn in 2008 and 2009 had only a comparatively minor impact on insolvency rates. The latter have been following a downward trend since as long ago as 2002, a trend interrupted only temporarily during the global financial crisis.

Creditworthiness of borrowers could be overstated.

Banking supervisors are currently checking specifically whether banks' internal models meet regulatory requirements and whether their results are reliable and comparable (Targeted Review of Internal Models: TRIM). A key aim of the TRIM project is to prevent inconsistencies and unjustified variability in the use of the models.

Allocation risks higher

Due to the sound situation in the corporate sector, credit risks have tended to decline on average. However, there are signs that, within the portfolios, loans to comparatively riskier enterprises have grown to a greater extent than

Increased allocation risks contribute to the cyclical vulnerability of the banking system.

9 The dynamic leverage ratio is calculated as total debt in relation to EBITDA.
10 See German Financial Stability Committee (2019b).

loans to less risky enterprises (see Chart 4.9). The share of loans to enterprises whose credit ratings would probably be worst hit in the event of an economic downturn has therefore tended to rise. These allocation risks have gone up in recent years and contribute to the cyclical vulnerability of the banking system.

Allocation risk can be measured as the ratio of relatively risky corporate exposures to relatively less risky corporate exposures. The two categories are separated from each other by the median. Rising allocation risks may indicate a greater willingness on the part of banks to take on risk. They could, however, also be the result of greater demand for credit. Furthermore, a selection process may be at work if riskier enterprises tend to raise funds through bank loans and less risky enterprises increasingly raise funds on the capital market in an economic upswing or require less external financing. An increase in allocation risks is therefore partly to be expected when an economic boom is at an advanced stage. At the beginning of the cycle, where demand for credit is subdued, loans are issued primarily to enterprises with good credit ratings. As the economy expands and asset prices rise, this also boosts the creditworthiness of less sound enterprises, thereby improving their access to credit.

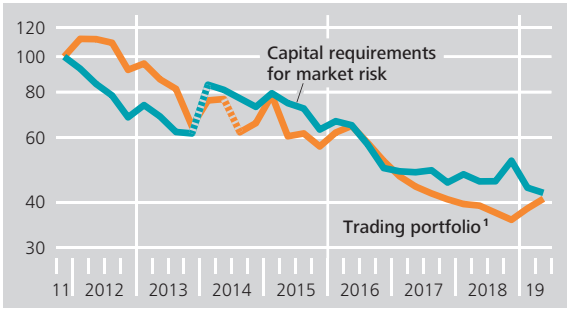
Rising allocation risks may indicate a greater willingness to take on risk.

Higher credit risks in the tails of the distribution can lead to a faster and sharper rise in impairments in an economic downturn than if credit risks were more evenly distributed. However, allocation risks, by their nature, are not reflected in microprudential own funds requirements, as these do not take into account the distribution of credit risk in the loan portfolio. For this reason, monitoring allocation risks is an important component of the macroprudential monitoring of cyclical risks in the banking sector.

Market risk at large, systemically important banks*

Chart 4.10

Q4 2011 = 100, log scale



***** Comprises the 13 other systemically important institutions (O-SIIs). Change in reporting in Q1 and Q3 2014. **1** Market value of trading portfolio positions (gross).

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Capital requirements for market risks can be procyclical

Following the global financial crisis, the rules for own funds requirements for trading operations were substantially tightened. Even though this segment has become less attractive for credit institutions as a result, trading operations still play an important role, particularly for large, systemically important banks. Capital requirements for market risk have fallen in recent years (see Chart 4.10). For the large, systemically important banks, they still constitute around 6% of all capital requirements. The extent to which the fall in capital requirements has been driven by banks withdrawing from trading cannot be established unambiguously.

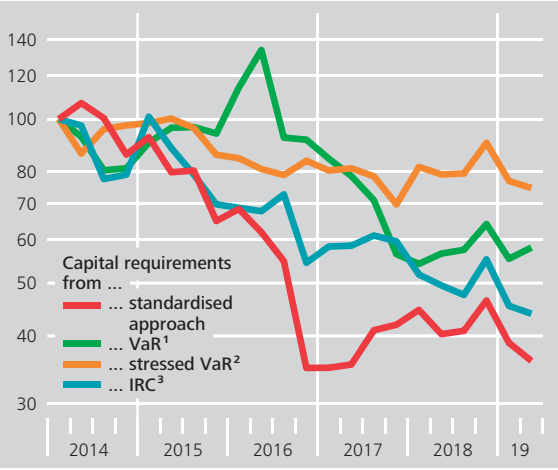
Trading operations still play an important role, particularly for systemically important banks.

The market value of the trading portfolio likewise contracted over the same period, but it is unsuitable as an indicator of the scope of trading operations and the risks stemming from them. Among other things, it does not allow the scope of trading operations to be determined independently of the market environment. This is because it fluctuates with

Components of capital requirements for market risk at large, systemically important banks*

Chart 4.11

Q1 2014 = 100, log scale



* Comprises the 13 other systemically important institutions (O-SIIs). Some of the volatility in the time series reflects idiosyncratic model changes or changes in the scope of the models. **1** Value-at-risk (VaR) for extreme losses stemming from changes in market prices. **2** For extreme losses stemming from changes in market prices under constant stress conditions. **3** The incremental risk charge (IRC) covers position risks from rating downgrades/defaults of credit products.

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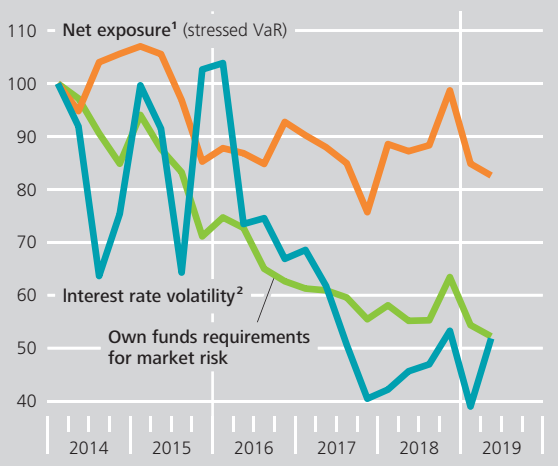
Factors influencing own funds requirements for market risk at large, systemically important banks*

Chart 4.12

Q1 2014 = 100, log scale



Sources: Bloomberg, Bundesbank statistics and Bundesbank calculations. * Comprises other systemically important institutions (O-SIIs) with internal market risk models. **1** Approximated by the stressed value-at-risk (VaR), which values the trading portfolio under constant, stressed market conditions. **2** Implied short-term interest rate volatility is approximated by the price of a short-term interest swaption in the money.

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changes in market prices. The decrease in capital requirements can be partially explained by market parameters in international financial markets improving, such as the fluctuation band of market prices. This becomes clear when the capital requirements for market risk are broken down into their main components (see Chart 4.11). The bulk of aggregated capital requirements for market risks are attributable to banks' internal models. Capital requirements based on internal models are determined, in turn, by various approaches, including a measure of extreme potential losses from changes in market prices (value-at-risk: VaR), extreme losses under constant stress conditions (stressed VaR), and the risks from rating downgrades of non-securitised debt instruments.[11]

Sharp falls can be seen, above all, in capital requirements calculated using the standardised approach. These falls are attributable, in particular, to the reduction in securitisations.[12] In addition, the requirements calculated from the VaR and for rating downgrades of non-securitised debt instruments have fallen significantly; this is likely to be attributable, in part, to the positive market setting.[13] By contrast, the stressed VaR, which is largely independent of current developments in the risk parameters, remained at a virtually constant level in recent years. Therefore, changes in market conditions are likely to have influenced the fall in capital requirements.

Changes in market conditions are likely to have influenced the fall in capital requirements.

11 The components of the capital requirements from the stressed VaR and for risks stemming from rating downgrades for non-securitised debt instruments were introduced following the financial crisis. See Basel Committee on Banking Supervision (2009).
12 In one instance, the fall in capital requirements under the standardised approach was partly attributable to a bank switching to internal models.
13 For all internal models – i.e. based on the VaR, the stressed VaR and for risks stemming from rating downgrades of non-securitised debt instruments – model changes can also have an impact on risk indicators and capital requirements in some instances.

Volatility indices are a commonly used indicator of general market conditions. Such indices approximate the implied fluctuation range on the basis of option prices. Volatility and, in particular, interest rate volatility have declined sharply over the past few years. Especially noticeable is the strong parallel movement of interest rate volatility with own funds requirements for market risk (see Chart 4.12). The stressed VaR is based on a constant valuation of the trading positions and is therefore suited for approximating the trade exposure that is independent of the current market setting. There has been only a slight decrease in the exposure calculated in this way.[14]

In this connection, there is a risk that the low volatility of the past few years might suddenly increase on account of growing uncertainty about future economic and political developments (see the chapter entitled "The international environment" on p. 17). Credit risks might emerge simultaneously, for example, if this were to coincide with a sudden economic downturn (see "Allocation risks higher" on p. 68). Banks would thus be confronted with sharply increased own funds requirements owing to the emergence of multiple risks and might be compelled to reduce their balance sheets in the short term. This, in turn, might reinforce negative economic developments (see the section entitled "Activation of the countercyclical capital buffer" on p. 72).

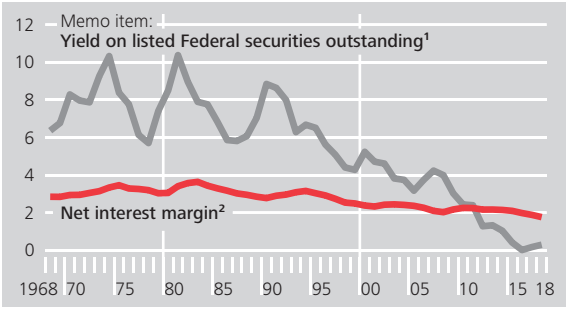
Volatility might suddenly increase on account of growing uncertainty

Vulnerabilities given persistently low interest rates

Since the 1980s, the net interest margin has been falling steadily for most of the time and amounted to no more than just under 1.8% at the end of 2018 in the case of savings banks and credit cooperatives (see Chart 4.13). This is a reflection not only of cyclical factors but also of the fact that the competitive environment has changed.[15] From a financial stability perspective, however, it is important that the banking sector in Germany generate net interest margins in interest business that are adequate and appropriate to the level of risk.

Net interest margin of savings banks and credit cooperatives Chart 4.13

%



1 With a residual maturity of more than three years. **2** Weighted net interest margin of savings banks and credit cooperatives. The interest margin corresponds to net interest income in relation to total assets.

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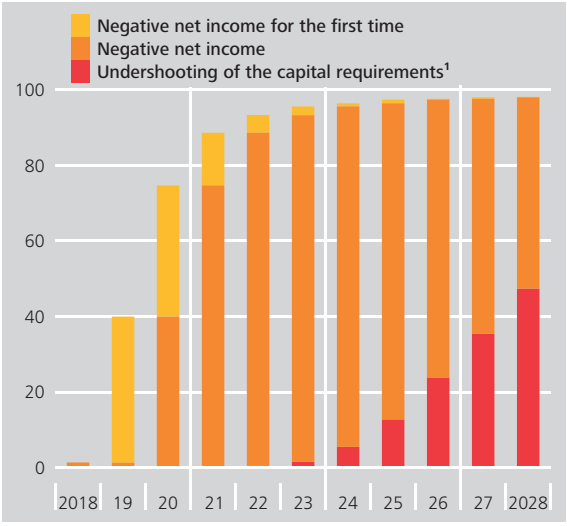
In order to simulate the risks from persistently low interest rates or a further decline in risk-free interest rates, it is assumed that net interest income decreases by 5% annually; after around 13 years, it would therefore have halved. At the same time, it is assumed that loan loss ratios will return to normal in the coming years, i.e. they will rise to the average figure of the period from 2003 to 2006 and stay there. In the context of a statistical balance sheet analysis, it is assumed that the institutions do not adjust their balance sheets in response to these developments. After as soon as one year, roughly 40% of the institutions would suffer losses (see Chart 4.14).[16] After five to six years, there would be a marked increase

14 Regression analyses likewise indicate that the own funds requirements for market risk are driven by both market volatility and the net exposure approximated by the stressed VaR.
15 See Busch and Memmel (2017); Claessens, Coleman and Donnelly (2018); Deutsche Bundesbank (2014).
16 This assumption represents a stress scenario. For comparison: in the period from 1983 to 2018, the net interest margin fell by around 2% per year on average.

Percentage of German banks at risk in the low interest rate scenario*

Chart 4.14

%



* In the baseline scenario, net interest income falls by 5% annually. The value adjustments in lending return for each institution to the median of the period from 2003 to 2006. **1** The capital requirements refer to common equity tier 1 capital, the Pillar 2 capital surcharges, the capital conservation buffer as well as the buffer for other systemically important institutions (O-SIIs).

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in distress in the banking system. After ten years, nearly 50% of the institutions would undershoot the minimum capital requirements. However, the calculations shown are projections made under, in some cases, rather strong assumptions and are not a forecast of a likely development. Nevertheless, the analyses show the pressure on banks to adapt in a low interest rate environment.

German banking supervisors are keeping a close eye on developments in interest business. To this end, they have to carry out special surveys in which banks must forecast developments under various interest rate assumptions. Fundamentally, the pressure to adjust given an ongoing low interest rate environment is confirmed by the institutions in the special survey conducted jointly by the Bundesbank and BaFin in the middle of the year.[17] In a scenario in which there is an abrupt fall in interest rates by 100 basis points, before valuation adjustments around 16% of the less significant banks would record a negative operating result within five years. Taking into account value corrections, the ratio would be noticeably higher. The majority of German institutions continue to be in possession of a sound capital base, however.

Institutions confirm the pressure to adjust given an ongoing low interest rate environment.

Generally, positive framework conditions are needed to enable structural change in the financial sector without hindering innovation or placing financial stability in jeopardy. This also means allowing banks – just like firms in other economic sectors – to exit the market if their business strategies are no longer sustainable. An effective resolution and restructuring regime can help market mechanisms to function properly. The objective of such a regime is to allow even systemically important banks to exit the market without endangering financial stability and exposing taxpayers to loss (see the box entitled "Regulation on the resolution of systemically important banks: status and outstanding issues" on p. 73).

Activation of the countercyclical capital buffer

Lending has increased significantly in the past few years, notably in the residential real estate sector and the non-financial corporate sector. At the same time, assessments of credit risk have fallen, while alloca-

The deployment of macroprudential instruments can limit risks.

17 The survey on the profitability and resilience of German financial institutions in a low interest rate environment, which was undertaken by BaFin and the Bundesbank, focused on 1,400 small and medium-sized credit institutions. Questions also covered credit standards, the importance of climate risks, and deposit rates. Details can be found at https://www.bundesbank.de/en/press/press-releases/results-of-the-2019-lsi-stress-test-807624

Regulation on the resolution of systemically important banks: status and outstanding issues

At the beginning of 2016, the Single Resolution Mechanism (SRM) was established for the countries of the euro area. The objective of a resolution is to allow even systemically important banks to exit the market without endangering financial stability and exposing taxpayers to loss. The resolution framework makes it possible for shareholders and creditors – rather than the state – to shoulder losses and contribute to the recapitalisation of a bank. By applying the bail-in tool, losses and the cost of recapitalisation are borne not only by the bank's shareholders and subordinated creditors but also by senior creditors. In this context, it is important that a bank has sufficient loss-absorbing and recapitalisation capacity. For this reason, the resolution authority sets a "minimum requirement for own funds and eligible liabilities" (MREL) for each institution. Among other things, the MREL rules were specified and brought into line with international standards under the recently adopted EU banking package, which amended EU banking regulation.[1] These revisions aimed at strengthening the resolution regime. However, past experience with bank failures indicates further points on how the regulatory framework could be improved.[2]

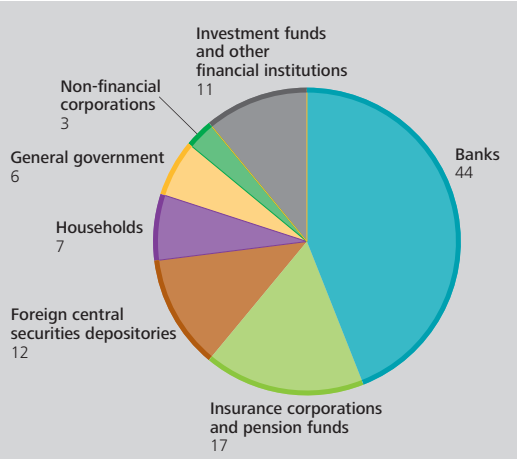
Of crucial importance is the point in time at which a bank is determined to be "failing or likely to fail" (FOLTF). On the one hand, if FOLTF is determined too late, there is a risk that further losses may accumulate and there is no longer sufficient loss-absorbing and recapitalisation capacity available. On the other hand, a bank should not be determined to be FOLTF when there is still the possibility of a successful recovery. Thus, the resolution authority must weigh up carefully when to determine that a bank is FOLTF. One key aspect here are the bank's assets that may serve as collateral for the bank's refinancing in the market or with the central bank. The availability of these resources, which are needed for a resolution, could serve as a formal criterion in deciding precisely when FOLTF should be determined. No such case has arisen so far.

Under the currently applicable EU rules, there are no limits for banks investing in MREL instruments of other institutions, with the exception of global systemically important institutions (G-SIIs). In Germany there is a high concentration with regard to investors in MREL instruments. At the end of 2018, 44% of MREL instruments issued by German banks (minus common equity tier 1 capital) were held within the German banking sector (see the chart). That corresponds to a total amount of €105 billion. This high level of interconnectedness between banks means that losses can be directly transferred in the event that the bail-in tool is used. On the one hand, contagion takes place when assets are directly written off. On the other hand, contagion might occur if changes in risk weights are applied to assets after conversion of debt capital into equity capital. If banks holding MREL instruments did not have sufficient resilience to such losses, their resolvability would be at risk. Under the EU banking package, G-SIIs are required to deduct their mutual investments in MREL instruments from their own MREL upwards of a particular threshold.[3] However, in the

1 See Deutsche Bundesbank (2019), pp. 31-49.
2 See Deutsche Bundesbank (2017), pp. 34-36.
3 In this respect, the EU regime falls short of the globally agreed minimum standard which provides for a deduction of investments in global systemically important institutions (G-SIIs) for all banks; see Basel Committee on Banking Supervision (2016).

Sectoral distribution of investors in MREL instruments of German banks*

%, as at 31 December 2018



Sources: BaFin (Liability Data Report), Securities Holdings Statistics and Bundesbank calculations. * Instruments to meet the minimum requirement for own funds and eligible liabilities (MREL). The resolution authority sets the MREL for each bank to ensure that sufficient loss-absorbing and recapitalisation capacity is available in the event of resolution.

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EU not only G-SIIs, but considerably more banks, are likely to be resolved after an FOLTF determination. All of those might potentially be subject to a bail-in. The lack of deduction rules for these banks and the associated contagion risks could compromise the credibility of the bail-in tool, thereby jeopardising the resolution regime. For this reason, investments in MREL instruments must be limited for banks for which, according to the resolution plan, a resolution is envisaged.[4] There is no need for a similar cap for banks exiting the market under national insolvency procedures, as a bail-in is not possible in such cases.

