



EUROPEAN CENTRAL BANK

EUROSYSTEM

Financial Stability Review

May 2022



Contents

Foreword	3
Overview	4
1 Macro-financial and credit environment	17
1.1 Euro area economic outlook weakens on the back of global cost pressures and the war in Ukraine	17
1.2 Normalisation of fiscal positions is challenged by a slower economic recovery and the impact of the war	21
1.3 Corporates face new headwinds as supply bottlenecks persist	24
Box 1 Identifying the corporates most vulnerable to price shocks following the pandemic	28
1.4 Households face rising inflation and greater uncertainty	31
1.5 Vulnerabilities continue to build in euro area real estate markets	33
Box 2 Drivers of rising house prices and the risk of reversal	35
2 Financial markets	39
2.1 War exacerbates existing trends of higher energy prices and higher inflation	39
2.2 Market sensitivity to pace of policy normalisation	42
2.3 Commodity price shocks may lead to a reassessment of risks in the corporate sector	47
Box 3 Financial stability implications of higher than expected inflation	50
Box 4 The impact of Chinese macro risk shocks on global financial markets	54
3 Euro area banking sector	57
3.1 Asset quality continues to improve, but higher energy prices revive risks for some loans	57
3.2 Profitability above pre-pandemic levels, but outlook weaker	63
Box 5 Interest rate risk exposures and hedging of euro area banks' banking books	67
3.3 Higher market funding costs and improved capital ratios	70

	Box 6 Assessing the resilience of the euro area banking sector in light of the Russia-Ukraine war	74
4	Non-bank financial sector	77
4.1	Non-bank financial sector faces higher credit risk as duration risk starts to materialise	77
4.2	Bond funds are vulnerable to rising yields and uncertain second-round effects from the war	80
	Box 7 Synthetic leverage and margining in non-bank financial institutions	83
4.3	Insurers face near-term headwinds from inflation, while benefiting from rising interest rates	86
5	Macroprudential policy issues	90
5.1	Setting the appropriate pace of policy action to address medium-term vulnerabilities	90
	Box 8 Transmission and effectiveness of capital-based macroprudential policies	93
5.2	Addressing both liquidity mismatch and leverage in the non-bank financial sector	96
5.3	Other ongoing policy initiatives that support euro area financial stability	99
	Special Features	101
A	Climate-related risks to financial stability	101
B	Decrypting financial stability risks in crypto-asset markets	113
	Acknowledgements	124

Foreword



The May 2022 Financial Stability Review (FSR) has been prepared against the backdrop of the devastating invasion of Ukraine. We do not yet know how the war will be resolved. But we do know that the human suffering it has caused is enormous. We hope for peace.

This war is also affecting the economy, in Europe and beyond. The invasion and the associated uncertainty have prompted some repricing in global financial markets, albeit with much less turmoil than seen in March 2020, and dampened the confidence of businesses and consumers that are only just emerging from the tight restrictions imposed during the coronavirus (COVID-19) pandemic. Higher energy and commodity prices are pushing up inflation and slowing the economic recovery. Elevated volatility has highlighted some liquidity risks, notably in some commodity derivatives markets. However, the main threat to euro area financial stability comes from the impact through macroeconomic channels. This implies additional challenges for indebted businesses at a point in time when countries' fiscal space is very limited and support may need to be more targeted than the broad fiscal policy response to the pandemic.

With these developments in mind, this FSR assesses financial stability vulnerabilities and their implications for financial markets, debt sustainability, bank resilience, the non-bank financial sector and macroprudential policies.

This issue of the FSR also includes two special features on topics that are increasingly part of our routine financial stability assessment at the ECB. The first focuses on recent advances in the monitoring of financial stability risks stemming from climate change, building on previous special features on the topic. The second special feature explores risks arising from crypto-assets – which have been increasing over time, as this sector grows both in its size and in its integration with the core financial system.

This issue of the FSR has been prepared with the involvement of the ESCB Financial Stability Committee, which assists the decision-making bodies of the ECB in the fulfilment of their tasks. The FSR exists to promote awareness of systemic risks among policymakers, the financial industry and the public at large, with the ultimate goal of promoting financial stability.

Luis de Guindos
Vice-President of the European Central Bank

Overview

Financial stability conditions have deteriorated

Energy and commodity price shocks, amplified by the Russian invasion of Ukraine, increase risks to post-pandemic growth, inflation and financial conditions in the euro area and globally.

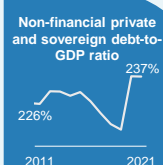
Higher financial market volatility, although largely orderly, underscores risks of sharp corrections. Non-banks are most exposed to duration, credit and liquidity risks.

Euro area sovereigns, corporates and households face higher interest rates and cost pressures that could test debt sustainability for the more highly indebted entities.

Banks, which have remained strikingly resilient and able to support the economy, see increased credit risk and a weaker profit outlook.

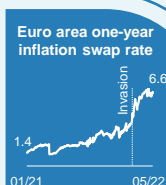
Rising inflation and lower growth put pressure on vulnerable borrowers

- Inflation spikes as outlook deteriorates
- House prices face correction risk
- Rising input costs weigh on corporate margins
- Ukraine war may challenge fiscal positions



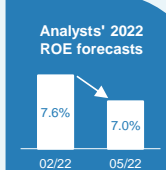
Markets vulnerable as rates adjust to inflation and growth weakens

- Higher-for-longer energy prices
- Corporate spreads widen as risks grow
- Financial fragmentation could emerge
- Interest rate volatility increases



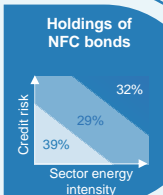
Renewed bank asset quality and profitability concerns

- Re-emerging credit risks
- Possible tightening of credit standards
- Higher bond funding costs
- Rising cyber risks



Non-banks face duration risk amid low liquidity and uncertain credit risk outlook

- Valuation losses from rising rates
- Fund outflows may trigger forced sales
- Increase in illiquid holdings of insurers
- Exposures from synthetic leverage



Macroprudential authorities should continue to address building vulnerabilities, adjusting the type of measure, pace and timing for economic conditions in order to avoid procyclicality.

Having macroprudential space and effective buffers using the whole range of macroprudential instruments would help support medium-term resilience.

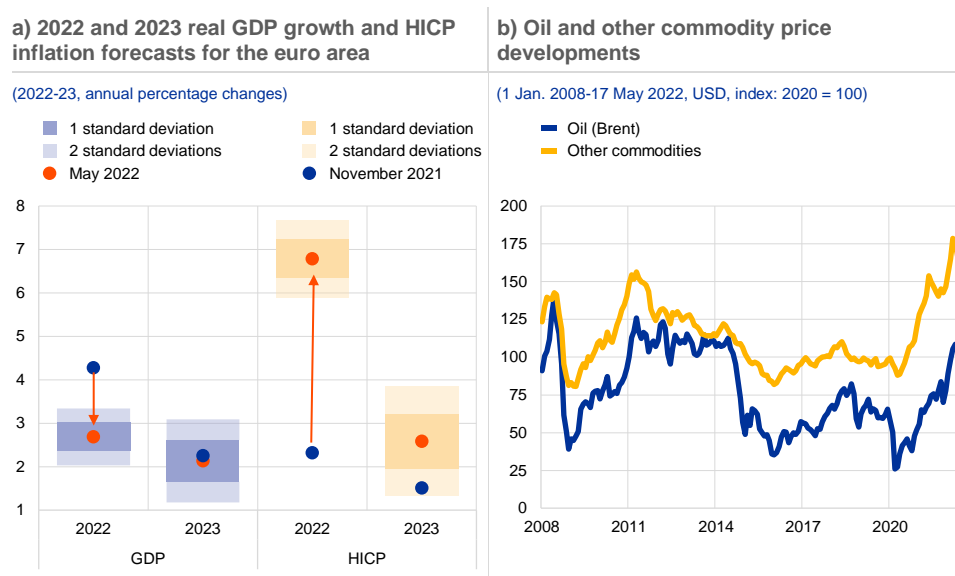
Risks arising from liquidity mismatches, leverage and margining practices in the non-bank financial sector need to be tackled comprehensively.

Higher prices, exacerbated by the Russia-Ukraine war, weaken the recovery and increase global risks

Financial stability conditions have deteriorated, as the post-pandemic recovery has been tested by higher inflation and Russia's invasion of Ukraine. Since late 2021, rising inflationary pressures have threatened to slow the momentum of the recovery in 2022. Upside risks to euro area inflation and downside risks to growth rose sharply following the outbreak of the Russia-Ukraine war (**Chart 1**, panel a). In particular, large rises in commodity and energy prices (**Chart 1**, panel b) and ongoing global supply chain pressures are expected to prolong the period of elevated inflation. The course and consequences of the Russia-Ukraine war are still hard to predict. While peace could reverse some pressures, a protracted conflict could imply sustained higher inflation and even lower growth outturns than currently expected. Risks to inflation, growth and global financial conditions could also be triggered by other global events, such as a broader resurgence of the coronavirus (COVID-19), emerging market weakness or a sharper economic slowdown in China (**Box 4**).

Chart 1

Risks of higher inflation and lower growth outturns in the euro area amplified by an intensified commodity and energy price shock



Sources: Consensus Economics Inc., Refinitiv, Hamburg Institute of International Economics and ECB calculations.
 Note: Panel a: shaded areas display one and two standard deviations in Consensus expectations for euro area real GDP growth and HICP inflation. HICP stands for Harmonised Index of Consumer Prices. Panel b: other commodities include food (cereals, oilseeds/oils and tropical beverages/sugar) and industrial raw materials (agricultural raw materials, non-ferrous metals and iron-ore/scrap).

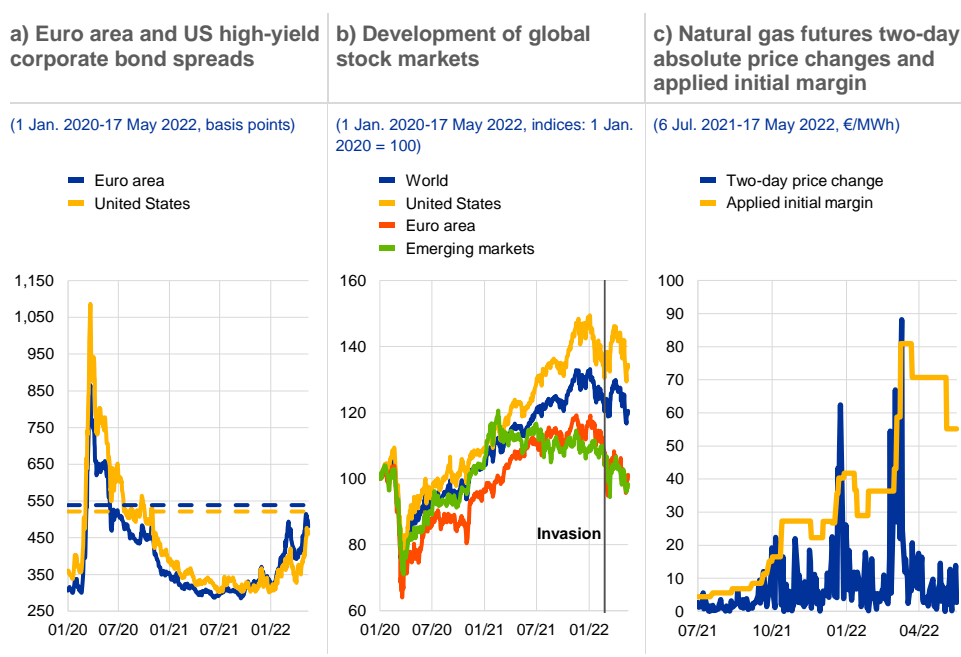
Higher inflation and lower growth could increase market volatility and challenge debt servicing capacity as financing costs rise. The consequences of the war and the shift to a lower-growth, higher-inflation environment affect virtually every aspect of economic activity and financing conditions. In turn, these developments might not only amplify, but could also trigger the materialisation of pre-existing financial stability vulnerabilities identified in previous issues of the FSR. These include heightened debt sustainability concerns in non-financial sectors or the possibility of corrections in both financial and tangible asset markets (**Box 3**).

Initial risk-off reaction in markets largely orderly, but asset price correction concerns remain

The Russian invasion of Ukraine triggered a large but, in most cases, short-lived market reaction. In early 2022, markets, positioning for solid growth, a temporary spike in inflation and relatively modest policy tightening, saw a repricing in global equity and bond markets. The outbreak of the war, which increased the risk of a higher-inflation, lower-growth scenario, saw market volatility increase, credit spreads widen and equity indices decline (**Chart 2**, panels a and b). The market response was substantial, but more modest than at the onset of the pandemic. Movements in commodity markets were most pronounced, as Russia and Ukraine are key suppliers. Euro area assets, given greater proximity and links to Russia and Ukraine, experienced larger losses than US assets. By the end of March, euro area markets had recovered most of the initial losses, but commodity prices remained elevated. Over the course of April and May, concerns about the global growth outlook and central banks' response to higher inflation rates led to renewed weakness in risky asset valuations.

Chart 2

The initial market correction to the war was largely orderly, but liquidity pressures arose in some derivatives markets



Sources: Bloomberg Finance L.P., EPFR Global, ICE Clear Europe and ECB calculations.

Notes: Panel a: dashed lines represent the long-term average over the past two decades. Government option-adjusted spreads are employed. Panel b: equity indices shown are the MSCI All Country World Index, the MSCI USA Index, the MSCI Euro Index and the MSCI Emerging Markets Index. Panel c: data on margins are provided by ICE Clear Europe in accordance with the [Terms of Use](#). Applied initial margins are based on the scanning ranges published by ICE Clear Europe. Full initial margins should be computed with the CCPs' proprietary risk models, in this case those of ICE Clear Europe, taking into account all risk parameters and full exposures.

Further corrections in financial markets could be triggered by an escalation of the war, even weaker global growth or if monetary policy needs to adjust faster than expected. Despite recent asset price corrections, valuations remain stretched in the light of the deterioration in macro-fundamentals, and further sharp corrections are

a risk. Such corrections could be triggered by a further escalation of the war, emerging market stresses or by more persistent inflation than currently foreseen, which might prompt faster monetary policy normalisation by major central banks. Higher interest rates could challenge the valuations of riskier assets, such as equities. Euro area sovereign and high-yield credit spreads have widened over the course of 2022. Spread increases are in part related to the rise in underlying risk-free rates, as the latter mechanically have a larger impact on the earnings and budget deficits of more indebted firms and sovereigns.

Large shifts in commodity prices and related margin requirements have posed challenges to liquidity management for some derivative market participants.

Commodity derivatives markets are used by a wide range of firms, including energy producers, suppliers and distributors, and users, to manage risks arising from volatile commodity prices, and enable them to fulfil contracts with corporates and households. In response to the recent rise in commodity price volatility, central clearing counterparties (CCPs) and clearing members have increased the initial margins for commodity derivatives (**Chart 2**, panel c). Margin requirements must be met by posting cash or highly liquid collateral. For some firms, these liquidity requirements may become prohibitive, while for others, the cost of hedging may have started to outweigh the perceived benefit. As a result, some firms may choose to reduce their hedging activities, or switch to contracts with lower collateralisation needs, including non-centrally cleared derivatives (**Chapter 2**). In the latter case, both the firm and the counterparty could be more exposed to counterparty credit risk. Sufficient margining is an important safeguard in the financial system. But recent developments do raise the question of whether margining practices (including those between the clearing member and their client) might be unnecessarily procyclical, and whether they are sufficiently transparent (**Chapter 5**).

Investment funds saw manageable outflows following the invasion, but euro area non-banks remain vulnerable to a further market correction, given high duration, credit and liquidity risk. Limited aggregate exposure to Russian and Ukrainian assets meant that only a few of the more specialist investment funds were suspended. That said, since early 2022, there has been a rotation from corporate to sovereign bond funds, as well as from growth to value equity funds. After the start of the war, there had been renewed interest in inflation-protected bond funds in anticipation of higher inflation, and in commodity-related equity funds in the light of the surge in energy prices. These trends slowed down or reversed again in late April in line with weaker performance of these asset classes (**Chart 3**, panel a). Some duration risk for non-banks has started to materialise in recent quarters, and further valuation losses may arise. Non-banks also have large exposures to weaker corporates which may be especially vulnerable to higher inflation and lower growth. The risk that investment funds could amplify a market correction due to fire sales remains, given low liquidity buffers (**Chart 3**, panel b). For some non-banks, additional vulnerabilities stem from their excessive synthetic leverage via derivatives (**Box 7**) or investments in crypto-assets, where growing institutional investor interest is deepening the linkages with the mainstream financial system (**Special Feature B**). In the medium term, however, a higher interest rate environment could reduce the non-bank sector's incentives to search for yield and benefit the insurance and

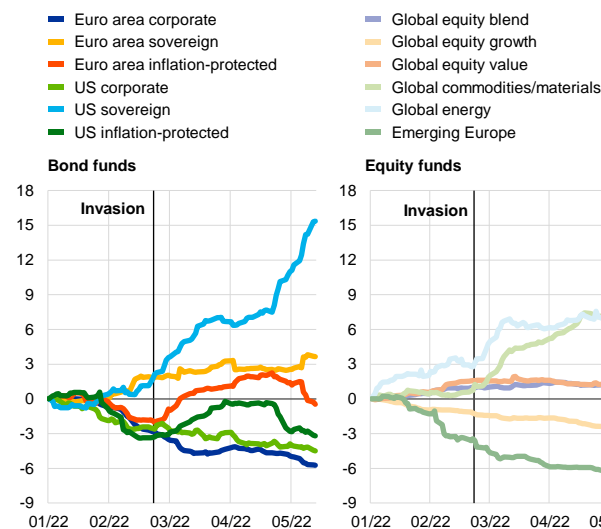
pension fund sector because of its negative duration gap, thereby mitigating overall financial stability risks (**Chapter 4**).

Chart 3

Non-banks proved largely resilient to the market impact of the invasion, but underlying credit, duration and liquidity risks remain causes for concern

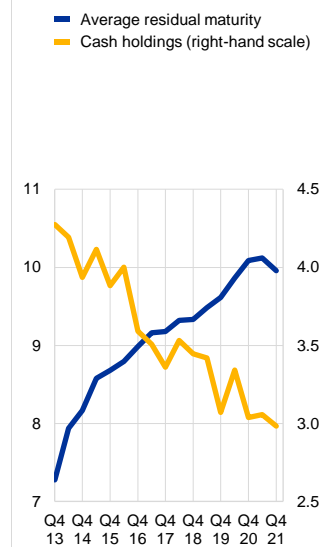
a) Euro area bond and equity fund flows

(1 Jan. 2022-17 May 2022, cumulative daily flows as a percentage of total net assets)



b) Investment fund duration and liquidity risk

(Q4 2013-Q4 2021, left-hand scale: years, right-hand scale: percentages of total assets)



Sources: EPFR Global, ECB (Investment Funds Balance Sheet Statistics and Securities Holding Statistics) and ECB calculations. Note: Panel b: average residual maturity is a proxy for duration risk and is used here because of the longer available time series.

Input price increases and higher financing cost add strains for more indebted firms and sovereigns

Euro area corporates face renewed headwinds as input prices have soared and the economic outlook has become more clouded. A solid economic recovery helped measures of aggregate corporate vulnerability to improve towards the end of 2021 (**Chapter 1.3**). Gross profits recovered to 7% above pre-pandemic levels, while policy support measures have kept corporate insolvencies at historic lows. However, a weaker economic growth outlook, coupled with growing margin pressure as a result of soaring input prices, has led to some increase in expected corporate default rates (**Chart 4**, panel a).

There is a sizeable cohort of more vulnerable and pandemic-strained firms, some of which are also sensitive to commodity prices. The most vulnerable corporates which are more indebted, less liquid and have lower sales levels might face particular challenges in the event of a pronounced economic slowdown (**Box 1**). Higher energy and commodity prices could hurt activity in economic sectors which have not yet fully recovered from the pandemic, such as air transport,

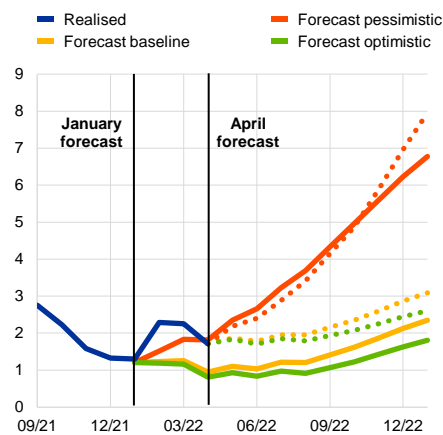
accommodation, and food and beverages (Chart 4, panel b), or which have low pricing power to pass on higher costs (Chapter 2). These vulnerabilities are compounded by the prospect of tighter financing conditions that would adversely affect the debt servicing capacity of lower-rated firms in particular. This could also fuel corporate downgrade risk, as the bulk of issuance activity in recent years has taken place in the lowest investment grade bucket (BBB).

Chart 4

Signs of renewed risks for the corporate sector, with some pandemic-strained sectors highly exposed to higher energy prices

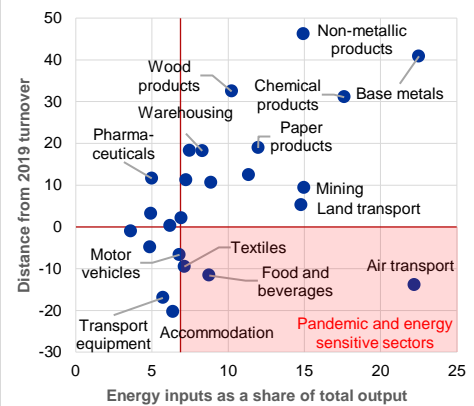
a) European speculative-grade 12-month trailing default rates

(Sep. 2021-Feb. 2023E, percentages)



b) Corporate turnover relative to pre-pandemic and energy use by industrial sector

(x-axis: 2018, percentages, y-axis: difference 2019/21, index: 2019 = 100)



Sources: Moody's Analytics, OECD Trade in Value Added (TIVA) database (2018), Eurostat and ECB calculations.

Notes: Panel a: European speculative-grade default rates forecast by Moody's Analytics as at January 2022 (solid lines) and April 2022 (dotted lines). The baseline forecasts incorporate low refinancing risk and healthy corporate fundamentals. The optimistic scenario builds on the favourable baseline, expecting markets to remain very supportive of speculative-grade issuers in 2022, while showing exceptional demand for high-yield debt in the search for yield. By contrast, the pessimistic scenario acknowledges a particularly weak ratings mix among European speculative-grade issuers. For more details on the different scenarios, see the [Moody's website](#). There is a structural break in the time series of realised rates as of March 2022, as defaulting and non-defaulting Russian issuers whose ratings were recently withdrawn have been excluded. Panel b: energy use includes direct and indirect use of: (i) electricity, gas, steam and air conditioning; (ii) mining and quarrying; and (iii) coke and refined petroleum products as a share of total output. Energy inputs by industry are classified according to the United Nations International Standard Industrial Classification for All Economic Activities (ISIC), Rev. 4, and are attributed to each sector based on the four-digit SIC code. The red vertical line represents the median usage of energy inputs as share of total output across all sectors of economic activity. Out of 42 NACE sectors, 24 are shown in the chart.

Euro area fiscal positions also face challenges as they now encounter a weaker recovery and tighter financial conditions.

In 2021, as the euro area economy began recovering from the COVID-19 shock, governments gradually withdraw the stimulus they provided during the pandemic. As a result, fiscal positions in 2022 are expected to improve compared to 2021. However, the repercussions of the war in Ukraine may create new draws on public finances. While immediate stress in euro area sovereign bond markets remained low, short-term fiscal pressures have increased in a number of countries (Chart 5, panel a). This is attributable to measures aimed at cushioning the adverse impact of higher energy prices on households and corporates, as well as the cost of managing the flow of refugees and higher defence spending in some countries. Market participants estimate the associated additional fiscal impact for the largest euro area countries at around 1.2 percentage points of GDP on average. Also, where coupled with lower economic

growth than previously anticipated, higher interest rates may translate into higher refinancing needs (Chart 5, panel b). This could put sovereign debt dynamics on an unfavourable trajectory, especially in higher-debt countries.

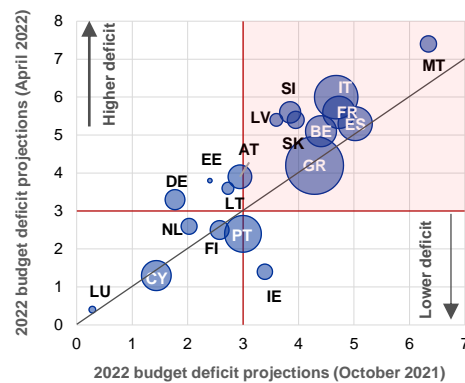
Additional fiscal space to cushion the economy from future shocks may have become more limited in some euro area countries. This, coupled with debt sustainability concerns, could contribute to a reassessment of sovereign risk by market participants and spur fragmentation pressures in sovereign bond markets. That said, countries with higher sovereign risk have taken advantage of low rates to prolong their debt maturity profile, which reduces their vulnerability to abrupt changes in market sentiment. To the extent that higher sovereign vulnerabilities coincide with fragilities in the corporate and banking sectors, risks materialising in any of these sectors (in isolation or combination) may lead to adverse feedback loops between sovereign, banks and corporates (Box 1).

Chart 5

Euro area sovereigns transition from pandemic support to tackling the repercussions of the war, as higher rates and lower growth challenge more indebted sovereigns

a) Budget deficit projections for 2022 across the euro area

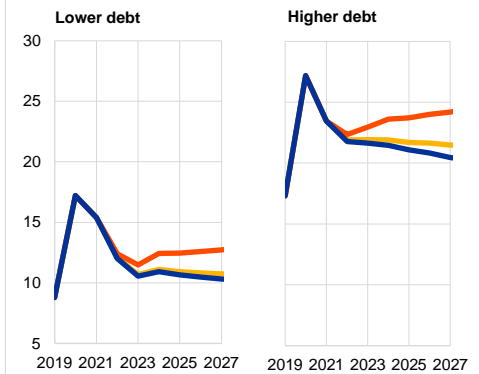
(2022E, percentages of GDP)



b) Impact of an interest rate and GDP shock on sovereign gross financing needs

(2019-27, percentages of GDP)

- Interest rate rise (+100 basis points)
- Interest rate rise (+100 basis points) + one percentage point lower potential growth for 3 years
- Benchmark



Sources: IMF Fiscal Monitor, ECB and ECB calculations.

Notes: Panel a: the horizontal and vertical red lines represent the 3% of GDP Maastricht threshold for the budget deficit. The size of the bubble represents the general government gross debt-to-GDP ratio in 2021. Panel b: the aggregate of higher-debt countries includes euro area countries with a 2021 general government debt-to-GDP ratio above 90%. The lower-debt aggregate includes the remaining euro area countries. The threshold of 90% of GDP for sovereign debt is based on findings in the empirical literature. See, for example, Checherita and Rother*. The benchmark refers to the main scenario of the debt sustainability analysis simulations based on the December 2021 Eurosystem staff macroeconomic projection exercise for the period 2021-24 and assumes broad minimum compliance of the fiscal path thereafter with the Stability and Growth Pact (gradual convergence to countries' specific medium-term fiscal objectives, with current debt rule requirements not included in the simulations). In the first scenario, a permanent increase in interest rates of 100 basis points is applied to all new and refinancing operations as of 2023 across the whole yield curve over a ten-year horizon. In the second scenario, the increase in interest rates is combined with a fall in potential GDP growth by one percentage point for three years over the period 2023-2025. No catching-up effect is expected after 2025, leading to a permanent downward shift of 3% in the potential GDP level.

*) Checherita, C. and Rother, P., "The impact of high and growing government debt on economic growth – an empirical investigation for the euro area", Working Paper Series, No 1237, ECB, 2010.

Expansion continues in residential real estate markets, increasing the vulnerability to corrections

Vulnerabilities in euro area residential real estate markets continued to build.

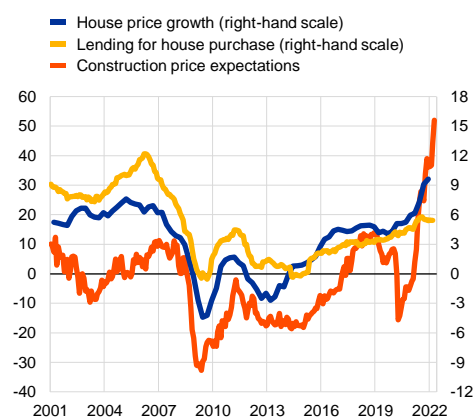
Euro area house prices increased at a rate of almost 10% in the final quarter of 2021 – the fastest pace observed in the last 20 years (**Chart 6**, panel a). The trend was driven among other things by changes in housing preferences triggered by the pandemic, low interest rates and supply-side constraints (**Box 2**). At the same time, the buoyant growth of residential real estate prices is coupled with robust mortgage lending (**Section 1.5**). The associated rise in vulnerabilities led to the European Systemic Risk Board issuing new warnings and recommendations in December 2021, strengthening the case for macroprudential action in some countries (**Chapter 5**). While house price pressures are buttressed in the near term by tight supply conditions and continued demand amid household and investor preference for housing, signs of overvaluation render some housing markets prone to price corrections. In particular, an abrupt increase in real interest rates could induce house price corrections (**Box 2**).

Chart 6

Euro area households could face the triple challenge of possible corrections in residential real estate markets, higher interest rates and an income squeeze

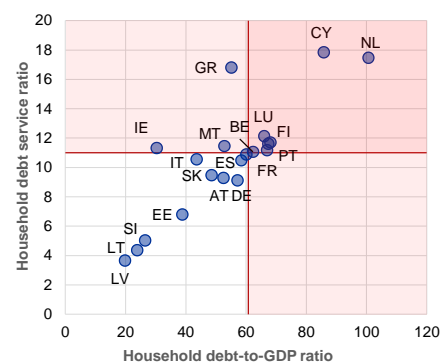
a) House price and mortgage lending growth, and construction price expectations

(Jan. 2001-Apr. 2022, left-hand scale: index, right-hand scale: percentages)



b) Household debt-to-GDP and household debt service ratios

(Q4 2021, percentages)



Sources: Eurostat, ECB and ECB calculations.

Notes: Panel a: construction price expectations refer to the three months ahead. RRE price growth is shown until the fourth quarter of 2021 and lending for house purchase until March 2022. Panel b: the red horizontal and vertical lines represent the euro area aggregate values. The debt service ratio is calculated as debt service cost divided by income following Drehmann et al.* Compensation of employees is used to measure the income of households.

*) Drehmann, M., Illes, A., Juselius, M. and Santos, M., "How much income is used for debt payments? A new database for debt service ratios", *BIS Quarterly Review*, September 2015.

Risks from mortgage indebtedness are amplified by the impact of higher costs on the debt servicing capacity of euro area households.

Despite rising indebtedness since the start of the pandemic (**Section 1.4**), balance sheet fundamentals of euro area households remained relatively solid overall. However, higher inflation and energy price outturns may reduce households' purchasing power,

unless wages catch up sufficiently without destabilising inflation expectations. The associated squeeze may particularly affect lower-income households, which spend a larger portion of their incomes on food and energy. At the same time, the currently relatively favourable financial and employment situations of euro area households could worsen, should prolonged economic weakness translate into a growing number of corporate insolvencies and restructurings. In an environment of deteriorating income positions and higher interest rates, households' debt servicing capacity could be challenged, particularly in countries with elevated debt levels and high debt servicing needs (**Chart 6**, panel b). That said, the shift towards more fixed-rate mortgage lending in recent years will shield many households from the immediate impact of higher interest rates (**Chart 7**, panel c). Similarly, active use of macroprudential policies in most euro area countries, notably through borrower-based measures, are helping to improve the resilience of borrowers.

Euro area banks show resilience, but profitability prospects worsen as asset quality concerns resurface

The positive market sentiment towards euro area banks in 2021 reversed sharply following the Russian invasion of Ukraine. Marked corrections in bank share prices (**Chart 7**, panel a) erased the gains made in 2021 amid improved earnings and expectations of higher interest rates. After the initial shock, markets reversed some of the losses as it became apparent that only a few banks had material direct exposures to Russia and Ukraine. In addition, the majority of banks signalled their commitment to previously announced dividend and share buyback plans for 2022.

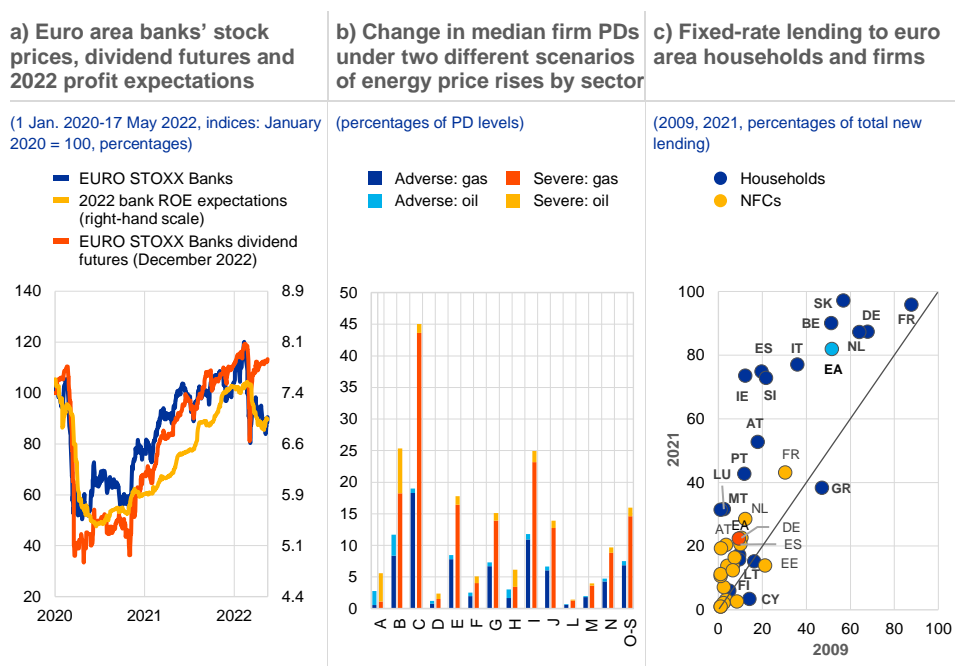
After a remarkable recovery in bank profitability in 2021, projections for 2022 have been revised down as credit risks have increased. Bank profitability surpassed pre-pandemic levels in 2021, driven by higher operating income and lower loan loss provisions, but profitability prospects have worsened in line with a weaker macroeconomic backdrop. Profitability remained solid at the start of 2022 too, but bank analysts revised down their 2022 return on equity (ROE) forecasts for euro area banks to around 7% (**Chart 7**, panel a) – a level which is still low by international standards. While banks showed resilience and credit risks associated with direct exposures are limited, the banking sector could be indirectly affected by the repercussions of the war. For example, it may be exposed to greater corporate and household credit risks as a result of higher commodity prices and disrupted global supply chains. In fact, a further major energy price shock could translate into higher corporate probabilities of default (PDs), including in some sectors that were badly hit by the pandemic, such as accommodation and food services (**Chart 7**, panel b). However, a broader vulnerability exercise suggests that overall the banking sector is resilient to the second-round effects arising from the Russia-Ukraine war (see **Box 6**).

A rise in interest rates may provide some support to bank margins in the short run, but some banks might face challenges in the medium term. A higher interest rate environment and steeper yield curve will mechanically support interest income and, in turn, bank profitability, but funding low-yielding assets profitably may become

challenging in the medium term. In particular, the large-scale shift over the last decade from floating to fixed-rate lending, especially for households, may dampen some of the benefits that banks enjoy from higher interest rates (Chart 7, panel c). This may pose a risk to banks' medium-term profitability prospects in cases where such interest rate exposures are less well hedged (Box 5). As interest rates rise, banks could also face higher credit risks, given growing exposures to vulnerabilities in the non-financial sector in recent years.

Chart 7

Bank stock prices reflect an uncertain outlook amid resurfacing asset quality concerns and rising interest rate risks for some banks



Sources: Bloomberg Financial L.P., Urgentem, Moody's Analytics, Bureau van Dijk – Orbis database, ECB and ECB calculations.
 Notes: Panel a: 2022 bank ROE expectations indicate the weighted average of a sample of 32 listed euro area banks. Panel b: adverse scenario: +69% on gas price and +24% on oil price; severe scenario: +138% on gas and +48% on oil price. The energy price assumptions are consistent with the scenario analysis conducted in the context of the [March 2022 ECB staff macroeconomic projections](#). NACE codes and corresponding economic activities: A – Agriculture, forestry and fishing, B – Mining and quarrying, C – Manufacturing, D – Electricity, gas, steam and air conditioning supply, E – Water supply; sewerage, waste management and remediation activities, F – Construction, G – Wholesale and retail trade; repair of motor vehicles and motorcycles, H – Transportation and storage, I – Accommodation and food service activities, J – Information and communication, L – Real estate activities, M – Professional, scientific and technical activities, N – Administrative and support service activities, O – Public administration and defence; compulsory social security, P – Education, Q – Human health and social work activities, R – Arts, entertainment and recreation, S – Other service activities. Panel c: NFCs stands for non-financial corporations.

Long-standing structural challenges, together with a greater need to manage cyber risk, continue to weigh on the outlook for euro area banks. Longer-term challenges associated with low cost-efficiency, limited revenue diversification and overcapacity compound growing cyclical headwinds. In addition, euro area banks urgently need to press ahead with their digital transformation, not least to be able to manage the growing threat of cyber risks. However, having focused on cost-cutting in recent years to boost profits, parts of the banking sector continue to lag behind global peers in terms of IT infrastructure investment (Chapter 3). Heightened uncertainty surrounding the outlook and lower profit expectations may now further delay the transformation plans of euro area banks, which would have an adverse impact on their competitiveness.

Financial institutions and markets need to accelerate the transition to a low-carbon economy

Banks and non-banks alike need to step up their efforts to support the move towards a net-zero economy.

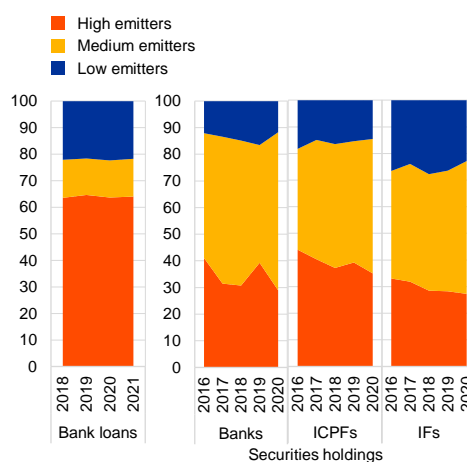
Metrics of financial institutions' exposure to climate-related risks show little evidence of a decline over the last few years. In fact, while euro area NFCs have reduced actual emissions, loans to more polluting firms still represent around two-thirds of banks' credit exposures (**Special Feature A**). Similarly, banks and non-banks have reduced their holdings of securities issued by firms with higher emission levels only slightly over the last five years (**Chart 8**, panel a). The Russian war in Ukraine has highlighted the risks that can arise from high dependency on fossil fuels, whose price and supply can be volatile.

Chart 8

The carbon footprint of financial institutions' portfolios has not decreased significantly, and greenwashing risks remain high in financial markets

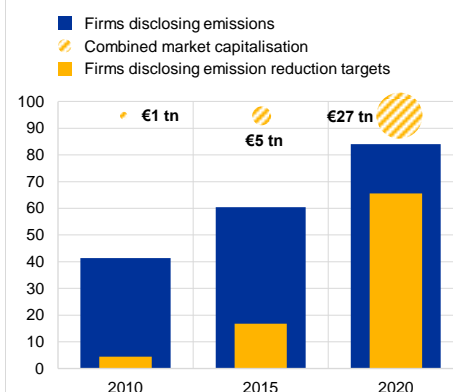
a) Euro area banks' credit exposures to, and securities holdings of, high and low emitters

(2018-21, 2016-20, percentages of total exposures and securities holdings)



b) Disclosure of NFC greenhouse gas (GHG) emission data by type of emitter

(2010-20, share of listed NFCs disclosing GHG emissions and emission-reduction targets; share of audited disclosures)



Sources: ECB (AnaCredit and Securities Holding Statistics), Bureau van Dijk – Orbis database, Refinitiv, Urgentem and ECB calculations.

Notes: Panel a: ICPFs stands for insurance corporations and pension funds; IFs stands for investment funds. High/low emitters are defined as firms with reported emission intensity in the top/bottom 33% of the distribution across euro area banks' borrowers as of end-2020, i.e. firms with annual emission intensity registered in 2020 above 556 tCO₂e/USD million and below 47 tCO₂e/USD million. ICPFs stands for insurance corporations and pension funds, IFs stands for investment funds. Panel b: combined market capitalisation refers only to firms disclosing emission-reduction targets.

While green financial markets continue to deepen, there is a need to monitor greenwashing risks.

Sustainable financial markets continued to grow at a brisk pace in 2021, amid growing investor interest in green finance. Firms are increasingly disclosing their exposure to transition risk as well as their commitments to reduce emissions (**Chart 8**, panel b), indicating increasing awareness of the need to transition to a low-carbon economy. That said, greenwashing risks do remain in capital markets. These need to be tackled using better, more consistent information and enhanced standards for financial instruments, to ensure that green finance effectively supports the transition to a low-carbon economy.

Macroprudential policy needs to strengthen resilience to handle future shocks

The euro area financial stability outlook has deteriorated as inflation has risen, especially since the start of the Russia-Ukraine war. Upside risks to inflation, especially from energy prices, and downside risks to growth are amplifying pre-existing vulnerabilities identified in previous issues of the FSR, such as those associated with mispricing in some financial and tangible asset markets, as well as the legacy of higher debt levels in non-financial sectors. The vulnerabilities identified could be exacerbated by shocks such as (i) a further escalation of the Russia-Ukraine war or further economic sanctions imposed in response to the war; (ii) unexpected changes in growth or inflation; or (iii) a resurgence in COVID-19 infections, with a greater economic impact than currently expected. The potential for these vulnerabilities to materialise simultaneously and possibly amplify each other further increases the medium-term risks to financial stability.

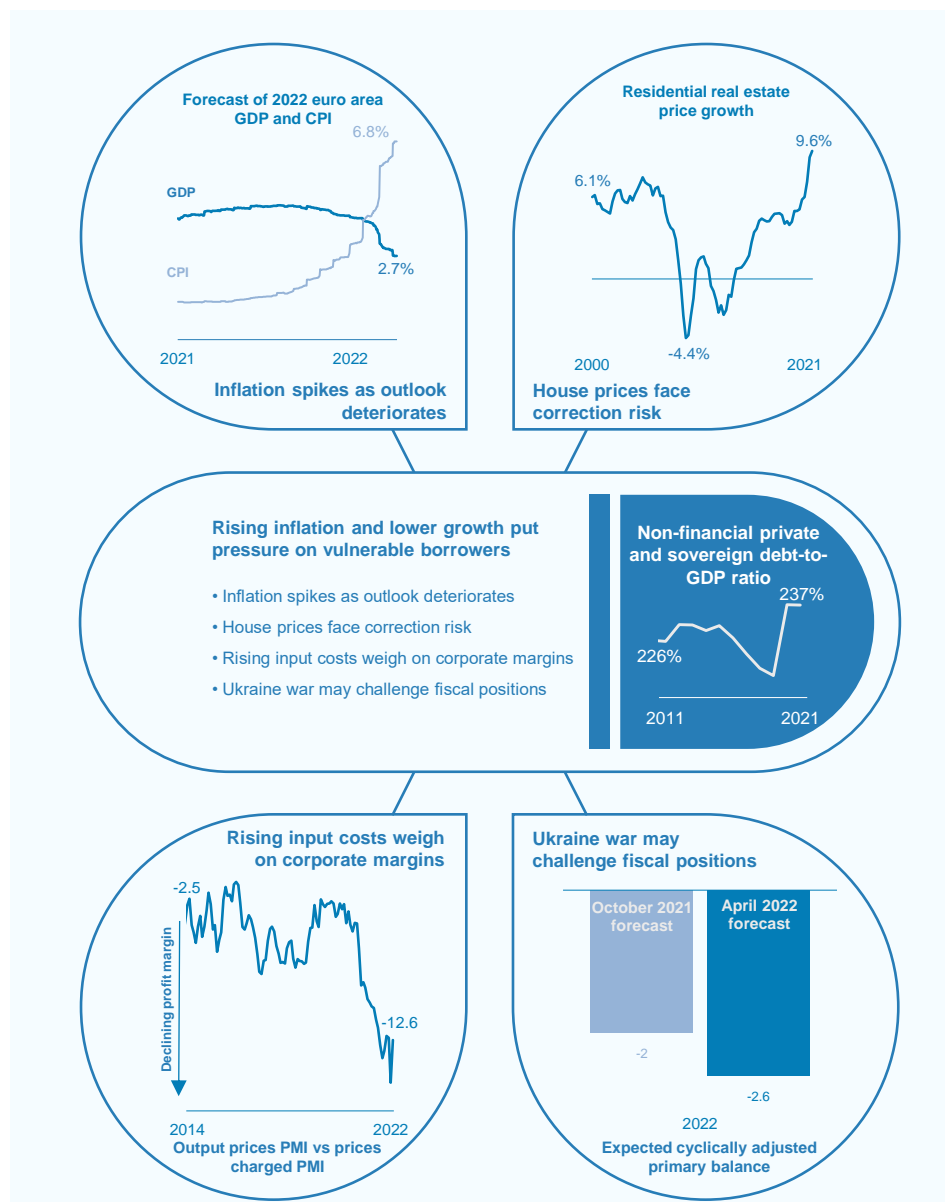
As economic conditions allow, further building resilience in a timely manner remains a sound policy strategy. Banks currently have ample capital headroom on top of their regulatory requirements, and a vulnerability analysis specifically assessing the adverse implications of the war in Ukraine indicates that the euro area banking system remains resilient under the scenarios considered. Nevertheless, macroprudential policy action would further enhance resilience against vulnerabilities that have already accumulated, including those in residential real estate markets, and mitigate the risk of bank de-leveraging if systemic risk materialises. As long as economic conditions do not deteriorate significantly, existing bank capital generation capacity and headroom should mitigate a detrimental impact on credit supply from increasing capital buffers. In addition, there are also costs associated with delayed action, especially if uncertainty persisted into the medium term and vulnerabilities remained unaddressed or continued to build. Overall, if the economic costs of activating additional capital buffers remain low and the financial cycle is expected to remain on an upward trend, as was the case prior to the outbreak of the war, when policy tightening commenced in some countries, authorities can continue to act appropriately while taking into account the uncertainty related to the war to avoid procyclical effects. Authorities should tailor their policy strategy to the national context by using the whole range of macroprudential instruments that are at their disposal, including borrower-based measures as already in place in several countries.

Creating additional macroprudential space while also enhancing the effectiveness of the existing countercyclical capital buffer would support the resilience of the financial system over the medium term. In its input to the European Commission's review of the macroprudential framework, the ECB has called for more macroprudential space in the form of a higher amount of releasable capital buffers that could further improve banks' loss absorption capacity while maintaining the provision of key services in a downturn. In addition, increasing the flexibility in the existing countercyclical capital buffer (CCyB) framework could facilitate timely policy action in both the activation and release phases. The ECB's response also included additional proposals to fill other gaps in the policy toolkit, promote the implementation of instruments at the national level, streamline the

activation and coordination procedures for macroprudential measures and address global risks.

Regulatory initiatives to tackle risks from liquidity mismatches, leverage and margining practices in the non-bank financial sector should continue to progress. Developing a comprehensive macroprudential approach for non-banks remains essential to address structural vulnerabilities and strengthen the sector's resilience. The focus of the international policy agenda has now shifted to structural liquidity mismatches in the investment fund sector and should prioritise a better alignment of asset liquidity with redemption terms. The use of leverage by non-banks in a highly interconnected global financial system is a key concern for financial stability and needs to be tackled using a range of measures across entities and activities. In addition, recent events have underlined the need to make further progress with international efforts to assess financial stability risks arising from margining practices.

1 Macro-financial and credit environment



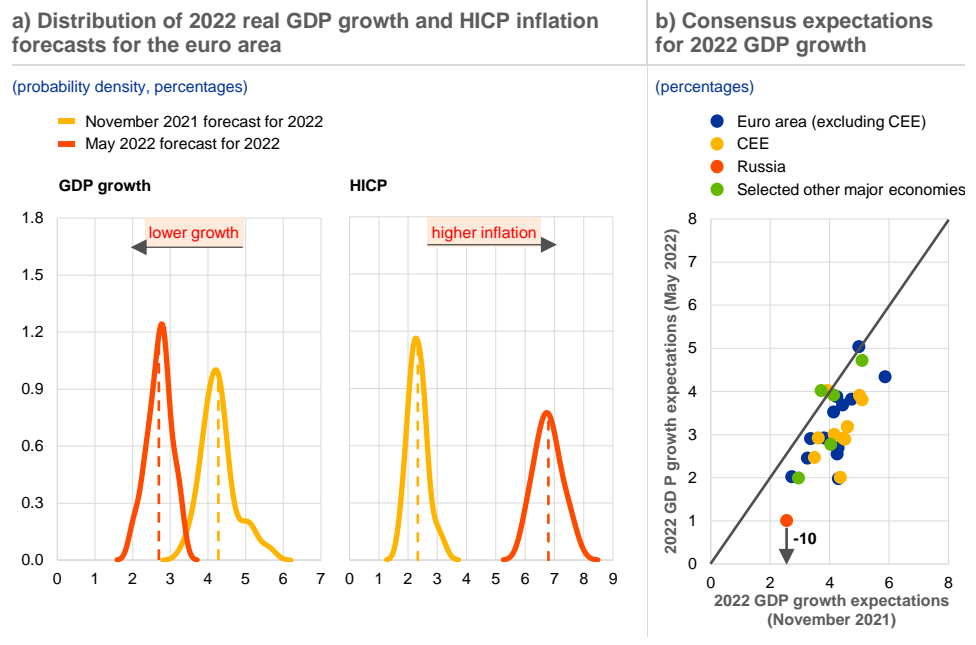
1.1 Euro area economic outlook weakens on the back of global cost pressures and the war in Ukraine

Since the November 2021 Financial Stability Review, the economic outlook for the euro area has weakened, while inflation projections have been revised upwards. Private sector forecasters have downgraded their growth expectations significantly since the end of last year as the repercussions of the Russian war in Ukraine reverberate globally, likely slowing the economic recovery. The supply chain and cost pressures that built up during the coronavirus (COVID-19) pandemic have

been amplified by the war, which has prompted further increases in commodity prices, affected supply chains and substantially weakened consumer confidence. As a result, consensus expectations for real GDP growth in the euro area in 2022 have been downgraded to 2.7% (down 1 percentage points since late February), while inflation expectations have been revised upwards to 6.8% (up 2.6 percentage points since late February) (**Chart 1.1**, panel a).

Chart 1.1

Forecasters pare back growth prospects and raise inflation projections as sanctions slow the economic recovery and hit the Russian economy particularly hard

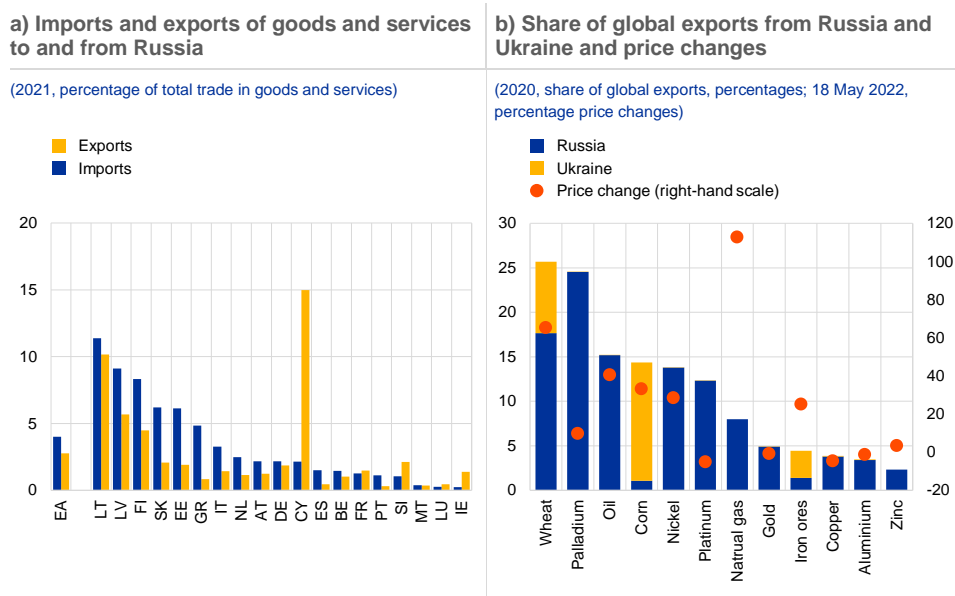


Sources: Consensus Economics Inc. and ECB calculations.
 Notes: Panel a: HICP stands for the Harmonised Index of Consumer Prices measure of inflation. The dashed vertical lines represent the average forecast values. Panel b: selected other major economies include Australia, Canada, China, Japan and the United States. CEE stands for central and eastern Europe and includes Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia and Slovakia. CEE and Russia forecasts show April 2022 consensus GDP growth expectations.

While the war in Ukraine has prompted material increases in energy and commodity prices, the more direct impact via euro area exports has been contained. Sanctions have served to significantly isolate Russia's economy, which is reflected in a sharp downgrade of its economic growth outlook and a simultaneous increase in inflation expectations (**Chart 1.1**, panel b). The direct impact of the conflict on the euro area economy has been relatively modest. On aggregate, exports to Russia account for 3% of foreign demand, with some eastern European countries having significantly larger exposures (**Chart 1.2**, panel a). Imports from Russia, at around 4% of the total, are also modest. However, the relatively small headline figures for imports and exports conceal the euro area's greater dependency in terms of energy supply. The euro area relies on Russian imports for 20% of its oil and 35% of its gas needs, with some larger economies showing even greater levels of dependency. Accordingly, those economies with a larger share of Russian energy in their total energy mix may face greater challenges in finding alternative sources and might be harder hit if further sanctions are imposed.

Chart 1.2

Trade links with Russia and Ukraine are modest on aggregate, but both countries are critical sources of some key commodities



Sources: Bloomberg Finance L.P., UN Comtrade database, Eurostat, ECB and ECB calculations.
Note: Panel b: price change is based on active future contracts quoted by Bloomberg.

The conflict in Ukraine has added to pre-existing global inflationary pressures as the war has increased the prices of food and non-food commodities. Prices have increased strongly in those commodities of which Russia and Ukraine are major global exporters (Chart 1.2, panel b). Moreover, the sharp rise in commodity prices observed since the start of the conflict is adding to pre-existing inflationary pressures in commodities used in the extraction or processing of other commodities (e.g. steel, aluminium) and potash used to produce fertilisers and metals. Spiralling commodity prices are posing particular difficulties for importing emerging market economies. Moreover, emerging markets, such as India, Turkey, Mexico and developing CEE countries, may experience significant rises in headline figures on the back of the weighting of commodities in their consumption baskets. Added to these concerns is the prospect of global monetary tightening and associated spillovers, which could have a negative effect on debt sustainability in emerging markets (Chapter 2).

Supply chain bottlenecks continue to weigh on the global recovery and may intensify. Global supply chains have been under pressure since late 2020 on account of strong demand for manufactured goods, shortages in the supply of certain key inputs and disruptions in the logistics industry. As a result, suppliers' delivery times in the euro area have lengthened considerably over the past year and have contributed to significantly higher input prices (Chart 1.3, panel a). Going forward, some supply chains are also likely to be affected by the war in Ukraine, given the significant role, among others, played by both Russia and Ukraine in global metal exports, among others (Chart 1.2, panel b). In addition, China's zero-COVID policy has resulted in strict lockdowns being imposed in several economic centres, further disrupting the supply of certain goods. Moreover, although the euro area Purchasing

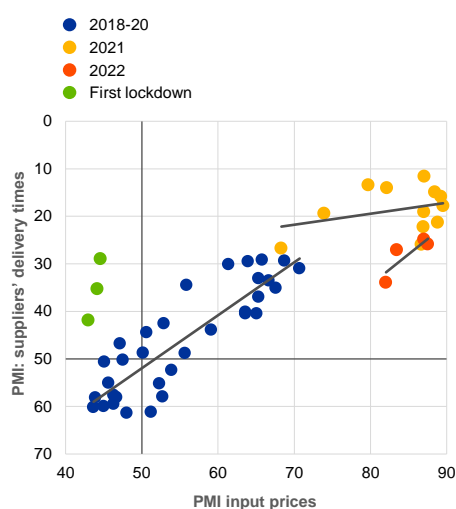
Managers' Index (PMI) remains comfortably in expansionary territory (55.8 in April 2022), disruptions continue to weigh on the business cycle, delaying the (global) recovery from the pandemic (**Chart 1.3**, panel b).

Chart 1.3

Supply chain disruptions increase input prices and depress the economic recovery

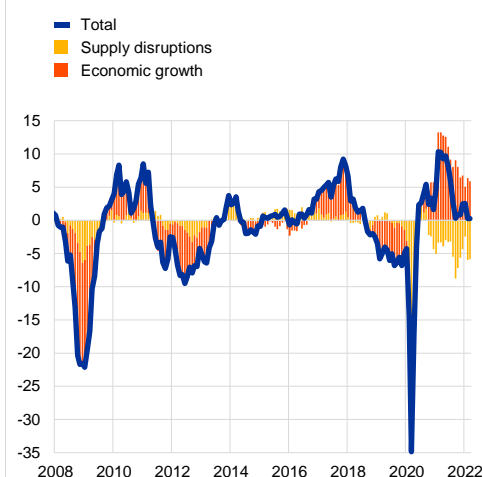
a) Euro area suppliers' delivery times PMI versus input prices PMI

(Jan. 2018-Apr. 2022, index)



b) Euro area output PMI and supply and demand factors

(Jan. 2008-Apr. 2022, deviation from long-run average)



Sources: IHS Markit, ECB and ECB calculations.

Notes: Panel a: suppliers' delivery times shown on an inverted scale; a lower reading indicates longer supplier delivery times. First lockdown refers to the period between March and May 2020. Panel b: historical decomposition of euro area output PMI, which was obtained using a two-variable Bayesian VAR with output PMI and suppliers' delivery times component of PMI, identified through sign restrictions and estimated over the period from January 1999 to April 2022. See also the box entitled "Supply chain disruptions and the effects on the global economy", *Economic Bulletin*, Issue 8, ECB, 2021. The identification strategy was inspired by Bhushan and Struyven*.

*) Bhushan, S. and Struyven, D., "Supply Chains, Global Growth, and Inflation", *Global Economics Analyst*, Goldman Sachs Research, 20 September 2021.

The slowdown in the Chinese economy is adding to the vulnerabilities in emerging markets and is increasing the downside risks to the global recovery.

The turmoil in China's property development sector continued at the start of 2022, with growth in residential real estate sales remaining negative and house prices weakening further. In addition, strict pandemic containment policies are depressing economic activity, which is forecast to grow at around 5% annually in the period 2022-24, significantly below the long-term average of 8%. A slowing Chinese economy also poses additional challenges for emerging market economies with close financial links to China. All in all, these developments add further downside risks for global economic prospects, with a potentially significant spillover to the euro area (**Box 4**).