When applying resolution tools, the resolution authorities take the resolution objectives into account, ensuring, for instance, the continuity of critical functions. Here, they select the instruments with which the relevant objectives might best be achieved based on the specific circumstances of each individual case. Following resolution there is a danger, however, that the bank has no access to market funding directly after recapitalisation – because it first has to build up its standing with investors, for example. In order to counter potential liquidity shortfalls post resolution, the volume of unencumbered and therefore pledgeable assets that would be available at the time of resolution already needs to be taken into consideration during the recovery and resolution planning phase. Such assets could then serve as collateral for the refinancing of the successor bank.

Moreover, the Single Resolution Fund (SRF) – including the European Stability Mechanism (ESM) as a backstop – is currently being set up in the euro area to provide a backup in the form of guarantees and credit lines in case of a liquidity shortage.[5] As things currently stand, at the close of the phase-in at the end of 2023, the SRF including a backup via the ESM will total around €120 billion. However, potential liquidity shortages during and after resolution can only be estimated very imprecisely beforehand.[6] Looking at past banking crises in the EU, liquidity guarantees and other liquidity measures approved by states totalled €906 billion in 2009 alone. This was the highest annual amount in the period from 2007 to 2017 and was needed to restore market confidence. Up to 2017, a total of €8.3 billion had

4 This refers to deduction rules for MREL instruments up to the class "senior non-preferred".
5 The ESM Treaty is currently being revised accordingly. The euro area Heads of State or Government are scheduled to reach a final agreement in December 2019, after which the national ratification processes can begin.
6 See Lehmann (2018).

been used.[7] Besides being financially far better equipped, resolution funds in other countries such as the United States or Japan are covered by a state guarantee. In countries like the United Kingdom and Canada, it is possible for the central bank itself to provide liquidity in the event of resolution, if need be.[8] However, the general set-up in those countries differs fundamentally from that in the euro area. For this reason, it could be worth considering scaling up the SRF resources (including the ESM backstop) in order to strengthen the financial clout and, thus, the credibility of the SRM.

7 Information on the volumes of government assistance and the guarantees called upon is available at http://ec.europa.eu/competition/state_aid/scoreboard/index_en.html; https://ec.europa.eu/eurostat/web/government-finance-statistics/excessive-deficit/supplemtary-tables-financial-crisis
8 For information on the United States and the United Kingdom, see Demertzis, Goncalves Raposo, Hüttl and Wolff (2018). Information on Japan and Canada is available at https://www.boj.or.jp/en/about/outline/data/foboj08.pdf; https://www.bankofcanada.ca/markets/market-operations-liquidity-provision/framework-market-operations-liquidity-provision/emergency-lending-assistance/

tion risk has increased. Additional strains and risks derive from persistently low interest rates and high valuations on the property market. This means that the banking system could have become more susceptible to negative changes in the underlying macroeconomic conditions. The deployment of macroprudential instruments can limit the associated systemic risks.

Macroprudential capital buffers address systemic risks

A stable financial system is characterised by its ability to cushion unfavourable macroeconomic developments and by not intensifying them. This ability is determined crucially by the level of available equity capital. Against this backdrop, it is a welcome development that German banks have significantly increased their capital since the global financial crisis. Numerous regulatory measures have played a part in this (see the box entitled "International standards for regulating banks: the adoption of the final Basel III reforms" on p. 81).

Macroprudential buffers are especially useful for limiting systemic risks. They are designed to strengthen banks' capacity to absorb losses beyond the microprudential capital requirements. This makes it possible to address not only banks' specific risks but also system-wide risk factors. The consequences for banks if they undershoot the relevant thresholds are less drastic than in the case of the microprudential minimum requirements. Non-compliance with the supervisory minimum requirements ultimately involves the threat of the banking licence being revoked. Undershooting the macroprudential capital

The macroprudential capital buffers can be used to cover losses.

buffers is allowed under certain circumstances, however. Non-compliance with the buffers leads primarily to a limitation of the profit distribution, i.e. bonus payments and dividends. Beyond this, regular business activity remains unaffected. The macroprudential capital buffers can therefore "breathe" and be used to cover losses. They have to be replenished again later, however.

Overall, it is possible to distinguish four different macroprudential capital buffers that have to be met with common equity tier 1 (CET 1) capital.

The capital buffer for global systemically important banks applies to large complex and interconnected financial institutions. In Germany, the buffer is currently imposed on one institution and amounts to 2% of risk-weighted assets.

The capital buffer for other systemically important institutions (O-SIIs) relates to banks which are crucial for the functioning of the national and European economy. For 2019, 13 institutions in Germany have to satisfy a capital buffer that amounts to up to 2% of risk-weighted assets. In the second quarter of 2019, the capital buffer for these 13 banks amounted to 1.2% of risk-weighted assets on average.

Given long-term risks that are non-cyclical, the systemic risk buffer (SyRB) can be imposed on all banks or individual categories of banks. After the Capital Requirements Directive (CRD) V has been transposed into national law, the buffer can be applied more flexibly and also be used explicitly for sector-specific risks.[18] This buffer is not imposed in Germany at present.

The countercyclical capital buffer is to be built up in times of increasing cyclical risks. It is designed to strengthen the resilience of the banking system and prevent institutions from behaving in a procyclical manner. An instance of procyclical behaviour would be if credit institutions were to excessively restrict their lending in an economic downturn, thus reinforcing the decline. A growing number of loan defaults could then have repercussions for the banking system. In contrast to the other capital buffers (as well as the minimum capital requirements), an existing countercyclical capital buffer can be lowered at any time. There is thus no need for the banks to replenish it if they undershoot it. In a downturn, this allows equity capital to be released, counteracting deleveraging and a restriction of lending. In July 2019, the buffer was activated for the first time in Germany.[19] Owing to their claims on borrowers from countries that have already imposed the capital buffer, the percentage of German banks' equity capital built up for cyclical systemic risks already amounted to 0.1% of their risk-weighted assets in the second quarter of 2019.

The countercyclical capital buffer is to be built up in times of increasing cyclical risks.

Countercyclical capital buffer activated in Germany for the first time

In activating the countercyclical capital buffer in July 2019 for the first time, Germany took its place alongside a group of other European countries which have likewise activated or raised the countercyclical capital buffer in the observation period (see Table 4.1). In Germany, the buffer currently amounts to 0.25% relative to the exposures located in Germany ("risk-weighted claims on residents") and is therefore at the lower end of

The banks' buffer of 0.25% has to be satisfied with effect from July 2020 at the latest.

18 See Directive (EU) 2019/878 of the European Parliament and of the Council of 20 May 2019 amending Directive 2013/36/EU as regards exempted entities, financial holding companies, mixed financial holding companies, remuneration, supervisory measures and powers and capital conservation measures.
19 See German Financial Stability Committee (2019a).

Increase in the countercyclical capital buffer in selected Euopean countries*

Table 4.1

as at Q3 2019

Country	Time of change in the CCyB	Change in the CCyB from …%	to …%	Buffer guide[1], %	Reason for change in the CCyB
Belgium	Q2 2019	0	0.50	0	– Private non-financial sector debt – Preventive measure – Gradual build-up of capital
Bulgaria	Q1 2019	0.50	1.00	0	– Private non-financial sector debt – Preventive measure
Czech Republic	Q4 2018 Q2 2019	1.50 1.75	1.75 2.00	0 0	– Private non-financial sector debt – Risk in the real estate sector
Denmark[2]	Q3 2019	1.00	1.50	0	– Private non-financial sector debt – Gradual build-up of capital to achieve announced target
France	Q3 2019	0.25	0.50	0	– Private non-financial sector debt – Risk of a revaluation of assets in the financial markets – Preventive measure
Iceland	Q3 2019	1.75	2.00	0	– Private non-financial sector debt – Risk in the real estate sector – Preventive measure
Luxem-bourg	Q4 2018	0	0.25	0	– Private non-financial sector debt – Preventive measure
Norway	Q4 2018	2.00	2.50	0	– Private non-financial sector debt – Risk in the real estate sector – Preventive measure
Slovakia	Q3 2019	1.50	2.00	2.00	– Private non-financial sector debt – Greater risk-taking in the banking sector

Sources: ESRB and national authorities. * Changes in countercyclical capital buffer (CCyB) since Q4 2018. The reference date for the change in the CCyB is the day on which the decision is published. Following the announcement, banks generally have 12 months to build up the buffer. **1** The buffer guide is derived from the credit-to-GDP gap. This shows, from a historical perspective, how much faster loans are increasing than a country's economic output. A positive gap may indicate an excessive growth in credit. From a positive credit-to-GDP gap of 2 percentage points upwards, a buffer guide derived from this suggests a possible need for macroprudential action (rules-based component). In arriving at their decision, the macroprudential supervisory authorities also take other indicators into consideration (discretionary component). For more details, see also Deutsche Bundesbank, Financial Stability Review 2015, pp. 76-79. **2** In October 2019, Denmark raised the CCyB by a further 0.5 percentage point to 2.00%, effective as at 30 December 2020.

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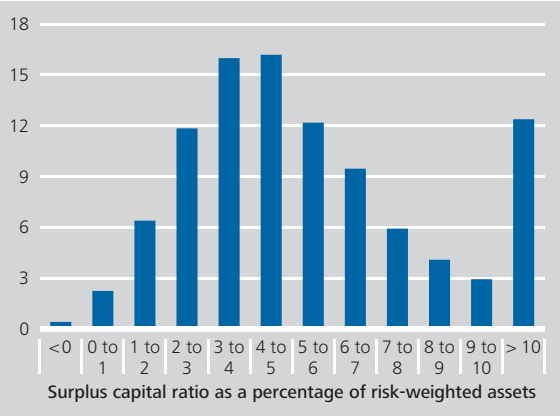
the table in a European comparison. The banks have a period of 12 months to meet this requirement, which means that the buffer of 0.25% has to be satisfied with effect from July 2020 at the latest. The countercyclical capital buffer must be met in addition to the existing capital requirements.

With its decision to set the countercyclical buffer at 0.25%, BaFin was following a recommendation of the German Financial Stability Committee. In its recommendation to activate the buffer, the Financial Stability Committee was guided by the principle of rules-based discretion.[20] Key in this context is the assessment of the credit-to-GDP gap.[21] The higher the figure is for this indicator, the higher is the probability of excessive lending and a resulting systemic risk. Starting from a negative gap of -10 percentage points at the end of 2011, the credit-to-GDP gap has risen since then almost without interruption. In the second quarter of 2019, it was in positive territory at just under 1 percentage point. This meant it was approaching the prudentially defined threshold

20 See European Systemic Risk Board (2014).
21 The credit-to-GDP gap shows, from a historical perspective, how much more quickly lending is growing than a country's economic output.

Prospective surplus capital* in the German banking system after the introduction of the countercyclical capital buffer Chart 4.15

Frequency distribution in percentage points, as at Q2 2019



* It is assumed that a) a countercyclical capital buffer of 0.25% already applies in Germany, b) the stricter definition of capital that is to enter into force from 2023 applies, c) banks already have to fully maintain their macroprudential capital buffers, and d) that the capital bound by voluntary capital recommendations under Pillar 2 is counted towards the surplus capital. Not taken into consideration are additional capital requirements that might result from the Basel III reforms being finalised by 2023. The analysis covered 1,470 German banks.

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of 2 percentage points, at which excessive lending is to be assumed. Besides the credit-to-GDP gap as a rules-based component, other indicators are included as discretionary components when activating and calibrating the countercyclical capital buffer.

After taking due account of all the relevant factors, the German Financial Stability Committee concluded that a positive figure for the countercyclical capital buffer is justified in the present macroeconomic and financial setting. The long period of economic expansion and persistently low interest rates have led to a build-up of cyclical systemic risks. These are reflected in potentially underestimated credit risk, a potential overvaluation of loan collateral encouraged by years of rising real estate prices, and interest rate risk. Given that this instrument was activated for the first time and in view of the existing uncertainties about the economic setting, the German Financial Stability Committee recommended to BaFin that the countercyclical capital buffer be set initially at 0.25%. BaFin followed this recommendation with effect from 1 July 2019. Since then, the institutions have been given a period of 12 months to satisfy the additional capital requirements.

At the present juncture, most institutions have a comparatively high level of voluntary surplus capital even after the countercyclical capital buffer was raised to 0.25% (see Chart 4.5). Additionally taking into consideration the findings of studies which show that higher regulatory capital requirements in the past did not substantially curb lending, no significant negative effects on lending are to be expected (see the box entitled "Effect of higher capital requirements on lending to enterprises" on p. 79).

The countercyclical capital buffer is designed to induce banks to build up sufficient equity capital in an upturn. Even if banks already possess a high level of surplus capital, the countercyclical capital buffer has a positive impact on the institutions' capital adequacy and stabilises lending. In the run-up to a potential crisis, it stops banks from reducing their equity capital by distributing profits.[22] Empirical analyses show, moreover, that banks faced with rising capital requirements first use their surplus capital. In the medium term, they endeavour to increase their capital ratio, however. [23] In this case, upon release of the countercyclical capital buffer, banks have more surplus capital available than in a situation where the buffer has not been built up in advance.

22 Empirical studies show that banks distribute profits precisely in periods of high losses in order to signal financial strength by distributing capital. This may create a misleading incentive for other banks to do the same. Capital buffers reduce this misleading incentive, as banks may only use the buffers on the condition of restrictions on the distribution of profits in order to cover any losses. See Acharya, Le and Shin (2016); Basel Committee on Banking Supervision (2010).

23 Various studies examine the extent to which banks use their surplus capital in the short term to fulfil additional capital requirements. See Alfon, Argimon and Bascunana-Ambros (2005); Bridges, Gregory, Nieslen, Pezzini, Radia and Spaltro (2014); de Bandt, Camara, Maitre and Pessarossi (2018); de-Ramon, Francis and Harris (2016); Francis and Osbourne (2010).

Effect of higher capital requirements on lending to enterprises

Banking regulation underwent fundamental reform worldwide in the wake of the global financial crisis. In particular, banks today must be better capitalised with regard to both the quantity and the quality of capital. Regulatory capital requirements are a key determinant in banks' entrepreneurial decisions. A growing literature is examining what implications might arise as a result. The online repository "Financial Regulation Assessment: Meta Exercise" (FRAME) of the Bank for International Settlements offers an extensive selection of studies on this topic.[1]

There are a variety of ways in which banks can react to changes in capital requirements. On the one hand, they can raise their capitalisation; on the other hand, they can scale back their risk-weighted assets.[2] Whether these adjustments will have implications for the lending behaviour and rates of the banks concerned is the subject of much discussion and research. However, the studies available to date do not present a uniform picture.[3] A number of studies point to a dampening effect on lending.[4] Studies that examine the longer-term or macroeconomic effects of capital requirements come to the conclusion, though, that higher capital requirements constrain banks' lending only temporarily.[5] Overall, the variation in results due to differing methodologies suggests further relevant influencing factors.

A recent research project looks at the extent to which changes to capital requirements for banks in Germany affect lending to non-financial corporations in the euro area and the corresponding lending rates.[6] Here, the analysis focuses on the short-term implications and takes into account relevant bank-specific factors which may help to explain the lack of consensus in the existing literature.

As capital requirements are defined as a percentage of risk-weighted assets, their capital impact depends on the size of the underlying risk weights. Risk density across banks varies, above all, with regard to loans to enterprises.[7] It can be assumed that a change to the regulatory requirements would have a stronger impact on lending to enterprises by banks with a higher risk density. The extent to which capital requirements affect a bank depends on the combination of the risk density of the corporate loan portfolio and the amount of the requirement. The capitalisation of banks is a further important determinant. For example, higher capital requirements are likely to have a smaller effect on lending by banks with high surplus capital levels beyond what is required by regulators.

The results do not show any relationship between increases in capital requirements and lending rates. A weakening effect on corporate lending growth is found only in the case of banks holding low levels of surplus capital, i.e. those institutions that hold only slightly more capital than required under the regulatory framework. Thus, the analysis complements the existing literature by taking into account relevant bank-specific factors.

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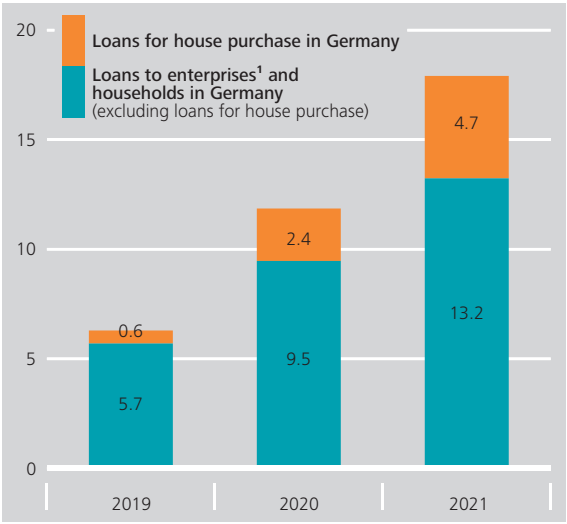
1 FRAME is available at https://stats.bis.org/frame/
2 See, inter alia, Admati, Demarzo, Hellwig and Pfleiderer (2018).
3 For overviews of the current literature, see, inter alia, Boissay, Cantú, Claessens and Villegas (2019); Basel Committee on Banking Supervision (2019).
4 See, inter alia, Gropp, Mosk, Ongena and Wix (2019).
5 See, inter alia, Eickmeier, Kolb and Prieto (2018).
6 See Imbierowicz, Löffler and Vogel (2019). There is currently no more up-to-date study for the German banking system on the effects of changes to the capital requirements. A recent related analysis looks at the relationship between non-performing loans and lending rates without finding a close connection. See Bredl (2018).
7 Risk density describes the ratio of risk-weighted exposures to the unweighted overall exposure. The aim of the analysis is to examine the euro-denominated exposures to the non-financial corporations sector in the euro area.

German banks' expected loan losses in the stress scenario* Chart 4.16

€ billion



* In the case of loans for house purchase, a cumulative decline in nominal property prices of 30% compared with 2018 is assumed along with a rise in the unemployment rate totalling 6.6 percentage points. For the other loans, it is assumed that loan loss provisions return to a pre-crisis median in the respective sector. **1** Excluding monetary financial institutions.

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BaFin examines every quarter whether the level of the buffer is appropriate. That is also the case during the 12-month introductory period. If there is a further build-up of cyclical risks, the buffer can be raised as an additional reserve against defaults. Conversely, the buffer can be reduced if the risk situation eases.

Countercyclical capital buffer has stabilising impact in periods of stress

To illustrate how the countercyclical capital buffer works, a stress test-based analysis consisting of two components is conducted. First, there is a distinct increase in loan losses in the stress scenario (see Chart 4.16). Second, there is an increase in the average risk weights, calculated using internal models, for loans to enterprises and for retail business.