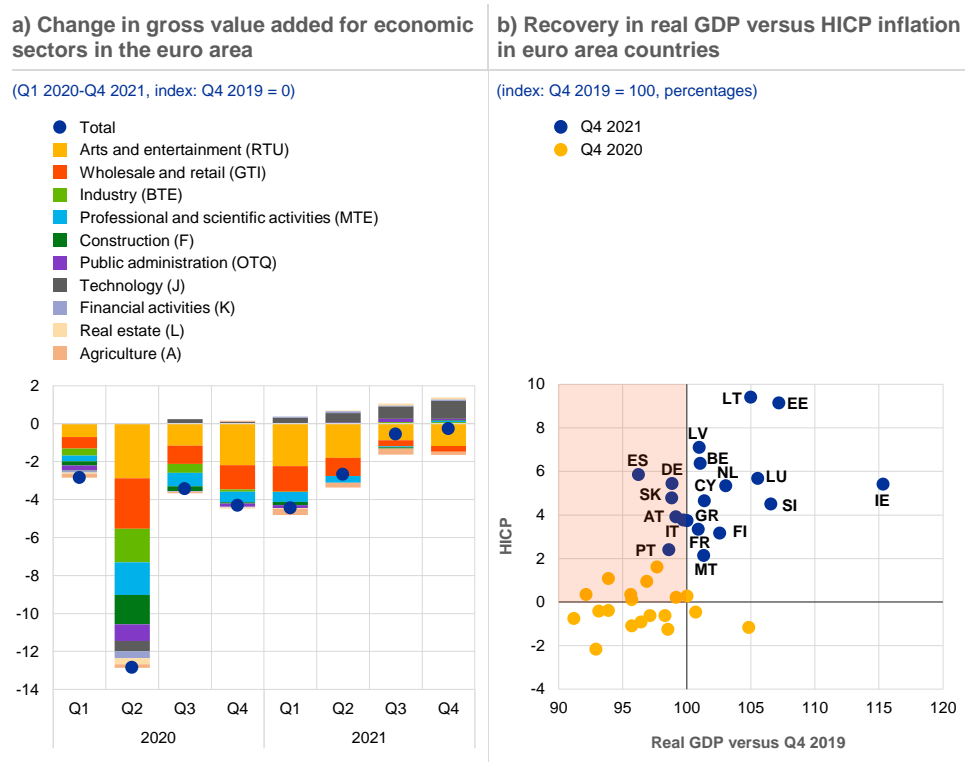
The new economic challenges come at a time when some sectors and countries are still recovering from the pandemic shock.

Although high vaccination levels and the less deadly Omicron variant have allowed euro area economies to largely reopen since the start of the year, economic sectors continue to be affected asymmetrically by the pandemic. For example, activity in the arts and entertainment sector still lags pre-pandemic levels, while the technology sector has clearly benefited

from the consumption trends observed during the pandemic (Chart 1.4, panel a). This sectoral fragmentation is also reflected in the economic recoveries of euro area countries. Some countries have only recently recovered from the pandemic but are currently facing high inflationary pressures (Chart 1.4, panel b). Moreover, depending on their degree of trade dependency with Russia and Ukraine, some euro area countries will be hit harder by the war in Ukraine than others, exacerbating asymmetries in growth and inflation rates.

Chart 1.4

While most euro area authorities have lifted major pandemic restrictions, some economic sectors and countries are still recovering



Sources: Eurostat and ECB calculations.
 Notes: Panel a: capital letters reflect NACE codes; RTU = Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organisations and bodies, GTI = Wholesale and retail trade, transport, accommodation and food service activities, BTE = Industry (except construction), MTE = Professional, scientific and technical activities; administrative and support service activities, F = Construction, OTQ = Public administration, defence, education, human health and social work activities, J = Information and communication, K = Financial and insurance activities, L = Real estate activities, A = Agriculture, forestry and fishing. Panel b: Q4 2019 reflects the pre-pandemic real GDP level.

1.2 Normalisation of fiscal positions is challenged by a slower economic recovery and the impact of the war

Downside risks to fiscal positions predominate as the recovery slows and governments cope with the economic impact of the Russia-Ukraine war. Before the war, it was expected that the euro area budget deficit would improve in response to lower discretionary spending on pandemic support measures, significant windfall

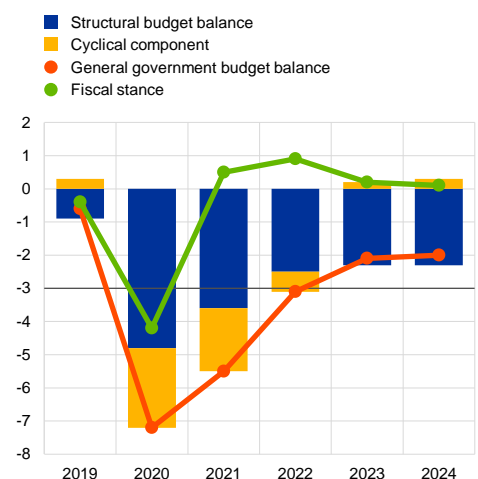
revenues¹ and a lower cyclical component (Chart 1.5, panel a). However, fiscal assumptions and projections are currently surrounded by a high degree of uncertainty, given the implications of the war in Ukraine. Slower economic growth than previously anticipated will have a negative impact on deficits. In addition, governments will face increases in expenditure on account of several factors including measures to mitigate the impact of higher energy prices on households, the influx of refugees from Ukraine and the higher levels of defence spending announced by some euro area governments. This could result in a slightly lower cyclically adjusted primary balance in 2022 than previously anticipated (Chart 1.5, panel b).

Chart 1.5

Public finances could be challenged by a slower economic recovery, energy price support measures, refugee flows and increased defence spending

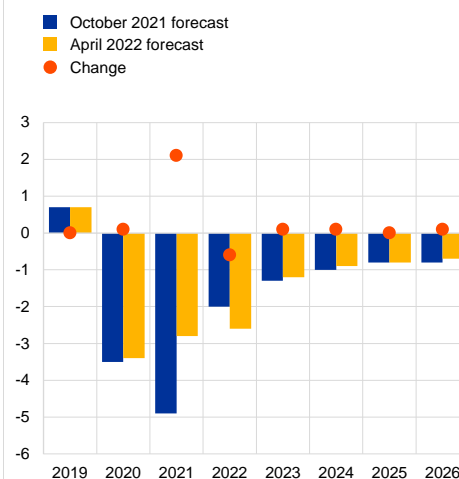
a) Fiscal balances and projections in the euro area, and contributing factors

(2019-24E, percentages of GDP)



b) General government cyclically adjusted primary balance in the euro area

(2019-26E, percentages of potential GDP)



Sources: Eurostat, March 2022 and September 2021 ECB staff macroeconomic projections, IMF Fiscal Monitor and ECB calculations. Notes: Panel a: the grey line depicts the 3% of GDP budget deficit threshold set in the Maastricht Treaty. The data refer to the aggregate general government sector of euro area countries. The fiscal stance is adjusted for the impact of Next Generation EU (NGEU) grants on the revenue side. The cyclical component refers to the impact of the economic cycle as well as temporary measures taken by governments, such as one-off revenues or one-off capital transfers. Panel b: the term "cyclically adjusted primary balance" is defined as the cyclically adjusted balance plus net interest payable/paid (interest expense minus interest revenue), following the IMF's World Economic Outlook convention.

Higher than projected budget deficits and a slower economic recovery might make debt dynamics less favourable. Following the implementation of economic support measures of around 4.0% of GDP in 2020 in response to the pandemic, crisis and recovery spending is estimated to have increased to about 4.3% of GDP in 2021. Despite this sizeable fiscal support, the economic recovery and favourable financing conditions have helped to stabilise government debt-to-GDP ratios in euro area countries with higher or lower levels of debt, although debt levels continue to diverge widely between euro area countries (Chart 1.6, panel a). The projected improvement in the budget balance from 2022 onwards is expected to be driven by a higher cyclically adjusted primary balance, as many of the emergency measures not funded by NGEU grants will expire. As a result, euro area debt-to-GDP levels are projected

¹ These were driven by higher than expected tax revenues, among others.

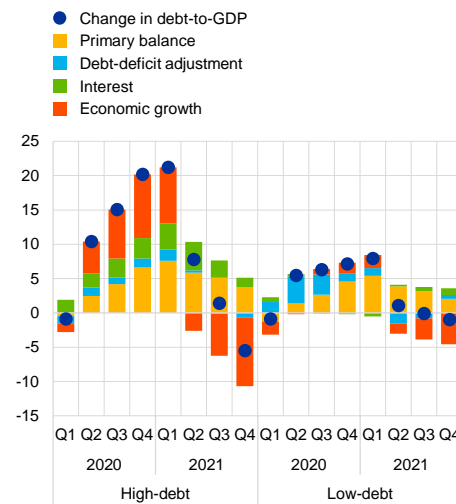
to decline from 95.6% of GDP in 2021 to 88.7% in 2024. Going forward, however, risks to sovereign indebtedness are to the upside as governments face challenges from higher than anticipated deficits and slowing economic activity. As such, debt-to-GDP ratios might not follow the downward path currently envisaged under the baseline scenario ([Overview](#)).

Chart 1.6

Debt ratios have declined under favourable growth dynamics as sovereign stress has so far been contained

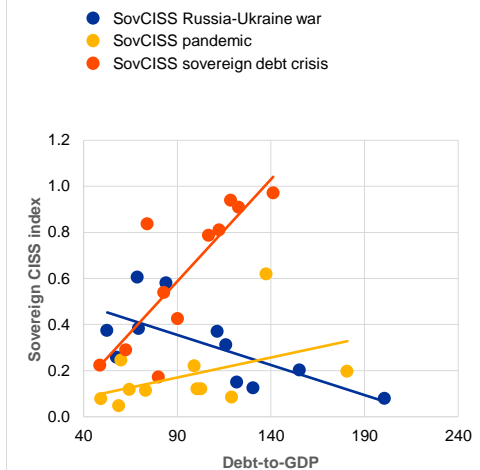
a) General government debt-to-GDP ratio and contributing factors for higher and lower indebted euro area countries

(Q1 2020-Q4 2021, percentage points of GDP)



b) Sovereign CISS index versus general government debt-to-GDP ratio for selected euro area countries

(quantile rank, percentage points)



Sources: Eurostat, ECB and ECB calculations.

Notes: Panel a: the debt-deficit adjustment (DDA) captures the effects of the accumulation or sale of financial assets; see Kezber and Maurer*. The aggregate of higher-debt countries includes euro area countries with a 2019 debt-to-GDP ratio above 90%. The lower-debt aggregate includes the remaining euro area countries. Figures are in nominal terms. Panel b: "sovereign debt crisis" refers to November 2011, "pandemic" refers to April 2020 and "Russia-Ukraine war" to April 2022. CISS stands for composite indicator of systemic stress. The chart shows the euro area countries for which a sovereign CISS Index is available, i.e. Belgium, Germany, Ireland, Greece, Spain, France, Italy, the Netherlands, Austria, Portugal and Finland.

*) Kezber, L. and Maurer, H., "Deficit-debt adjustment (DDA) analysis: an analytical tool to assess the consistency of government finance statistics", *Statistics Paper Series*, No 29, ECB, November 2018.

Higher than expected inflation can contribute to debt servicing pressures, especially in cases of high refinancing needs and relatively large shares of inflation-indexed securities. Although debt ratios would benefit from a declining real debt burden owing to first round effects (a favourable denominator effect), higher risk premia and slower economic growth could still contribute to increasing debt ratios in the medium term, particularly for high-debt countries.² As such, additional fiscal space to cushion the economy from future economic downturns might become more limited in some euro area countries. Moreover, the level of recovery from the pandemic and inflation rates diverge widely across euro area countries, contributing to higher fragmentation risks ([Section 1.1](#)).

² See the box entitled "Sensitivity of sovereign debt in the euro area to an interest rate-growth differential shock", *Financial Stability Review*, ECB, November 2021.

Financing conditions for euro area sovereigns have remained favourable

overall. Although government bond yields have increased of late, financing conditions have remained relatively favourable in recent months, despite the heightened uncertainty, increasing sovereign bond yields and deteriorating macroeconomic backdrop. Moreover, although measures of sovereign stress are rising, so far this has not affected higher-debt countries more than other euro area countries (**Chart 1.6**, panel b). In addition, governments had extended the average residual maturity to eight years by the end of March 2022, mostly by issuing longer-term securities, increasing their resilience to rising interest rates. At the same time, debt servicing needs remain elevated, with some euro area countries facing refinancing and interest expenditure in excess of 40% of GDP over the next two years. As such, a further deterioration in financial conditions could weigh on fiscal positions going forward.

All in all, risks to sovereign debt sustainability appear to be manageable in the short run, but sovereign risks could intensify in the event of a sustained rise in credit risk premia or more subdued growth outturns.

Although sovereign yields have increased of late, the economic recovery at the end of 2021 and largely favourable financing conditions have helped to stabilise debt levels in the euro area. Going forward, fiscal policy will be affected by both exposure to the war and recovery from the pandemic. Moreover, the fundamental role of economic growth dynamics in determining fiscal sustainability underlines the need for fiscal policy to be growth-friendly. The NGEU package could provide additional cushioning for the euro area economy and trigger the kind of reforms required to boost long-term growth potential. Adding to sovereign risks, some sovereigns with higher debt are also exposed to weaker banks and exhibit a less robust, more fragmented corporate landscape, increasing risks relating to a sovereign-bank-corporate nexus (**Box 1**). These adverse developments could trigger a reassessment of sovereign risk by market participants and reignite pressures on more vulnerable sovereigns.

1.3 Corporates face new headwinds as supply bottlenecks persist

Following the solid recovery seen in the second half of 2021, euro area corporates are now facing increasing headwinds from rising producer prices and supply chain pressures.

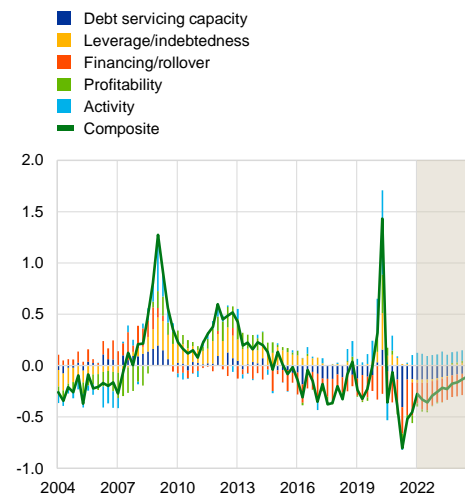
Measures of aggregate corporate vulnerabilities improved as the economy experienced a robust recovery in the second half of 2021, with gross profits bouncing back to 7% above pre-pandemic levels. Moreover, the economic recovery and pandemic support measures have helped to keep financing conditions favourable, cushioning debt service needs and rollover risks. As a result, the composite indicator for euro area corporate vulnerabilities has remained well below its historical average (**Chart 1.7**, panel a). However, corporates now face new headwinds stemming from a slowing economy, higher interest rates, worsening supply chain bottlenecks and rising energy prices (**Section 1.1**).

Chart 1.7

Euro area non-financial corporates have benefited from favourable financing conditions and robust profits, but activity remains subdued

a) Composite indicator of corporate vulnerabilities and contributing factors

(Q1 2004-Q1 2024E, z-scores)



b) Ratio of sales and EBIT to total assets for euro area non-financial corporations

(Q1 2000-Q4 2021, percentages)



Sources: Eurostat, ECB, IHS Markit and ECB calculations.

Notes: Panel a: positive values indicate higher vulnerability and negative values indicate lower vulnerability. The shaded area represents a forecast. For the construction of the index in more detail, see the box entitled "Assessing corporate vulnerabilities in the euro area", *Financial Stability Review*, ECB, November 2020. Panel b: total assets are the sum of total financial and non-financial assets (liabilities) of non-financial corporations. Sales and earnings before interest and taxes (EBIT) are approximated by the four-quarter moving average of gross value added and mixed income respectively, as reported in the quarterly sector accounts. Series multiplied by 100.

The sharp increase in input prices may squeeze corporate profit margins.

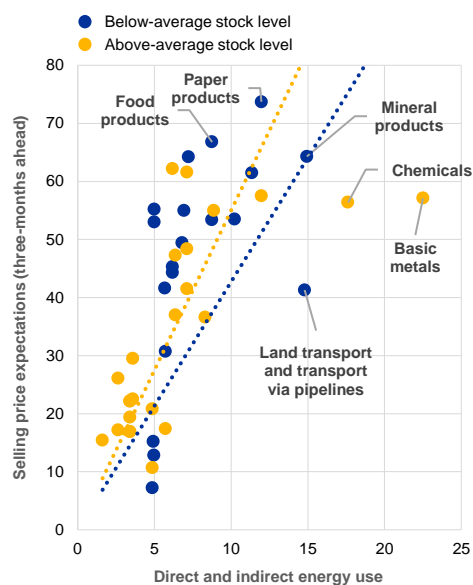
Despite the robust recovery in corporate earnings, activity in the corporate sector remained subdued towards the end of 2021 (Chart 1.7, panels a and b). Moreover, corporate profitability partially recovered on account of higher profit margins, offsetting the more persistent loss in output since the start of the pandemic (Chart 1.7, panel b). Going forward, it might become harder for some sectors to sustain high profit margins as input prices soar in many sectors and the economy slows. Higher input prices currently translate into expectations of increased selling prices going forward, especially for sectors with high energy consumption and low inventories (Chart 1.8, panel a). At the same time, some firms have started to indicate that input prices are increasing faster than output prices, possibly resulting in margin compression. This seems to be the case for the corporates that still face challenges stemming from the pandemic and for corporates with high energy needs, such as manufacturers of metals (Chart 1.8, panel b). Historically, higher input prices are largely passed on to end users, particularly when the cost-push shock is global, although given the fact that the economic outlook has softened considerably some producers might have less pricing power going forward. Moreover, the magnitude of current price volatility could be a concern for companies with (unhedged) fixed contractual obligations, and which cannot easily adjust pricing, such as utilities and construction firms (Chapter 2).

Chart 1.8

Margins might come under pressure as input prices soar and the economy slows

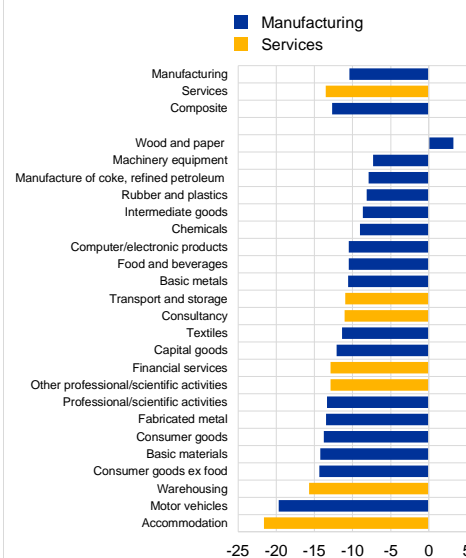
a) Selling price expectations versus use of energy as input and inventory level

(Apr. 2022, index)



b) Euro area output prices PMI minus producer prices PMI

(Apr. 2022, index)



Sources: OECD Trade in Value Added (TIVA) database (2018), European Commission, Eurostat, IHS Markit and ECB calculations. Notes: Panel a: energy intensity measured is measured by the average share of input from mining and quarrying, energy producing products, coke and refined petroleum product and the electricity, gas, steam and air-conditioning industries for each sector, classified according to the United Nations International Standard Industrial Classification for All Economic Activities (ISIC), Rev. 4. Rev. 4. ISIC codes are converted back to NACE codes and matched with survey data on selling price expectations. Selling price expectations reflect seasonally adjusted selling price expectations for the services, retail and industry sectors. The data are extracted on subsector level from the European Commission business and consumer surveys. Direct and indirect energy use reflect 2018 figures. Selling price expectations reflect expectations from the April 2022 European Commission Business and consumer surveys. Panel b: shown as the PMI output price index minus the producer prices PMI on sector level. A narrowing spread between output and producer prices PMIs can be interpreted as margin compression.

External financing needs have risen in response to robust economic activity, but the economic impact of the war in Ukraine might dampen credit growth going forward.

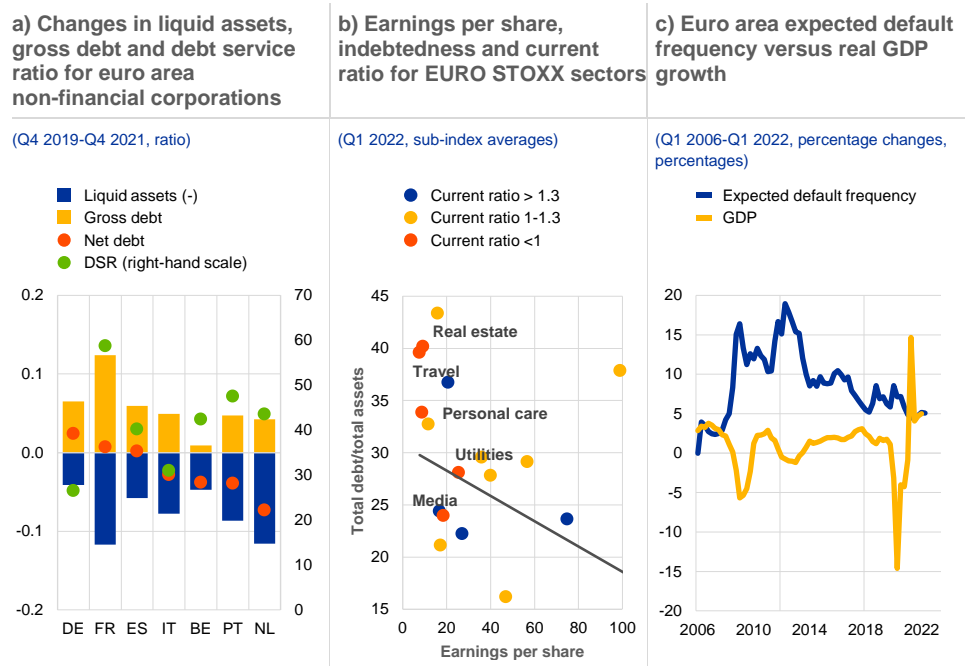
Bank lending to corporates continued to increase in the first months of 2022, but moderated in March as credit standards tightened, and risk perceptions increased as a result of the war in Ukraine. During the first months of the year the demand for loans remained high on account of high working capital and fixed investment requirements. The need for higher working capital mainly reflects financing demands created by the pandemic situation, while the increase in fixed investment is driven by the economic recovery. Amid a wide range across firms and euro area countries, debt levels declined to 80% of GDP in the fourth quarter of 2021 but remained above the 75% of GDP recorded before the pandemic.³ The increase in net debt has been much less pronounced, reflecting elevated working capital levels and liquid holdings (Chart 1.9, panel a). Going forward, corporate financing conditions might deteriorate when economic growth slows, inflation remains elevated and both markets and banks reassess the risk surrounding corporate activity (Chapter 2). Moreover, banks anticipate a stronger net tightening of credit standards in the future, reflecting the uncertain economic impact of the war. This might be

³ This reflects consolidated debt securities and loans of non-financial corporations as a share of GDP.

particularly concerning for firms that exited the pandemic with high debt levels, subdued earnings and lower liquidity buffers (**Chart 1.9**, panel b, and **Box 1**).

Chart 1.9

The increase in debt levels has varied across firms and euro area countries as default rates might rise



Sources: Bank for International Settlements, Bloomberg Finance L.P., Moody's Analytics, ECB and Eurostat.
Notes: Panel a: "Liquid assets" comprises currency and deposits; "Gross debt" refers to consolidated debt securities and loans of non-financial corporations; "Net debt" is the difference between gross debt and liquid assets. The debt service ratio (DSR) is defined as the ratio of interest payments plus amortisations to income. As such, the DSR provides a flow-to-flow comparison – the flow of debt service payments divided by the flow of income; see "How much income is used for debt payments? A new database for debt service ratios", *BIS Quarterly Review*, September 2015. Panel b: earnings per share reflect Bloomberg consensus estimates for the sector level sub-indices of the STOXX EUROPE index. The total debt and current ratio are sub-index averages. The current ratio reflects the ratio of current assets to current liabilities and measures a firm's ability to settle short-term liabilities with its short-term assets.

Insolvencies, which would normally be expected to rise as economic growth softens, have remained well below their pre-pandemic levels. Policy support measures have successfully mitigated solvency risks which, together with robust economic growth, kept insolvencies 20% below their pre-pandemic levels in the first quarter of 2022. Moreover, forward-looking measures for defaults remain subdued (**Chart 1.9**, panel c). At the same time, firms whose balance sheets weakened by the pandemic now face fresh challenges from strong input price inflation, softening economic growth and rising interest rates. Furthermore, results from the latest ECB bank lending survey show banks indicating that they are concerned that supply chain disruptions, high energy and other input prices, and corporate exposures to Russia, Ukraine and Belarus might amplify firms' credit risks. As such, insolvencies could rise in the sectors most affected by supply chain disruptions and by an economic recovery that has proved fragile since the pandemic.

Overall, firms weakened by the pandemic now face additional challenges from intensifying cost pressures as the economic recovery slows. Some countries and sectors have experienced an increase in net debt levels since the start of the pandemic. Moreover, some corporates will also face significant debt servicing needs

over the coming years (**Chart 1.9**, panel a). Although public guarantee schemes have helped corporates to attract longer-term funding during the pandemic and corporates have built significant cash buffers, a possible further rise in interest rates might impact non-financial corporations that borrow at variable rates. In addition, some firms have been less able to profit from the economic recovery over recent quarters as their business models have continued to be affected by pandemic containment measures. Some of these corporations also have higher debt, lower liquidity and lower sales levels and might face challenges when the economy slows or if they cannot pass on increases in input prices to end users in full (**Box 1**). Adding further to these vulnerabilities, weaker corporates are also concentrated in countries with greater sovereign and bank vulnerabilities.

Box 1

Identifying the corporates most vulnerable to price shocks following the pandemic

Prepared by Julian Metzler, Benjamin Mosk, Nander de Vette and Peter Welz

By the end of 2021, the aggregate profitability and debt positions of euro area non-financial corporations (NFCs) had recovered to pre-pandemic levels. While overall gross debt relative to gross value added remains elevated at around 160%, net debt has returned to its pre-pandemic level of around 100% of gross value added, with firms having increased precautionary cash buffers amid favourable financing conditions. However, these aggregate developments were mostly driven by large firms, while the net debt positions of small firms increased as they used credit to offset those cash flow losses that were not covered by government support measures. In addition, many corporates now face broad-based increases in input prices on the back of energy price rises and supply chain disruptions. Against this backdrop, this box uses firm-level balance sheet data for around 91,000 euro area non-financial corporations to identify vulnerable firms based on the Altman Z-score, a measure of insolvency risk that uses five balance sheet and income statement ratios and their joint importance.^{4, 5, 6} It then matches bank and sovereign exposures to consider related risks associated with the sovereign-bank-corporate nexus.

Although corporate revenues deteriorated sharply during the COVID-19 pandemic, policy support measures helped to keep insolvencies remarkably subdued. The economic effects of the pandemic have weakened firms' balance sheets, particularly in the services sector. At the same time, firms in technology and many consumer goods sectors also benefited (**Chart A**, panel a). Declining revenues appear to have been the biggest driver of deteriorating financial health. Firm-level data also suggest that more leveraged firms experienced a larger decline in financial health (**Chart A**, panel b), and firms classified as weak had relatively higher debt, lower earnings and lower revenues than firms classified as healthy. Compared with the broad-based revenue declines, earnings and margins remained relatively resilient. This can be explained in part by government support measures.⁷

An increase in liabilities, lower liquidity levels and subdued earnings continue to pose a risk for a subset of companies. Translating Altman Z-scores into implied corporate credit ratings, the

⁴ For more details, see Casey, C.J., Bibeault, D. and Altman, E.I., "Corporate financial distress: A Complete guide to Predicting, Avoiding, and Dealing with Bankruptcy", *Journal of Business Strategy* (pre-1986), Vol. 5, Issue 000001, 1984, p. 102f.

⁵ See also the article entitled "Assessing corporate vulnerabilities in the euro area", *Economic Bulletin*, Issue 2, ECB, 2022.