With regard to the expected loan losses, the analysis makes a distinction between real estate loans and other loans. In the case of loans to enterprises and loans to households (excluding real estate loans), loan loss ratios rise within three years to the median figure of the period from 2003 to 2006 (i.e. the average figure prior to the financial crisis). In the manufacturing sector, which is particularly sensitive to business cycles, loan loss ratios grow by an additional amount that is to be expected on average every six to seven years. The additional stress corresponds to one standard deviation of the loan loss ratios of the period from 2002 to 2018. For residential real estate loans, it is assumed that the nominal prices for residential properties decline within three years by 30% compared with their 2018 level. This slump in prices leads to rising loan loss ratios for loans for house purchase, as the banks' loan defaults increase and, at the same time, losses occur in the realisation of collateral.[24]

The sample calculations show that, under the assumptions, the loan loss ratios of small and medium-sized banks would increase sixfold. The loan loss ratios of the large, systemically important banks would double and therefore be significantly smaller because real estate business is less important for these banks. Overall, a decline in equity capital of 1.3% of risk-weighted assets would be expected. In the second component of the analysis, the risk-weighted assets would increase in the stress period by around 17%. The increase in risk-weighted assets is due to a rise in the average IRBA risk weights in the case of loans to enterprises and for retail business. For this purpose, a point in time during the period from 2008 to 2018 when the risk weight assumed the maximum was identified for each bank. The median of the risk weight was then calculated from a three-year window around this maximum, and it was assumed that the currently observed risk

24 For the methodology, see Barasinka, Haenle, Koban and Schmidt (2019).

International standards for regulating banks: the adoption of the final Basel III reforms

In December 2017, the Basel Committee on Banking Supervision (BCBS) agreed on the last part of the Basel III reform package following the adoption of initial reform steps as long ago as 2010. Key elements of the reform are new approaches to calculating risk-weighted assets in credit risk (the credit risk standardised approach and the internal ratings-based approach (IRBA)), the abolition of the models-based approach and the introduction of a binding standardised approach, an output floor of 72.5% for the capital requirements – relative to the capital requirements when applying the standardised approach – for institutions which calculate their risk using internal models, and the revised procedure for calculating counterparty risk in derivatives business (credit value adjustments).[1]

The European Commission is working on transposing the final parts of the Basel III reforms into European law. Specifically, the standards set in Basel will be incorporated into the Capital Requirements Regulation (CRR III) and the Capital Requirements Directive (CRD VI). The Commission's work in this respect is based in part on a European Banking Authority (EBA) report which investigated the effects of the Basel reform package on the banking industry and real economy in Europe.[2] The legislative proposal to amend the CRR is scheduled to be presented in the first half of 2020. What is important here is that EU implementation is consistent with Basel III.

As a result of the reform package, changes in the minimum capital requirements are to be expected, reflecting the objectives of the reform and taking very different forms depending on the institution and the business model. Since 2011, the Basel Committee has been regularly studying the effects of the reforms on selected institutions. For the German sample in this Basel III monitoring exercise, the minimum capital requirements for tier 1 capital will increase on aggregate by just over 22% by 2027.[3] Roughly 75% of this increase is due to the output floor. This places a limit on the differences between the capital requirements calculated using banks' internal models and those that would derive applying a standardised approach. The Basel III monitoring exercise covers mostly large complex financial institutions which employ their own internal measuring systems. As a result, the capital increase of more than 22% overstates the figure for the German banking sector as a whole. For smaller institutions, the increase amounts to 8%.

The last part of the Basel III reforms will strengthen credit institutions' resilience and make the banks' capital requirements more robust, more comparable and less cyclical.

1 See Basel Committee on Banking Supervision (2017); Deutsche Bundesbank (2018b), pp. 73-89.
2 See European Banking Authority (2019). Further information may be retrieved from https://eba.europa.eu/eba-advises-the-european-commission-on-the-implementation-of-the-final-basel-iii-framework
3 Further information may be retrieved from https://www.bundesbank.de/en/tasks/banking-supervision/legal-basis/basel-framework/basel-iii-monitoring-622584

weight would rise to this figure. This stress scenario could prompt the German banking system to simultaneously deleverage because the institutions have to adhere to their capital requirements even in a downturn.[25]

Without the introduction of a countercyclical capital buffer, a simultaneous deleveraging of up to 4% would be possible in the stress scenario (as at Q2 2019). Each 0.25 percentage point raising of the countercyclical capital buffer results in an approximately linear reduction of 0.26 percentage point in the deleveraging of the balance sheet. This presupposes that the countercyclical capital buffer has already been fully built up and was released by the supervisory authority in the stress period. The aim of the countercyclical capital buffer is not to prevent deleveraging generally, however, but rather to mitigate it. Beyond these stress test-based results, BaFin's intention with its decision was to set the countercyclical capital buffer initially at 0.25% given that the instrument had been activated for the first time and the fact that uncertainties existed about the future development of the general economic climate.

Without the introduction of a countercyclical capital buffer, simultaneous deleveraging of up to 4% would be possible in the stress scenario.

Deployment of the countercyclical capital buffer is geared to the financial cycle

Activation of the countercyclical capital buffer does not imply that the economy is booming. Rather, its deployment is guided by the build-up of cyclical vulnerabilities in the financial system, which is not necessarily linked to the business cycle. Nevertheless, the overall state of the economy together with the current situation in the banking system plays a part in increasing the buffer. The deployment of the countercyclical capital buffer itself is not intended to contribute to a procyclical response on the part of the banking sector. Present and currently expected economic developments as well as the fact that banks are equipped with surplus capital suggest that such a procyclical response by the banking sector is not to be expected at present.

List of references

Acharya, V. V., H. Le and H. S. Shin (2016), Bank Capital and Dividend Externalities, BIS Working Paper No 580.

Admati, A. R., P. M. Demarzo, M. F. Hellwig and P. Pfleiderer (2018), The Leverage Ratchet Effect, The Journal of Finance, Vol. 73 No 1, pp. 145-198.

Alfon, I., I. Argimon and P. Bascunana-Ambros (2005), How Individual Capital Requirements Affect Capital Ratios in UK Banks and Building Societies, Banco de España Working Paper No 0515.

Barasinska, N., P. Haenle, A. Koban and A. Schmidt (2019), Stess Testing and the German Mortgage Market, Deutsche Bundesbank Discussion Paper No 17/2019.

Basel Committee on Banking Supervision (2009), Revisions to the Basel II Market Risk Framework, BCBS Publications.

Basel Committee on Banking Supervision (2010), An Assessment of the Long-term Economic Impact of

25 Capital requirements are composed of the minimum capital requirements, the bank-specific capital requirements from Pillar 2 and the capital buffer requirements. The buffer requirements correspond to the sum of the capital conservation buffer of 2.5%, the capital buffers for systemically important banks as well as the buffers due to positive countercyclical capital buffers abroad and to be used reciprocally in Germany. The countercyclical capital buffer is released domestically in line with the assumptions in a stress period and therefore no longer represents a capital requirement in the observed scenario.

Stronger Capital and Liquidity Requirements, BCBS Publications.

Basel Committee on Banking Supervision (2016), Standard TLAC Holdings, BCBS Publications.

Basel Committee on Banking Supervision (2017), Basel III: Finalising Post-crisis Reforms, BCBS Publications.

Basel Committee on Banking Supervision (2019), The Costs and Benefits of Bank Capital: A Review of the Literature, BCBS Working Paper No 37.

Boissay, F., C. Cantú, S. Claessens and A. Villegas (2019), Impact of Financial Regulations: Insights from an Online Repository of Studies, BIS Quarterly Review, March 2019.

Bredl, S. (2018), The Role of Non-Performing Loans for Bank Lending Rates, Deutsche Bundesbank Discussion Paper No 52/2018.

Bridges, J., D. Gregory, M. Nieslen, S. Pezzini, A. Radia and M. Spaltro (2014), The Impact of Capital Requirements on Bank Lending, Bank of England Working Paper No 486.

Busch, R. and C. Memmel (2017), Banks' Net Interest Margin and the Level of Interest Rates, Credit and Capital Markets, Vol. 50 No 3, pp. 363-392.

Claessens, S., N. Coleman and M. Donnelly (2018), "Low-For-Long" Interest Rates and Banks' Interest Margins and Profitability: Cross-country Evidence, Journal of Financial Intermediation, Vol. 35, pp. 1-16.

de Bandt, O., B. Camara, A. Maitre and P. Pessarossi (2018), Optimal Capital, Regulatory Requirements and Bank Performance in Times of Crisis: Evidence from France, Journal of Financial Stability, Vol. 39, pp. 175-186.

Demertzis, M., I. Goncalves Raposo, P. Hüttl and G. Wolff (2018), How to Provide Liquidity to Banks after Resolution in Europe's Banking Union, Economic Governance Support Unit.

de-Ramon, S. J. A., W. B. Francis and Q. Harris (2016), Bank Capital Requirements and Balance Sheet Management Practices: Has the Relationship Changed After the Crisis?, Bank of England Working Paper No 635.

Deutsche Bundesbank (2012), Monthly Report, June 2012.

Deutsche Bundesbank (2014), Monthly Report, September 2014.

Deutsche Bundesbank (2017), Financial Stability Review.

Deutsche Bundesbank (2018a), Financial Stability Review.

Deutsche Bundesbank (2018b), Monthly Report, January 2018.

Deutsche Bundesbank (2019), Monthly Report, June 2019.

Eickmeier, S., B. Kolb and E. Prieto (2018), The Macroeconomic Effects of Bank Capital Regulation, Deutsche Bundesbank Discussion Paper No 44/2018.

European Banking Authority (2019), Policy Advice on the Basel III Reforms: Credit Risk, August 2019.

European Systemic Risk Board (2014), Recommendation on guidance to EU member states for setting countercyclical buffer rates, ESRB/2014/1, June 2014.

Francis, W. B. and M. Osbourne (2010), On the Behavior and Determinants of Risk-Based Capital Ratios: Revisiting the Evidence from UK Banking Insti-

tutions, International Review of Finance, Vol. 10 No 4, pp. 485-518.

German Financial Stability Committee (2019a), Empfehlung zur Erhöhung des antizyklischen Kapitalpuffers, AFS/2019/1, May 2019.

German Financial Stability Committee (2019b), Sechster Bericht an den Deutschen Bundestag zur Finanzstabilität in Deutschland.

Gropp, R., T. Mosk, S. Ongena and C. Wix (2019), Banks Response to Higher Capital Requirements: Evidence from a Quasi-Natural Experiment, The Review of Financial Studies, Vol. 32 No 1, pp. 266-299.

Imbierowicz, B., A. Löffler and U. Vogel (2019), The Transmission of Bank Capital Requirements and Monetary Policy to Bank Lending, mimeo.

Lehmann, A. (2018), Cash Outflows in Crisis Scenarios: Do Liquidity Requirements and Reporting Obligations Give the Single Resolution Funds Sufficient Time to React?, Economic Governance Support Unit.

Interconnectedness in the German financial system

Interconnectedness within the financial system – as well as between the financial system, the real economy and general government – is significant for financial stability. This interconnectedness can give rise to systemic risk, for example if minor shocks are amplified via contagion and second-round effects. Parts of the financial system may then be unable to fulfil their functions or even fail altogether. However, interconnectedness can also have a positive impact, such as by mitigating shocks and thereby stabilising the system.

The global financial crisis demonstrated that contagion effects can occur in a number of different ways: contagion can spread to market participants directly if, for instance, they are connected to each other through loans or derivatives. This results in the danger of a shock impacting large parts of the financial system via knock-on effects. These kinds of risks, which could jeopardise the financial system as a whole, were a deciding factor in the bailout of US insurance corporation AIG. In addition, contagion can spread to agents indirectly if, for instance, share or bond prices fall sharply as a result of sales of commonly held securities. Another example would be an institutional default that leads to a loss of confidence in a particular market segment. This risk was significant in the bailout of the German mortgage bank HRE, as it played a key role on the German Pfandbrief market.

In many cases, the availability of data determines the extent to which interconnectedness and possible contagion channels can be analysed. The data pool has improved considerably since the global financial crisis. Cross-sectoral analyses can be used to investigate direct contagion risks, such as the way in which a real economic shock is transmitted to and then propagates within the financial system. The analysis shows that second-round effects can be more significant than the direct losses arising from a shock. An investigation of the German investment fund sector illustrates indirect contagion risks and demonstrates that funds can amplify market price shocks via securities sales.

Interconnectedness of the financial system

For many questions regarding financial stability, it is essential to have a good understanding of the way in which individual agents or parts of the financial system interact with each other or with the real economy. One core question concerns the effects on the financial system and the real economy caused when individual agents or specific market segments run into difficulties. The significance of interconnectedness is exemplified by the insolvency of the US investment bank Lehman Brothers in 2008, which is regarded as a major trigger for the outbreak of the global financial crisis.[1] Although the bank was not especially large, it was highly interconnected within the global financial system. Its insolvency exacerbated the existing turmoil on the markets and led to considerable losses around the world. It jeopardised other institutions in the banking and insurance sector that were directly or indirectly connected to Lehman Brothers. Many institutions were propped up by extensive public bailout programmes, which caused government debt to rise. Furthermore, many countries entered into deep recessions.

Direct and indirect interconnectedness is significant

If an economy experiences a shock, such as unexpected losses amongst enterprises, this can be transmitted to agents either directly or indirectly (see Chart 5.1).[2] Direct transmission channels arise from contractual relationships based on financing instruments, such as loans, shares or derivatives. If a shock causes the credit risk of debt claims to rise, or even the debtor to default, the claim holder incurs losses and the shock spreads to other market participants.

A shock can be transmitted to agents either directly or indirectly.

In the case of equity claims such as shares, contagion can spread to the contracting parties through fluctuations in the value of these exposures.

Market participants can also transmit shocks indirectly. This is the case when one agent's behaviour affects other, initially uninvolved market participants which are not directly connected to this agent via contractual relationships (external effect). For example, a shock could hit a group of agents that hold the same securities. The shock can trigger sales of these securities, which would cause the prices of the securities involved as well as the prices of similar securities to fall. Other market participants that also hold these securities would likewise incur losses, i.e. they would be affected by contagion via this indirect channel. The market participants affected by indirect contagion could then also come under pressure to undertake emergency sales of assets (fire sales). A reason for this, for example, could be the need to fulfil minimum requirements set by regulators or expected by the market. In this context, an individual market participant would consider it wise to react quickly in order to keep discounts as low as possible when selling.[3] This can trigger downward price spirals that affect a very large number of market participants. Market participants can also be affected by indirect contagion if a fall in prices affects collateral posted for collateralised transactions and they are required to furnish additional collateral as a consequence.[4]

An additional channel for indirect contagion is comprised of bad news and rumours (confidence channel). For example, rumours surrounding the in-

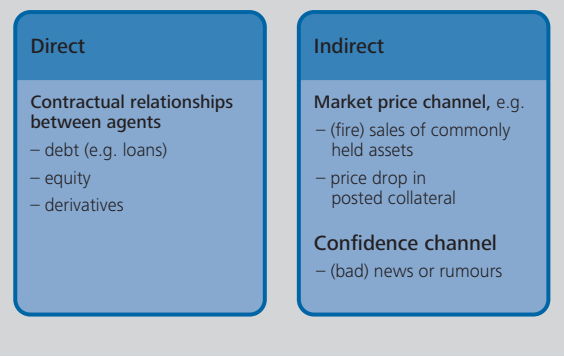
1 See Hellwig (2009).
2 See Clerc, Giovannini, Langfield, Peltonen, Portes and Scheicher (2016).
3 See Chen, Goldstein and Jiang (2010); and Goldstein, Jiang and Ng (2017).
4 Analyses indicate that the potential for contagion due to regulatory requirements is immaterial in comparison to the potential for contagion arising from obligations to post additional collateral; see Georgescu (2015).

solvency of a bank could lead to a wave of deposit withdrawals (bank run). Even for investors who initially do not believe these rumours to be justified, it could be rational to withdraw their deposits, as banks only have limited liquidity buffers. Banks typically engage in maturity transformation, i.e. they obtain short-term funding and grant long-term loans. In the event of deposit withdrawals reaching critical mass, the bank would no longer have sufficient liquidity to service all of its customers.[5] Particularly in a crisis situation, rumours about the solvency of a bank can emerge and quickly affect other institutions as well.[6] A similar kind of run is also possible amongst other financial market agents that finance themselves using short-term liabilities. For example, customers of money market funds or investment funds could be incentivised to redeem their shares as quickly as possible (see the section entitled "Indirect contagion risks significant in the investment fund sector" on p. 100).

From the perspective of financial stability, an understanding of these transmission channels is vital in order to be able to gauge the effects of negative developments in the financial system for the real economy and the financial system. Losses can additionally be amplified through second-round effects in the financial system and the real economy. In the event of a shock, the affected parties incur immediate losses and often transmit these via the aforementioned direct and indirect transmission channels, causing the shock to propagate through the financial system and potentially the real economy as well. It is often not the direct losses from a shock but rather the second-round effects that have an especially destabilising impact. Direct and indirect contagion effects as well as second-round effects can occur between agents within a given sector (intrasectoral interconnectedness) and also between agents in different sectors (intersectoral interconnectedness). However, indirect contagion and second-round effects cannot always be clearly distinguished.

Second-round effects often have an especially destabilising impact.

Contagion channels in the financial system Chart 5.1



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Interconnectedness can have a stabilising effect

Interconnectedness, however, does not just pose a risk, it can also stabilise the financial system. The way in which a shock is transmitted depends on a number of factors. In this regard, the degree of interconnectedness within the system and the magnitude of the shock play a key role. Other relevant factors are the type of agent affected by a shock, such as banks or insurance corporations, and whether the shock hits assets, i.e. wealth, or liabilities, i.e. debt and equity.

The degree of interconnectedness determines the number of parties to which a shock is passed on and spread. Usually, a shock in the financial system can

5 See Diamond and Dybvig (1983).
6 The liquidity risk to a bank arising from a withdrawal of deposits is admittedly limited, as deposit insurance schemes are in place and emergency loans can potentially be provided by the central bank. However, bank runs can also be triggered as a consequence of other short-term financing instruments not being extended, for example.

be withstood more effectively when it is spread out across a large number of market participants. However, studies show that, if the magnitude of the shock exceeds a certain threshold, a strongly interconnected system can be more fragile than a weakly interconnected system.[7]

Usually, a shock can be withstood more effectively when it is spread out across a large number of market participants.

The way in which a shock propagates through the financial system and whether it is amplified or moderated by interconnectedness is also dependent on the type of agent that is affected by the shock. For example, banks and insurance corporations perform different functions within the financial system. These functions are reflected in the maturity structures of their assets and liabilities. Banks engage in maturity transformation and have only limited liquidity available. Therefore, in the event of a shock, funding bottlenecks can occur if short-term financing instruments, such as bank debt securities, are not extended. Substantial write-downs that reduce capital may also be necessary. If banks wish to maintain their capital ratio or liquidity buffers, they need to make adjustments to their balance sheets. However, since the loans granted generally have long maturities and are often also illiquid, these can only be scaled back slowly or at a considerable markdown. For banks, this means that maturing loans can be replaced less frequently and new loans can only be granted on a very restrictive basis. As a result, banks tend to amplify shocks and have a procyclical impact.

Banks tend to amplify shocks and have a procyclical impact.

The situation is typically different among life insurance corporations. Here, since the maturities of liabilities are usually longer than the maturities of investments, life insurance corporations do not necessarily need to scale back the assets side of their balance sheets in the event of assets losing market value and can instead disregard short-term and limited value fluctuations. As a result, life insurance corporations tend to transmit shocks to a lesser degree than banks, for instance, and can potentially even dampen them. However, if liabilities are hit by a shock during a crisis – such as an upsurge in life insurance policy lapses – the stabilising function of life insurance corporations could be undermined precisely when it would be especially desirable with regard to financial stability.[8] In Germany, life insurance policyholders have the option of terminating their contracts for a fixed surrender value at any time. For insurance policyholders, it can be beneficial to terminate their contracts even after factoring in the costs of termination, such as lapse fees.[9] Such an upsurge in policy lapses could, for example, be triggered by significant losses, an abrupt rise in interest rates (market price channel) or by rumours about the solvency of the insurer (confidence channel). Life insurance corporations would then be forced to sell off assets, which would push interest rates up further. In addition, they could withdraw their investments from banks and investment funds, thereby transmitting the shock.[10]

Life insurance corporations tend to transmit shocks to a lesser degree than banks.

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7 See, inter alia, Acemoglu, Ozdaglar and Tahbaz-Salehi (2015); and Allen and Gale (2000). In addition, the structure of interconnectedness in the system as a whole plays a role, i.e. whether, for example, the system exhibits a core-periphery structure, as is the case in the German interbank market: if a shock hits a highly connected core institution, the systemic impact could be more pronounced than if the same shock were to hit an isolated institution ("too interconnected to fail"). See Deutsche Bundesbank (2017), p. 76; and Hüser (2015).

8 See Chodorow-Reich, Ghent and Haddad (2018).

9 See Förstemann (2019). For details on surrender values, see Deutsche Bundesbank (2018), pp. 90-91.

10 Furthermore, the market value-oriented valuation of assets under the Solvency II prudential regime could also contribute to life insurance corporations needing to respond to short-term value fluctuations during a crisis by selling off their investments. Solvency II already envisages regulatory instruments intended to counteract the potential procyclical incentives resulting from the risk-oriented and market value-oriented rules; see Deutsche Bundesbank (2018), pp. 95-99.

Rest of world relevant for direct linkages

The direct financial linkages between the sectors in Germany and the rest of the world (aggregate of all sectors) is illustrated in Table 5.1. Financial linkages are measured on the basis of non-consolidated claims and liabilities, i.e. including claims on and liabilities to the respective sector itself. Only those financing instruments for which a counterparty can be identified are factored into the calculation of the values.[11]

The most important creditors are, by a considerable margin, domestic monetary financial institutions, with total claims amounting to just under 280% of German gross domestic product (GDP). The monetary financial institutions sector mainly comprises banks, but also central banks and money market funds. This sector primarily grants loans to the rest of the world (such as banks domiciled abroad) as well as domestically to the same sector, the real economy, and general government.[12]

Other major creditors are foreign market participants (just under 180% of GDP) and domestic households (around 170% of GDP).[13] Households provide funding for banks in particular via sight, time and savings deposits. Furthermore, households have large claims against insurance corporations and pension funds in that they hold life insurance products as old-age provisions. As a whole, German sectors are financed mainly by monetary financial institutions and, to a much lesser extent, by insurance corporations, pension funds, investment funds and other financial institutions.[14] The prominent position of monetary financial institutions in relation to other financial intermediaries can also be observed in other euro area countries.[15]

Monetary financial institutions are not only the most significant creditors, but, at the same time, are the most significant debtors in Germany. Their liabilities amount to 250% of GDP. Other major debtors are the rest of the world and non-financial corporations. The latter are typically highly interconnected within their own sector via their group structures.

Monetary financial institutions are not only the most significant creditors, but, at the same time, are the most significant debtors in Germany.

If claims and liabilities are offset against one another to calculate the net positions, households are the largest net creditors due to their high savings (just under 120% of GDP). Non-financial corporations and general government are among the largest net debtors, as both of these sectors are typically heavily engaged in investment.

As a whole, the table highlights how strongly Germany is connected to foreign market participants via financial claims and liabilities. The rest of the world is, both as a creditor and as a debtor, counted among the three most important sectors. In this context, Germany's claims against the rest of the world outweigh its liabilities. Chiefly responsible for this are Germany's positive current account balances, which have led to a build-up of foreign assets. Germany's current account balance has been continuously positive since 2002 and totalled around 7% of GDP in the second quarter of 2019.[16] Germany's net claims

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11 The underlying data of Table 5.1 (generally data from the financial accounts) contain counterparty information for only around 80% of the claims.
12 For more details on the interconnectedness between banks and sovereigns (sovereign-bank nexus), see, inter alia, Deutsche Bundesbank (2017), pp. 30-31.
13 If subsidiaries of German enterprises are domiciled abroad, they are counted as foreign market participants in this context.
14 Included in this sector are financial enterprises that are not monetary financial institutions, insurance corporations, pension funds, or investment or money market funds. This sector comprises, for example, leasing companies and special purpose entities (SPEs).
15 Data source: Euro area accounts of the European Central Bank.
16 Table 5.1 does not contain all financing instruments, but only those for which the counterparty is known. Amounts and also differences over time are therefore only broadly consistent with the current account balance, which is based on comprehensive macroeconomic accounts.

Direct financial linkages between the sectors in Germany*

Table 5.1

Quarter-end figures as a percentage of GDP, as at Q2 2019

Debtor		Creditor: Domestic financial sector – Monetary financial institutions[1]	Domestic financial sector – Insurance corporations and pension funds	Domestic financial sector – Investment funds[2] and other financial institutions[3]	Domestic real economy – Households[4]	Domestic real economy – Non-financial corporations	Domestic general government	Rest of the world	Total (of which Germany)
Domestic financial sector	Monetary financial institutions[1]	62.5	9.5	8.1	72.2	16.7	10.2	70.3	**249,5** (179.2)
	Insurance corporations and pension funds	0.2	4.8	0.5	59.6	1.9	0.0	3.7	**70.6** (66.9)
	Investment funds[2] and other financial institutions[3]	14.6	31.9	9.3	11.9	6.9	1.1	24.0	**99.7** (75.7)
Domestic real economy	Households[4]	50.6	2.5	0.9	—	—	—	0.0	**54.0** (54.0)
	Non-financial corporations	26.7	2.1	6.7	13.7	36.4	3.2	48.2	**136.9** (88.7)
Domestic general government		28.2	4.8	2.1	0.2	2.3	0.7	32.0	**70.3** (38.3)
Rest of the world		93.3	18.9	54.3	14.4	14.6	8.2	—	**203.6**
Total (of which Germany)		**276.1** (182.9)	**74.6** (55.6)	**81.8** (27.5)	**171.9** (157.6)	**78.7** (64.1)	**23.4** (15.3)	**178.1**	**884.7** (502.9)

Sources: Financial accounts of the Bundesbank, Federal Statistical Office and Bundesbank calculations. * Data on the following claims were taken into account: deposits, debt securities, loans, listed shares, investment fund shares, insurance technical reserve entitlements, and trade credits. **1** Banks, central bank, and money market funds. **2** Excluding money market funds. **3** Including financial vehicle corporations, security and derivative dealers, financial corporations engaged in lending (particularly leasing and factoring), financial auxiliaries, as well as captive financial institutions and money lenders (particularly pure holding companies). **4** Including non-profit organisations serving households.

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against the rest of the world are considerably higher than the average of euro area countries.

The high degree of interconnectedness with the rest of the world could make the German economy vulnerable to shocks originating abroad. For example, in the event of a shock from abroad, German lenders could be affected by greater default risk. Furthermore, foreign investors could abruptly withdraw funds in the event of a shock. Parts of the domestic financial sector could then experience liquidity bottlenecks and may potentially be forced to sell off securities. If market prices fall as a consequence, other market participants could be affected. The financial linkages with the rest of the world can also have a stabilising effect, however. For example, the European sovereign debt crisis showed that Germany, through its status as a safe haven for investment, can profit from shocks originating from abroad

The German economy is vulnerable to shocks originating abroad.

as these can lead to inflows of capital.[17] In this context, savers could withdraw their funds from foreign banks and deposit them at German banks. This would benefit German banks as they would then have liquidity inflows during times of crisis.

Structure of financial linkages changing only slowly

The claims and liabilities shown in Table 5.1 are changing only slowly over time. Since the first quarter of 2013, substantial changes have been observable for only few relationships.[18] For example, insurance corporations and pension funds reduced their asset holdings with monetary financial institutions and now invest a larger portion of their assets through investment funds. In addition, German investment funds are now investing more heavily abroad.[19] In this context, investment funds are increasingly holding shares of foreign investment funds.[20] This development is being driven primarily by German funds of funds and mixed securities funds. German funds chiefly hold foreign fund shares from Luxembourg, Ireland and France.

Loans granted by domestic banks to other domestic banks have declined over the past few years. As the data from the credit register for loans of €1 million or more show, the volume of interbank loans has decreased since 2008, having almost halved. Alongside regulatory reforms and better access to alternative sources of funding, non-standard monetary policy measures, which the Eurosystem implemented in response to the crisis, are likely to have influenced this development in interbank loans. Direct contagion risks via the interbank market have therefore trended downwards since the outbreak of the financial crisis. The lower contagion risks are also partly a consequence of the changed structure of the interbank market: despite the lower total volume of interbank loans, the number of relationships between banks has risen, which has made the network more dense. This structure means that shocks can be distributed more evenly and usually better mitigated.[21]

Direct contagion risks via the interbank market have decreased since the financial crisis.

Derivatives played a key role in the financial crisis and continue to be used by many agents in the financial system, for instance to hedge risk. Figures on derivatives are not featured in Table 5.1, so other data have to be used for the analysis instead.[22] Transaction data indicate that bilateral contractual relationships are losing significance on the markets for standardised over-the-counter derivative instruments. The reason for this is that central counterparties are playing ever larger roles as nodes in the financial system (see the box entitled "Use of central counterparties changes interconnectedness in OTC derivatives markets" on p. 93).

Financial linkages relevant for second-round effects

Based on the figures for direct financial linkages in Table 5.1, it is possible to estimate the creditor sectors' vulnerability to shocks originating from the debtor sectors. The direct linkages illustrate how significant the risks

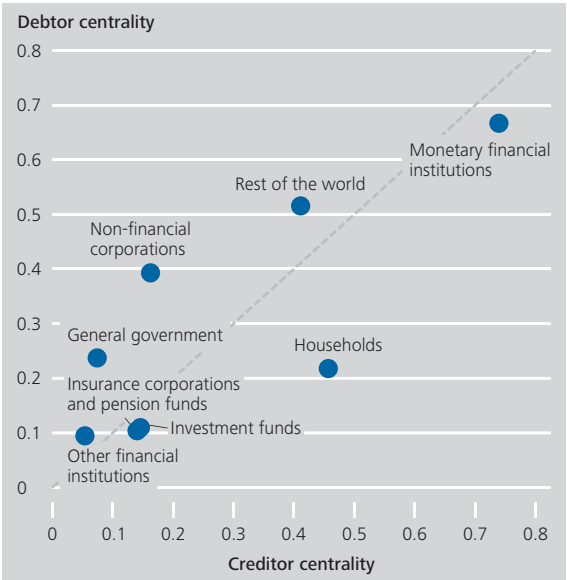
A sector has a greater impact on financial stability if it has extensive business relationships with important sectors.

17 See, inter alia, Boeing-Reicher and Boysen-Hogrefe (2017); Dewachter, Iania, Lyrio and de Sola Perea (2015); and Ehrmann and Fratzscher (2017).
18 The time series used to calculate Table 5.1 begin in the first quarter of 2013.
19 See, inter alia, Deutsche Bundesbank (2018), pp. 98-99.
20 Based on data from MorningstarDirect, Investment Funds Statistics (IFS) and Securities Holdings Statistics (SHS).
21 See Acemoglu, Ozdaglar and Tahbaz-Salehi (2015); Allen and Gale (2000); and Freixas, Parigi and Rochet (2000).
22 See Abad, Aldasoro, Aymanns, D'Errico, Fache Rousová, Hoffmann, Langfield, Neychev and Roukny (2016).

Centralities for German sectors and the rest of the world*

Chart 5.2

As at Q2 2019



* Eigenvector centrality based on the debtor-creditor matrix in Table 5.1. Higher creditor or debtor centrality indicates greater significance of that sector as a creditor or debtor for the system as a whole.

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arising from direct relationships between two sectors can be. However, to look exclusively at claims and liabilities vis-à-vis direct counterparties is to disregard further relevant information. In this way, for example, it is not possible to directly derive the degree to which individual sectors are able to influence the overall system. In this regard, measures of centrality are useful. The centrality of a sector depends not only on its claims and liabilities vis-à-vis direct counterparties, but also on the significance of the sector's largest counterparties within the system as a whole. Thus, a sector gains in importance and has a greater impact on financial stability if it has extensive business relationships with important sectors. As a result, centrality also captures potential second-round effects (see Chart 5.2).[23]

Chart 5.2 shows that monetary financial institutions exhibit the highest centrality both as creditors and as debtors. This means that they are a central node in their roles both as creditors and as debtors. The high centrality values underline the particular importance of the banking sector and show that macroprudential supervision of this sector is essential. Furthermore, the chart highlights the great importance of the rest of the world for the German financial system. For the system as a whole, non-financial corporations and general government are of greater relevance in their roles as debtors. The situation is different in the case of households, which are more important as creditors because they have claims against monetary financial institutions, which themselves have large claims against the rest of the world. This means that households, alongside their limited direct exposure abroad, are also indirectly connected with the rest of the world via monetary financial institutions.

Households are connected with the rest of the world via monetary financial institutions.

Models can be used to investigate how shocks are transmitted and amplified through direct and indirect contagion channels. The following sections outline selected models that can be used to analyse risks arising from interconnectedness. Table 5.2 provides an overview of the analyses, which are subsequently described in greater detail.

Cross-sectoral approach for direct transmission channels

Many models of contagion risks focus on one fragment of the entire system, such as individual agents within a sector, and there-

The analysis of contagion effects in the system as a whole is often approached from a simplified bird's-eye view.

23 For the definition of eigenvector centrality, see Glasserman and Young (2016), pp. 815-816.

Use of central counterparties changes interconnectedness in OTC derivatives markets

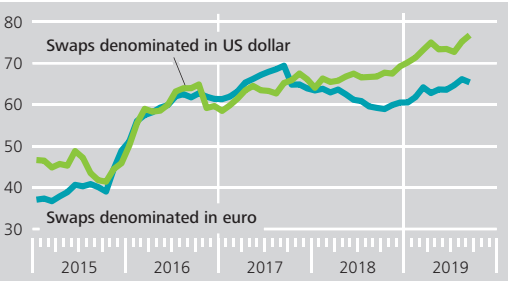
Derivatives enable market participants to specifically hedge against certain risks, such as foreign exchange risk, credit risk and interest rate risk. Global holdings of over-the-counter (OTC) derivatives have increased more than sixfold over the last 20 years.[1] Derivatives transactions can serve as a significant channel of contagion. For instance, it was the anticipated losses for counterparties from OTC derivatives transactions that made it necessary to bail out the US insurance group AIG during the global financial crisis.[2]

A plethora of reforms has been launched at the G20 level since 2009 with the aim of reducing the risks stemming from OTC derivatives. One particularly important aspect in this regard was the obligation to use central counterparties (CCPs) for standardised OTC derivatives contracts. CCPs offset opposing transactions and can thereby reduce the net positions resulting from these transactions.[3]

As the implementation of these reforms has progressed, CCPs have indeed taken on an increasingly prominent role in the clearing of standardised OTC derivatives. Transaction data can be used to calculate the share of outstanding contracts vis-à-vis CCPs in the overall volume of contracts. German domestic systemically important banks (other systemically important institutions, or O-SIIs) increased their share of centrally cleared interest rate swaps denominated in euro from around 40% in 2015 to just under 66% in September 2019 (see the chart). The sole slight dip in this percentage was recorded in the period from end-2017 to end-2018. The share of centrally cleared contracts denominated in US dollar has risen virtually continuously since 2015, peaking at close to 77% in September 2019. However, CCPs are rarely involved in currency derivatives or non-standardised derivatives contracts, such as swaptions.

Central clearing of interest rate swaps traded by large, systemically important banks*

As a percentage of outstanding notional values



Sources: DTCC, REGIS-TR and Bundesbank calculations. * OTC interest rate swaps traded by German other systemically important institutions (O-SIIs).

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The greater use of CCPs for OTC derivatives is changing the character of interconnectedness within the financial system. From a single market player's perspective, using a CCP means replacing multiple bilateral relationships with a single relationship to one CCP.[4] The results are twofold: first, there are fewer interconnections in the network and, second, new central nodes

1 In outstanding notional values; based on reports from 74 international banks. Data source: BIS OTC derivatives statistics.
2 See Glasserman and Young (2016).
3 See Duffie and Zhu (2011); and Ghamami and Glasserman (2017).
4 Through novation, one contract between two market participants is replaced by two new contracts. The CCP then acts as a buyer for the original seller and as a seller for the original buyer. This can result in multiple concurrent settlement options. See Deutsche Bundesbank (2016), pp. 79-90. For a critical discussion of CCPs' role for financial stability, see Duffie and Zhu (2011).

come into being – the CCPs.[5] Provided that CCPs have well-functioning risk management systems in place, they can mitigate the contagion effects arising from the default of a large market participant.[6]

However, international big banks continue to play a major role in the international OTC derivatives markets.[7] They act as dealer banks and are often clearing members of several CCPs. As a clearing member, they provide their clients with indirect access to CCPs and the associated services. Their clients often include smaller banks, non-financial corporations, funds or insurance corporations for which direct membership in a CCP would be too costly.[8]

5 See Basel Committee on Banking Supervision, Committee on Payments and Market Infrastructures, Financial Stability Board, International Organization of Securities Commissions (2018).
6 Risk management includes, inter alia, margin payments and contributions to the CCP's default fund.
7 See, for example, Fiedor, Lapschies and Országhová (2017).
8 These market participants hold accounts with a clearing member that handles interaction with the CCP jointly for its clients.

fore do not take into consideration how shocks are transmitted from the real economy to the financial system or what feedback effects can occur. The analysis of contagion effects in the system as a whole is often approached from a simplified bird's-eye view that consolidates the individual market participants in each sector, such as in Table 5.1 on p. 90. As previously discussed at the beginning of this article, contagion effects within the global financial system as well as the feedback effects between the financial system and the real economy contributed to the severity of the global financial crisis and the ensuing economic downturn. A cross-sectoral perspective allows for an investigation into how shocks spread across sectors and how significant second-round effects can be. Furthermore, data availability has improved since the global financial crisis, meaning that more granular data are now available for a cross-sectoral approach.

Contagion possible via equity and debt claims

Using a cross-sectoral approach, the way in which shocks are transmitted through interlinkages based on equity and debt relationships can be analysed (direct transmission channels). The model takes account of two channels through which contagion can spread across the sectors.[24] Through the first channel, losses are passed on from one sector to another via shares and other equity (equity channel). If the value of a sector's equity falls, for example due to an exogenous shock, the shareholders of that sector have to bear losses and undertake write-downs, which consequently reduces the value of equity in their sector. The second channel concerns debt claims (credit risk channel). If a sector suffers loss-

24 The construction of the network of institutional sectors and the shock transmission mechanism is consistent with Beck, Kotz and Zabelina (2015); Castrén and Kavonius (2009); and Silva (2010).

Overview of models in this chapter

Table 5.2

Model	Cross-sectoral approach (see p. 94)	Bank model (see p. 101)	Funds stress test (see p. 102)
Sectors modelled	All German sectors and the rest of the world	German banking sector	German investment fund sector
Contagion channel	Direct (equity and debt)	Indirect (market prices)	Indirect (market prices)
Data	Financial accounts, international investment position, monthly balance sheet statistics, Securities Holdings Statistics, Centralised Securities Database, insurance statistics, Bloomberg	Supervisory liquidity reporting, Mercato Telematico dei Titoli di Stato (MTS), Bloomberg	Investment Funds Statistics, Centralised Securities Database, Securities Holdings Statistics, Bloomberg
Reporting date	Q4 2018	Q1 2019	Monthly from November 2015 to July 2019 at the end of each month
Scenario	Abrupt drop in equity prices of German non-financial corporations; rise in equity price volatility in all sectors	Withdrawal of deposits by bank customers	Abrupt drop in prices on global equity and bond markets
Shock scenario calibration	Historical; price drop: 1st percentile of monthly CDAX returns (13%); rise in equity price volatility to historical maximum for non-financial corporations, 20% rise for all other sectors	Payment outflows over 5 calendar days based on supervisory standard scenario	Historical; 1st percentile of monthly securities returns (14.2% price drop for shares, 4.5% price drop for bonds)

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es and has to undertake write-downs, that sector's equity falls. As a result, the sector cannot cope as effectively with additional losses. The credit risk originating from the sector therefore rises. Sectors that have lent to this sector thus expect greater losses on their debt claims.