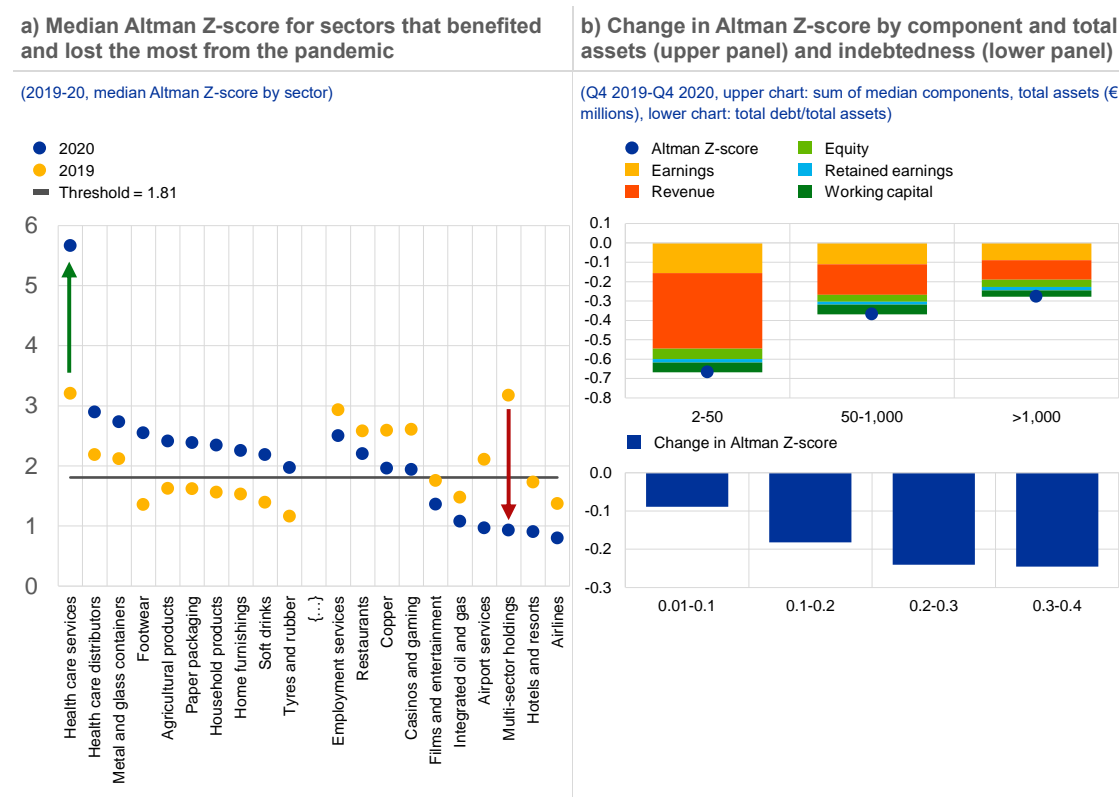
⁶ The results reported in this box pertain to the specific sample at hand, which is not fully representative for the overall corporate sector as it contains relatively fewer micro firms.

⁷ See also the box entitled "The role of profit margins in the adjustment to the COVID-19 shock", *Economic Bulletin*, Issue 2, ECB, 2021.

share of firms that would be rated CCC or lower increased from 7.5% in 2019 to over 9% in 2020, which is in line with the relatively benign increase in downgrades among rated firms. Overall, however, the share of vulnerable firms (those with an Altman Z-score below 1.81 or implied credit rating below BBB-) increased from 36% prior to the pandemic to 42% at the end of 2020. On balance, more firms migrated to a lower implied rating than to a higher implied rating.⁸ Moreover, incoming quarterly financial results suggest that a significant share of firms had not fully recovered by mid-2021. This reflects weakness in the tourism, entertainment and aviation sectors, while larger listed firms in technology and industrial sectors benefited from strong demand and improved their cash positions.

Chart A

The financial health of smaller firms, firms with high debt levels and firms in the services sector has been more heavily affected by the pandemic, driven by weaker revenues



Sources: S&P Global Market Intelligence, ECB and ECB calculations.

Notes: Panel a: the grey line reflects the weaker firm threshold (1.81) based on the Altman Z-score as at end-2020. The Altman Z-score is calculated as $0.717 \times \text{working capital}/\text{total assets} + 0.847 \times \text{retained earnings}/\text{total assets} + 3.107 \times \text{EBIT}/\text{total assets} + 0.420 \times \text{equity}/\text{debt} + 0.998 \times \text{sales}/\text{total assets}$. A higher Altman Z-score is associated with lower default risk. Sample size (N) = 91,649. The sample contains roughly half of the total debt outstanding for NFCs in the euro area and around 40% of total assets. The leverage ratio (total debt/total assets) for the firms in the sample is 34% compared with 30% for all euro area NFCs. Panel b: sum of the median changes in the variables included in the Altman Z-score: working capital (working capital/total assets), retained earnings (retained earnings/total assets), earnings (EBIT/total assets), revenue (sales/total assets) and equity (equity/debt). The upper chart reflects the impact on the 25th percentile of firms most affected by the pandemic in terms of Altman Z-score. The lower panel reflects the change in Altman Z-score per bucket of indebtedness measured by the firm's total debt/total assets. The debt level is fixed on the end-2019 debt and asset level.

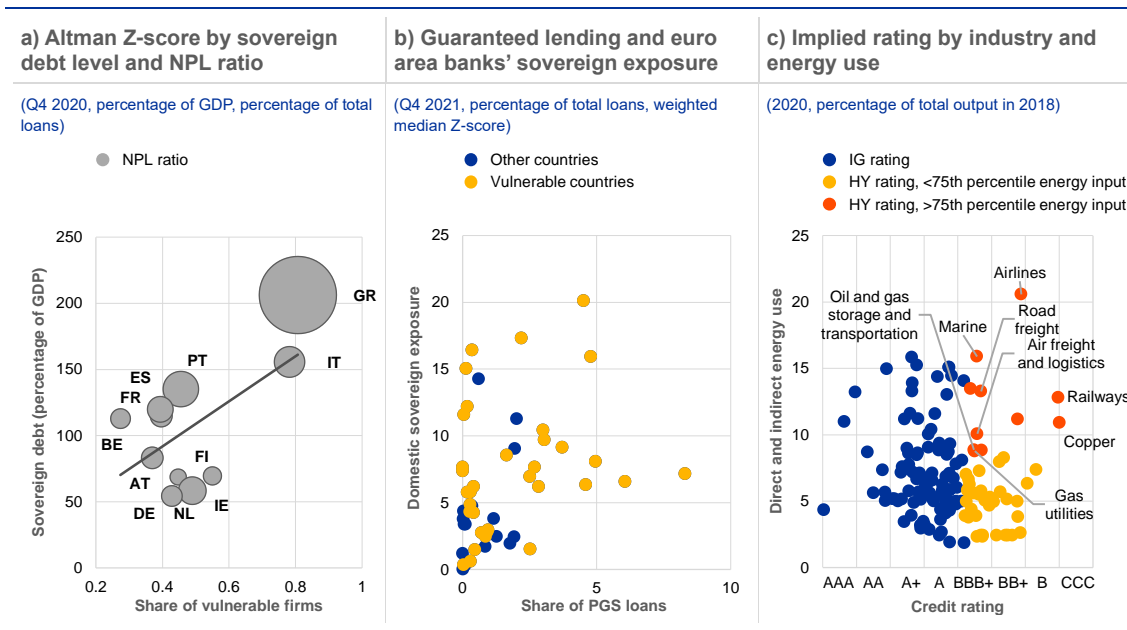
Vulnerable corporates are clustered in countries with elevated sovereign debt levels, higher non-performing loan ratios and stronger interlinkages between banks and domestic sovereigns. Euro area countries with higher sovereign debt levels also have higher shares of weaker corporates (Chart B, panel a). For those countries, the median Altman Z-scores also remain

⁸ Converting the Altman Z-score into a credit rating is based on Altman, E.I., "A Fifty-Year Retrospective on Credit Risk Models, the Altman Z-Score Family of Models and their Applications to Financial Markets and Managerial Strategies", *Journal of Credit Risk*, Vol. 14, No 4, 2018. For this purpose, the z"-score is used excluding revenues.

significantly below the pre-pandemic levels. In addition, spillover vulnerabilities exist in several countries due to a tighter sovereign-corporate-bank nexus. These countries tend to have higher shares of vulnerable corporates, and banks hold larger credit exposures to the domestic sovereign; at the same time, the sovereign has provided sizeable loan guarantees, notably for loans to firms in vulnerable sectors (**Chart B**, panel b).

Chart B

Corporate vulnerabilities are clustered in countries with elevated sovereign debt and weaker banks



Sources: OECD Trade in Value Added (TIVA) database (2018), S&P Global Market Intelligence and ECB calculations.

Notes: Panel a: a higher Altman Z-score is associated with lower default risk. The chart excludes Estonia, Cyprus, Latvia, Lithuania, Luxembourg, Malta, Slovakia and Slovenia due to low firm count in the sample. The bubble size reflects the gross NPL ratio. Sample size (N) = 91,649. Panel b: PGS stands for public guarantee scheme. Yellow circles represent low Altman Z-score countries, i.e. those with a Z-score < 1.81. Panel c: converting the Altman Z-score into a credit rating is based on Table 6 in Altman E.I., op. cit. To this end, the modified Altman Z'-score is used, which exclude a revenue component. IG stands for investment grade; HY stands for high-yield. Direct and indirect energy use is measured by the average share of input from mining and quarrying, energy producing products, coke and refined petroleum product and the electricity, gas, steam and air-conditioning industries for each sector, classified according to the United Nations International Standard Industrial Classification for All Economic Activities (ISIC), Rev. 4. This is attributed to each sector based on the 4-digit SIC code.

Weaker firms and firms with lower pricing power are more vulnerable to supply chain disruptions and rising input prices.

Indices measuring input prices for euro area producers increased strongly over the course of 2021 and the first months of 2022, driven by higher energy costs and supply bottlenecks. Moreover, some key input materials showed double-digit price rises. The large increase in input prices and costs will likely put pressure on profit margins, notably for firms that have weaker pricing power and cannot easily pass on price increases. This could create cash flow challenges in the short run and undermine the debt sustainability and investment capacity in the medium term. Vulnerabilities are concentrated in firms at the intersection of lower pricing power and those with higher energy intensity of production and lower Altman Z-scores (**Chart B**, panel c).

All in all, corporate vulnerabilities remain and are correlated with exposures to the pandemic and the fallout from the Russian war in Ukraine.

The corporate sector on aggregate proved resilient to the pandemic shock, as reflected in the recovery of profits. However, the euro area has a sizeable cohort of vulnerable smaller firms that are still recovering from the pandemic and are now facing additional cost pressures from the sharp rise in input prices observed over recent months. At the current juncture, financing conditions remain in their favour, but they could deteriorate quickly if the economy slows and lenders reassess the risks relating to certain business models. Moreover, uncertainty will reduce investment and contribute to bleaker growth prospects going forward.

1.4 Households face rising inflation and greater uncertainty

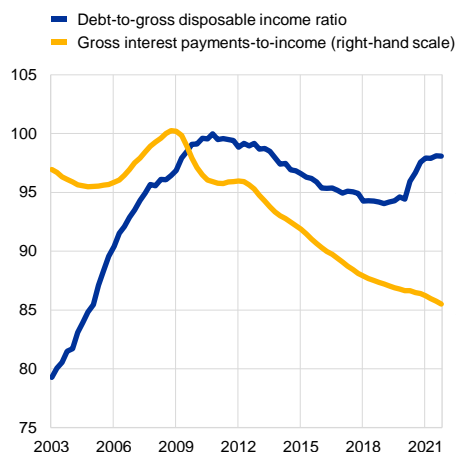
While the aggregate financial position of euro area households has remained stable, downside risks have increased in the light of higher inflation and the war in Ukraine. Throughout the second half of 2021, households benefited from the economic recovery, low unemployment and favourable financing conditions. The debt-to-disposable income ratio stabilised at 98%, as nominal income growth remained solid and debt servicing costs reached record lows (**Chart 1.10**, panel a). Supported by valuation gains in financial investments and house prices, households' net worth surged to 785% of disposable income in the fourth quarter of 2021, up 26 percentage points on a year earlier, but remains unevenly distributed across households. At the same time, however, consumer sentiment became clouded by the pick-up in consumer prices and, when energy and food prices rose further following the Russian invasion of Ukraine, plunged back towards the low levels observed after the pandemic first broke out in Europe (**Chart 1.10**, panel b). In a tail risk scenario, the war may also indirectly affect households via labour markets, where conditions could deteriorate if a large number of firms fail to withstand the adverse effects of higher input prices and supply chain disruptions reinforced by sanctions on Russia.

Chart 1.10

Household debt levels remain contained, but rising inflation and the war in Ukraine have prompted a sharp deterioration in sentiment

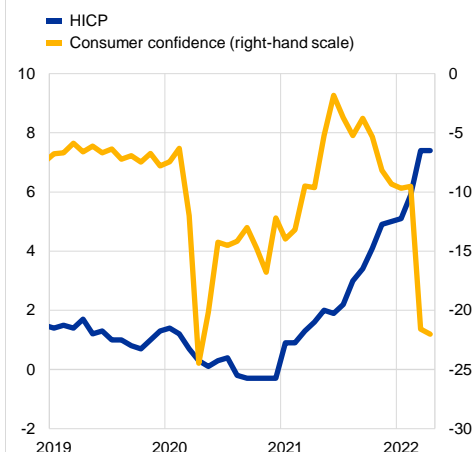
a) Debt- and gross interest-to-gross disposable income ratios

(Q1 2003-Q4 2021, percentages)



b) Inflation and consumer confidence

(Jan. 2019-Apr. 2022, left-hand scale: percentages, right-hand scale: index)



Sources: Eurostat and ECB calculations.

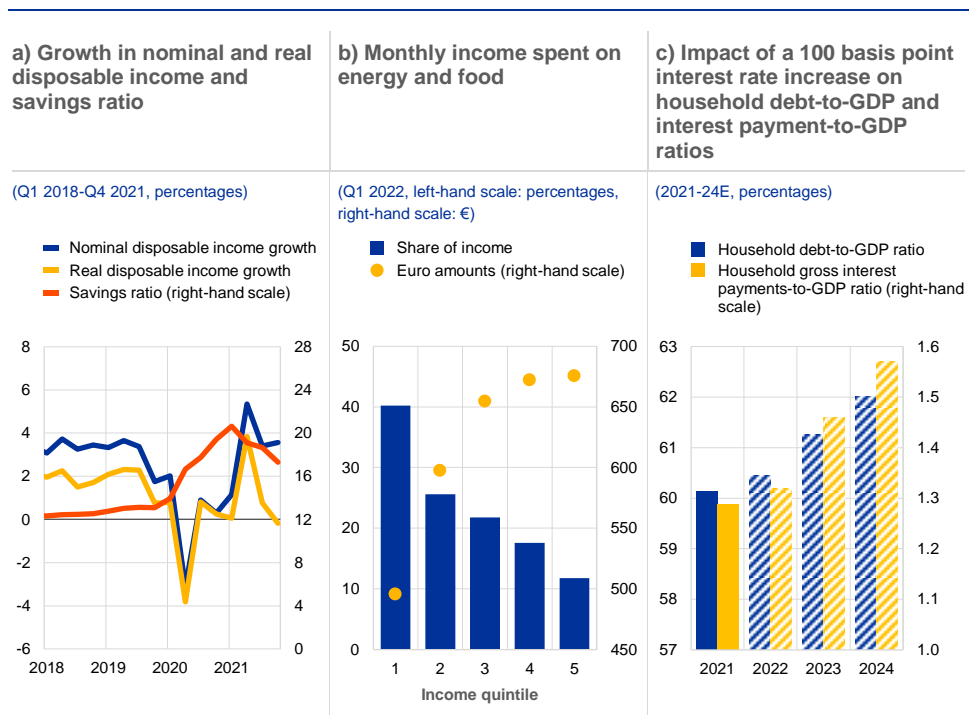
Notes: Panel a: debt is defined as total loans granted to households by all institutional sectors. Gross interest payments are measured before allocation of financial intermediation services indirectly measured (FISIM). Panel b: HICP stands for the Harmonised Index of Consumer Prices measure of inflation.

Inflation weighs on real household incomes and may have a disproportionate effect on both lower-income households and those with weaker debt servicing capacity. Nominal income growth returned to pre-pandemic levels in the fourth quarter of 2021. However, due to increases in consumer prices driven predominantly by energy and food items, real incomes shrunk in the same period (**Chart 1.11**, panel

a). Many households may be able to temporarily cushion the impact of higher prices by scaling back saving or drawing on excess savings accumulated during the pandemic. But these savings are likely concentrated in higher-income households, whereas lower-income households are more exposed to the inflation shock as they spend a relatively larger share of their income on energy and food-related items (Chart 1.11, panel b). Accordingly, a share of households has to rely on fiscal relief measures or cut down on non-essential consumption. In general, some households may benefit from higher than expected inflation in the sense that it lowers the real cost of pre-existing debt, but it is unlikely that these households are sufficiently compensated for the rise in inflation through higher nominal income.

Chart 1.11

A decline in real incomes may disproportionately affect lower income households



Sources: Eurostat, ECB (Consumer Expectations Survey) and ECB calculations.

Notes: Panel b: data cover surveys from Belgium, Germany, Spain, France, Italy and the Netherlands. The share of income spent on energy and food is calculated as the share of households' reported spending on utilities, transport and food, beverages, groceries and tobacco divided by monthly income, where income is inferred from income buckets. Data shown are averages over the full period for which CES data are available, i.e. April 2020 to January 2022. Questions on spending are surveyed once per quarter. Accordingly, the data should be interpreted with caution and mainly as an illustration of differences across different income classes. Panel c: shaded bars show projections. The simulations capture the effects of a permanent one-off 100 basis point increase in short and long-term market interest rates in July 2022 (with higher rates kept constant thereafter) on gross interest payments (based on a national accounts concept before FISIM allocation) and consolidated gross indebtedness ½, 1½ and 2½ years after the shock. The results are based on models and tools used in the context of the Eurosystem projection exercises. They take into account the dampening impact of higher market interest rates on economic activity, prices and debt financing. The increase in the household debt-to-GDP ratio is mostly due to a denominator effect as GDP is projected to decline more than debt levels.

Vulnerabilities among households have picked up, albeit from generally moderate levels.

With strong balance sheets thanks to excess savings, solid net wealth and low debt servicing costs, households are well positioned to weather economic headwinds. At the same time, rising inflation is having an adverse effect on households' purchasing power, which could slow the economy's return to its pre-pandemic growth path. Some households may have to limit consumption or become dependent on government support. While the impact of rising interest rates on aggregate household indebtedness and interest payments may be limited (Chart

1.11, panel c), some households' debt servicing capacity could suffer. Vulnerabilities could build further over the medium term and concerns over household debt sustainability may rise, especially in countries where residential properties are overvalued, debt levels are elevated and a larger share of household debt has variable interest rates.

1.5 Vulnerabilities continue to build in euro area real estate markets

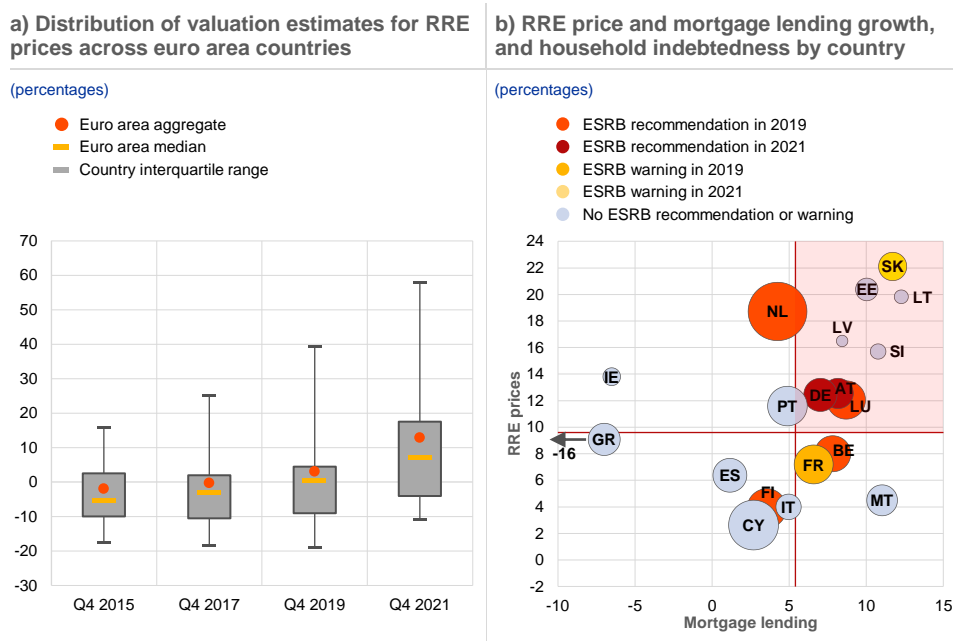
Prices in euro area residential real estate (RRE) markets rose at a record pace, resulting in increasingly stretched valuations. Nominal house prices rose by 9.6% year-on-year at the euro area level in the fourth quarter of 2021, the fastest rate observed in the last 20 years (**Chart 6**, panel a, **Overview**). The key factors putting upward pressure on prices are the low cost of borrowing coupled with stronger demand for housing stemming from shifts in household preferences (e.g. demand for home office space) and supply-side constraints. Shortages of both labour and materials are raising expectations of increasing prices in the construction sector, contributing to further upward pressure on house prices going forward. Such growing supply-side constraints, together with flight-to-safety effects amid higher inflation, may be exacerbated by the war in Ukraine. As house price dynamics exceed the fundamentals, estimates of overvaluation are also growing (**Chart 1.12**, panel a).

Accelerating mortgage lending has increased household indebtedness, raising concerns of further debt-fuelled house price rises. Lending for house purchase in the euro area remains robust, with the pace of growth at 5.4% in March 2022, contributing to the build-up of household debt. Patterns vary greatly from country to country: in some euro area countries, upward movements in both house prices and lending are pronounced, indicating that a price-loan spiral may have started emerging. Overall, while most euro area countries have macroprudential measures in place, a further build-up of medium-term vulnerabilities in some countries led the ESRB to issue new warnings and recommendations in December 2021 (**Chart 1.12**, panel b).⁹ This strengthens the case for considering further macroprudential policy measures to build resilience, as economic conditions allow and taking into account the uncertainty related to the war (**Chapter 5**).

⁹ See also the report "[Vulnerabilities in the residential real estate sectors of the EEA countries](#)", ESRB, February 2022 and the [overview of macroprudential measures](#).

Chart 1.12

Rising RRE prices result in increasingly stretched valuations, underpinned in some countries by buoyant lending growth



Sources: ECB, Eurostat, European Systemic Risk Board (ESRB) and ECB calculations.

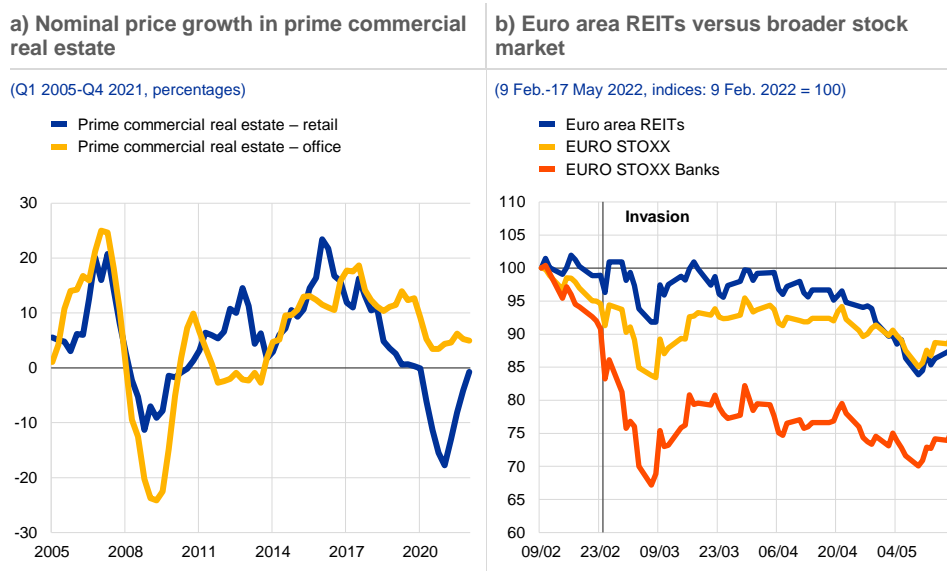
Notes: Panel a: the average valuation estimate is the simple average of the price-to-income ratio and an estimated Bayesian vector autoregression (BVAR) model. For details of the methodology, see Box 3 in the *Financial Stability Review*, ECB, June 2011, and Box 3 in the *Financial Stability Review*, ECB, November 2015. Overall, estimates from the valuation models are subject to considerable uncertainty and should be interpreted with caution. Alternative valuation measures can point to lower/higher estimates of overvaluation. Whiskers denote minimum and maximum values. For Belgium, Ireland, Finland and Austria the last observation is from Q3 2021. Panel b: latest available data are shown, RRE price growth and household debt-to-GDP ratio refer to Q4 2021 and mortgage lending growth refers to Q1 2022. Horizontal and vertical red lines indicate the euro area aggregate. The bubble size indicates the size of the household debt-to-GDP ratio.

Conditions in commercial real estate (CRE) markets appear to be stabilising, and markets have initially not priced in a major impact from the war in Ukraine.

After suffering a tangible decline during the pandemic, price growth dynamics for prime CRE are beginning to stabilise (Chart 1.13, panel a). However, prime segments account for only a relatively small share of CRE markets. Conditions remain challenging in non-prime markets due to environmental, social and governance (ESG) concerns and changed patterns of behaviour in the wake of the pandemic. Comparing initial REIT price reactions with those in wider equity markets after the outbreak of the war in Ukraine suggests that investors see real estate as a sector less affected by the war (Chart 1.13, panel b). Nevertheless, demand for CRE assets would be affected by any economic downturn resulting from the war. A pronounced correction in CRE markets could have an adverse effect on the wider financial system and the real economy. This is because financial institutions may suffer from direct losses, increased credit risk and declines in collateral values, which could limit their ability to provide financing to non-financial corporations and may be exacerbated through negative feedback loops.

Chart 1.13

Conditions in commercial real estate markets appear to be stabilising as the initial impact of the war in Ukraine appears limited



Sources: Jones Lang LaSalle, Bloomberg Finance L.P. and ECB calculations.

Notes: Panel b: 9 February 2022 corresponds to the peak of the EURO STOXX index before the invasion of Ukraine. REITs stands for real estate investment trusts. The FTSE EPRA Nareit Eurozone Index is shown here.

Uncertainty in real estate markets is rising as different factors put upward pressure on prices simultaneously while also increasing the risk of a price correction. RRE prices have continued to benefit from tight supply conditions and stable household and investor demand for housing. Over the medium term, this continued expansion and signs of overvaluation render some RRE markets prone to a correction. At the same time, an abrupt increase in real interest rates could induce house price corrections in the near term, with the current low level of interest rates making substantial house price reversals more likely (**Box 2**). In CRE markets, low-quality segments are under pressure from structural demand shifts. While resilience is supported by macroprudential measures and relative household strength (**Section 1.4**), the financial sector may be exposed to the risk of real estate market corrections, especially in those countries where debt levels are elevated, exposures are high and properties are overvalued.

Box 2

Drivers of rising house prices and the risk of reversal

Prepared by Paola Di Casola, Daniel Dieckelmann, Magdalena Grothe, Hannah Hempell, Barbara Jarmulka, Jan Hannes Lang and Marek Rusnák

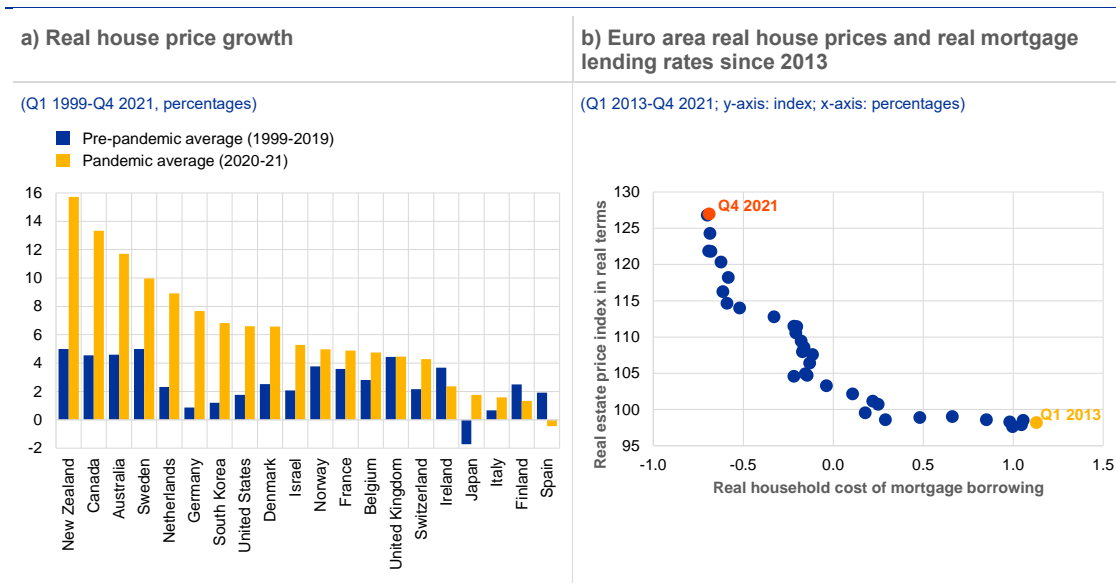
House prices increased substantially during the pandemic, fuelling concerns about possible price reversals and their implications for financial stability. In many advanced economies, real house price growth exceeded 4% during the pandemic (**Chart A**, panel a), reaching 4.3% in the euro area in the fourth quarter of 2021¹⁰ amid signs of exuberance in some countries.¹¹ At the same time,

¹⁰ Nominal house price growth in the euro area amounted to 9.6% in the fourth quarter of 2021, the second-highest rate since the first quarter of 2005, exceeded only by the growth rate of the third quarter of 2021.

real mortgage lending rates in the euro area have fallen further to reach historic lows in the current low interest rate environment (**Chart A**, panel b).¹² Against this backdrop, this box discusses the main drivers of recent house price increases across advanced economies and in the euro area, and the associated risks of possible price reversals and the potential implications for financial stability.

Chart A

Strong house price growth in advanced economies coincides with the period of low interest rates



Sources: Federal Reserve Bank of Dallas, ECB and ECB calculations.

Notes: Panel a: real house price growth across advanced economies is measured year on year and seasonally adjusted; the dataset is described in Mack and Martínez-García*. The trends observed during the pandemic are compared with observations during the 20 years before the pandemic. Panel b: real mortgage lending rates are computed as country-specific average nominal mortgage lending rates minus the ECB's inflation target of 2%.

* Mack, A. and Martínez-García, E., "A Cross-Country Quarterly Database of Real House Prices: A Methodological Note", *Working Paper Series*, No 99, Globalization and Monetary Policy Institute, Federal Reserve Bank of Dallas, 2011.

Shifts in housing preferences and low interest rates have been important drivers of recent strong house price growth across advanced economies. Estimates based on country-specific Bayesian vector autoregression (BVAR) models indicate that the house price increases across advanced economies during 2020-21 were mainly driven by increased demand for housing. There is a positive correlation between the magnitude of the estimated housing demand shock across countries and the share of teleworkable jobs, signalling that the housing demand shocks are related to a shift in housing preferences during the pandemic (**Chart B**, panel a), possibly reflecting a desire for more space coupled with less need for commuting.¹³ Increased demand for housing could also be related to search-for-yield behaviour in the low-yield environment. In addition, monetary policy shocks

¹¹ See Box 2 entitled "[Assessing the strength of the recent residential real estate expansion](#)", *Financial Stability Review*, ECB, November 2021. For tests of house price exuberance across advanced economies, see a modified unit root test of real house price growth in Pavlidis, E. et al., "Episodes of Exuberance in Housing Markets: In Search of the Smoking Gun", *Journal of Real Estate Finance and Economics*, Vol. 53, Issue 4, November 2016, pp. 419-449, and the [updated assessment based on this test](#) provided by the Federal Reserve Bank of Dallas.

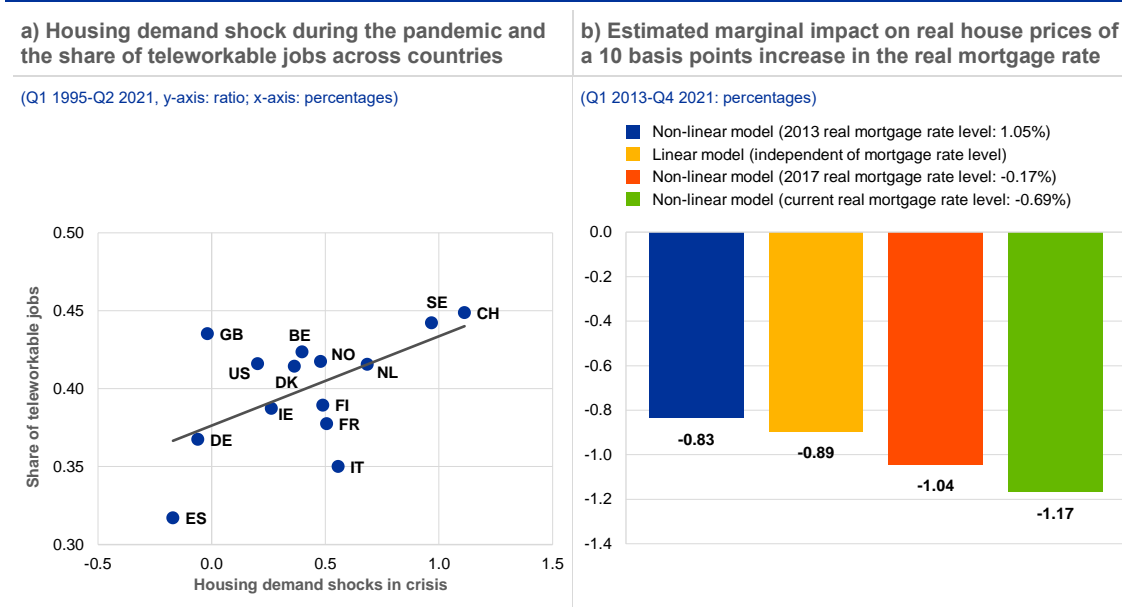
¹² Average nominal euro area mortgage lending rates reached historic lows in 2021, and increased slightly at the start of 2022, back to levels observed in 2020.

¹³ These results are in line with the related assessments in recent policy analysis. See, for example, the article entitled "[The euro area housing market during the COVID-19 pandemic](#)", *Economic Bulletin*, Issue 7, ECB, 2021; the box entitled "[Assessing the strength of the recent residential real estate expansion](#)", *Financial Stability Review*, ECB, November 2021; European Systemic Risk Board, "[Vulnerabilities in the residential real estate sectors of the EEA countries](#)", February 2022; and Igan, D., Kohlscheen, E. and Rungcharoenkitkul, P., "[Housing market risks in the wake of the pandemic](#)", *BIS Bulletin*, No 50, Bank for International Settlements, March 2022.

combined with mortgage supply shocks contributed to the recent house price increases across advanced economies, including the euro area. Unlike housing demand shocks, monetary policy and mortgage supply shocks move interest rates and house prices in opposite directions.

Chart B

A reversal in housing preferences or an abrupt increase in real interest rates could induce house price corrections, with potential adverse implications for macro-financial stability



Sources: Federal Reserve Bank of Dallas, Dingel and Neiman*, Haver Analytics, ECB and ECB staff calculations.
 Notes: Panel a: average standardised housing demand during the pandemic (Q1 2020-Q2 2021) and the share of teleworkable jobs from Dingel and Neiman*. The authors classify the feasibility of working at home for all occupations and merge this classification with occupational employment counts, but no values are provided for Australia, Canada, Israel, Japan, South Korea and New Zealand. The estimation results come from structural country-specific BVAR models in the spirit of Calza et al.** and Nocera and Roma***, with the following structural shocks: monetary policy, housing demand, mortgage supply, aggregate demand and aggregate supply, identified with a combination of sign and zero restrictions as well as a max share approach for the housing demand shock. The model includes the following variables: household credit, consumer prices index, real GDP, real house price, interest rate/shadow rate and the real effective exchange rate. For all the countries except the United States, the model includes cross-country average interest rate/shadow rate, CPI and GDP as block-exogenous. Estimation sample starts later than Q1 1995 for a few countries due to data limitations. Panel b: house price responses from an asset-pricing model where real house prices are explained with current real rents in the numerator and the expected long-term real interest rate plus the risk premium minus the expected future real rent growth in the denominator. "Linear model" denotes a formulation in log-levels, "Non-linear model" in log-logs. The models use euro area country-level data from Q1 2013 to Q4 2021 and account for country fixed effects.
 *) Dingel, J.I. and Neiman, B., "How many jobs can be done at home?", *Journal of Public Economics*, Vol. 189, 2020.
 **) Calza, A., Monacelli, T. and Stracca, L., "Housing finance and monetary policy", *Journal of the European Economic Association*, Vol. 11, pp. 101-122.
 ***) Nocera, A. and Roma, M., "House prices and monetary policy in the euro area: evidence from structural VARs", *Working Paper Series*, No 2073, ECB, 2017.

In the current low interest rate environment, increased sensitivity of house price growth to changes in real interest rates makes substantial house price reversals more likely. Evidence for the euro area shows that a model with an interest rate-dependent sensitivity of real house prices to real interest rates outperforms a model with a constant sensitivity. Such a non-linear model is consistent with asset pricing theory and implies that the lower the level of the real interest rate, the larger should be the response of house prices for a given change in that rate.¹⁴ Given the current low level of interest rates, therefore, potential reversals in residential real estate prices could be larger than several years ago, especially if interest rates increased sharply. In particular, the comparison between estimated linear and non-linear models (**Chart B**, panel b) for the euro area shows that the estimated house price response to a 0.1 percentage point increase in real mortgage rates from the

¹⁴ The net present value of a given income stream (e.g. rents) is more sensitive to changes in the discount rate, when the discount rate is low.

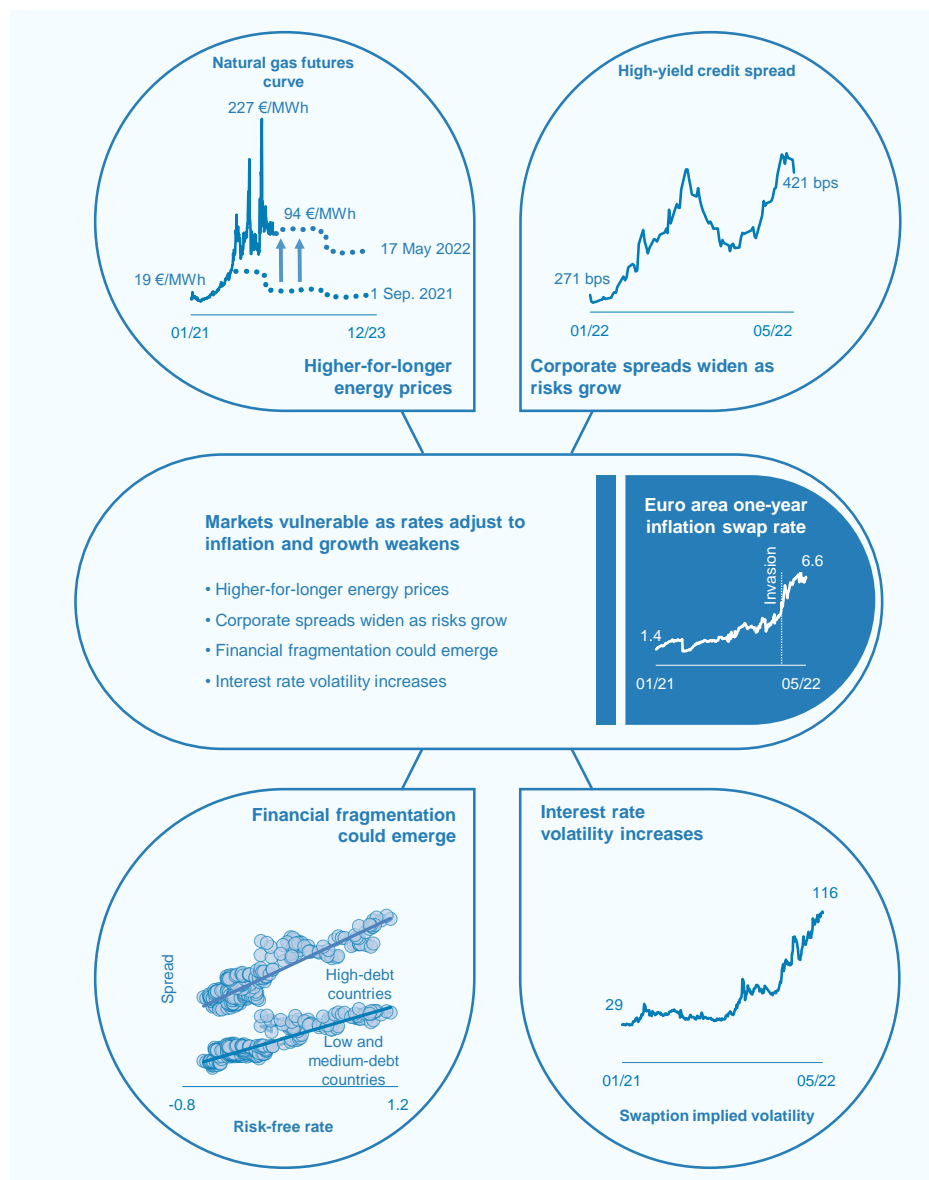
current very low level is around 28 basis points stronger when accounting for non-linear relationships (**Chart B**, panel b).¹⁵

An abrupt repricing in the housing market – if the demand for housing were to go into reverse, for example, or real interest rates were to rise significantly – could produce spillovers to the wider financial system and economy. Such price reversals in housing markets could reflect a return to pre-pandemic work modalities or a strong increase in real interest rates. Other possible factors include a change in investor preferences for holding residential real estate assets, as well as a more general deterioration in risk sentiment related to an exacerbation of geopolitical risks or progressing climate change. The BVAR models described above indicate that a 1% drop in house prices due to a shift in housing demand could, on average across countries, generate a peak drop in real GDP of 0.2% after two years. However, the decline varies from country to country, with a fall of up to 0.9% in some advanced economies and wide uncertainty bands around these estimates. To cushion adverse financial stability implications of potential house price reversals, a tightening of macroprudential measures seems warranted in some countries, especially where strong house price growth has been accompanied by buoyant credit dynamics.¹⁶

¹⁵ Any further increase in real mortgage lending rates would imply a lower marginal house price response. The estimated pattern is consistent with asset pricing theory, which implies that real house prices should respond more than proportionally to changes in interest rates, with price sensitivities increasing as rates decline. See also Liu, H., Lucca, D., Parker, D. and Rays-Wahba, G., “[The Housing Boom and the Decline in Mortgage Rates](#)”, *Liberty Street Economics*, Federal Reserve Bank of New York, 7 September 2021; and Igan et al, op. cit..

¹⁶ See also the [ESRB's warnings and recommendations on medium-term residential real estate vulnerabilities](#) published in February 2022.

2 Financial markets



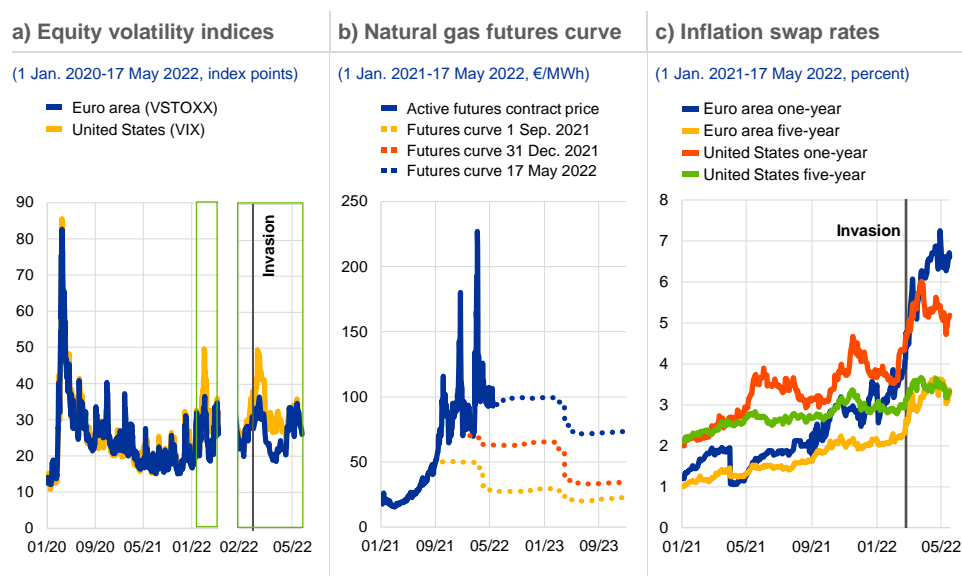
2.1 War exacerbates existing trends of higher energy prices and higher inflation

The Russian invasion of Ukraine triggered a moderate, short-lived “risk-off” market reaction, during which market functioning remained largely orderly. In the immediate aftermath of the invasion, volatility increased (**Chart 2.1**, panel a), credit spreads widened, euro area equity indices fell (**Chart 2.2**, panel a) and government bond yields declined. Compared with the March 2020 market turmoil following the outbreak of the coronavirus (COVID-19) pandemic, the initial market

reaction to the invasion was relatively mild. Despite the profound medium and long-term implications of the war, as discussed in detail below, this correction was followed by a relatively fast rebound. A significant further escalation, in economic and/or military terms, could still cause renewed market stress. However, regardless of how the conflict evolves (e.g. a ceasefire agreement, prolonged entrenchment or further escalation), several medium-term consequences have crystallised, as discussed below. Notably, the war increases the risk of a higher-inflation, lower-growth scenario resulting from higher energy prices and supply chain disruptions (**Chapter 1**). The policy response to higher inflation and concerns about the global growth outlook have contributed to renewed weakness in financial markets during the second quarter of 2022.

Chart 2.1

The initial risk-off market reaction to the invasion was temporary and limited, but energy prices are expected to be higher for longer and the upward trend in inflation swap rates accelerated after the invasion



Sources: Bloomberg Finance L.P., Refinitiv and ECB calculations.
Notes: Panel b: futures curves are based on futures contracts for different delivery dates. The active futures contract price refers to the futures contract that matures in the next month. Futures contracts are traded on the Intercontinental Exchange (ICE) and linked to Dutch TTF natural gas. Panel c: inflation swap rates refer to the fixed rate at which contracts are opened, whereby the floating leg, with annual payments over the duration of the contract, is tied to an inflation index. Inflation swap rates do not purely reflect inflation expectations, as they also include a risk premium.

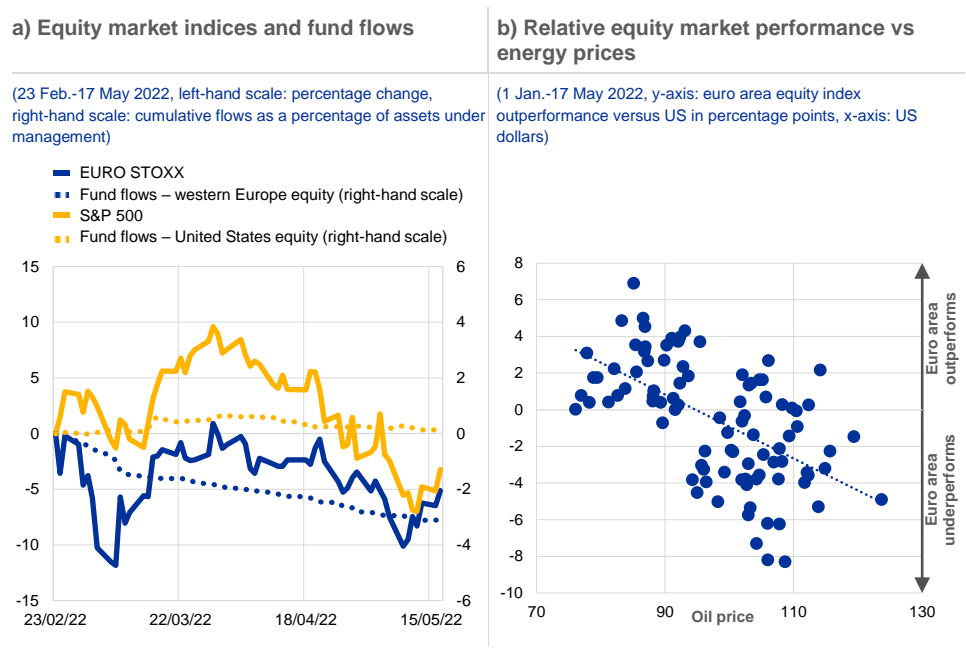
Commodity futures prices suggest that energy prices will remain higher for longer. Energy prices had already increased markedly before the start of the war in Ukraine: tensions had already risen in the second half of 2021, with strong demand for commodities as economies recovered from the pandemic. For example, the average natural gas price in the fourth quarter of 2021 was 550% higher than in the same quarter of 2020. As the conflict escalated, increases were not limited to spot prices. The natural gas forward curve now points to elevated prices up to and including the winter of 2023 (**Chart 2.1**, panel b).

The upward trend in inflation swap rates accelerated after the invasion was launched. Inflation swap rates surged, driven in part by rising energy prices (**Chart**

2.1, panel c). The euro area one-year inflation swap rate currently stands at around 6.6%,¹⁷ its highest level since the introduction of the euro, up from around 3.4% at the end of 2021. The implications of higher than expected inflation are discussed from a conceptual point of view in **Box 3**, while empirically observed consequences for financial markets are discussed in this chapter.

Chart 2.2

A divergence between the United States and the more energy import-dependent euro area emerged after the start of the invasion of Ukraine



Sources: Bloomberg Finance L.P., EPFR Global, Refinitiv and ECB calculations.
 Notes: Panel a: percentage change since 23 February 2022, fund flows as a share of assets under management. Western Europe equity refers to funds that invest in developed European markets, namely Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. Panel b: daily data on relative performance in terms of the EURO STOXX price change versus the S&P 500 price change, as of 1 January 2022, mapped against the oil price in US dollars. The result is not driven by differences in the shares of the oil and gas sector between the indices.

Euro area equity markets experienced a relatively weak recovery during the first weeks after the invasion, as compared with US markets. While the EURO STOXX index had just returned to pre-invasion levels by the end of March, the S&P 500 index had already posted a 10% gain (Chart 2.2, panel a). Prior to the invasion, global fund managers were positive on European equities,¹⁸ but this sentiment shifted with the start of the war, as evidenced by the outflows from funds with a focus on western European equities (Chart 2.2, panel a). The euro area’s high level of dependence on energy imports may explain much of this divergence: energy prices are correlated with performance differentials between US and euro area equities (Chart 2.2, panel b). At the same time, other factors also impact this differential, especially in April and May. Notably, more recent underperformance in US equity markets may be

¹⁷ As of 17 May 2022.
¹⁸ For example, Bank of America’s December Global Fund Manager Survey showed that a net 31% of fund managers were “bullish” on euro area equities. US equities came in second with a net 18% of fund managers.

seen in the context of a repricing in bond markets consistent with a faster expected pace of US monetary policy normalisation.

Following the invasion, pre-existing emerging market underperformance was magnified by an increase in food and energy prices, along with a number of idiosyncratic factors (Chart 2.3). Equity indices covering eastern European countries fell by more than their western European peers and have not recovered to pre-invasion levels. This underperformance may be explained by these countries' closer proximity to the conflict and stronger trade links with Russia. Some emerging markets (currencies and/or hard currency debt) may also experience pressures from US dollar strengthening. China has also underperformed in debt and equity markets (Chart 2.3), but for more idiosyncratic reasons. Its zero-COVID strategy and regulatory tightening (Chapter 1) have contributed to a further deterioration in conditions in the offshore dollar-denominated high-yield bond market, with spillovers to offshore investment-grade bonds (Chart 2.3, panel a). At the same time, the onshore renminbi-denominated bond market remains resilient. If these financial stresses were to intensify, it could affect developed markets through the global demand channel; the risk of direct spillovers to financial markets outside China is smaller (Box 4).

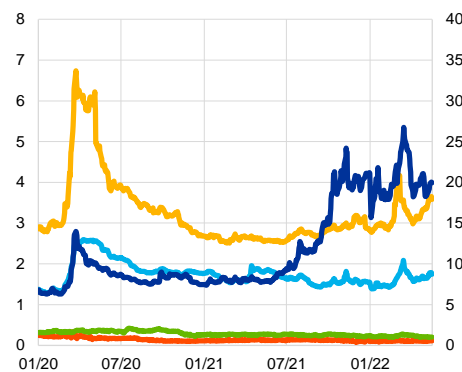
Chart 2.3

Emerging markets continue to show weakness, led by China

a) Option-adjusted spreads of emerging market bond indices

(1 Jan. 2020-17 May 2022, percent)

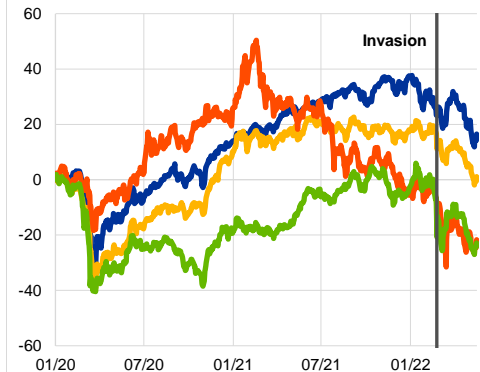
- China high-yield offshore USD (right-hand scale)
- Emerging market hard currency debt
- Emerging market soft currency debt
- China aggregate onshore CNY
- China investment-grade offshore USD



b) Emerging market equity indices

(1 Jan. 2020-17 May 2022, percentage change since 1 Jan. 2020)

- MSCI World
- MSCI Emerging Markets ex China
- MSCI China
- MSCI EM Eastern Europe ex Russia



Sources: Bloomberg Finance L.P., Refinitiv and ECB calculations.

Note: Panel a: the emerging market hard currency debt index includes USD-, EUR- and GBP-denominated debt from sovereign, quasi-sovereign and corporate issuers.

2.2

Market sensitivity to pace of policy normalisation

Historically, episodes of (anticipated) monetary policy adjustment have been associated with elevated volatility. This section describes how recent market

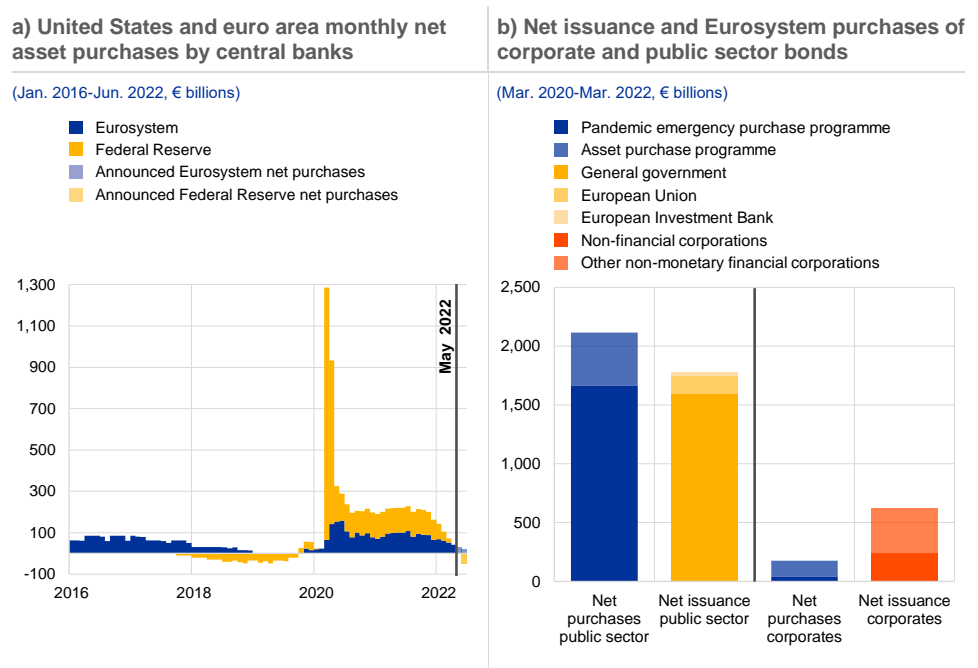
repricing is consistent with changing expectations around the pace of monetary policy normalisation. It also discusses the associated risks of financial fragmentation and a disorderly correction in markets for risky assets.¹⁹

In recent months, central banks around the world have moved towards reducing net asset purchases and signalled a tighter monetary policy stance ahead.

Notably, the Federal Reserve System ended its net asset purchases as of March, while the ECB terminated its net purchases under the pandemic emergency purchase programme (PEPP) at the same time. In addition, the ECB's Governing Council has stated that incoming data have reinforced its expectation for net asset purchases under the asset purchase programme (APP) to be concluded in the third quarter of 2022. This would mark an end to the rapid expansion of central bank balance sheets in response to the COVID-19 crisis (Chart 2.4, panel a). During that period, firms and governments benefited from favourable financing conditions supported by central bank purchases (Chart 2.4, panel b).

Chart 2.4

Firms and sovereigns face changing market conditions as central bank purchases are reduced



Sources: Bloomberg Finance L.P., ECB and Federal Reserve System.
 Notes: Panel a: net asset purchases by the Federal Reserve shown include only those under System Open Market Account (SOMA) treasury transactions and SOMA agency MBS transactions; net asset purchases under the Eurosystem include those under the APP and PEPP. Net purchases are negative when monthly redemptions surpass gross purchases. Panel b: net issuance of debt securities by euro area public sector and corporate entities. The general government category is as defined in the European System of Accounts (ESA 2010).

¹⁹ In the monthly Bank of America Global Fund Manager Surveys conducted between December 2021 and February 2022, fund managers saw “Hawkish central bank rate hikes” as the biggest tail risk. In the March 2022 survey, this position was overtaken by “The Russia-Ukraine conflict”. The April survey listed “Global recession” as the largest risk (26%), closely followed by “Hawkish central banks” (25%). The leading position was taken once again by “Hawkish central banks” (31%) in the May edition.

Markets have repriced for a faster pace of policy normalisation in both the euro area and the United States, compared with 2021. Pricing for interest rate derivatives suggests that market participants now foresee more imminent policy rate hikes than previously (**Chart 2.5**, panel a).²⁰ Interest rates rebounded from a brief decline immediately after the invasion and continued their climb in subsequent weeks as market participants considered it increasingly likely that central banks would move faster towards monetary policy normalisation in response to inflationary pressures (**Chart 2.5**, panel b).

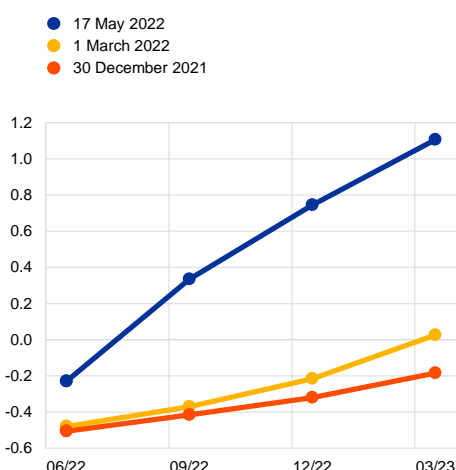
Differences in the pace of policy adjustment can lead to a spillover of risks from the United States to the euro area. Higher US yields may affect global capital flows and thereby indirectly affect euro area yields. In addition, elevated volatility in US markets can spill over to euro area markets and lead to a deterioration in risk sentiment.²¹

Chart 2.5

Markets are pricing in a faster pace of monetary policy tightening than previously

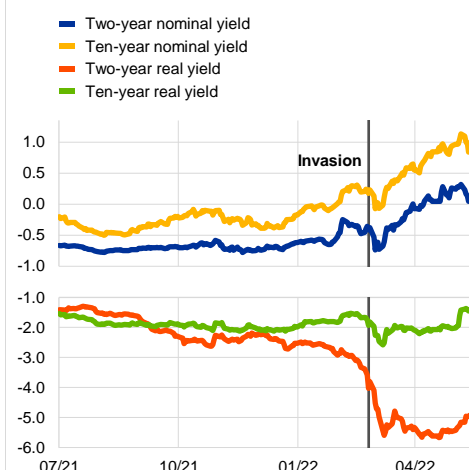
a) EURIBOR futures curve

(Jun. 2022-Mar. 2023, percent)



b) Longer-term German government real and nominal bond yields

(1 Jul. 2021-17 May 2022, percent)



Sources: Bloomberg Finance L.P. and ECB calculations.