Due to the write-downs incurred on equity and debt claims, the creditor sectors must revalue their equity. Second-round effects now emerge as the creditor sectors in turn pass on their losses to other sectors via both channels. The latter must undertake write-downs as a result, and the shock then cascades through the entire economy (see the box entitled "Database and methodology used in the cross-sectoral approach" on p. 97). The contagion mechanism described here requires that equity and debt claims are subject to mark-to-market accounting, as is typical in IFRS accounting. However, if accounting is based on the German Commercial Code, there can be scope for discretion in terms of write-downs, which is why the actual write-downs on equity and debt claims can be smaller. Using this method of accounting, the contagion effects could therefore be more moderate.

Risk scenarios could impact non-financial corporations

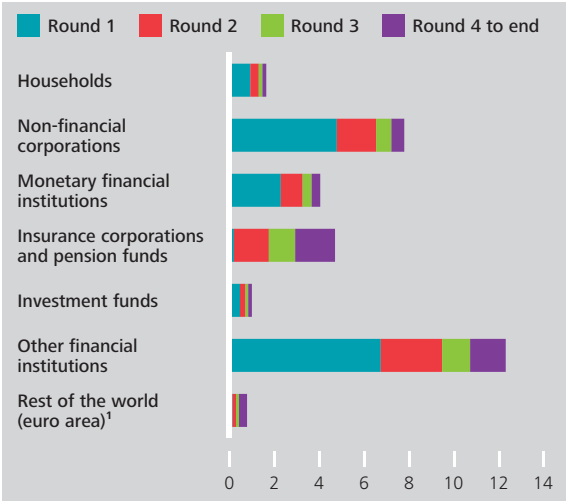
The cross-sectoral approach serves to illustrate how important the aforementioned direct transmission channels are. The model can be used to examine the sensitivity of the financial sector and the real economy in the event of, for example, a correction of asset prices. The scenario under consideration posits a 13% decline in the valuation level across the whole German

Cross-sectoral approach illustrates how important transmission channels are.

Stress scenario: total losses by sector*

Chart 5.3

As a percentage of each sector's equity based on data from Q4 2018



Sources: Bundesbank statistics, Bloomberg and Bundesbank calculations. * The scenario assumes a considerable drop in prices of equity in German non-financial corporations as well as significantly increased market volatility (see Table 5.2). Round 1 shows the direct effects of the scenario; all subsequent rounds show the respective knock-on effects of the preceding rounds. For the delineation of sectors, see Table 5.1. **1** Full data on non-euro area not available.

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non-financial corporations sector.[25] This is on a par with the drop seen by listed corporations in 2008. Valuations fell even more sharply in 2011. Since market data are only available for listed corporations, it is assumed that the prices of equity in non-listed enterprises follow a similar path.[26] In addition, it is assumed that the volatility of enterprise values increases in all sectors since periods of stress are generally accompanied by heightened volatility on the equity markets. This increased volatility is a relevant factor when it comes to changes in the value of debt instruments, that is to say the credit risk channel.[27]

Second-round effects significant

In the scenario, the majority of losses are attributable to second-round effects.

In the scenario, German sectors see a 4.4% decline in the value of equity overall. The majority of the losses are attributable to second-round effects, with aggregate losses far exceeding the initial loss.[28] The total losses thus amount to around two and a half times the direct losses arising from the original shock in the corporate sector.

The aggregate losses are unevenly distributed across the sectors in the system (see Chart 5.3). Domestic households, investment funds and the remaining euro area countries experience only minor losses.[29] Insurance corporations and pension funds see losses amounting to 4.7% of their original equity, while those of monetary financial institutions amount to 4%. The non-financial corporations sector and the other financial institutions sector record the highest losses as measured against original equity, at 7.8% and 12.3% respectively.[30] There are also considerable differences between sectors with respect to the proportion of losses originating in second-round effects. While 39% of total losses for non-financial corporations arise through second-round effects, that figure is 96% for insurance corporations and pension funds. The latter are barely impacted by the original shock because they hold little in the way of shares and other equity in non-financial corpor-

25 The assumed decline of 13% is based on the 1st percentile of monthly returns on the Composite DAX (CDAX) from 2000 to 2018.
26 The assumption that the prices of listed corporations evolve in a similar way to those of non-listed enterprises is a simplification. Equity prices are also driven by market sentiment and tend towards exaggerations. This would suggest that the equity prices of non-listed enterprises would fluctuate less strongly than those of listed corporations. The assumed decline of 13% for all enterprises therefore reflects a more severe scenario below the 1st percentile. All in all, the simulation should be regarded simply as an illustrative stress scenario.
27 It is assumed that the implied volatility of prices of shares and other equity in the non-financial corporations sector climbs to a historical maximum; in all other sectors implied volatility increases by 20%.
28 In the assumed stress scenario, the losses per round converge to zero as the number of rounds increases. After 20 rounds, barely any losses are incurred. The contagion mechanism is thus halted after 20 rounds.
29 For the households sector, equity is defined as net financial assets, i.e. the difference between financial assets and financial liabilities.
30 For the non-financial corporations sector, losses are quoted as a percentage of equity after the exogenous shock.

Database and methodology used in the cross-sectoral approach

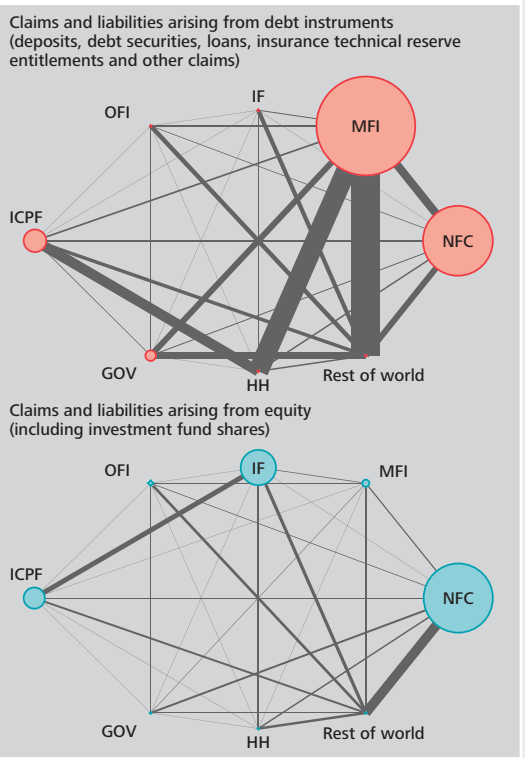
The cross-sectoral approach is based on financial accounts data for Germany.[1] These data have been supplemented by various other statistics such as the international investment position, the ESCB insurance statistics and the monthly balance sheet statistics. This allows results to be obtained not only for German sectors, but also for the rest of the world, which is represented as a single sector in Table 5.1 and broken down into euro area and non-euro area here. The rest of the world, however, is not broken down into individual sectors. Information on the financial claims and liabilities of the sectors is available for various financing instruments (e.g. debt securities, loans, equity).

In order to identify cross-sectoral contagion effects, it is necessary to capture the bilateral claims and liabilities between all sectors. Based on the underlying data, it is possible to identify the counterparties for the majority of the claims and liabilities. This means that the value of a claim or liability of sector A vis-à-vis sector B is known. However, some linkages between sectors remain unknown for a number of instruments (especially unlisted shares and other equity) and therefore need to be estimated. A common estimation method in the literature – the maximum entropy principle – is used for this purpose.[2] As an example, the chart depicts the estimated networks separately for equity and debt instruments.

Using a contingent claims analysis, the change in the market value of debt is calculated in line with the literature.[3] In this context, the market value of equity, its expected volatility and also the outstanding liabilities are used. The contingent claims analysis enables the assets' implied value and volatility to be calculated. Subsequently, the expected loss of the debt instruments – which is essential for the credit risk channel – is derived.

Germany's sectoral networks*

Based on data for Q4 2018; values partly estimated



* The thickness of the lines reflects the amount of gross exposures (claims plus liabilities) between the sectors. The size of the nodes reflects intra-sector gross exposures. The sectors are non-financial corporations (NFC), monetary financial institutions (MFI), investment funds (IF), other financial institutions (OFI), insurance corporations and pension funds (ICPF), households (HH), general government (GOV) and the rest of the world. For a sectoral breakdown, see Table 5.1.

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1 On the content and methodological structure of the financial accounts, see Deutsche Bundesbank (2019).
2 See, for example, Sheldon and Maurer (1998), Upper and Worms (2004), and Wells (2004).
3 For details on the methodology of the contingent claims analysis, see, for example, Castrén and Kavonius (2009), Gray, Merton and Bodie (2007), and Silva (2010).

Given that households do not issue equity, no shocks are transmitted through them in the equity channel of this model. They do, however, transmit shocks through the credit risk channel; this is because net financial assets are relevant here.[4] General government does not transmit shocks through either the equity channel or the credit risk channel as this sector does not issue equity and Germany's public debt is classified as risk-free. In addition, the model does not take into account any feedback effects from non-euro area countries.

4 Nevertheless, households can, of course, reduce their consumption in the event of losses, thereby infecting other sectors. This consumption channel is disregarded in the model.

ations. This means that they start recording marked losses only once the shock spreads throughout the financial system.

Almost all of the losses arise through the equity channel. The share of losses stemming from the increased credit risk is negligible by contrast. A key reason for this is the fact that some sectors have a very high ratio of equity to debt, in particular non-financial corporations. With equity forming a sizeable loss buffer, the probability of default still remains very low even when equity is squeezed by the exogenous shock and volatility rises. The value of debt therefore falls only slightly. While the losses through the equity channel are linearly dependent on the magnitude of the exogenous shock, losses through the credit risk channel behave in a non-linear fashion (see Chart 5.4). This means that the losses through the credit risk channel become appreciable only once the shock exceeds a certain magnitude, but then increase relatively sharply. If the exogenous shock is sufficiently large, the effects through the credit risk channel may be more significant than the effects from the equity channel. The literature refers to this critical point as a tipping point.[31]

If the shock is sufficiently large, the credit risk channel has the potential to exert a stronger impact than the equity channel.

31 See Allen and Gale (2000); and Castrén and Kavonius (2009).

Analyses of indirect transmission channels in the German financial system

Recent years have seen increased interest in analyses of indirect interconnectedness within the financial system. Various studies suggest that indirect transmission channels can often be of greater importance for the financial system than direct transmission channels.[32] This is plausible given that, through direct contagion channels, a single agent typically affects only its direct counterparties to begin with. It is only through chains of direct contagion that a shock can spread in the system and impact on other agents. By contrast, shocks can often reach a significantly greater number of agents through indirect contagion channels. A case in point would be where an agent engages in large-scale sales of financial assets and thus triggers a decline in the price of those assets. The falling prices mean losses for other agents with the same assets in their portfolios.[33] Indirect contagion effects can thus be significant for all financial sector agents. The transmission mechanisms at play can vary from sector to sector, however.

Banks can amplify downward price spirals

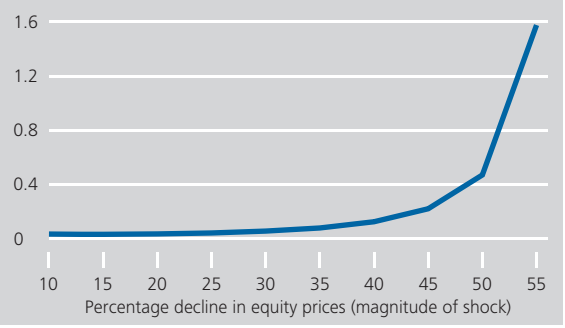
Banks can be affected indirectly in the event, for example, of changes in the prices of securities that they hold for liquidity management purposes. If banks expect the market price of these securities to fall, it may be rational for them to dispose of them as early as possible. Banks selling securities on the basis of this strategic thinking can compound a fall in prices. This can result in much larger market value losses in the system.

A model is used to analyse this contagion channel.[34] It assumes an initial shock in the form of a system-wide funding bottleneck forcing banks to offload securities. It is assumed that, over a period of five calendar days, bank customers withdraw a portion of their deposits. The assumptions for this initial shock are based on a scenario defined by banking supervisors addressing payment outflows that banks can expect to encounter in the short term.[35] It is assumed that banks cannot offset the deposits being withdrawn through other funding sources. The cash outflows can be covered by selling off securities. When selling, the banks select what they view as the optimum strategy which minimises their market value losses.[36] This strategic bank behaviour can further amplify price declines. The cumulative price change for government bonds serves to illustrate the dynamics of the simulated downward price spiral

Bank behaviour can further amplify price declines.

Stress scenario: losses on debt claims* — Chart 5.4

As a percentage of total scenario losses



* Losses for all sectors in the scenario from Table 5.2 given different shock magnitudes.

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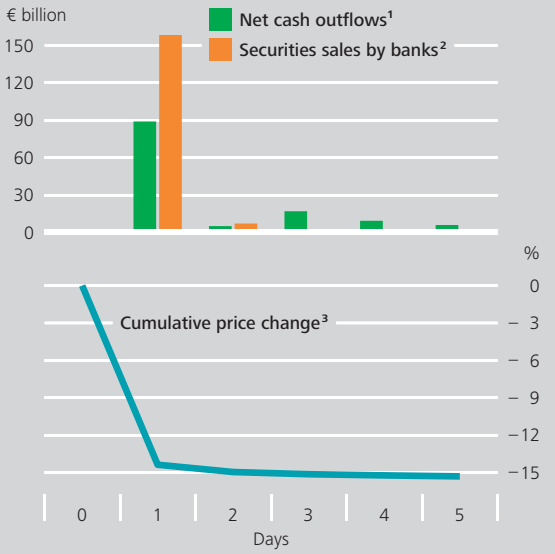
32 See Caccioli, Farmer, Foti and Rockmore (2015); and Glasserman and Young (2015).
33 See Brunnermeier and Pedersen (2009).
34 See Deutsche Bundesbank (2016), pp. 38-39; and Krüger, Roling, Silbermann and Wong (2019).
35 The payment outflows are taken from the liquidity reports submitted under the supervisory reporting framework (COREP). Payment outflows are derived by reference to contractual obligations. There is an exception for overnight deposits for which banks report a behaviour-based estimate.
36 In doing so, they take into account the impact that their activities have on the behaviour of other banks and on the price of the securities sold.

Funding shock and its effects at German banks Chart 5.5

Based on data for Q1 2019



1 Payment outflows assumed in model exceeding banks' cash holdings. **2** Sales of securities with a view to covering cash outflows and minimising own portfolio losses. **3** Price decline resulting from sales (using the example of government bonds).

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(see Chart 5.5). Over the first two days, prices fall very sharply since just under half of the banks – in particular small and medium-sized institutions – sell off their assets right at the start. Banks sell securities far earlier and also in larger quantities than would be necessary for the purposes of honouring the payment outflows in a timely manner (see Chart 5.5). If the banks were to forgo this kind of strategic thinking, and instead gear their sales towards covering payment outflows punctually, the simulated market value loss in the system would be almost halved.

Indirect contagion risks significant in the investment fund sector

Indirect contagion risks also play a role in the case of investment funds.[37] Such risks could arise in the event of large-scale redemptions of fund shares by investors during an abrupt decline in asset prices.[38] In order to cover large volumes of redemptions, a fund has to sell securities and this can place further pressure on the market prices of the securities in question. This means that, particularly in periods of stress, there are incentives for investors to redeem fund shares at the earliest opportunity, which can spark a run on investment funds. This can intensify negative price and liquidity spirals and hit other financial market agents.

The investment fund sector has experienced strong growth since the global financial crisis. A significant portion of that growth stems from valuation effects, rendering this sector more vulnerable to sudden changes in financial asset prices.[39] Indirect contagion risks can be aggravated by the interplay between vulnerabilities to price slumps and vulnerabilities to sudden fund share redemptions.

Indirect contagion risks can be aggravated by the interplay between vulnerabilities.

Investment funds could amplify shocks

The Bundesbank has developed a stress test for the German investment fund sector,[40] the aim of which is to gauge how sales of commonly held securities by

37 The terms "investment funds" and "open-end investment funds" are used synonymously here and in the remainder of the text. The following analysis does not include the German closed-end investment fund sector since closed-end funds only account for some 3% of the aggregate total assets of the investment fund sector in Germany. Furthermore, shares in closed-end funds cannot be redeemed. From a financial stability perspective, at least in terms of the risk channels considered below, closed-end funds are therefore less significant overall.

38 See Deutsche Bundesbank (2017), pp. 94-99; and Deutsche Bundesbank (2018), p. 101.

39 See Fricke (2019).

40 See Fricke and Wilke (2019). The stress test is an extension of the approach applied in Fricke and Fricke (2019). The data on balance sheet/portfolio structure are drawn from the German Investment Funds Statistics (IFS) and include open-end investment funds established under German law. Information on individual securities is gathered from the Centralised Securities Database (CSDB). Data on the holder structure of funds come from the Securities Holdings Statistics (WP Invest).

investment funds could amplify shocks.[41] The analysis includes equity, bond and mixed securities funds (both retail and specialised funds in each case). This covers around 80% of the aggregate total assets of the German fund sector and is an important step towards an approach which considers the entire German fund sector.[42] There are three steps to the model.

Step 1: An initial shock is assumed in the form of an abrupt drop in global equity and bond prices, leading to losses in the funds' securities portfolios. Step 2: As a result, funds have to sell securities because the losses from step 1 prompt investors to redeem fund shares (flow-performance relationship).[43] In addition, the initial shock increases the leverage ratio of funds operating using debt.[44] Assuming these funds engage in leverage targeting – holding their leverage ratios as close as possible to the baseline value – they will need to sell securities.[45] In the model, investment funds keep their portfolios as stable as possible and sell securities proportionally to the make-up of the portfolio.[46] Step 3: The sales from step 2 lead to a further decline in prices of the securities involved, with the scale of the price declines depending on the sales volume and market liquidity; the larger the sales volume and the lower the market liquidity, the more sharply the price will fall. The second-round effect from step 3 leads to portfolio losses for funds holding these securities.[47]

The core metric of the stress test is the aggregate vulnerability of the fund sector. The aggregate vulnerability is the sum of the fund sector's portfolio losses resulting from step 3. The metric measures risks from second-round effects in the investment fund sector and bundles a number of macroprudential risk factors (e.g. leverage, market liquidity and indirect interconnectedness). The metric is always dependent on the initial shock, but quantifies only the pure second-round effect. In the interests of comparability over time, the aggregate vulnerability of the sector is given relative to the fund sector's total net assets before the initial shock in each case.

In the stress test, an adverse and empirically plausible stress scenario in the form of an abrupt and strong decline of the most important equity and bond market indices is assumed. A 14.2% fall in equity prices and a 4.5% fall in bond prices is taken as the initial shock.[48] Comparable slumps were seen, for example, at the height of the financial crisis in September 2008. In the assumed stress scenario, the value of the issued fund shares (total net assets) falls by an average of 7.5% overall due to the assumed market price declines.

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41 The Financial Stability Board has also recommended that the relevant authorities engage in developing macroprudential stress testing for investment funds; see Financial Stability Board (2017). In this regard, the Bank of England has, for example, devised a stress test for bond funds; see Baranova, Coen, Lowe, Noss and Silvestri (2017).

42 Existing stress tests for funds are limited in scope to equity or bond funds; see Baranova, Coen, Lowe, Noss and Silvestri (2017); and Fricke and Fricke (2019).

43 See Berk and Green (2004); Dötz and Weth (2019); and Fricke and Fricke (2019).

44 The financial leverage ratios of open-end investment funds are subject to strict regulatory provisions. For example, the European UCITS Directive stipulates that a retail fund's borrowing may not exceed 10% of its net assets. For the period from November 2015 to July 2019, the figures reported for German funds lie well below the prescribed regulatory levels at a median of 0.3% for retail funds and 0.1% in the case of specialised funds.

45 Compared with similar model applications for the banking sector, the leverage targeting channel plays less of a role when it comes to the aggregate vulnerability of the fund sector; see Greenwood, Landier and Thesmar (2015).

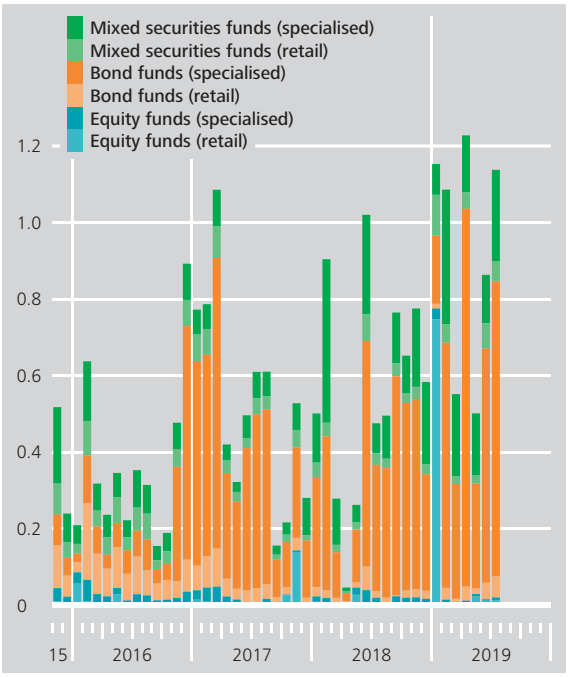
46 An alternative assumption would be that funds sell off their most liquid securities first. For a discussion of portfolio liquidation strategies, see Dötz and Weth (2019); and Jiang, Li and Wang (2017).

47 Unlike in the model for the banking sector discussed above, the initial shock assumed here is on the assets side of funds' balance sheets. Funds' securities sales are the endogenous result of further adjustments on the liabilities side (such as fund unit redemptions). In the bank model, meanwhile, the assumed initial shock comes in the form of deposit withdrawals which need to be honoured by means of securities sales.

48 This is equivalent to the average 1st percentile of the monthly returns for the relevant market indices. The stress test is applied separately for each individual month of the observation period. For each month, the same initial shock at the individual security level is assumed.

Second-round effects in the stress scenario: aggregate vulnerability of the German investment fund sector and contribution of specific fund types* Chart 5.6

Contribution to portfolio losses as a percentage of total net assets



Sources: Investment Funds Statistics, Securities Holdings Statistics, Centralised Securities Database and Bundesbank calculations. * Aggregate vulnerability shows the portfolio losses sustained by investment funds (second-round effects). These losses arise in a scenario of an abrupt drop in global equity and bond prices (see Table 5.2) as the funds respond to the resulting losses by selling off securities, thereby triggering further price declines. The chart shows the contribution to aggregate vulnerability resulting from each of the depicted fund categories' securities sales.

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Investment fund sector vulnerable through indirect contagion

The results of the analysis show that sales of commonly held securities by the German investment fund sector may exacerbate a possible abrupt drop in equity and bond prices. The aggregate vulnerability of the German investment fund sector exhibits considerable variation during the period under observation (see Chart 5.6).[49] For April 2018, the simulated portfolio losses arising through second-round effects amount to 0.1% of total net assets. For April 2019, however, they come to 1.2%. The second-round effect is pronounced in phases of low market liquidity, amongst other things. In the period considered, securities sales by the fund sector can amplify the initial shock by up to 15%.[50] The chief contributors to aggregate vulnerability are the securities sales made by bond and mixed securities funds since these funds typically hold fewer liquid securities in their portfolios.

Overall, the results make the German investment fund sector look relatively robust, especially in comparison to similar analyses for the European banking sector.[51] It is worth noting, however, that the period considered here reflects a phase of relatively low market stress.

The aggregate vulnerability of the German investment fund sector varies over time.

The fact that funds are so strongly interconnected with other sectors means that there are contagion risks for other financial market agents. For example, insurance corporations and pension funds are significant holders of German investment fund shares. These two groups of holders would therefore potentially sustain the biggest portfolio losses through second-round effects (see Chart 5.7).[52]

49 An initial shock of greater magnitude than the scenario assumed here leads to a greater aggregate vulnerability as funds would then sell more securities. However, the relationship between the magnitude of the initial shock and aggregate vulnerability is not proportional. For example, doubling the initial shock at the security level in January 2019 – giving 28.4% for equities and 9% for bonds – produces an aggregate vulnerability of less than 2%.

50 The second-round effects in this model thus differ from those in the cross-sectoral approach. In the model described here, the second-round effects arise through indirect contagion effects which are induced by the sales made by German investment funds. By contrast, in the cross-sectoral approach the second-round effects arise through direct contagion effects emanating from the German sectors and other euro area countries.

51 See Greenwood, Landier and Thesmar (2015).

52 These portfolio losses are based on a mark-to-market view and would be realised only once the groups of holders concerned redeem their shares.

The portfolio losses for households are comparably small in the observation period, though climb to over 3% of their total net assets for a time at the end of 2018 and start of 2019. This is primarily due to the surge in equity market volatility in December 2018 and an associated reduced level of equity market liquidity. During that period, equity sales thus entailed higher markdowns, meaning that sales by retail equity funds in particular made a major contribution to aggregate vulnerability (see Chart 5.6). Since households invest heavily in German retail equity funds this renders them more vulnerable during this phase compared to other holder groups. However, given that investment fund shares make up only a relatively small proportion of households' savings in Germany (see Table 5.1 on p. 90), the effect of these portfolio losses on their total wealth is likely to be moderate overall.

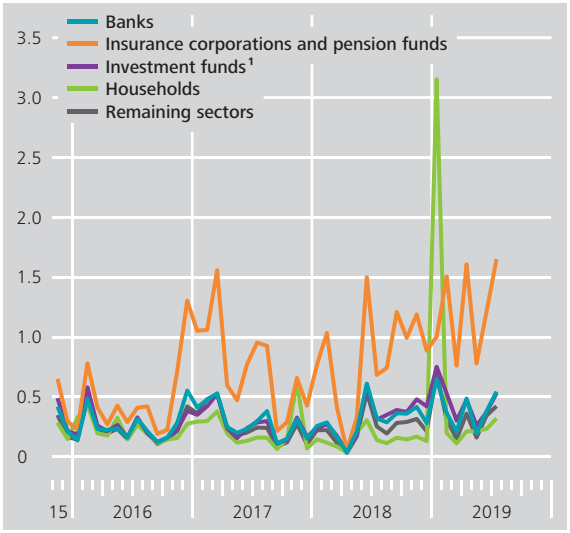
The fact that funds are strongly interconnected with other sectors means that there are contagion risks for other financial market agents.

Due to the limited availability of data, the analysis only examines potential securities sales by investment funds established in Germany. Were securities sales by other funds and other financial market agents to be included, the decline in equity and bond prices and the resulting losses could be substantially larger.

Chart 5.7

Second-round effects in the stress scenario: losses for holders of investment fund shares by sector*

As a percentage of total net assets held by each sector



Sources: Investment Funds Statistics, Securities Holdings Statistics, Centralised Securities Database and Bundesbank calculations. * Losses arising for fund shareholders as a result of the securities sales by funds in Chart 5.6. 1 Excluding money market funds.

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List of references

Abad, J., I. Aldasoro, C. Aymanns, M. D'Errico, L. Fache Rousová, P. Hoffmann, S. Langfield, M. Neychev and T. Roukny (2016), Shedding Light on Dark Markets: First Insights from the New EU-wide OTC Derivatives Dataset, ESRB Occasional Paper No 11/2016.

Acemoglu, D., A. Ozdaglar and A. Tahbaz-Salehi (2015), Systemic Risk and Stability in Financial Networks, American Economic Review, Vol. 105, No 2, pp. 564-608.

Allen, F. and D. Gale (2000), Financial Contagion, Journal of Political Economy, Vol. 108, No 1, pp. 1-33.

Baranova, Y., J. Coen, P. Lowe, J. Noss and L. Silvestri (2017), Simulating Stress Across the Financial System: The Resilience of Corporate Bond Markets and the Role of Investment Funds, Bank of England Financial Stability Paper No 42.

Basel Committee on Banking Supervision, Committee on Payments and Market Infrastructures, Financial Stability Board, International Organization of Securities Commissions (2018), Analysis of Central Clearing Interdependencies, CPMI Papers No 181.

Beck, G., H.-H. Kotz and N. Zabelina (2015), Euro Area Macro-Financial Stability: A Flow-of-Funds Perspective, SAFE White Paper No 29.

Berk, J. B. and R. C. Green (2004), Mutual Fund Flows and Performance in Rational Markets, Journal of Political Economy, Vol. 112, No 6, pp. 1269-1295.

Boeing-Reicher, C. A. and J. Boysen-Hogrefe (2017), Estimating the Effects of the "Flight to Quality", with an Application to German Bond Yields and Interest Payments, IfW Kiel Working Paper No 2086.

Brunnermeier, M. K. and L. Heje Pedersen (2009), Market Liquidity and Funding Liquidity, Review of Financial Studies, Vol. 22, No 6, pp. 2201-2238.

Caccioli, F., J. D. Farmer, N. Foti and D. Rockmore (2015), Overlapping Portfolios, Contagion, and Financial Stability, Journal of Economic Dynamics and Control, Vol. 51, pp. 50-63.

Castrén, O. and I. Kristian Kavonius (2009), Balance Sheet Interlinkages and Macro-Financial Risk Analysis in the Euro Area, ECB Working Paper No 1124/2009.

Chen, Q., I. Goldstein and W. Jiang (2010), Payoff Complementarities and Financial Fragility: Evidence from Mutual Fund Outflows, Journal of Financial Economics, Vol. 97, No 2, pp. 239-262.

Chodorow-Reich, G., A. Ghent and V. Haddad (2018), Asset Insulators, NBER Working Paper No 24973.

Clerc, L., A. Giovannini, S. Langfield, T. Peltonen, R. Portes and M. Scheicher (2016), Indirect Contagion: The Policy Problem, ESRB Occasional Paper No 9/2016.

Deutsche Bundesbank (2016), Financial Stability Review.

Deutsche Bundesbank (2017), Financial Stability Review.

Deutsche Bundesbank (2018), Financial Stability Review.

Deutsche Bundesbank (2019), Ergebnisse der gesamtwirtschaftlichen Finanzierungsrechnung für Deutschland – 2013 bis 2018, June 2019.

Dewachter, H., L. Iania, M. Lyrio and M. de Sola Perea (2015), A Macro-Financial Analysis of the Euro Area Sovereign Bond Market, Journal of Banking & Finance, Vol. 50, pp. 308-325.

Diamond, D. W. and P. H. Dybvig (1983), Bank Runs, Deposit Insurance, and Liquidity, Journal of Political Economy, Vol. 91, No 3, pp. 401-419.

Dötz, N. and M. Weth (2019), Redemptions and Asset Liquidations in Corporate Bond Funds, Deutsche Bundesbank Discussion Paper No 11/2019.

Duffie, D. and H. Zhu (2011), Does a Central Clearing Counterparty Reduce Counterparty Risk?, Review of Asset Pricing Studies, Vol. 1, No 1, pp. 74-95.

Ehrmann, M. and M. Fratzscher (2017), Euro Area Government Bonds – Fragmentation and Contagion during the Sovereign Debt Crisis, Journal of International Money and Finance, Vol. 70, pp. 26-44.

Fiedor, P., S. Lapschies and L. Országhová (2017), Networks of Counterparties in the Centrally Cleared EU-wide Interest Rate Derivatives Market, ESRB Working Paper No 54/2017.

Financial Stability Board (2017), Policy Recommendations to Address Structural Vulnerabilities from Asset Management Activities.

Förstemann, T. (2019), Lethal Lapses: How a Positive Interest Rate Shock Might Stress Life Insurers, mimeo.

Freixas, X., B. M. Parigi and J.-C. Rochet (2000), Systemic Risk, Interbank Relations, and Liquidity Provision by the Central Bank, Journal of Money, Credit and Banking, Vol. 32, No 3, pp. 611-638.

Fricke, C. and D. Fricke (2019), Vulnerable Asset Management? The Case of Mutual Funds, Journal of Financial Stability, forthcoming.

Fricke, D. (2019), Flows or Valuation? A Growth Decomposition for Investment Funds, mimeo.

Fricke, D. and H. Wilke (2019), Connected Funds, mimeo.

Georgescu, O.-M. (2015), Contagion in the Interbank Market: Funding Versus Regulatory Constraints, Journal of Financial Stability, Vol. 18, pp. 1-18.

Ghamami, S. and P. Glasserman (2017), Does OTC Derivatives Reform Incentivize Central Clearing?, Journal of Financial Intermediation, Vol. 32, pp. 76-87.

Glasserman, P. and H. Peyton Young (2015), How Likely is Contagion in Financial Networks?, Journal of Banking & Finance, Vol. 50, pp. 383-399.

Glasserman, P. and H. Peyton Young (2016), Contagion in Financial Networks, Journal of Economic Literature, Vol. 54, No 3, pp. 779-831.

Goldstein, I., H. Jiang and D. T. Ng (2017), Investor Flows and Fragility in Corporate Bond Funds, Journal of Financial Economics, Vol. 126, No 3, pp. 592-613.

Gray, D. F., R. C. Merton and Z. Bodie (2007), New Framework for Measuring and Managing Macrofinancial Risk and Financial Stability, NBER Working Paper No 13607.

Greenwood, R., A. Landier and D. Thesmar (2015), Vulnerable Banks, Journal of Financial Economics, Vol. 115, No 3, pp. 471-485.

Hellwig, M. F. (2009), Systemic Risk in the Financial Sector: An Analysis of the Subprime-Mortgage Financial Crisis, De Economist, Vol. 157, No 2, pp. 129-207.

Hüser, A.-C. (2015), Too Interconnected to Fail: A Survey of the Interbank Networks Literature, SAFE Working Paper No 91.

Jiang, H., D. Li and A. Wang (2017), Dynamic Liquidity Management by Corporate Bond Mutual Funds, mimeo.

Krüger, U., C. Roling, L. Silbermann and L.-H. Wong (2019), Systemic Liquidity Risk in Banking Systems, mimeo.

Sheldon, G. and M. Maurer (1998), Interbank Lending and Systemic Risk: An Empirical Analysis for Switzerland, Swiss Journal of Economics and Statistics, Vol. 134, No IV, pp. 685-704.

Silva, N. (2010), Inter-Sector Relations in the Portuguese Economy: An Application of Contingent Claims Analysis, Financial Stability Report, Banco de Portugal.

Upper, C. and A. Worms (2004), Estimating Bilateral Exposures in the German Interbank Market: Is there a Danger of Contagion?, European Economic Review, Vol. 48, No 4, pp. 827-849.

Wells, S. J. (2004), Financial Interlinkages in the United Kingdom's Interbank Market and the Risk of Contagion, Bank of England Working Paper No 230.

Impact of climate-related risks on financial stability

Climate change has grown to become a major topic in financial markets and thus for central banks as well. There is a huge mismatch, both in terms of timing and geography, between the causes of climate change and its impact. Climate-related risk can also have a bearing on financial stability. Assessing or recommending policy responses to climate change is not a matter for financial stability analysis, however.

Climate action will drive up the relative prices of activities that are detrimental to the climate, triggering adjustments in economic structures which will also be reflected in the financial system. Technological progress can smooth the necessary changes to consumption and production structures. Developments and effects driven by technological advances and policy action are fraught with uncertainty, however, as are the implications of climate change itself.

Climate risk has multiple impacts, not least on traditional risk categories like credit and market risk. From the vantage point of macroprudential supervision, it is crucial that the financial system is sufficiently resilient to the uncertainties and risks related to climate change and climate policy, and that systemic risk does not accumulate.

The interdisciplinary nature of climate-related challenges adds considerably to the complexity of financial stability analysis. More than 45 central banks and supervisors worldwide have joined forces in the Network for Greening the Financial System to pool their analytical and methodological capabilities and build up a meaningful information base.

Climate change: a potential source of systemic risk

Climate change has become a major talking point in political circles and society at large, and its impact on the environment, society and the economy is attracting intense debate. There is a broad consensus that climate change will add noticeably to the global average temperature and trigger more frequent extreme weather events.

However, it is uncertain just how climate change will evolve and what effects it will have. This largely depends on how technological progress plays out in the future, but the policy response is also crucial, given that it will have a major bearing on greenhouse gas emissions in the years ahead.

Effects of climate change are fraught with uncertainty.

But one feature common to all the possible trajectories is that the expected change in climate, and the climate policy responses it triggers, will significantly change economies and the way they are structured. The resulting credit, market and underwriting risks will also affect the financial system.

A stable financial system needs to be able to ride out this period of upheaval and continue functioning – that is, providing protection against risk as well as supplying the real economy with credit and other financial products. This is particularly vital in times of stress, when unexpected or disruptive events materialise.

Expressed in economic terms, climate change is the outcome of negative externalities: global warming causes locally emitted greenhouse gases to inflict damage worldwide, and the emitters – or the consumers of the goods and services they provide – bear no responsibility, or not enough, for the effects of their actions. Ideally, politicians would respond to this market failure by making the parties responsible for these greenhouse gases pay for the damage they cause (the "polluter pays" principle). In reality, though, the costs are often borne by society at large. Not just that: the global magnitude of climate change makes it an extremely complex problem to solve. Effective climate policy needs to resolve key global coordination issues because individual countries tend to differ in terms of how much they contribute to global CO_2 emissions.

Ideally, the "polluter pays" principle would apply.

Signatories to the Paris Agreement pledged to reduce greenhouse gas emissions in order to keep the increase in the global average temperature to well below 2°C above pre-industrial levels, and ideally to limit the temperature increase to no more than 1.5°C.[1] The aim here is to effectively limit the magnitude of climate change. Economic policymakers have a variety of options for curbing net carbon emissions, and ultimately for avoiding them in the first place, but these need to be implemented at the national level. Options range from imposing bans or requirements regarding the technologies to be used, to a CO_2 tax, all the way to trading systems for CO_2 allowances. When considering an appropriate response, policymakers also need to consider unpredictable technological developments, which should not, moreover, be throttled by policy decisions.

Action to curb greenhouse gas emissions will drive up the relative prices of emissions-intensive products and services. This price mechanism is of pivotal importance because it incentivises changes in consumer behaviour and production processes that are conducive to achieving the climate policy objective of lowering greenhouse gas emissions. The change in production structures and consumption behaviour this

1 See United Nations (2015).

will spur is difficult to forecast. In addition, the structural changes themselves will pose major challenges for politicians and society. What politicians ultimately face is an intertemporal decision-making problem, which challenges them to trade off the future costs of climate change against the present-day costs of structural change. Furthermore, when politicians choose one particular climate pathway, they do so amid great uncertainty. It is therefore likely that the climate pathway followed globally and nationally will be repeatedly recalibrated in the future as new insights and information come to light. Against this backdrop, the Paris Agreement gives countries an opportunity to conduct suitable policy evaluations.