Notes: Panel a: EURIBOR futures curves are based on contracts traded on the Intercontinental Exchange (ICE) based on the underlying three-month EURIBOR. Panel b: real yields are shown as the nominal German government bond yield less the break-even inflation rate.

Volatility and uncertainty in interest rate and government bond markets, as well as potential upward pressure on real rates, could challenge risky asset valuations. Markets, already priced for faster increases in short-term rates (**Chart 2.5**, panel a), have become increasingly sensitive to information that could – as seen

²⁰ In the ECB Survey of Monetary Analysts, the **December 2021 results** showed December 2023 as the median expected timing of the next increase in the deposit facility rate. This median had shifted forward by more than one year to September 2022 in the **April survey results**. In addition, the Bloomberg Economist Survey conducted between 1 and 6 April 2022 found -0.25% to be the median expectation for the deposit facility rate for December 2022 compared with a median expectation of -0.5% in the survey conducted between 8 and 14 December 2021.

²¹ See the Box entitled “**Risk of spillovers from US equity market corrections to euro area markets and financial conditions**”, Financial Stability Review, May 2021, ECB.

through the lens of market participants – affect the pace of policy normalisation. As inflationary pressures built over the course of 2021, implied volatility in euro area government bond markets increased, as did uncertainty²² with regard to future short-term interest rates (**Chart 2.6**, panel a). In addition, there is now the potential for real interest rate rises after years of declines (**Chart 2.5**, panel b). All else equal, increases in both nominal and real rates are typically associated with investor de-risking, and may lead to pressures on valuations of risky assets such as equities. A theoretical exercise, with cyclically adjusted earnings and equity risk premia²³ held constant, shows that equity valuations could decline significantly for given, relatively limited increases in longer-term, risk-free real interest rates (**Chart 2.6**, panel b). Nevertheless, (euro area) real risk-free rates remain in negative territory. In addition, equities are also considered to have some inflation hedging properties, which can support valuations in the current inflation environment.

The first half of 2022 saw a sizeable market correction especially in higher-duration equities and more speculative asset classes. As set out in the November 2021 Financial Stability Review (FSR), equity markets have become increasingly sensitive to interest rate increases in recent years. As rates increased sharply since November 2021, higher duration equities, such as those in the technology sector, underperformed.²⁴ Market volatility also expanded into crypto-asset markets. Bitcoin lost 50% of its value (versus the US dollar),²⁵ and stresses emerged in markets for stablecoins.²⁶ While a number of stablecoins lost their peg against the US dollar, broader financial stability risks remain limited. At the same time, the implications of stresses on stablecoin Tether could be significant for the crypto-asset ecosystem. A failure of Tether may pose a threat to the stability of crypto-asset markets, as it provides a substantial amount of trading liquidity for buying and selling of other crypto-assets.²⁷ A run on Tether could disrupt trading and price discovery in crypto-asset markets, which could turn disorderly. Contagion effects for the broader financial system arising from a potential “crypto crash” still seem limited (**Special Feature B**), although individual investors may suffer significant losses.

²² As measured by the standard deviation of the option-implied probability density functions.

²³ In this exercise, the excess cyclically adjusted price/earnings (CAPE) yield, which is sometimes interpreted as the equity risk premium, is held constant. In addition, cyclically adjusted earnings – by design a relatively stable variable based on a long-term inflation-adjusted average – are also held constant. It would be possible to relax the assumption of a fixed equity risk premium, and in theory, there could even be a relationship between the equity risk premium and the risk-free interest rate. Evidence presented below (Chart 2.7) suggests that *credit* risk premia have shown a positive relationship with risk-free rates more recently. There have been historical episodes with both positive and negative relationships between the risk-free rate and the equity risk premium.

²⁴ For example, between 17 November 2021 and 17 May 2022 the Nasdaq Composite declined by 25 percent. Sources: Bloomberg, ECB calculations.

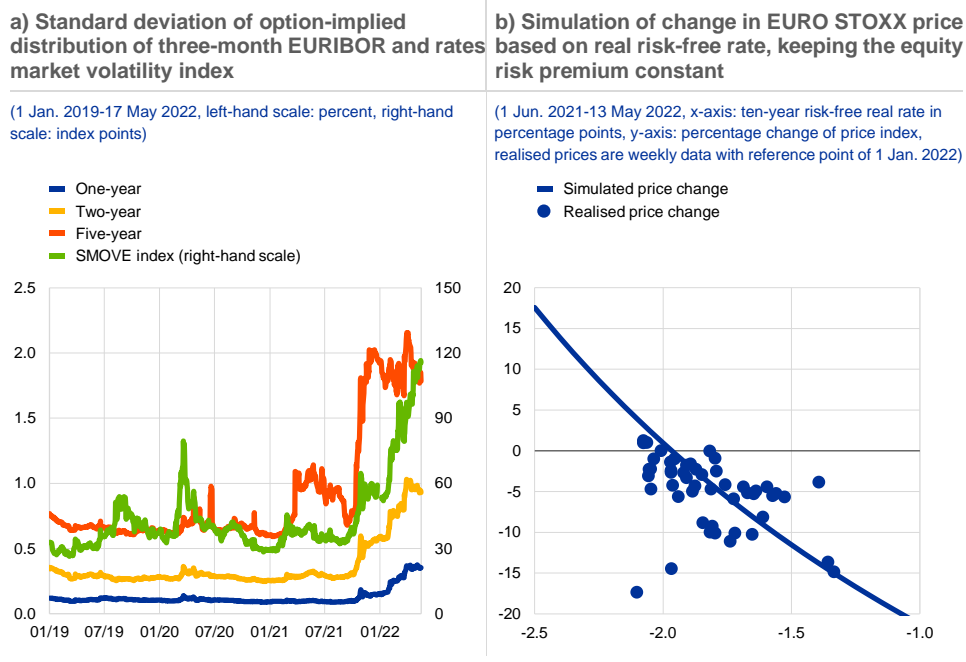
²⁵ Between 17 November 2021 and 17 May 2022 the Bitcoin lost 50 percent of its value versus the US dollar. Sources: Bloomberg, ECB calculations.

²⁶ See also “[The expanding functions and uses of stablecoins](#)”, *Financial Stability Review*, ECB, November 2021.

²⁷ See the updated “[Assessment of Risks to Financial Stability from Crypto-assets](#)”, Financial Stability Board, February 2022.

Chart 2.6

Volatility and upward pressure on real rates could challenge valuations of risky assets



Sources: Bloomberg Finance L.P., Refinitiv and ECB calculations.
 Notes: Panel a: the Swaption Merrill Option Volatility Estimate (SMOVE) is a yield curve-weighted index of the normalised implied volatility on three-month swaptions. It is the weighted average of volatilities on 2-year, 5-year, 10-year and 30-year maturity swaps. Panel b: equity price movements are projected for different levels of real risk-free rates. The excess cyclically adjusted price/earnings yield over the risk-free rate ("equity risk premium") is assumed to be constant and equal to its value as at 1 January 2022. Dots indicate historically realised price changes in the EURO STOXX index compared with 1 January 2022.

Rising interest rates could present challenges to highly indebted firms and governments. An increase in interest rates exposes borrowers to higher (re)financing costs. For more indebted firms and sovereigns, the impact of higher financing costs on earnings and budget deficits is mechanically larger. This implies that, all else equal, the debt sustainability of more indebted firms and governments may deteriorate relatively more rapidly than for less indebted firms and governments. This in turn can lead to higher credit and sovereign spreads and increasing financial fragmentation (**Chart 2.7**). At the same time, both firms and governments have extended the maturity of their debt in recent years, which might shield them from the higher marginal cost of funding to some extent.

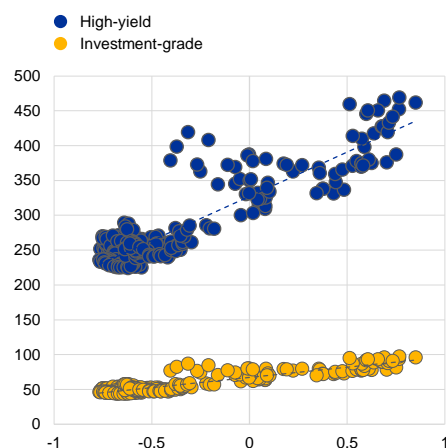
Interest rate increases may entail risks, especially if underlying growth dynamics are muted. All else equal, a tighter monetary policy stance generally leads to increasing interest rates and an attenuation of (expected) growth. Consequently, monetary policy tightening can drive a wedge between interest rates and growth, and this can have consequences for debt sustainability (**Box 3**). At the same time, increases in market rates (the marginal cost of funding) only feed through into average interest rates paid slowly, as existing fixed-rate debt matures and new debt is issued. Issuers with relatively higher outstanding amounts of variable-rate or inflation-linked debt instruments are more directly exposed.

Chart 2.7

Higher rates could challenge debt sustainability and drive spread-widening

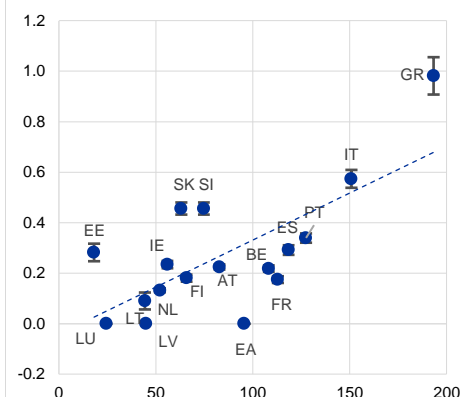
a) Euro area corporate spreads vs. risk-free rates

(1 Jan. 2021-17 May 2022, y-axis: basis points, x-axis: percentage points)



b) Rate elasticity of sovereign spreads vs. debt-to-GDP ratio

(1 Jan. 2021-17 May 2022, y-axis: basis point spread per basis point of risk-free rate, x-axis: 2021 government debt/GDP, percentages)



Sources: Bloomberg Finance L.P., ECB and ECB calculations.

Notes: Panel a: high-yield spreads refer to the five-year iTraxx Crossover CDS spreads; risk-free rate refers to the Germany five-year government bond yield. Panel b: spreads and rates refer to ten-year government bond yields of euro area countries; risk-free rate refers to German government ten-year yields. Error bars indicate a two standard deviation confidence interval around the parameter estimate. There are not sufficient data for Cyprus and Malta.

2.3 Commodity price shocks may lead to a reassessment of risks in the corporate sector

Corporate spreads increased in a challenging environment of higher commodity prices, higher inflation, higher interest rates and a weaker growth outlook. After a brief spike, spreads on high-yield corporate bonds returned to pre-invasion levels, but remain elevated compared with 2021, reflecting the more challenging macro-financial environment (Chart 2.8, panel a). Higher commodity prices and inflation will probably translate into higher cost and input prices, which can,

in turn, erode earnings. Rising financing costs may further impair earnings as rates increase, especially for firms with variable-rate loans (e.g. leveraged loans) or floating-rate bonds, and for firms with significant near-term refinancing needs. Since the invasion, issuance of high-yield corporate bonds has remained subdued. Rating agencies have recently upgraded their predictions for speculative grade defaults and also indicated that risks are seen to the upside (Chart 4, panel a, Overview).

Sector-level equity performance over the course of 2021 was closely related to firms' ability to maintain or increase margins (Chart 2.8, panel b). Pricing power is a key factor determining firms' ability to cope with higher inflation and higher commodity prices (Chapter 1). In particular, a high energy intensity in production does not automatically imply that earnings will be materially compressed by higher energy prices. Firms might be able to pass on much of the cost increases to their customers, depending on their pricing power. Indeed, equity sub-indices for several

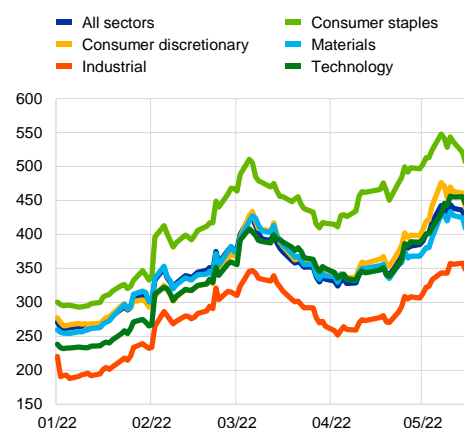
industries with a high energy intensity in production²⁸ (e.g. paper products, metals and mining, and chemicals) have outperformed the broader EURO STOXX index in recent months. Data suggest that firms in these industries are able to exploit their pricing power to pass on cost increases to their customers (Chart 2.8, panel b). Ultimately, higher commodity prices permeate through production chains and affect the economy as a whole, leaving firms with lower pricing power most vulnerable (Box 1 and Box 3). In the euro area, some firms might struggle to maintain their margins if they face competition from producers in countries with lower energy cost.

Chart 2.8

Corporate spreads have widened, and equity performance suggests that pricing power is key in this more challenging environment

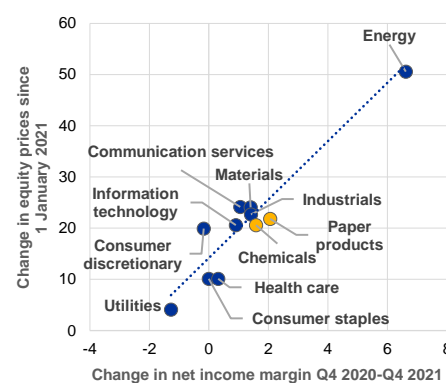
a) Corporate high-yield bond spreads

(1 Jan. 2022-17 May 2022, option-adjusted spread in basis points)



b) Sector equity performance vs. net income margin changes

(31 Dec. 2020- 17 May 2022, y-axis: percentage change, x-axis: percentage point change)



Sources: Bloomberg Finance L.P. and ECB calculations

Notes: Panel a: euro area. Panel b: change in equity prices refers to percentage change of subsector equity indices between Q4 2020 and Q4 2021; change in net income margin refers to change of the median net income margin between Q4 2020 and Q4 2021, at sector-level. Panel of 1,524 unique euro area non-financial corporations. Yellow dots indicate industries with a high energy intensity of production.

Firms are facing elevated uncertainty and upside risks to future energy prices.

Oil prices have increased sharply in 2022, but in addition, the option-implied probability density of future oil prices has also broadened, pointing to high uncertainty (Chart 2.9, panel a). As oil prices peaked in March 2022, the implied volatility for call options exceeded that for put options for an extended range of maturities (Chart 2.9, panel b); this reflected market participants' concerns over upward tail risks for oil prices, and/or that there was relatively more demand for insurance against price increases, as opposed to price decreases.²⁹ More recently, this dynamic has normalised, as downward risks for demand are seen in light of global growth concerns.

²⁸ See the box entitled "Natural gas dependence and risks to euro area activity", *Economic Bulletin*, Issue 1, ECB, 2022.

²⁹ For most financial assets, the "risk reversal" – the difference between call and put option prices with the same exercise date and similar sensitivity to the underlying (delta) – is usually negative.

Hedging helps energy suppliers and users manage price changes, but it does not fully shield firms from volatility and price increases in commodity markets.

Firms can hedge their exposures to commodity prices (e.g. utilities) in derivatives (e.g. futures) markets. Hedging helps firms to offer longer-term fixed contracts to customers or suppliers, while offsetting resulting risk exposures. In other words, hedging can reduce uncertainty across production chains and indirectly for consumers as well. Other, typically smaller firms do not hedge, as the cost and expertise required may be prohibitive for them. These firms are directly exposed to price changes and volatility.³⁰ But even for firms that actively hedge, the protection may be somewhat limited: as existing derivative contracts settle, new contracts need to be entered into at prevailing market prices. Furthermore, hedges are often imperfect or partial and leave firms partially exposed to underlying risks (“basis risk”).

Hedging of energy exposures became more challenging and complicated for some participants as commodity price volatility jumped. More recently, central counterparties have substantially increased their initial margin requirements on commodity futures contracts in response to elevated volatility (**Chart 2.9**, panel c). This means that a clearing bank (clearing member) must post a sizeable upfront margin to the central clearing counterparty (CCP), which might increase further at a later point of time. In turn, the clearing members require their clients to post similar or larger initial margins to them. For natural gas and electricity, these initial margins have reached up to 80% of the contract price,³¹ meaning that hedgers are faced with larger liquidity needs.³² In other words, firms can only hedge if they are willing and able to post such margins. For some firms, the cost of hedging may have started to outweigh the perceived benefit. While the posted initial margins limit counterparty risk and help to safeguard the financial system against systemic risk, the liquidity needs can be prohibitive for some firms with hedging needs. Firms that decide to remain unhedged retain their exposure to the underlying asset. Risks stemming from such exposures can ultimately threaten their solvency, if underlying (commodity) prices swing in a disadvantageous direction. Other firms might attempt to hedge their exposures through non-centrally cleared derivatives, although open interest for contracts such as (centrally cleared) natural gas futures did not show a major decline.³³ If firms were to hedge their exposures in this way, both the firm and the counterparty could be more exposed to counterparty credit risk. More broadly, this raises the question of whether margining practices, including those between the clearing member and their clients, are simply appropriately reflecting the more volatile market conditions, or whether there might be some unnecessary procyclicality (**Chapter 5**).

³⁰ A number of smaller, relatively unhedged UK energy utilities have recently defaulted; see, for example, “[Losing their hedge: why so many UK energy suppliers went bust](#)”, Risk.net, 4 November 2021.

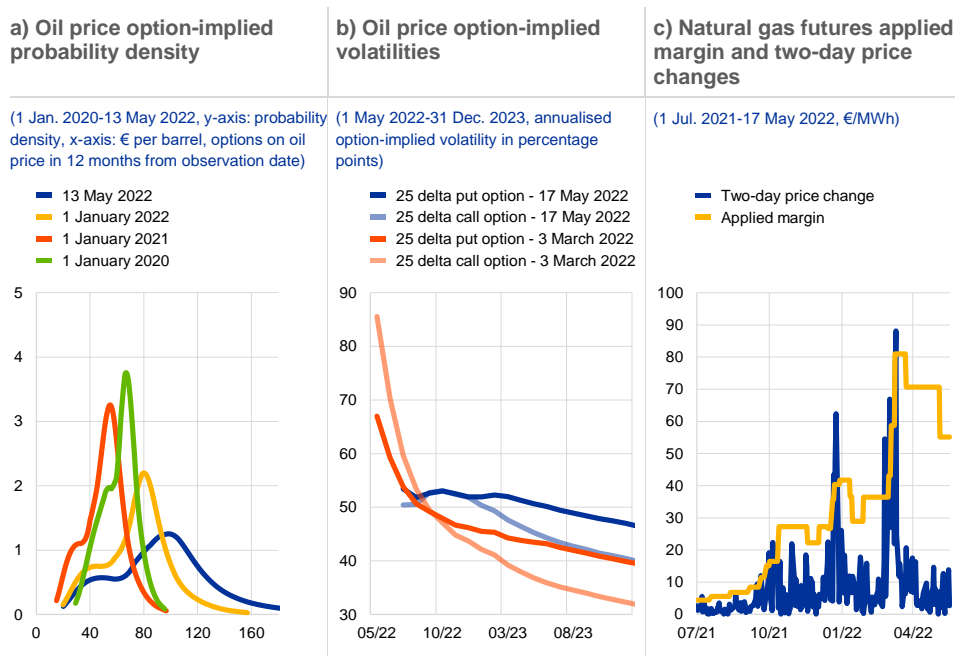
³¹ In March 2022, the applied margin by ICE Clear Europe to the active Dutch TTF Natural Gas Futures Contract amounted to above 80% of the futures price on several days. Sources: ICE Clear Europe, Bloomberg L.P. and ECB calculations.

³² In addition to initial margin, counterparties to a derivative trade also exchange variation margin, which moves mechanically with the price of the contract.

³³ As margin requirements increased, open interest, weighted by contract size, showed some migration from the Intercontinental Exchange (ICE) towards the European Energy Exchange (EEX) for natural gas futures contracts. This may be related to differences in contract maturities and characteristics – but could also be related to differences in margining requirements. Sources: Bloomberg L.P. and ECB calculations.

Chart 2.9

Energy prices increased, but also became more uncertain and more volatile, which increases the liquidity demands for hedging with cleared derivatives



Box 3

Financial stability implications of higher than expected inflation

Prepared by Benjamin Mosk and Peter Welz

Global inflation rates have increased substantially over the past year, driven by high energy prices, supply chain constraints and a rebound in demand. Inflation in the euro area is expected to remain elevated throughout 2022. Since the end of 2020, professional forecasters have repeatedly revised up their inflation projections as outturns surprised to the upside (**Chart A**, panel a).³⁴ Future developments in terms of energy prices and supply bottlenecks present upside risks to inflation.³⁵ This box assesses the channels through which higher than expected inflation could affect financial stability, taking into account the effects for governments, firms, households and financial markets.

Significant inflation surprises can lead to market volatility, increasing the probability of a disorderly repricing of assets. When faced with an inflation shock, market participants try to anticipate the potential response of central banks as they seek to maintain price stability. This can prompt adjustments in market interest rates at the short and long end (depending on market participants' expectations), followed by adjustments in other market prices. If nominal interest rates

³⁴ See, for example, the [Eurosystem and ECB staff macroeconomic projections](#).

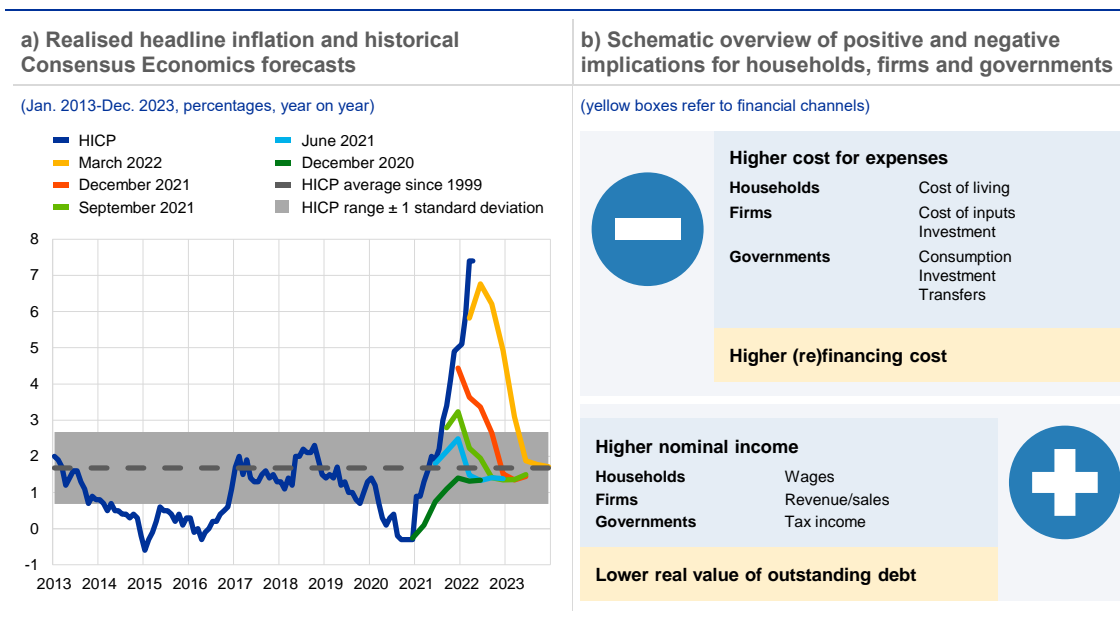
³⁵ In response to these developments, the Governing Council has stated that "If the incoming data support the expectation that the medium-term inflation outlook will not weaken even after the end of its net asset purchases, the Governing Council will conclude net purchases under the APP in the third quarter [of 2022]" ([ECB Monetary Policy Decisions, 10 March 2022](#)). In addition, the Governing Council has stated that it "judged that the incoming data since its last [April] meeting reinforce its expectation that net asset purchases under the APP should be concluded in the third quarter" ([ECB Monetary Policy Decisions, 14 April 2022](#)).

increase by more than (expected) inflation rates, (expected) real yields increase. All else being equal, higher real yields are typically associated with de-risking by investors. Over the past decade, search-for-yield behaviour has led to compressed risk premia and elevated asset prices. This increases the potential scale of adjustments when real yields start to rise. At the same time, in an inflationary environment, equities may be more attractive than fixed income products, as the coupon payments on nominal bonds do not offer protection against inflation. The ultimate impact on equity markets also hinges on economic growth prospects.

Higher than expected inflation also affects the capacity of different borrowers to service their debts, even as inflation may reduce the real value of outstanding debt. The real value of any nominal amount of outstanding debt decreases as prices increase. This means that, in aggregate, borrowers' loan repayments are relatively smaller in real terms, such that they have to forego relatively fewer "consumption baskets" to repay their loans. However, borrowers could run into debt servicing problems if their income does not increase enough to offset the higher cost of consumption and investment (**Chart A**, panel b). This is more likely to happen if supply shocks result in both lower growth and higher inflation. Generally, borrowers with variable-rate debt contracts are more directly exposed to rising interest rates, with their debt servicing capacity hurt by more than that of borrowers with fixed-rate debt.

Chart A

Inflation can ease some aspects of debt burdens, but it can also create challenges for debt servicing and rollover



Sources: Eurostat, Consensus Economics Inc. and ECB.

Notes: Consensus Economics forecasts are at quarterly frequency; observations for months within the quarters are linearly interpolated.

Highly indebted sovereigns could face a deterioration in debt servicing capacity if rising interest rates and risk premia drive a wedge between nominal interest rates (i) and nominal economic growth (g). The interest rate-growth differential ($i-g$) is a key parameter in the analysis of government debt sustainability.³⁶ When interest rates exceed the growth rate, a primary surplus is needed to stop the debt ratio from rising. This pressure on governments' balance sheets is also called the "snowball effect". Theoretically, both nominal interest rates and nominal growth rates could increase with inflation. However, expected output growth will likely face downward pressures when

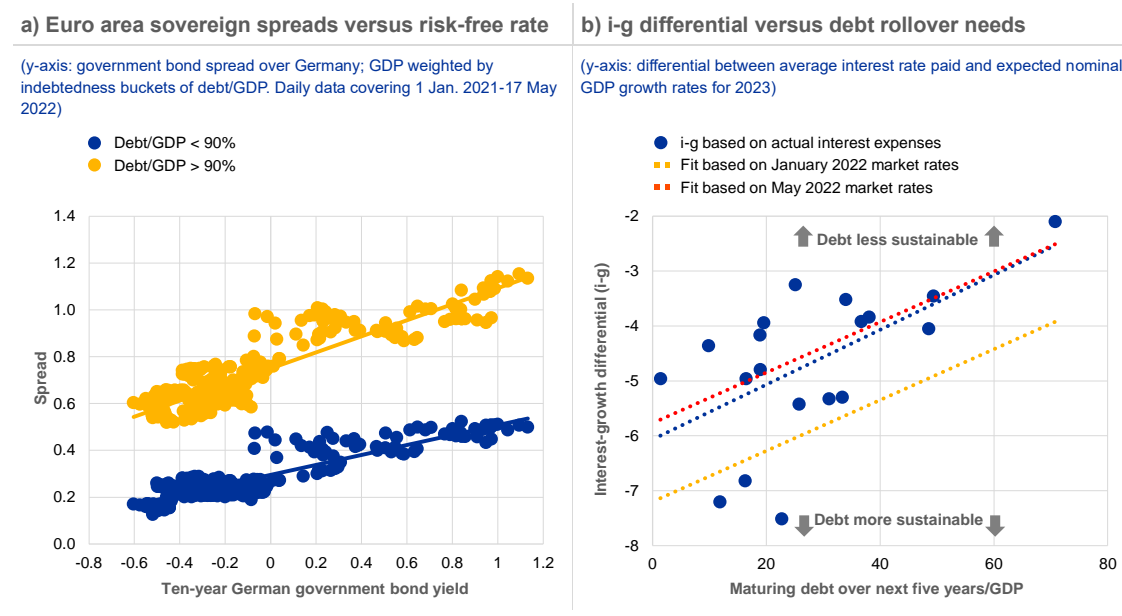
³⁶ For more details, see the box entitled "Sensitivity of sovereign debt in the euro area to an interest rate-growth differential shock", *Financial Stability Review*, ECB, November 2021.

nominal rates increase, everything else equal. A wedge could thus be driven between i and g , further exacerbated by increasing risk premia. An increase in risk-free rates may have a larger impact on the budget of more indebted sovereigns, and may therefore be accompanied by a widening of sovereign spreads (**Chart B**, panel a). This could be of greater concern for more indebted countries with relatively high short- to medium-term refinancing needs, as their interest rate-growth differential, which is already higher, might increase by more than that of countries with lower short- to medium-term refinancing needs (**Chart B**, panel b).

That said, several factors are alleviating the risk of elevated pressure on highly indebted sovereigns. Sovereigns in the euro area continue to benefit from relatively low interest rates. Despite recent increases, current market rates are still close to the average rate paid by many euro area countries (**Chart B**, panel b). Furthermore, governments have generally strengthened their debt structures over the last decade by increasing the average residual maturity, diversifying their portfolio of instruments and expanding the investor base. This means that any increase in the marginal cost of funding feeds through to the average interest rate relatively slowly. Consequently, the interest rate-growth differential could improve especially during the early stages of an inflationary shock if nominal GDP growth is boosted by inflation, whilst the average interest rate paid on the total debt stock adjusts gradually. Furthermore, since mid-2021 countries have benefited from the support offered through the Recovery and Resilience Facility, a centrepiece of the European Union’s Next Generation EU (NGEU) package. This support will continue until 2026, although the share of allocated grants and loans varies across countries. However, countries will face higher contributions to the EU budget to finance the NGEU package in the medium to long run.