The expected impact of climate change, and the micro- and macroeconomic adjustment processes that unfold as climate action takes effect, will resonate directly within the financial system. In particular, this will force market participants to give the effects and risks (physical risk) of climate change due consideration in their decisions and assessments. The same can be said for the economic transformation which climate policy looks set to trigger and the almost inevitable uncertainties surrounding the policy pathway (transition risk).[2]

Impact of climate change will resonate within the financial system.

Generally speaking, it is in every market participant's interest to be properly protected against these perils by calibrating their risk management operations accordingly and safeguarding their resilience, for example. Climate risk is not necessarily a risk category in its own right; instead, it has a bearing on traditional risk categories like credit and market risk.[3] Microprudential supervisors will still have the task of investigating whether individual financial market participants like banks and insurers are incorporating the material risks for their operations into their risk assessments and using adequate risk models, and whether they have the information they need for these purposes. What matters from a macroprudential vantage point, meanwhile, is that the financial system as a whole is sufficiently resilient to uncertainties and risks surrounding climate change and climate policy, and that systemic risk does not accumulate, which can happen if agents collectively underestimate climate and policy drivers. Assessing or recommending specific climate policy decisions, on the other hand, is not a task for financial stability analysis.

Macroprudential supervisors face the same challenges as other market agents when it comes to analysing climate-related risks and their possible implications from the particular angle of transition risk. Existing models and established methods are of little use here. Complicating matters further, the interdisciplinary nature of climate-related issues makes analysis far more complex in the field of financial stability. Details on many of the drivers and channels of impact are still sketchy, which is why the existing toolkit will need to be improved upon, particularly by leveraging insights and analyses made in the sciences. Significant information deficits are another problem. Thus, for many assets, there is still no harmonised classification of the extent to which they are exposed to physical and transition risk. Since economic risks resulting from climate change only materialised to a limited extent in the past, risk analysts are lacking a pool of empirical data that is broad enough to compute sensitivities to global warming, for example, and would allow them to quantify the potential risks this might present.

Financial stability analysis is made more complex by the interdisciplinary nature of climate-related issues.

2 See Network for Greening the Financial System (2019a).
3 See Federal Financial Supervisory Authority (2019).

Physical risk: how climate change might impact on the financial system

Climate change and the foreseeable rise in global temperatures are playing out against the backdrop of physical risk that can manifest directly or indirectly in the macroeconomy and thus affect the financial system. Physical risks range from rising sea levels worldwide to more frequent extreme weather events. Though the severity of physical risk will vary geographically, its effects will probably ripple through the tight mesh of economic and financial ties to have a worldwide impact. It is also thought that global warming might lead to a situation where renewable resources can no longer be cultivated in certain regions, depriving economic sectors that depend on them of the inputs they need to operate. Supply chains can be disrupted if intermediate products are sourced from regions which are hit more often by acute climate events. The financial system is affected by physical risk through multiple direct and indirect transmission channels, such as the impact on asset prices, credit risk and loan collateral, as well as through the insurance sector (see Chart 6.1). Adjustments to the prices of assets affected by climate-related changes will probably be a key channel of impact over a short to medium-term horizon.[4]

Physical risk will ripple out worldwide through the tight mesh of economic and financial ties.

Physical risk can furthermore have a bearing on credit risk. If climate change makes major loss events to real assets or means of production a more frequent occurrence, this can plunge borrowers into financial difficulties, hindering or even preventing them altogether from servicing their liabilities.[5] Lenders also need to consider that the expected climatic changes can affect entire regions or economic sectors, not just individual borrowers.[6] It still needs to be investigated, then, whether lenders are already paying enough attention to the possibility that climate change will trigger far higher default rates, with losses potentially being clustered within particular geographical regions. One question, for example, is whether these factors are being taken into account when loans are granted or decisions on the composition of credit portfolios are made. This also means considering the recoverability of loan collateral, which can lose value at the same time as a default because physical risks have materialised.

The risk of underestimating the damage that future climate events might inflict would also affect insurers if the losses they underwrite crystallise more often. If insurers run into financial difficulties, this would have economic repercussions for policyholders if it were no longer or only partially possible to adjust their claims.[7] The mounting risk of severe physical damage could make primary insurers and reinsurers more wary about underwriting risk in regions or sectors that are particularly susceptible to climate risk.

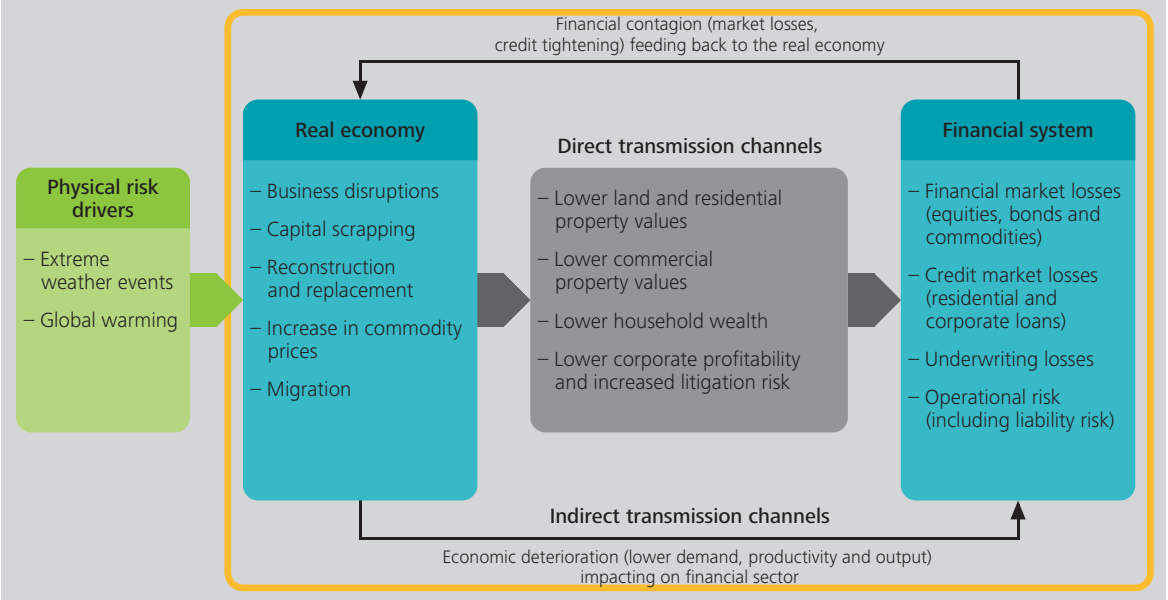
Mounting loss risks will probably make insurers less willing to offer cover.

Transition risk: how climate action might impact on the financial system

Climate change will also induce transition risk, which materialises due to the phase-out of fossil fuels as well as the almost inevitable uncertainties surrounding the structural adaptation pathway. Politicians have mapped out a path to a low-carbon economy in the Paris Agreement, amongst others, though the precise trajectory and its specific design have not yet been fully staked out.[8] The economic transformation

4 See Batten (2018).
5 See Faiella and Natoli (2018).
6 See Koetter, Noth and Rehbein (2019).
7 See Prudential Regulation Authority (2015).
8 See United Nations (2015); Intergovernmental Panel on Climate Change (2019); Federal Government of Germany (2019).

Physical risk: how climate change might impact on the financial system (according to the NGFS report) Chart 6.1



Source: Bundesbank chart based on Network for Greening the Financial System (NGFS), A Call for Action: Climate Change as a Source of Financial Risk – First Comprehensive Report, 2019, p. 14.
Deutsche Bundesbank

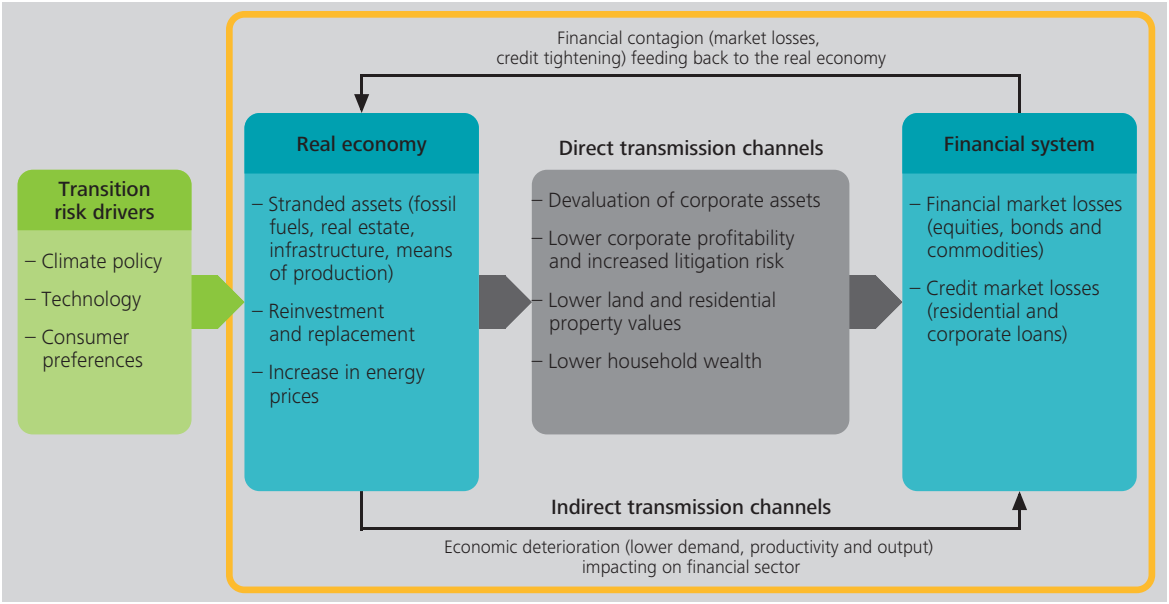
this will involve and the almost inevitable uncertainties surrounding the course of climate policy are a source of transition risk. It includes technological changes and uncertainties, modified consumer preferences and legal and regulatory adjustments aimed at lowering CO_2 levels, all the way to carbon neutrality (see the section entitled "Uncertainties surrounding the adaptation pathway" on p. 116).[9]

The phase-out of fossil fuels will probably impact directly on the capital stock and the structure of the economy – rising fossil fuel prices are likely to make it far more expensive to operate existing fossil-fuel-intensive production facilities. Relative prices will change, because in the absence of technological progress, the goods produced by enterprises from sectors reliant on the use of fossil fuels, such as aviation, will become more expensive, relatively speaking. This is how climate policy directly affects asset prices through the relative price channel.[10] Assets which lose value due to the phase-out of fossil fuels are called "stranded assets" in the literature.[11] This phenomenon can be expected to have a particularly heavy impact on enterprises and countries which extract or market fossil fuels.[12] Analysts investigating the risks to the real economy and financial system often base their research on an extreme scenario in which the stranded assets lose much or even all of their value (see Chart 6.2).

The phase-out of fossil fuels will probably impact directly on the structure of the economy.

9 See Gros, Lane, Langfield, Matikainen, Pagano, Schoenmaker and Suarez (2016).
10 See International Renewable Energy Agency (2017).
11 The term "stranded assets" was mainly coined by the Carbon Tracker Initiative and Oxford University's Stranded Asset Programme, before Mark Carney picked it up for a speech. See Carbon Tracker Initiative (2013); Caldecott, Tilbury and Carey (2014); Carney (2015).
12 See Weyzig, Kuepper, van Gelder and van Tilburg (2014).

Transition risk: how climate action might impact on the financial system (according to the NGFS report) Chart 6.2



Source: Bundesbank chart based on Network for Greening the Financial System (NGFS), A Call for Action: Climate Change as a Source of Financial Risk – First Comprehensive Report, 2019, p. 17
Deutsche Bundesbank

An unexpectedly rapid phase-out of fossil fuels could trigger a sudden revaluation of assets. Business, market and credit risk could arise mainly because technological progress does not follow a smooth or predictable path, but goes through spells with above average growth rates and also experiences technological breakthroughs which might necessitate a policy response.[13] Technical change can quickly render existing technologies obsolete. It can also leave the cost of maintaining technical facilities much higher and output levels far lower than originally planned. These business, market and credit risks can thus trigger further, potentially abrupt corrections in asset prices.

An unexpectedly rapid phase-out of fossil fuels could trigger a sudden revaluation of assets.

An ongoing Bundesbank research project indicates that Germany's banking sector tends to grant loans to enterprises which benefit from the transition to a low-carbon economy or do not deviate systematically from the market average (see the box entitled "How does the market gauge the risks associated with a phase-out of fossil fuels?" on p. 113).

Transparency crucial for climate-related risks

Two factors are crucial for gauging climate-related risks. First, information is needed on the carbon intensity of individual assets. Enterprises, investors and financial institutions need this information because otherwise they can-

An extensive pool of data is key to estimating the financial impact of extreme natural events.

13 See Kurzweil (2004).

How does the market gauge the risks associated with a phase-out of fossil fuels?

The capital-market-based approach used in the University of Augsburg's Carbon Risk Management project (CARIMA) can be applied to approximate the effects of climate-related transition risk on the equity prices of listed companies. Under this approach, a "brown minus green" (BMG) carbon risk factor is added to a classic extended capital asset pricing model (CAPM).[1] This factor is equivalent to the difference in the returns of 624 brown and 484 green companies compiled by the University of Augsburg from a global master dataset of around 40,000 companies with the aid of 55 variables. Changes in climate policy, technological breakthroughs or modified consumer preferences should be reflected in the BMG factor. This model investigates how the BMG factor impacts on the returns of companies with credit links to German banks.

The underlying factor model takes the following form:

$$er_{i,t} = a_i + ß_i^{mkt} er_{M,t} + ß_i^{smb} SMB_t + ß_i^{hml} HML_t + ß_i^{mom} MOM_t + ß_i^{bmg} BMG_t + \varepsilon_{i,t}$$

The excess return (er) of company i at time t is regressed on the excess return of the market and the returns of the global size (SMB_t), value (HML_t), momentum (MOM_t) and brown minus green (BMG_t) factors. The resulting carbon betas ($ß_i^{bmg}$) measure the extent to which the return of company i reacts to changes in the BMG factor. A significantly negative beta coefficient indicates an increase in the expected return of company i relative to the market if the BMG factor is negative – i.e. if the return of the green companies has risen relative to that of their brown counterparts.

This CARIMA analytical approach is applied to a dataset comprising listed companies with which German banks have a credit relationship (dataset taken from the Bundesbank's credit register for loans of €1 million or more). The data vintage is 2016. The dataset encompasses 1,224 listed companies and an aggregate credit volume of €670 billion, which is equivalent to around 10% of the aggregate German banking system's exposures recorded in the credit register. Around 90% of the credit volume was issued to listed companies headquartered in Europe.

The carbon beta coefficient is estimated for each of these companies. In this way, it is possible to gauge German banks' credit exposure to companies which will reap above average benefits (green companies) from a more successful transition to a low-carbon economy than expected, and which will lose out in relative terms (brown companies).

Initial estimates reveal that for the vast majority of the companies – 1,131 observations – neither a green nor a brown significant carbon beta was identified.

A significant negative carbon beta was estimated for 71 companies, which means their returns are likely to benefit from a relative price change in favour of green companies. These companies' outstanding loans amount to €63 billion, which is just under 9% of the credit volume investigated here.

Just 22 companies were found to have a significant positive carbon beta, the credit volume issued to these companies coming to 0.4% (€2.8 billion) of the credit volume under consideration.

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1 See Görgen, Jacob, Nerlinger, Riordan, Rohleder and Wilkens (2019).

not suitably incorporate transition risk into the decisions they make. Second, there needs to be an extensive pool of data to allow experts to estimate how an expected increase in extreme weather and natural events might affect the economy and financial system. This underlines the interdisciplinary nature of climate-related analyses which aim to leverage scientific climate scenarios for certain economic sectors and facilitate forward-looking assessments. An altogether improved pool of data that can help in measuring asset price sensitivity to both carbon emissions and higher physical risk would be very valuable indeed. The G20 Green Finance Study Group has mapped climate-related risks to traditional financial sector risk categories such as business, market, credit and liability risk.[14] A robust data pool is also needed by micro- and macroprudential supervisors, and especially by politicians, who ultimately have to evaluate whether their climate policy has achieved the desired outcomes.

The G20 Green Finance Study Group has mapped how climate-related risks fit into financial sector risk categories.

The work of the Task Force on Climate-Related Financial Disclosures (TCFD), a body established by the Financial Stability Board (FSB), marks a major step towards a standardised approach to reporting climate-related risks. The TCFD has drawn up a framework for voluntary, consistent, comparable and efficient corporate financial disclosures of relevant climate-related risks.[15] It has issued 11 principle-based recommendations around the four core elements of how organisations operate: governance, strategy, risk management, and metrics and targets. Until enterprises have built up the capacities needed to capture climate risks in quantitative terms, they can begin by reporting at a purely qualitative level. What makes the TCFD's recommendations particularly useful is that they do not confine the topic of climate risks simply to adding transparency to existing assets – when the recommendations are implemented, disclosures will also include how climate-related aspects are incorporated into firms' risk management, corporate strategy and governance. Micro- and macroprudential supervisors would also like to see further standardisation of the disclosure formats to boost comparability.

It will take some time for the TCFD's recommendations to be operationalised. Monitoring would ensure that the recommendations can be recalibrated in light of the experience gained. For this reason, having presented its recommendations, the TCFD was given a follow-on mandate by the FSB to monitor the implementation process. The European Commission's Action Plan on Financing Sustainable Growth likewise builds upon the TCFD's recommendations. Amongst other initiatives, this action plan aims to establish a unified classification system for sustainable economic activities at the European level.[16]

Scenario analysis: a possible tool for investigating climate-related risk

More than 45 central banks and supervisors worldwide have joined forces in the Network for Greening the Financial System (NGFS) with the aim of investigating the financial impact of climate-related risks and pooling their analytical capacities. The NGFS's methodological work is based in particular on scenario analysis, which is a useful tool for exploring developments which are not readily forecastable.[17] Using scenario analysis

Scenario analysis is useful for gauging developments which are not readily forecastable.

14 See G20 Green Finance Study Group (2016).
15 See Task Force on Climate-Related Financial Disclosures (2017).
16 See European Commission (2018). For more on the design of the EU Action Plan and the taxonomy developed by the European Commission, see Deutsche Bundesbank (2019), pp. 13 ff.

calibrated with a wide spectrum of possible technological and political developments, the NGFS intends to assess how climate change affects the real economy and financial system over a longer time horizon. Scenario analysis can be useful for gauging the influence on key financial stability indicators, such as losses in the banking system.

An assumed scenario in this context is not a forecast of a future state of the world, but a representative pathway going forward based on various assumptions, such as on future emissions, policy responses and energy prices. Given the considerable uncertainties and the broad spectrum of possible climate change pathways, it is important to consider and map multiple scenarios, including extreme events. The NGFS intends to publish a scenario analysis guide on climate-related risks next year, and it is planning to model four different representative scenarios which are each driven by differing degrees of physical or transition risk (see Table 6.1).

Given the broad spectrum of possible pathways, it is important to consider multiple scenarios.