Chart B

Indebted sovereigns are more vulnerable to a widening of the interest rate-growth differential



Sources: European Commission, Eurostat, Bloomberg Finance L.P., ECB and ECB calculations.

Notes: Panel a: interest rate spreads for euro area countries. Panel b: market rates are based on seven-year or nearest available to seven-year government benchmark bond yields. Market rates in January and May are computed as average over the available daily observations. Last observation 17 May 2022.

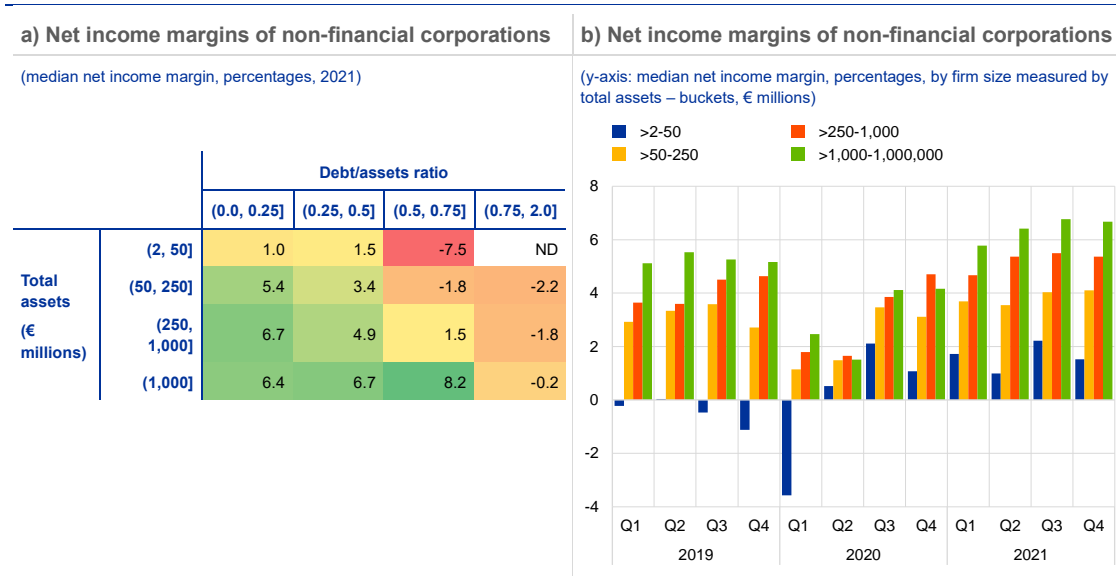
Households’ real disposable incomes could suffer if nominal wages do not offset price increases, with potential implications for residential real estate markets. A drop in real disposable income could lead to lower consumption as households try to continue servicing their debt. A serious deterioration in real disposable income could lead to bank loan losses, as households with weak balance sheets may struggle to repay debt, including mortgages and consumer loans, especially when rates on such loans are variable. As households have moved to long-term fixed-rate

contracts in many euro area countries, they might be shielded to some extent against this effect. In addition, households' borrowing capacity could deteriorate, potentially putting downward pressure on valuations of residential real estate. In aggregate, households still benefit from the sizeable volumes of liquid assets that they accumulated during the pandemic and that would, to some extent, relieve the debt servicing burden, which on aggregate is also low relative to disposable income. However, this masks the fact that liquid assets are unevenly distributed and that higher than expected inflation can have negative distributional consequences that affect low-income households the most. Finally, consumer confidence may erode in a high inflation environment, with potentially adverse consequences for consumption.

Vulnerable corporates with lower pricing power and higher debt are more exposed to pressure on debt sustainability from inflation shocks than other corporates. While some firms can pass on cost increases to consumers, other firms with less pricing power may face cost increases that outpace revenue growth. Smaller and more indebted firms might have lower pricing power, according to data on net income margins (Chart C).³⁷ Insolvency rates have been very low recently, but vulnerabilities have built up in the sectors worst affected by the pandemic. If higher inflation rates drive cost increases while revenue growth is subdued, insolvency cases may start to rise among vulnerable and indebted firms, raising creditor losses.

Chart C

Smaller and more indebted firms have lower net income margins, pointing to lower pricing power



Sources: S&P Global Market Intelligence and ECB calculations.

Notes: Net income margins vary by sector. Sample of 1,183 unique euro area non-financial corporations.

If higher inflation is accompanied by subdued growth, the negative impact of inflation on financial stability would be exacerbated amid limited scope for offsetting income increases.

Inflation exists in different forms, such as *demand-pull*, *cost-push*, *imported* or *wage/price-spiral* inflation. When inflation is driven by more exogenous supply shocks or cost-push shocks generated by higher energy prices, the scope for higher income is more limited, the balance of risks is tilted to the downside and the *i-g* gap is more likely to widen.

³⁷ Lower net income margins do not necessarily point to lower pricing power. For example, margins for more indebted firms may simply be lower due to higher interest expenses. At the same time, this still leaves these firms vulnerable, as the “buffer” in terms of positive margins is already smaller to begin with, meaning that a compression of margins may result in realised losses more quickly.

While financial stability is a prerequisite for price stability, price stability also affects financial stability. The ECB monetary policy strategy review conducted in 2021 recognises that price stability depends on financial stability³⁸ and states that the preparation of monetary policy decisions will be enhanced with additional information on financial stability considerations. At the same time, the considerations presented in this box illustrate that financial stability is also influenced by price stability.

Box 4

The impact of Chinese macro risk shocks on global financial markets

Prepared by David Lodge, Ana-Simona Manu and Ine Van Robays

Since the middle of last year, global investors have stepped up their scrutiny of risks emanating from China as it experiences rising defaults and a slowing economy.³⁹ In the past, spillovers from China to other financial markets were typically judged to be small,⁴⁰ reflecting China's less developed financial markets, a largely closed capital account regime, a managed exchange rate and a relatively small share of foreign investors in the domestic market. Yet China's footprint in the global economy has grown rapidly over recent years, while domestic financial markets have deepened and integrated more with global capital markets.⁴¹ This box looks at how Chinese macro risk shocks identified from movements in Chinese and US asset prices can affect global and European financial markets.

This box takes a two-step approach to quantify the importance of China-specific shocks for global financial markets. The first step involves applying a structural Bayesian vector autoregression (BVAR) model using daily financial market data from 2017 to 2021 to disentangle the drivers of movements in US and Chinese financial markets.⁴² The five structural shocks – Chinese macro risk and monetary policy shocks, US macro risk and monetary policy shocks, and global risk shocks – are identified using sign restrictions⁴³ and relative magnitude restrictions in the spirit of the recent literature.⁴⁴ The second step entails assessing the effects of shocks originating in China on

³⁸ See [The ECB's monetary policy strategy statement](#).

³⁹ See Box 4 entitled "[Downside Risks from Property Developer Stress](#)", *Staff Report*, International Monetary Fund, January 2022.

⁴⁰ See Arslanalp, S. et al., "[China's Growing Influence on Asian Financial Markets](#)", *IMF Working Papers*, No 2016/173, International Monetary Fund, 2016, which documents how spillovers from China to Asian equity markets have increased during the period since the global financial crisis, though they remain lower than those from the United States.

⁴¹ However, the foreign ownership of the Chinese onshore bond market remains relatively low, accounting for around 4% of the total market.

⁴² The sample starts in 2017 in order to focus the analysis on a period when China's policy paradigm shifted closer to a market system after interest rates were broadly liberalised by 2015. Since then, efforts have been made to increase the flexibility of the renminbi.

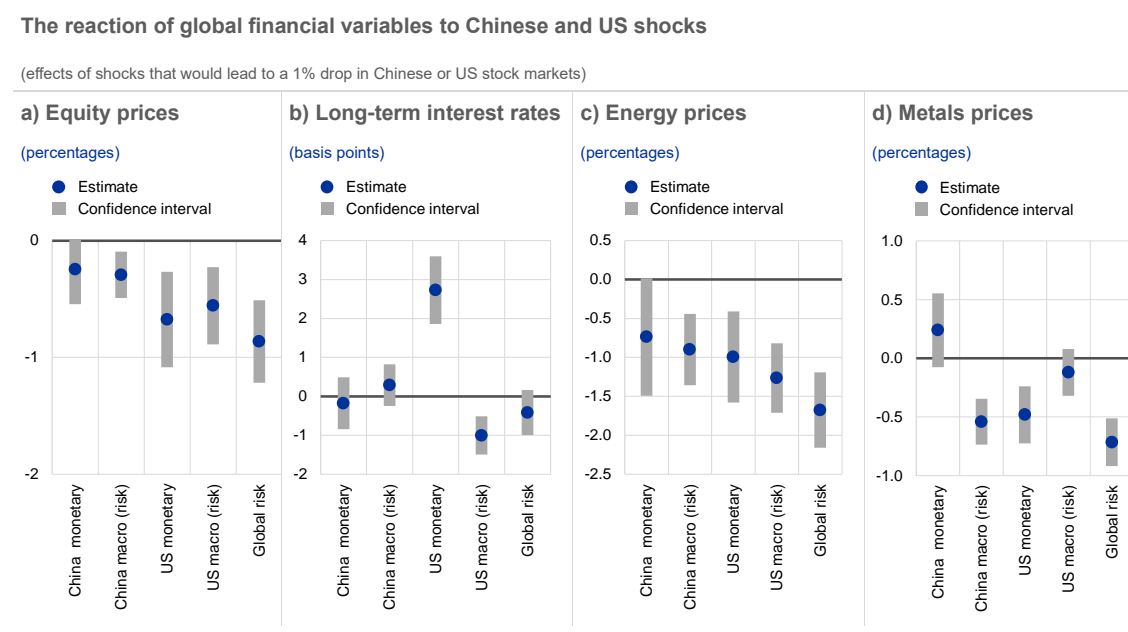
⁴³ The estimations are made using the BEAR toolbox – see Dieppe et al., "[The BEAR toolbox](#)", *Working Paper Series*, No 1934, ECB, 2016. For China and the United States, accommodative monetary policy shocks are assumed to lower domestic yields and boost equities, while a favourable macro outlook is assumed to boost both yields and equities. Chinese shocks are separated from US shocks based on assumptions that shocks in both countries have a larger impact on domestic yields than foreign yields. In addition, the safe-haven role of the US dollar is used to identify a global risk shock, similar to Brandt et al., "[What drives euro area financial market developments? The role of US spillovers and global risk](#)", *Working Paper Series*, No 2560, ECB, 2021.

⁴⁴ See Brandt et al., *op. cit.*

global financial markets using panel local projections⁴⁵ in a sample of advanced and emerging economies.

Chart A

Shocks originating in China have a modest impact on core financial markets, but a larger impact on commodity markets



Sources: Haver Analytics, Bloomberg Finance L.P., Refinitiv and ECB calculations.

Notes: Panels a) and b) show the (same-day) impact of structural shocks on financial market prices in a sample of 30 advanced and emerging economies. Panels c) and d) show the impact on commodity price indices. To make it easier to compare results, the impulse response function to Chinese shocks is scaled to represent the effect of a shock that would lead to a decline of 1% of China's stock market capitalisation. Similarly, the responses to US and global risk shocks are scaled to represent the effect of a shock that would lead to a decline of 1% of the S&P500 equity price index. For all countries in our sample, equity prices refer to the spot domestic stock market indices, while long-term interest rates refer to long-term yields on government bonds with five- or ten-year maturity, depending on data availability. Energy prices and metals prices refer to the S&P GSCI Energy Index and Industrial Metals Index. The S&P GSCI Spot Index is calculated using the most recent prices for liquid commodity futures contracts and world production weights.

The empirical evidence suggests that shocks emanating from China have a noticeable effect on global financial markets, although the impact is smaller than in case of shocks originating in the United States or global risk shocks. Global equity prices respond significantly to Chinese macro risk shocks. However, the impact is roughly half of the effect of shocks stemming from the United States and a third as large as after global risks shocks (**Chart A**). At the same time, shocks in China are associated with a much more modest impact on global bond markets.

By contrast, shocks originating in China have larger spillover effects on commodity markets, which in some cases are even larger than those of shocks originating in the United States.

This is consistent with the major role played by China in the demand for global energy and non-energy commodities. For example, China consumes a similar amount of energy goods to the United States and yet a significantly higher share of global non-energy commodities (such as metals).⁴⁶ This suggests that a shift in the outlook for the Chinese economy could expose firms in

⁴⁵ The panel local projections regress changes in financial market prices on the estimated shocks, lags of the dependent variable, a series of controls (the VIX and the US and Global Citigroup Economic Surprise Index) and country fixed effects. Regressions for commodity prices use a similar specification, but in a time-series context.

⁴⁶ According to the OECD Trade in Value Added database, in 2015 final demand for energy goods as a share of world value added stood at around 17% in China and 18% in the United States, while the final demand for non-energy goods as a share of world value added was 24% in China compared with only 12% in the United States.

commodity-related industries to increasing financing costs, making it harder for them to secure or roll over debt.

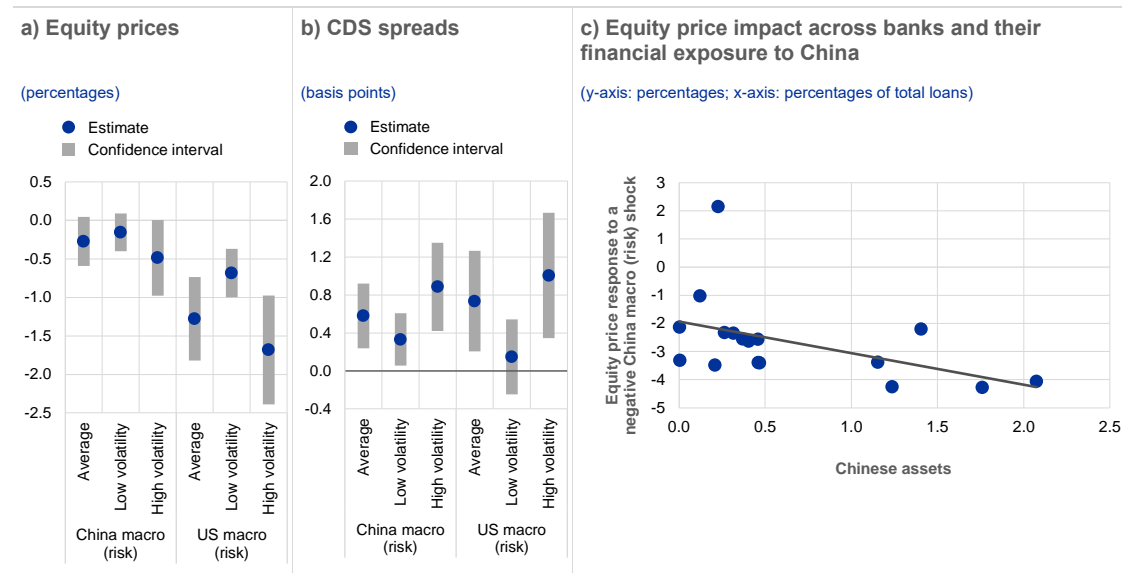
Shocks from China also affect European bank valuations, with a greater impact when general market conditions are more volatile. While, on average, the effects on European banks from Chinese macro risk shocks appear modest (**Chart B**, panel a and panel b), the impact is more pronounced during periods of high market stress. Moreover, there is some evidence to suggest that banks with higher exposure to China are likely to see their equity prices react more heavily to negative Chinese macro risk shocks (**Chart B**, panel c).

Chart B

Shocks from China also affect European bank valuations, with larger effects during periods of heightened market volatility

The reaction of European bank equity prices and CDS spreads

(effects of shocks that would lead to a 1% drop in Chinese or US stock markets)



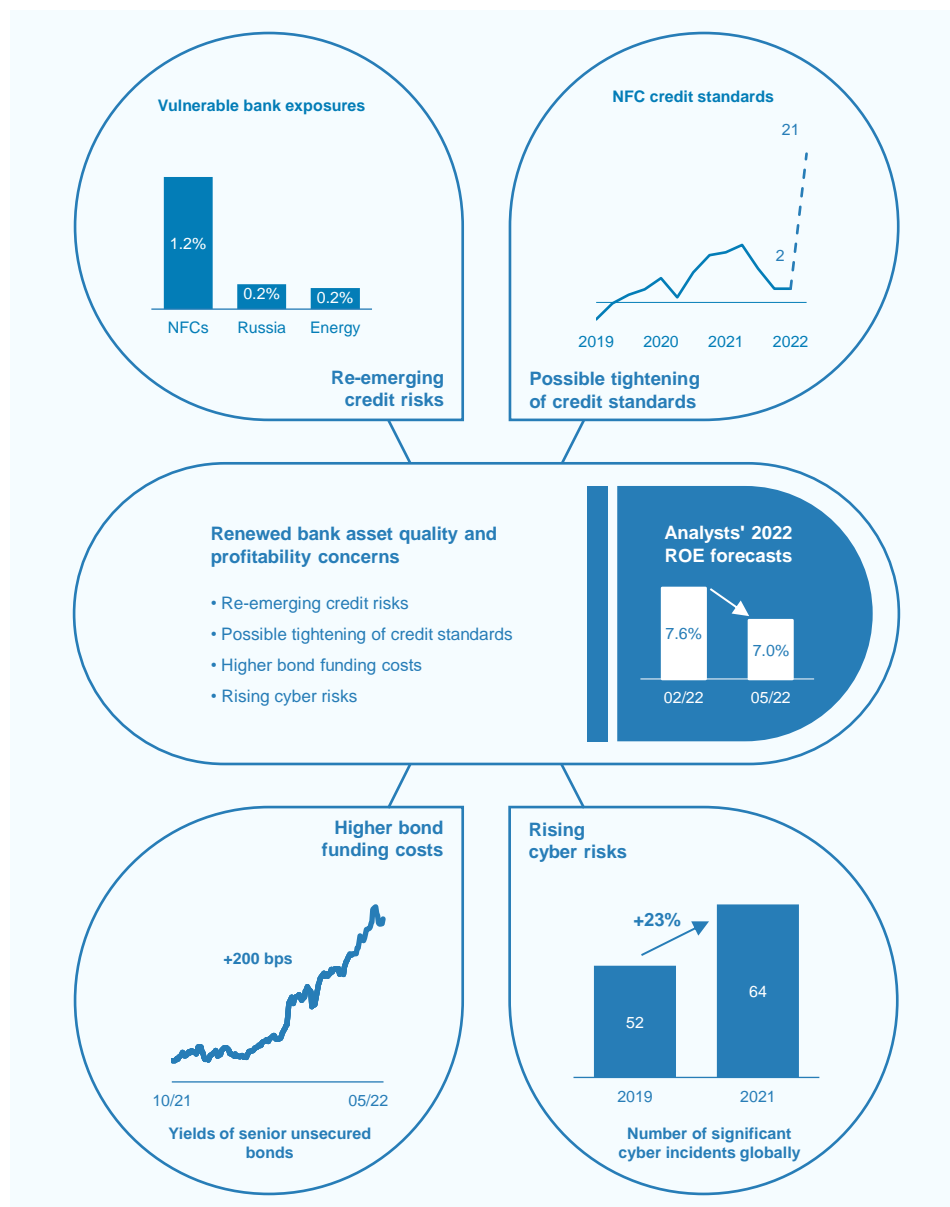
Sources: Bloomberg Finance L.P., Refinitiv and ECB calculations.

Notes: Panels a) and b) show the (same-day) impact response of equity prices and five-year CDS spreads of EU banks to structural shocks from local projections. The responses are scaled to represent the impact of Chinese (US and global shocks) shocks that would knock 1% off Chinese (US) equity prices. The grey bars indicate the 95% confidence intervals based on corrected Driscoll-Kraay standard errors. Panel c) shows the individual response of a bank's equity price to a positive Chinese macro (risk) shock that would knock 1% off Chinese stock market capitalisation relative to the bank's exposure to China as a share of total assets.

All in all, the analysis suggests that macro risk shocks originating in China can have a material impact on global financial markets in specific asset classes such as equities and commodities. This is particularly true when such shocks hit in a time of heightened global volatility. China's policy paradigm has shifted from a tightly controlled system towards a more market-based mechanism with ongoing efforts to allow market forces to play a greater role in the functioning of credit and forex markets. Consequently, its impact on global financial markets will continue to catch up with its role in the global economy⁴⁷, increasing the country's importance for euro area financial stability. This calls for close monitoring of developments in China from the perspective of both financial market liberalisation and economic growth.

⁴⁷ In 2021 China accounted for 19% of global output, whereas the share of the renminbi in various measures of international use remains low.

3 Euro area banking sector



3.1 Asset quality continues to improve, but higher energy prices revive risks for some loans

The asset quality of euro area banks improved during 2021 as stocks of non-performing loans (NPLs) continued to fall and inflows into riskier asset stages decelerated. In the fourth quarter of 2021, the aggregate NPL ratio fell further, to 2.1% of total loans, its lowest level since 2008. This was 58 basis points lower than in the fourth quarter of 2020, and continued the downward trend that had been sustained throughout the previous two years of the coronavirus (COVID-19)

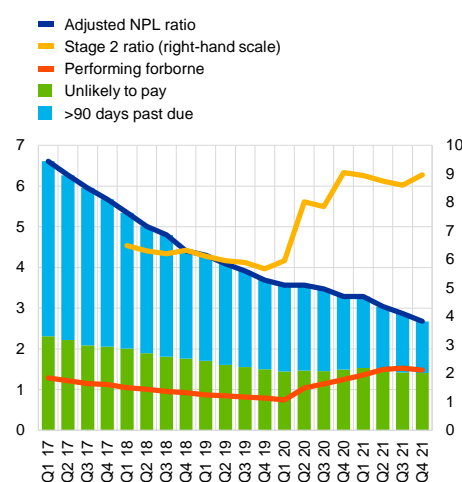
pandemic (**Chart 3.1**, panel a). At the same time, the ratio of loans classified as “underperforming” stage 2 remained stable at elevated, end-2020 levels of around 9%, well above pre-pandemic levels. Loans subject to forbearance measures⁴⁸, have stabilised at around 1.5% of total loans since the second quarter of 2021. The reduction in NPLs was driven by disposals and securitisations of loan portfolios between late 2020 and early 2021 (**Chart 3.1**, panel b). Cure rates of loans brought back to performing forborne status remain low, which underlines the importance of a functioning, liquid secondary market for NPL sales and securitisations as the primary measure for reducing larger NPL volumes.

Chart 3.1

Asset quality ratios continued to improve throughout 2021 on the back of sales and securitisations

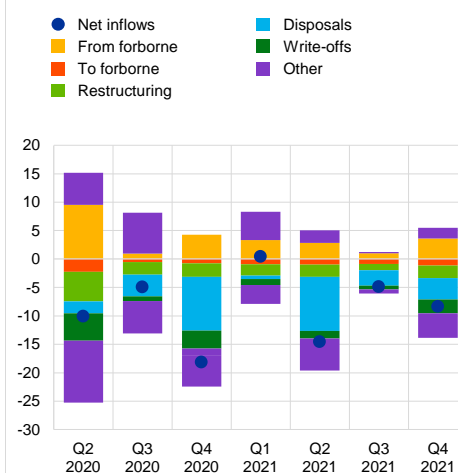
a) Asset quality and stage 2 ratios

(Q1 2017-Q4 2021, percentages of total loans)



b) Quarterly NPL inflows and outflows

(Q2 2020-Q4 2021, € billions)



Sources: ECB (Supervisory Banking Statistics) and ECB calculations.

Notes: Panel a: the adjusted NPL ratio displayed deducts central bank cash reserves from the total loan denominator. The category “Performing forborne” excludes non-performing measures. Panel b: the “Restructuring” category consists of restructuring measures that have led to the partial repayment of outstanding debt and the seizure of collateral. Disposals relate to the sale of NPL portfolios as well as the securitisation of NPLs. “Other” captures flows that cannot be linked to any of the other, specified sources of flows. Among other things, it includes changes in the gross carrying amount of non-performing exposures due to additional amounts disbursed during the period, the capitalisation of past due amounts including capitalised fees and expenses, and changes in exchange rates related to non-performing loans and advances that were classified as non-performing at the end of the preceding financial year and have been continuously classified as such ever since.

Although the surge in “underperforming” stage 2 loans tapered off in 2021 on aggregate, the volume remains above pre-pandemic levels and has continued to increase in some sectors which are still affected by the pandemic. New flows into stage 2 loan classification stabilised at between 1.3% and 1.4% per quarter, based on four-quarter moving averages. This is still 70 basis points above pre-pandemic levels. The recovery in loan quality since the start of the pandemic has been widespread across most corporate sectors and for household (HH) loans (**Chart 3.2**, panel a). However, credit risk is still struggling to fall in some sectors that had

⁴⁸ Forbearance measures are concessions towards an obligor that is experiencing or is likely to experience difficulties in meeting its financial commitments. A modified contract is classified as performing if it has been classified as performing before the modification or would not be classified as non-performing in the absence of modification.

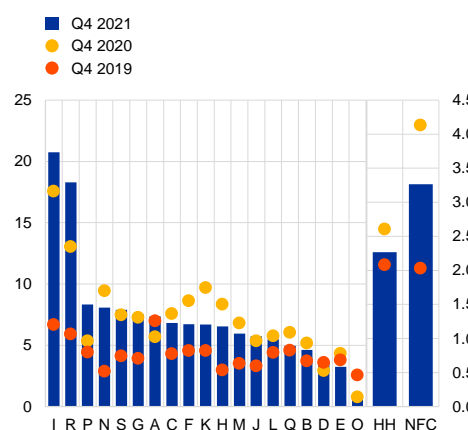
already demonstrated vulnerabilities to economic shocks during the pandemic. Given their pre-existing vulnerabilities, these sectors remain sensitive to a slowing economy, higher interest rates, the intensification of supply chain bottlenecks and rising energy prices ([Chapter 1](#)).

Chart 3.2

Net stage 2 inflows stabilised in 2021 at elevated levels, but below the pandemic peak, while corporate fundamentals underlying new stage 2 loans improved

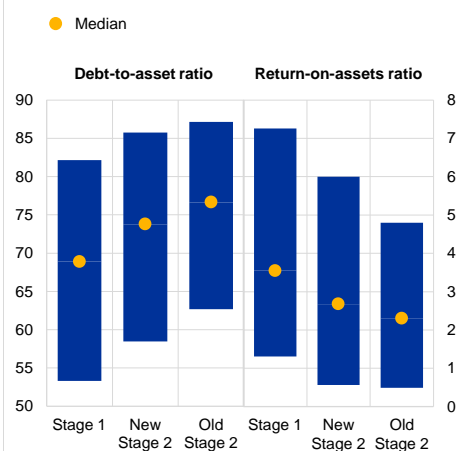
a) Four-quarter trailing stage 2 flows for corporate and household loans

(Q4 2019-Q4 2021, left chart: percentages of total loans by sub-sector, right chart: percentages of total household loans and NFC loans)



b) Leverage and return on assets for different asset stages

(Q4 2020-Q4 2021, blue bars: interquartile range, y-axis: percentages, left chart: debt-to-assets ratio, right chart: return-on-assets ratio)



Sources: ECB (AnaCredit and Supervisory Banking Statistics), Bureau van Dijk's Orbis database and ECB calculations. Notes: Panel a: NACE codes and corresponding economic activities: A – Agriculture, forestry and fishing, B – Mining and quarrying, C – Manufacturing, D – Electricity, gas, steam and air conditioning supply, E – Water supply; sewerage, waste management and remediation activities, F – Construction, G – Wholesale and retail trade; repair of motor vehicles and motorcycles, H – Transportation and storage, I – Accommodation and food service activities, J – Information and communication, K – Financial and insurance activities, L – Real estate activities, M – Professional, scientific and technical activities, N – Administrative and support service activities, O – Public administration and defence; compulsory social security, P – Education, Q – Human health and social work activities, R – Arts, entertainment and recreation, S – Other service activities. Panel b: sample of 533,167 firms with an active lending relationship with a euro area bank at end-2020. New S2 loans are loans to firms that were classified as stage 1 in Q4 2020 and are classified as stage 2 in Q4 2021. Old S2 loans are loans to firms that were classified as stage 2 in Q4 2020 and are still classified as stage 2 in Q4 2021.

Debtors of corporate loans which moved from stage 1 to stage 2 during 2021 have better than expected corporate fundamentals.

Compared with the pre-existing stock of stage 2 loans, loans that are newly transitioned to stage 2 are less leveraged and more profitable ([Chart 3.2](#), panel b). Concerns about cliff effects associated with the phasing-out of pandemic support to corporates, which would have left corporates in distress, have therefore not materialised despite the expiration of most moratorium schemes and a halt to additional state-guaranteed funding. However, individual sectors – notably those that were most affected by the pandemic – have experienced significant reductions in profitability coupled with increased leverage ratios, leaving pockets of vulnerability on banks' balance sheets. In parallel, euro area banks have also increased their exposure to leveraged lending,⁴⁹ which is at its highest level since 2008 and has increased strongly after 2017. Although

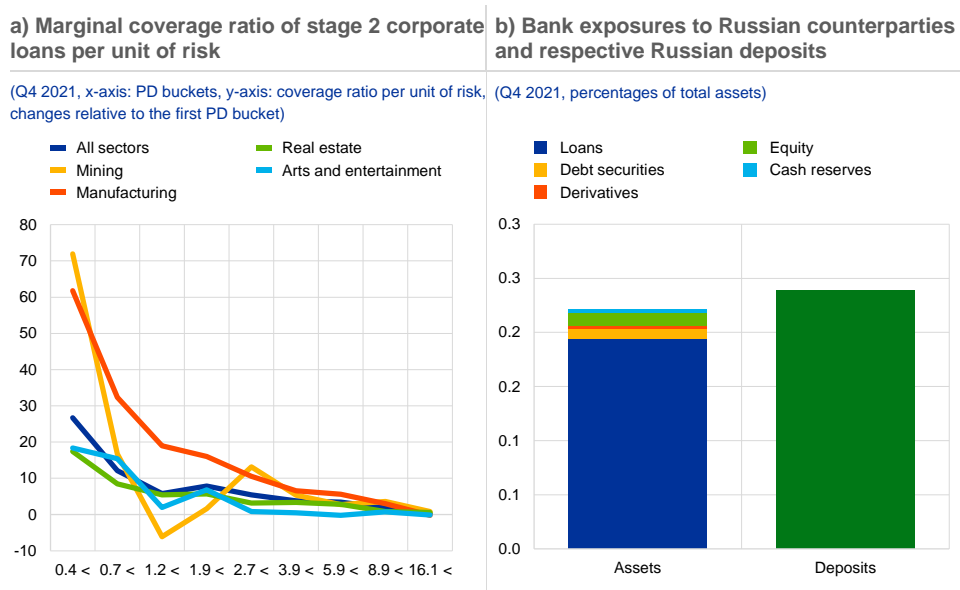
⁴⁹ See the [SSM letter to CEOs on leveraged transactions](#). See also the ECB opinion piece on [Financial leverage and banks' risk control](#).

outstanding amounts originated by euro area banks are manageable, activity is concentrated in a few large institutions.