The real economy and financial system are most at risk in a scenario where there is a disorderly and thus abrupt policy response to discontinue the use of fossil fuels and the climate targets are not met (see Table 6.1). In this scenario, investors might only be able to adjust their portfolios at a loss, and fossil assets would abruptly decline in value. This scenario would also see an increase in physical risk, since it is assumed that no policy action was taken beforehand to mitigate that risk. The scenario with probably the smallest macroeconomic welfare losses is the one where the move away from fossil fuels begins early and follows an orderly path, because the transition would take place in a predictable fashion for all market participants (see Table 6.1).

Stylised climate change scenarios (according to the NGFS report) Table 6.1

Adaptation pathway …	Strength of response / Climate targets are …	
	… met	… not met
… disorderly	**Disorderly transition** Late and abrupt reduction of emissions; climate targets are met.	**Hot house world and disorderly transition** Late and abrupt reduction of emissions, but not enough to meet climate targets; physical risks amplify transition risks.
… orderly	**Orderly transition** Predictable and adequate reduction of emissions; climate targets are met.	**Hot house world** Emissions continue to rise and physical risks increase.

Source: Bundesbank table based on Network for Greening the Financial System (NGFS), A Call for Action: Climate Change as a Source of Financial Risk - First Comprehensive Report, 2019, p. 21.

Deutsche Bundesbank

Scenario analysis can be used to illustrate the impact of both physical and transition risk, since it can plausibly map out possible representative future pathways. It does not go far enough to facilitate an adequate risk assessment, though. Scenarios only ever map out a single possible future pathway, so decisions should not be based on them alone. Any assessment of climate-related risks in terms of financial stability needs to be expanded to include a qualitative evaluation of risks as well as additional analytical methods, such as sensitivity analysis. This would give analysts a broader platform from which to classify and assess the magnitude of the risks which are difficult to measure.

Assessment of climate-related risks in terms of financial stability needs to be expanded to include additional analytical methods.

17 See Network for Greening the Financial System (2019b), p. 29.

Uncertainties surrounding the adaptation pathway

Scenario analysis assumes various hypothetical pathways along which the transition to a low-carbon economy can take place. Depending on the assumptions made, scenario analysis can produce a range of different estimated changes in the observed variables. These reflect the uncertainties surrounding the concrete outcome over the passage of time. However, in addition to these uncertainties along a given trajectory, there are also ambiguities surrounding the chosen pathway itself. Externalities and changes in public perception can have a bearing on the democratic decision-making process, possibly leading to policy decisions being revised over time. Similarly conceivable is a divergence of decisions in different countries, which can feed off each other and also impact globally.

Uncertainties surround the pathway chosen.

One example of an ad hoc reappraisal of political decisions is the reversal of initial plans to extend the scheduled lifespans of Germany's atomic power plants in the wake of the Fukushima nuclear disaster. Another is the US administration's decision that the United States will withdraw at the end of 2020 from the Paris Agreement, to which it was a signatory in December 2015. When analysing different conceivable pathways, it should be noted that these are subject to technological or institutional constraints, which are described in greater detail below.

Adaptation could be held back by bottlenecks and rebound effects

Bottlenecks could arise during the transition to a low-carbon economy.[18] Constraints may emerge in the funding of the transition, both on the supply side, e.g. in cases where enterprises lack the funds to transition to low-carbon manufacturing, and on the demand side, say, if households or municipalities cannot afford to purchase climate-neutral goods. In addition, the supply of qualified workers could run short in certain professions which take on greater significance during the transition. Commodities, intermediate goods and land required for manufacturing and using green goods, such as wind energy or biomass, are further possible constraints on the adjustment process.

Moreover, the transition may be held back by rebound effects.[19] A direct rebound effect is generated when improved energy efficiency in goods and services drives up demand or leads to more frequent or more intensive use. For instance, more efficient internal combustion engines for motor vehicles could lead to the incorporation of more powerful motors or drivers using economical cars more frequently. An indirect rebound effect occurs when the lower costs of more efficient goods and services free up additional income which is then used to consume other products. Rebound effects can also arise at a macroeconomic level, when falling demand for energy drives down energy prices, resulting in higher energy consumption elsewhere.

A rebound effect is generated when improved energy efficiency drives up demand for goods and services or leads to more frequent use.

Path dependencies warrant attention

In addition to the obstacles to the transition outlined above, which are largely independent of historical developments, there are path dependencies stem-

18 See Lutz, Becker and Lehr (2018).
19 See Frondel, Peters and Vance (2009); Behl, Dette, Frondel and Vance (2019).

ming from prior events or currently established patterns of thought and behaviour.[20] These lock-in effects run along multiple dimensions. Existing infrastructures, production facilities and goods often entail high investment and fixed costs and a long lifecycle, resulting in a technological lock-in effect. One consequence of this effect, among others, is that the more abrupt and unexpected the transformation to a low-carbon economy, the greater the depreciation of the existing capital stock will be. Alongside technological lock-in effects, institutional path dependencies may also hold back the adjustment process if there are incentives to maintain the status quo.

These drags on the adjustment process may be mutually reinforcing and should be taken into account both in financial institutions' risk analyses and in financial supervision. The outlined bottlenecks, rebound effects and path dependencies make it more difficult to fully gauge the possible implications for the financial system.

Path dependencies make it more difficult to fully gauge possible implications for the financial system.

International cooperation and improving the data pool

Society, the economy and the financial system must all ready themselves for the expected consequences of increasing global warming and for the impact of the transition to a sustainable economy. It remains to be seen which sectors will be best able to rise to these challenges and which technologies will come to the fore in the future. Financial sector regulation, in particular, should therefore maintain its risk-based focus and should not be politically instrumentalised to manage the transition to a sustainable economy. Nonetheless, both regulation and supervision should take adequate account of climate-related risks, keeping track both of risks arising from investment in unsustainable, fossil-fuel-intensive technologies and of a possible asset bubble in new, more sustainable technologies.[21] The Bundesbank is therefore monitoring the transition to a sustainable economy from multiple angles.

Financial sector regulation should maintain its risk-based focus.

In terms of financial stability, rigorous development and discussion of methodologies is key, as these will form the basis for gauging climate-related risks.[22] However, it is difficult to capture these risks analytically as both physical and transition risks have a very broad impact on the economy and the financial system. At present, financial market participants have only a partial overview of the resulting uncertainty, which means that a general strengthening of resilience is necessary.

The two main sources of uncertainty are global political decisions with very long-term repercussions and unanticipated technological developments. Expected climate change and the transition to a sustainable economy are global phenomena. These unique traits of climate-related risks mean that conventional risk models for analysing systemic risk are of only limited use in this area. International cooperation bringing together the analytical expertise of central banks and supervisors, e.g. in the NGFS, is therefore crucial. At both a national and international level, the Bundesbank is playing an active role in drawing up and implementing NGFS recommendations.

First of all, a suitable data pool needs to be created to enable enterprises and investors to gauge the fi-

20 See Clausen and Fichter (2017); Seto, Davis, Mitchell, Stokes, Unruh and Ürge-Vorsatz (2016).
21 This topic is discussed in more detail, for instance, in the current debate on a possible carbon bubble; see Delis, de Greiff and Ongena (2018); Battiston, Mandel, Monasterolo, Schütze and Visentin (2017).
22 See Network for Greening the Financial System (2019a), p. 20.

nancial repercussions of expected climate change and thus increase resilience to climate risk. Improved data availability is key not just for microprudential and macroprudential supervision; it is also in the banks' interest to carefully examine whether the data they record and use in their analyses allow them to adequately identify and quantify climate risk. A special survey conducted by BaFin and the Bundesbank in 2019 found that just under two-thirds of the responding institutions had not yet integrated climate-related risks into their risk analyses. However, 22% of the institutions indicated that they were currently planning to add climate risk to their risk management.[23]

A suitable data pool should be created to allow the repercussions of climate change to be gauged.

At present, limited data availability and a lack of consistency among data sources continue to pose a substantial obstacle to adequate risk assessment. Consequently, building on the initiatives of the G20 Green Finance Study Group and the United Nations Environment Programme (UNEP), the NGFS recommends that public authorities make data of relevance to climate risk assessment publicly available,[24] and is currently developing a strategy to this end. An all-round improvement in the data pool would also help those working in other policy areas to effectively evaluate the success of green policies and adequately address the risks outlined in this article.

Ultimately, it is crucial to expand the scope of academic research to include topics relating to the climate and financial stability and to raise awareness of climate-related risks among financial market participants.[25] To better understand how climate factors can translate into financial risks and opportunities, an ongoing exchange of expertise and experience with other institutions, academia and financial market participants is essential.

Ongoing exchange of expertise with other institutions, academia and financial market participants is essential.

List of references

Batten, S. (2018), Climate Change and the Macro-Economy: A Critical Review, Bank of England Staff Working Paper No 706.

Battiston, S., A. Mandel, I. Monasterolo, F. Schütze and G. Visentin (2017), A Climate Stress-Test of the Financial System, Nature Climate Change, Vol. 7, No 4, pp. 283-288.

Behl, P., H. Dette, M. Frondel and C. Vance (2019), A Focused Information Criterion for Quantile Regression: Evidence for the Rebound Effect, Quarterly Review of Economics and Finance, Vol. 71, pp. 223-227.

Caldecott, B., J. Tilbury and C. Carey (2014), Stranded Assets and Scenarios, Stranded Assets Programme Discussion Paper.

Carbon Tracker Initiative (2013), Unburnable Carbon 2013: Wasted Capital and Stranded Assets.

Carney, M. (2015), Breaking the Tragedy of the Horizon: Climate Change and Financial Stability, speech delivered in September 2015.

23 The Survey on the Profitability and Resilience of German Financial Institutions in a Low-Interest-Rate Environment, which was undertaken by BaFin and the Bundesbank, focused on 1,400 small and medium-sized credit institutions. It included questions about lending standards, the significance of climate risk and interest on deposits. Details can be found at https://www.bundesbank.de/en/press/press-releases/results-of-the-2019-lsi-stress-test-807624
24 See Network for Greening the Financial System (2019a), p. 29.
25 See Network for Greening the Financial System (2019a), p. 30.

Clausen, J. and K. Fichter (2017), Pfadabhängigkeiten: Querschnittsanalyse auf Basis von fünfzehn Transformationsfeldern, Evolution2Green.

Delis, M. D., K. de Greiff and S. Ongena (2018), Being Stranded on the Carbon Bubble? Climate Policy Risk and the Pricing of Bank Loans, CEPR Discussion Paper No 12928.

Deutsche Bundesbank (2019), Monthly Report, October 2019.

European Commission (2018), Action Plan: Financing Sustainable Growth.

Faiella, I. and F. Natoli (2018), Natural Catastrophes and Bank Lending: The Case of Flood Risk in Italy, Banca d'Italia Occasional Papers No 457.

Federal Financial Supervisory Authority (2019), Guidance Notice on Dealing with Sustainability Risks.

Federal Government of Germany (2019), Climate Action Programme 2030.

Frondel, M., J. Peters and C. Vance (2009), Fuel Efficiency and Automobile Travel in Germany: Don't Forget the Rebound Effect!

G20 Green Finance Study Group (2016), Green Finance Synthesis Report.

Görgen, M., A. Jacob, M. Nerlinger, R. Riordan, M. Rohleder and M. Wilkens (2019), Carbon Risk, mimeo.

Gros, D., P. Lane, S. Langfield, S. Matikainen, M. Pagano, D. Schoenmaker and J. Suarez (2016), Too Late, Too Sudden: Transition to a Low-Carbon Economy and Systemic Risk, Reports of the ESRB Advisory Scientific Committee No 6.

Intergovernmental Panel on Climate Change (2019), Global warming of 1.5°C: An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways.

International Renewable Energy Agency (2017), Stranded Assets and Renewables: How the Energy Transition Affects the Value of Energy Reserves, Buildings and Capital Stock.

Koetter, M., F. Noth and O. Rehbein (2019), Borrowers under Water! Rare Disasters, Regional Banks and Recovery Lending, Journal of Financial Intermediation, forthcoming.

Kurzweil, R. (2004), The Law of Accelerating Returns, in Alan Turing: Life and Legacy of a Great Thinker, Springer-Verlag Berlin Heidelberg, pp. 381-416.

Lutz, C., L. Becker and U. Lehr (2018), Mögliche Engpässen für die Energiewende, GWS Research Report Series No 2018/08.

Network for Greening the Financial System (2019a), A Call for Action: Climate Change as a Source of Financial Risk – First Comprehensive Report.

Network for Greening the Financial System (2019b), Macroeconomic and Financial Stability: Implications of Climate Change – NGFS Technical Supplement.

Prudential Regulation Authority (2015), The Impact of Climate Change on the UK Insurance Sector: A Climate Change Adaptation Report.

Seto, K. C., S. J. Davis, R. B. Mitchell, E. C. Stokes, G. Unruh and D. Ürge-Vorsatz (2016), Carbon Lock-In: Types, Causes, and Policy Implications, Annual Review of Environment and Resources, Vol. 41, pp. 425-452.

Task Force on Climate-Related Financial Disclosures (2017), Final Report, Financial Stability Board.

United Nations (2015), Paris Agreement.

Weyzig, F., B. Kuepper, J. W. van Gelder and R. van Tilburg (2014), The Price of Doing Too Little Too Late: The Impact of the Carbon Bubble on the EU Financial System, Green New Deal Series Vol. 11.

Glossary

BaFin	Federal Financial Supervisory Authority
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
BLS	Bank Lending Survey
CCP	Central counterparty
CCyB	Countercyclical capital buffer
CET1	Common equity tier 1 capital
CLO	Collateralised loan obligation
CRD	Capital Requirements Directive
CRR	Capital Requirements Regulation
DAX	German share index
DSTI	Debt-service-to-income ratio
DTI	Debt-to-income ratio
EBA	European Banking Authority
EBITDA	Earnings before interest, taxation, depreciation and amortisation
ECB	European Central Bank
EEA	European Economic Area
EIOPA	European Insurance and Occupational Pensions Authority
EPU	Economic Policy Uncertainty Index
ESM	European Stability Mechanism
ESMA	European Securities and Markets Authority
ESRB	European Systemic Risk Board
ETF	Exchange-traded fund
EU	European Union
FCA	Financial Conduct Authority
FOLTF	Failing or likely to fail
FRAME	Financial Regulation Assessment: Meta Exercise
FSB	Financial Stability Board
FSI	Financial stress index
GDP	Gross domestic product
GFSG	Green Finance Study Group
G-SII	Global systemically important institution
HGB	German Commercial Code *(Handelsgesetzbuch)*
IFRS	International Financial Reporting Standards
IMF	International Monetary Fund
IRBA	Internal ratings-based approach
KWG	German Banking Act *(Kreditwesengesetz)*
LCR	Liquidity coverage ratio

LTI	Loan-to-income ratio
LTV	Loan-to-value ratio
MFI	Monetary financial institution
MoU	Memorandum of Understanding
MREL	Minimum requirement for own funds and eligible liabilities
NFC	Non-financial corporation
NGFS	Network for Greening the Financial System
OECD	Organisation for Economic Co-operation and Development
O-SII	Other systemically important institution
OTC	Over the counter
PHF	Panel on Household Finances
PRA	Prudential Regulatory Authority
RWA	Risk-weighted assets
SME	Small and medium-sized enterprises
SRF	Single Resolution Fund
SRM	Single Resolution Mechanism
SSM	Single Supervisory Mechanism
TLAC	Total loss-absorbing capacity
TRIM	Targeted review of internal models
UNEP	United Nations Environment Programme
VaR	Value-at-risk

Bundesbank publications concerning financial stability

This overview lists selected recent Bundesbank publications on the subject of financial stability. The Financial Stability Review and the Monthly Report are available in both German and English, while most discussion papers are only published in English. The publications are provided in electronic format on our website (under Publications); printed copies can also be ordered or subscribed to free of charge under this menu item.

The charts and tables as well as background information on the analyses in the report are also available on the Bundesbank's website (under Tasks > Financial and monetary system > Financial Stability Review) along with a selection of underlying data as of the cut-off date. In addition, extensive data are available for various Bundesbank statistics, which are continuously updated (under Statistics, in particular in the time series databases).

Financial Stability Reviews

Financial Stability Reviews for the period 2005 to 2018; usually published once a year in November.

Articles from the Monthly Report

October 2019	The European market for investment funds and the role of bond funds in the low interest rate environment
October 2019	The sustainable finance market: a stocktake
September 2019	The performance of German credit institutions in 2018
August 2019	Monetary policy and banking business
June 2019	The European banking package – revised rules in EU banking regulation
May 2019	Monetary policy and banking business
April 2019	Interest rate pass-through in the low interest rate environment
February 2019	Monetary policy and banking business
January 2019	The impact of an interest rate normalisation on the private non-financial sector in the euro area from a balance sheet perspective

January 2019	Financial cycles in the euro area
November 2018	Monetary policy and banking business

Discussion papers

38/2019	The real effects of bank distress: evidence from bank bailouts in Germany	Johannes Bersch, Hans Degryse, Thomas Kick, Ingrid Stein
36/2019	Uncertainty shocks and financial crisis indicators	Nikolay Hristov, Markus Roth
31/2019	A novel housing price misalignment indicator for Germany	Markus Hertrich
30/2019	Risk weighting, private lending and macroeconomic dynamics	Michael Donadelli, Marcus Jüppner, Lorenzo Prosperi
25/2019	Macro to the rescue? An analysis of macroprudential instruments to regulate housing credit	Alexander Falter
23/2019	Bank loan supply shocks and alternative financing of non-financial corporations in the euro area	Martin Mandler, Michael Scharnagl
22/2019	Financial cycles across G7 economies: A view from wavelet analysis	Martin Mandler, Michael Scharnagl
21/2019	Bank profitability, leverage constraints, and risk-taking	Natalya Martynova, Lev Ratnovski, Razvan Vlahu
19/2019	Banks' holdings of risky sovereign bonds in the absence of the nexus: yield seeking with central bank funding or de-risking?	Rainer Frey, Mark Weth
17/2019	Stress testing the German mortgage market	Nataliya Barasinska, Philipp Haenle, Anne Koban, Alexander Schmidt
12/2019	Fear, deposit insurance schemes, and deposit reallocation in the German banking system	Falko Fecht, Stefan Thum, Patrick Weber
11/2019	Redemptions and asset liquidations in corporate bond funds	Niko Dötz, Mark Weth
10/2019	Procyclical leverage in Europe and its role in asset pricing	Markus Baltzer, Alexandra Koehl, Stefan Reitz
08/2019	The nonlinear dynamics of corporate bond spreads: Regime-dependent effects of their determinants	Henning Fischer, Oscar Stolper
05/2019	What drives the short-term fluctuations of banks' exposure to interest rate risk?	Christoph Memmel
01/2019	The interest rate exposure of euro area households	Panagiota Tzamourani
57/2018	Credit crunches from occasionally binding bank borrowing constraints	Tom D. Holden, Paul Levine, Jonathan M. Swarbrick
54/2018	Effects of bank capital requirement tightenings on inequality	Sandra Eickmeier, Benedikt Kolb, Esteban Prieto

52/2018	The role of non-performing loans for bank lending rates	Sebastian Bredl
51/2018	Bank capital buffers in a dynamic model	Jochen Mankart, Alexander Michaelides, Spyros Pagratis
48/2018	An evaluation of early warning models for systemic banking crises: Does machine learning improve predictions?	Johannes Beutel, Sophia List, Gregor von Schweinitz
44/2018	Macroeconomic effects of bank capital regulation	Sandra Eickmeier, Benedikt Kolb, Esteban Prieto