The aggregate provision coverage ratio for euro area banks has been stable, albeit with signs of misalignment between coverage and credit risk at both the bank and the sector level. For “underperforming” corporate loans, the marginal amount of additional provision and collateral coverage for increases in credit risk is falling as risk increases for some sectors (Chart 3.3, panel a). Typically, banks provision more or ask for additional collateral coverage for loans to counterparties with a higher estimated probability of default (PD), as this would indicate a higher likelihood of loss materialisation. Looking at PD buckets across sectors, the increase in coverage ratios is small compared with the corresponding relative increase in counterparty credit risk in stage 2 loans, revealing a decreasing trend for marginal loan coverage per unit of risk in several sectors. This leaves exposures to riskier counterparties within the stage 2 classification relatively less protected against loan default, increasing tail risks of uncovered losses for stage 2 loans.

Chart 3.3

Coverage ratios for riskier counterparties are lagging behind in some sectors, and euro area banks’ Russian exposures are limited and often locally funded



Sources: ECB (AnaCredit and Supervisory Banking Statistics) and ECB calculations.

Notes: Panel a: “All sectors” is a weighted average of all NACE subsectors. The coverage ratio per unit of risk is calculated by dividing the additional coverage ratio per PD decile relative to the first decile by the spread between the average PD in the respective decile and the average PD in the lowest decile for each sector. PDs follow a through-the-cycle concept based on the IRB approach. X-axis values indicate the ranges of PD buckets. Each tick on the x-axis refers to PD values that are greater than the value displayed and smaller than the next value on the right. “PD” stands for probability of default. Panel b: Q4 2021 data include some subsidiaries of Russian banks that ceased operating in the euro area due to the war.

The economic impact of the Russian invasion of Ukraine has exposed banks to a number of risks, although direct credit exposures to Russia are limited, locally funded and mainly via subsidiaries. Russian banks have been the most severely affected by the invasion: their problems include stress in their euro area subsidiaries that has led to several resolutions and wind-ups. For euro area banks, credit to Russian borrowers amounted to around 0.2% of total assets at end-2021,

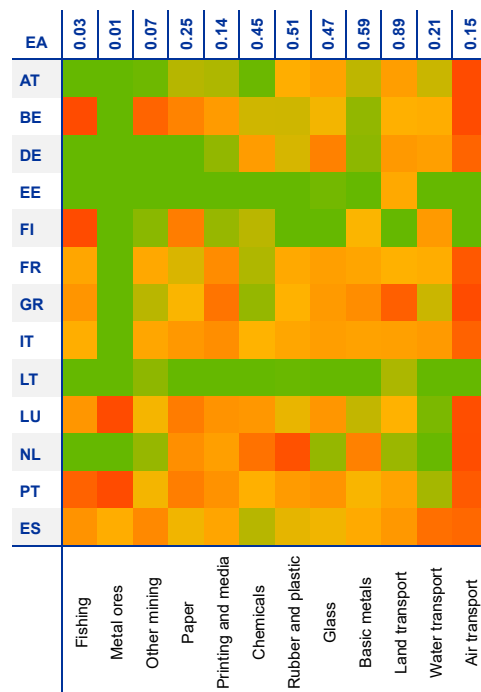
with a selection of banks from Italy, Cyprus, Latvia, Luxembourg and Austria having relatively higher exposures in terms of total assets (Chart 3.3, panel b). Most credit exposures were funded by Russian deposits, reducing the net exposure to Russia.⁵⁰ Recently, large euro area banks with sizeable exposures to Russia reported increases in their loan loss provisioning for Q1.

Chart 3.4

Euro area banks' exposures to energy-intensive sectors and to direct risks from energy prices are concentrated in certain sectors and the derivatives market

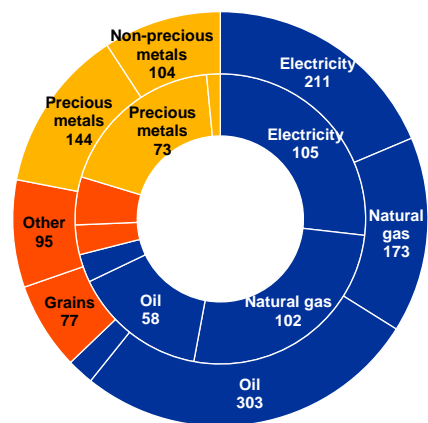
a) Euro area banks' country exposures to high energy usage and vulnerable firms

(Q4 2021, percentages of total corporate loans)



b) Breakdown of euro area banks' and corporates' commodity derivatives holdings

(12 May 2022, gross notional, € billions, inner ring: NFCs' derivatives holdings, outer ring: euro area banks' derivatives holdings)



Sources: ECB (AnaCredit, Supervisory Banking Statistics and European Market Infrastructure Regulation), OECD Trade in Value Added (TIVA) database (2018) and ECB calculations.

Notes: Panel a: colour scale from green to orange to red. Green indicates small exposures to vulnerable firms; cells become orange/red if share of exposure increases. Vulnerable firms are entities with an Altman z-score below 1.81. The Altman z-score is calculated as $0.717 \times \text{working capital}/\text{total assets} + 0.847 \times \text{retained earnings}/\text{total assets} + 3.107 \times \text{EBIT}/\text{total assets} + 0.420 \times \text{equity}/\text{debt} + 0.998 \times \text{sales}/\text{total assets}$. Sector average energy intensity is measured by the share of input from the energy-producing mining and quarrying sector, coke and refined petroleum products as well as the electricity, gas, steam and air conditioning industries, classified according to the United Nations International Standard Industrial Classification for All Economic Activities, Rev. 4., and is attributed to the sector based on the four-digit Standard Industrial Classification code. Firms in sectors above the 75th percentile of the energy intensity ratio are regarded as high-energy consumers. Panel b: the rings represent the gross notional outstanding (€ billions) in energy (blue), agricultural (red) and metal (yellow) derivatives for which at least one of the two counterparties of the trade is a bank domiciled in the euro area (outer ring) and for which at least one of the two counterparties of the trade is a non-financial firm.

Looking ahead, elevated and volatile energy and commodity prices have increased credit risk, especially for more vulnerable corporates.

The shift in the outlook for euro area growth and inflation is, in general, likely to weigh on corporate profitability and debt sustainability (Chapter 1). Credit granted by euro area banks to

⁵⁰ Although linkages of euro area banks with Russia are limited to a few banks, exposures and deposits are not always located in the same entity but often separated between subsidiary and parent company.

firms with significant reliance on energy and specific forms of fossil fuel⁵¹, and weak corporate fundamentals⁵² amounts to 3.8% of total corporate lending.⁵³ Loans to the transport and manufacturing sectors appear to be the most vulnerable, although total exposure is limited at both the country and the euro area level (**Chart 3.4**, panel a).

Euro area banks also have some exposures stemming from their role in intermediating derivatives markets, as they act as counterparties in over half of euro area core commodity derivatives contracts. Commodity derivatives account for less than 1% of the overall euro area derivatives market's size in terms of gross notional. However, the business is highly concentrated in a few large banks which provide both client clearing services and ancillary financing services to commodity traders and energy sector firms.⁵⁴ Financial stability considerations might arise with regard to substitutability, given that a limited number of large NFCs access the commodity derivatives market via a few large banks. These banks offer liquidity through market making in the bilateral market segment and act as clearing members of the few central counterparties clearing commodity derivatives (**Chart 3.4**, panel b).

The prices of futures on commodities rose rapidly during March 2022, and this was accompanied by corresponding increases in margin calls. The recent volatility in energy prices has also seen liquidity pressures in some derivatives markets (**Chapter 2**). The surge in commodity prices and volatility exerted liquidity pressure on NFCs with hedging activities, especially for energy derivatives, given their need to meet initial and variation margin calls. Initial margins posted by NFCs on cleared commodity derivatives more than doubled between December 2021 and March 2022. The high proportion of centrally cleared trades (68% in terms of gross notional), especially for energy derivatives, decreases banks' counterparty credit risk towards their clients; this does, however, introduce some residual step-in liquidity risk to cover the margins required by CCPs if some NFCs are unable to meet margin calls. Banks' exposures to NFCs in this market are limited, though, and should therefore not add significant counterparty risk to banks' balance sheets.

Overall, euro area banks' asset quality has remained stable, albeit with material risks to corporate loans persisting. Concerns about aftershocks from 2020 have not materialised over the last year, although some sectors of NFCs remain vulnerable to shocks. Overlaps between firms affected by weak debt sustainability and high energy prices have led to pockets of default risks in the corporate sector. Looking ahead, the combination of existing vulnerabilities and effects of inflation and the war in Ukraine increases risks to asset quality.

⁵¹ For details on the identification and dependence of euro area firms on natural gas, see the box entitled "[Natural gas dependence and risks to euro area activity](#)", *Economic Bulletin*, Issue 1, ECB, 2022.

⁵² For more details, see Casey, C.J., Bibeault, D. and Altman, E.I., "Corporate financial distress: A Complete guide to Predicting, Avoiding, and Dealing with Bankruptcy", *Journal of Business Strategy*, Vol. 5, No 1, 1984, p. 102. See also the box entitled "Identifying the corporates most vulnerable to price shocks following the pandemic shock" in this edition of the Financial Stability Review.

⁵³ 3.8% of total corporate loans refers to exposures to corporates reliant on a high share of energy input to generate outputs as well as weak corporate fundamentals as measured by z-scores.

⁵⁴ Universal and investment banks usually have the capacity to run proprietary trading, maintain a trading desk and play an active role in the derivatives market.

3.2 Profitability above pre-pandemic levels, but outlook weaker

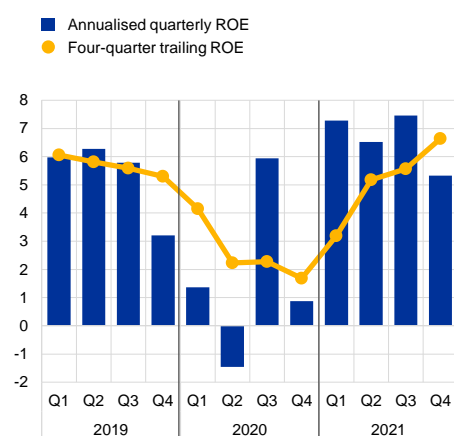
The financial performance of euro area banks improved substantially during 2021 and exceeded pre-pandemic levels, amid lower loan loss provisions. On aggregate, euro area significant institutions recorded a return on equity (ROE) of 6.6%, up from 1.7% a year earlier (**Chart 3.5**, panel a).⁵⁵ Looking at a sample of listed euro area banks, for which the data span a longer period, reveals that this was their strongest performance in a decade. Weak profitability in the euro area banking sector has been a concern as it affects financial stability by reducing banks' intermediation capacity and resilience.⁵⁶ While banks' performance was adversely affected by pandemic-related impairments during 2020, robust economic growth, lower loan loss provisions and higher operating profits contributed to the marked improvement in 2021. With net interest income (NII) remaining unchanged and expenses rising, the improvement in operating profits was largely down to higher net trading income (NTI) and, especially, net fee and commission income (NFCI). Results for listed banks' first quarter 2022 earnings suggest that profitability remained robust in Q1, albeit slightly lower than in Q4, amid weaker other profit and loss items and higher provisions, while operating income improved on the back of stronger NII.

Chart 3.5

Profitability in 2021 exceeded pre-pandemic levels on the back of lower loan loss provisions and higher non-interest income components

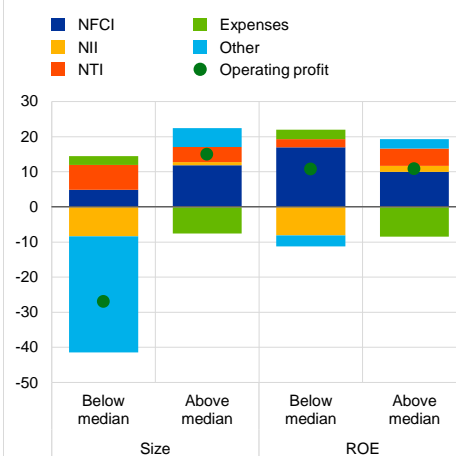
a) ROE of euro area significant institutions

(Q1 2019-Q4 2021, percentages)



b) Main factors contributing to annual changes in operating profits for banks of above/below-median size and profitability

(Q4 2021, percentage changes and percentage point contributions)



Sources: ECB (Supervisory Banking Statistics) and ECB calculations.

Notes: Based on a balanced sample of 89 significant institutions. Panel b: "Other" stands for other operating profits.

⁵⁵ In the Financial Stability Review, the four-quarter average of stock variables is used, while flow variables are annualised using trailing four-quarter sums. In addition, to avoid composition effects, a balanced sample of banks is used, which might result in figures which are different from those in the published supervisory banking statistics.

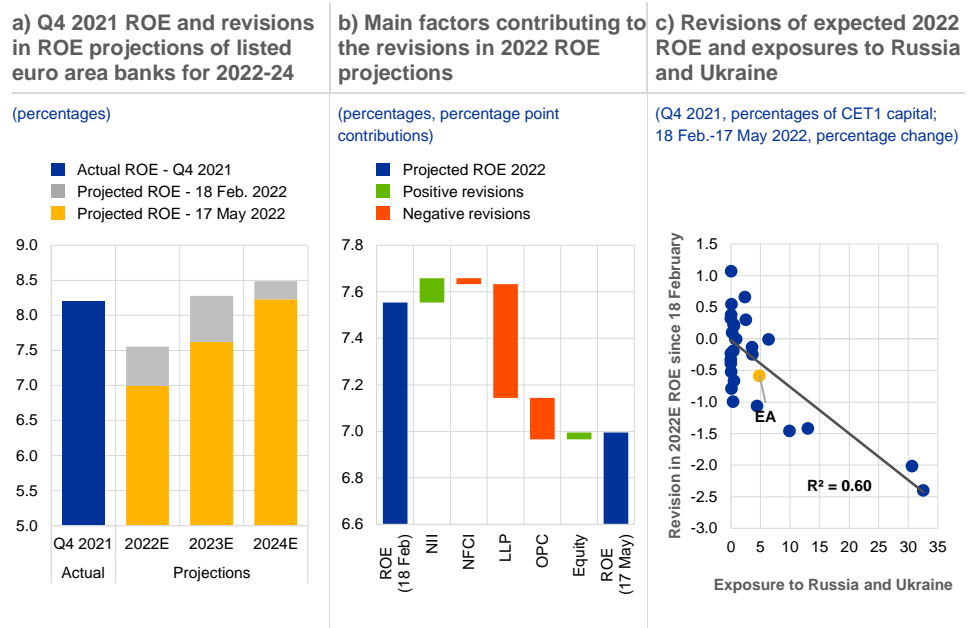
⁵⁶ See the special feature entitled "Euro area bank profitability: where can consolidation help?", *Financial Stability Review*, ECB, November 2019.

Net fee and commission income, driven by asset management activities, strongly supported profitability in 2021, while net interest income remained flat.

In 2021, euro area banks saw their NFCI grow by almost 12%, by far the largest increase observed over the past few years, thanks to the economic recovery and strong growth in assets under management. The positive role played by NFCI in supporting operating profits was more pronounced for larger banks and for those with below-median ROE, as the latter faced a decline in their NII (Chart 3.5, panel b). NFCI might, however, be vulnerable to stock market corrections. The decline in operating profits for smaller banks was driven to a large extent by NPL sales of Greek banks. On aggregate, NII remained broadly unchanged on the previous year and is slowly climbing back towards pre-pandemic levels on the back of rising lending volumes and a bottoming-out of margins. However, heterogeneity among banks continues to be pronounced, with around 45% of banks still reporting lower NII than in the previous year.

Chart 3.6

Downward revisions in 2022 ROE projections as a result of the war in Ukraine, with higher impairments seen as the main driver



Sources: Bloomberg Finance L.P., Refinitiv, ECB (Supervisory Banking Statistics) and ECB calculations.
Notes: Panels a) and b) are based on a sample of 32 listed euro area banks. Actual and projected ROEs are averages weighted by banks' total assets. Panel b: LLP stands for loan loss provisions; OPC stands for operating costs. Panel c) is based on a sample of 28 listed euro area banks. Raiffeisen Bank International has been excluded from the sample in the interests of better readability. EA indicates the euro area average.

The Russia-Ukraine war casts uncertainty on the economic outlook and implies a downward revision of bank profitability for this year. After strong profitability results in 2021, the ROE of listed euro area banks is expected to be lower this year before gradually improving over the next few years to 8.2% in 2024, although analysts have lowered their bank profitability projections on account of the economic fallout from the war (Chart 3.6, panel a). The downward revisions of ROE this year are attributed to higher impairments and rising costs, coupled with lower NFCI while NII is expected to be higher (Chart 3.6, panel b). Since the direct exposure of euro

area banks to Russia and Ukraine, comprising 5% of Common Equity Tier 1 (CET1) capital, is rather limited, market analysts consider the impact on aggregate euro area bank profitability to be contained. The differences at the bank level are pronounced, however; analysts have lowered their profitability projections for a few listed banks more substantially to reflect their more elevated exposures to Russia and Ukraine, but even for these banks the impact appears manageable (**Chart 3.6**, panel c).

Net interest income is expected to benefit from higher interest rates from 2023 onwards, although some banks might face challenges in the medium term.

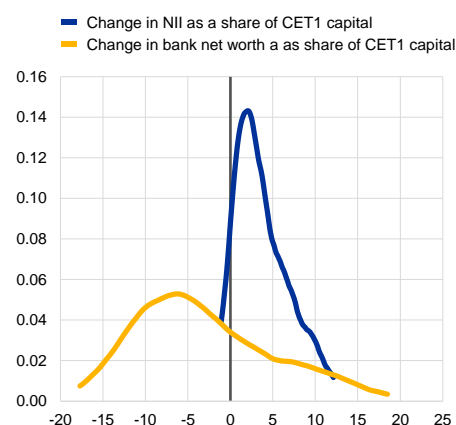
Forward rates imply an improvement in NII from next year. Supervisory data on interest rate risk in the banking book suggest that, in the short run, higher rates appear to be beneficial for almost all banks (**Chart 3.7**, panel a). The median change in NII, an earnings-based measure of interest rate risks over a one-year horizon, caused by a parallel upward shift of the yield curve by 200 basis points amounts to 2.8% of CET1 capital. As loans have increasingly been granted with longer interest rate fixation periods in recent years, these long-dated assets need to be funded at costs which rise alongside gradually higher rates. While banks hedge some of their interest rate risks, rising interest rates might adversely affect some banks in the medium term. This is reflected in the change in a bank’s net worth, an economic value-based measure of interest rate risks that takes the entire maturity spectrum of the banking book into account (**Box 5**). Indeed, the economic value of banks with a higher share of fixed-rate asset cash flows seems to decline more under a scenario of higher rates (**Chart 3.7**, panel b).

Chart 3.7

The impact of higher rates on banks may vary over time, as the relative repricing of liabilities and assets depends on the share of fixed-rate assets

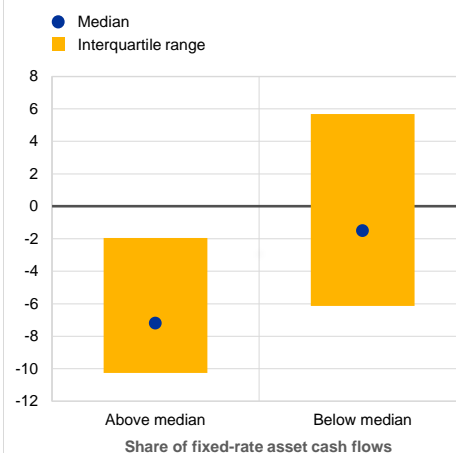
a) Impact of a 200 basis point parallel upward shift of the yield curve across euro area banks

(Q4 2021, x-axis: percentage of CET1 capital, y-axis: density)



b) Change in bank net worth due to a 200 basis point increase in rates for banks with an above/below-median share of fixed-rate asset cash flows

(Q4 2021, percentages)



Sources: ECB (Supervisory Banking Statistics) and ECB calculations.
Note: Based on a sample of 80 significant institutions.

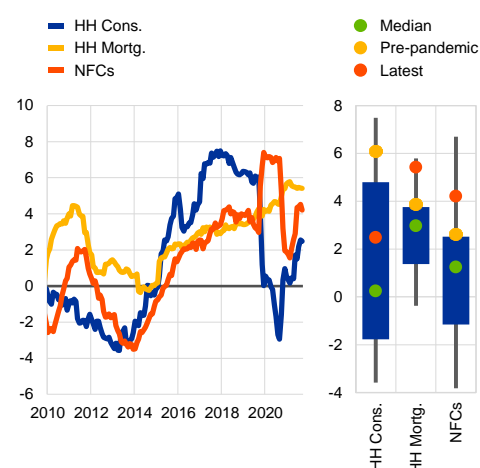
Lending to the non-financial private sector recovered in 2021, but tighter lending standards, lower confidence and revised growth expectations might weigh on future lending. Bank lending to households and NFCs recovered in 2021 to exceed pre-pandemic levels. Average monthly lending flows to the non-financial private sector amounted to €39 billion in 2021, which is 40% above the levels observed between 2017 and 2019. While mortgages accounted for most of the lending at the beginning of the year, corporate lending picked up significantly in the second half of 2021. Annual growth rates of lending to households for house purchases and to corporates are, at 5.4% and 4.2% respectively, substantially above the median for their historical range since 2010, with only consumer lending growth, at 2.5%, remaining substantially below its pre-pandemic levels (Chart 3.8, panel a). According to the ECB's bank lending survey, the share of banks reporting a tightening of credit standards declined over the last four quarters across all loan types, while loan demand picked up over the same period (Chart 3.8, panel b). However, banks expect both a significant tightening of lending standards in the second quarter, in particular for corporate lending, and weaker loan demand. In addition, since confidence indicators, which typically lead lending growth, have fallen recently because of the war in Ukraine, and economic growth for both 2022 and 2023 has been revised downwards, loan growth may well slow going forward.

Chart 3.8

Except for consumer lending, loan growth is back above pre-pandemic levels, although lending standards are expected to tighten and loan demand to weaken

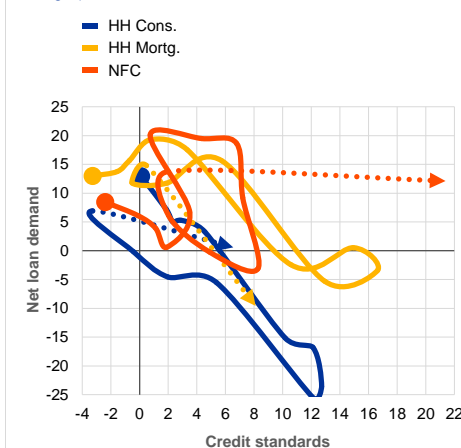
a) Annual growth rate of monetary financial institutions' loans in the euro area

(Jan. 2010-Mar. 2022, percentage growth)



b) Changes in euro area credit standards and net demand for loans

(Q1 2019-Q2 2022, weighted net percentages, four-quarter moving averages)



Sources: ECB and ECB calculations.

Note: Panel b: the solid lines represent four-quarter moving averages, backward-looking three months until Q1 2022, while the dotted lines represent the trend towards the expected values for Q2 2022.

The number of major, global cyber incidents targeting financial institutions has increased since 2019, and euro area banks lag behind their peers in terms of IT investment. The number of major cyber incidents targeting global financial institutions has increased substantially in recent years, although it has declined somewhat since the peak reached in 2020 (Chart 3.9, panel a). In terms of attacks

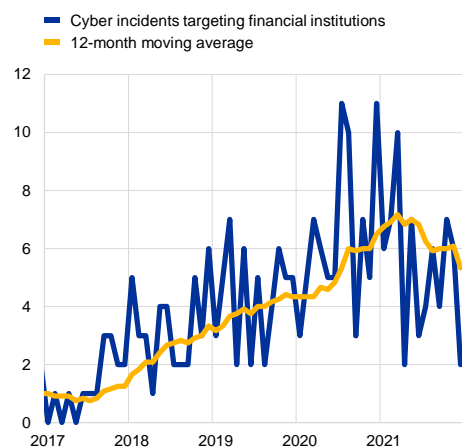
targeting significant institutions in the euro area, this global trend was mirrored by the number of cyber incidents reported to the ECB, which reached the highest level ever in the fourth quarter of 2020. It is also worth noting the change in rankings for euro area bank regarding incident types, with a higher share of social engineering and third-party provider incidents as well as accidental data leakages in 2021 than in the previous year. Banks need to invest in their IT infrastructure if they are to deal with cyberattacks adequately. Compared with US banks, euro area banks have invested much less into information technology, despite the fact that this is essential to remain ahead of cyberattacks in the future (**Chart 3.9**, panel b).

Chart 3.9

The number of cyber incidents targeting global financial institutions has increased in recent years, but euro area banks' IT investment lags behind that of their US peers

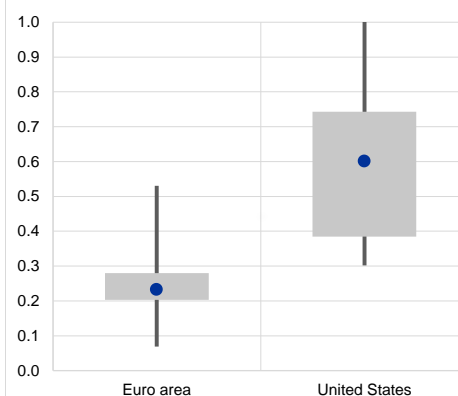
a) Major cyber incidents targeting financial institutions globally

(Jan. 2017-Dec. 2021, number per month)



b) IT spending of selected listed banks as a share of their total assets

(Q4 2020, percentage of total assets)



Sources: Carnegie Endowment for International Peace and bank annual reports.

Notes: Panel a: some of the events are related to financial institutions in the broader sense and might ultimately affect the clients of financial institutions. Panel b: based on a sample of ten euro area and six US listed banks.

Box 5

Interest rate risk exposures and hedging of euro area banks' banking books

Prepared by Jonathan Dries, Benjamin Klaus, Francesca Lenoci and Cosimo Pancaro

While rising interest rates are expected to improve banks' net interest income in the short term, they may also weigh on banks' net worth in the medium term. On aggregate, euro area banks exhibit a positive duration gap,⁵⁷ which implies that if interest rates rise, assets will lose more value than liabilities, thus reducing banks' economic value of equity. After narrowing in 2020, the duration gap started widening again as of the first quarter of 2021 (**Chart A**, panel a), signalling that banks were reverting closer to pre-pandemic levels of interest rate risk. Over time, derivatives have, on aggregate, played an offsetting role; in other words, banks' interest rate risk (IRR) exposure arising

⁵⁷ The duration gap measures the mismatch between the repricing timing of cash inflows (assets) and cash outflows (liabilities) of instruments which are already on banks' balance sheet. A positive duration gap indicates that the duration of assets is larger than the duration of liabilities. In this analysis, the duration gap is computed as in Esposito et al. (see Notes to Chart A) using supervisory data on behavioural cash flows for 62 euro area banks.

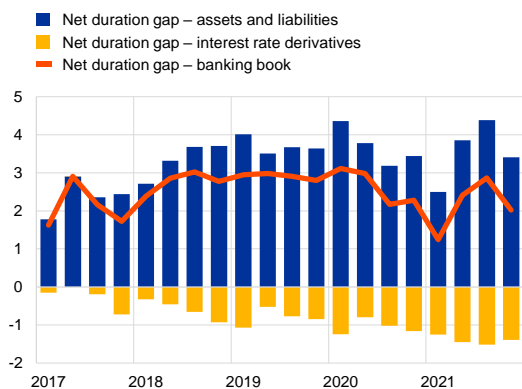
from their non-derivative positioning was partly counterbalanced by their derivative positions in the banking book.

Chart A

Euro area banks' duration gap has widened recently, increasing their interest rate risk

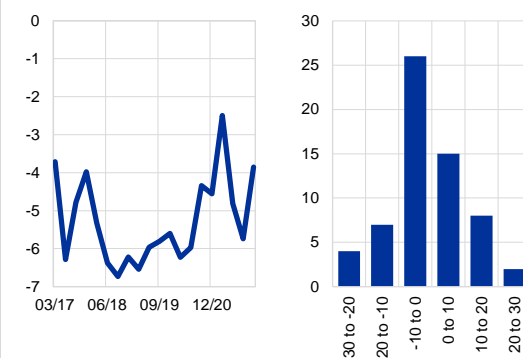
a) Decomposition of duration gap by banking book category

(Q1 2017-Q4 2021, percentages of CET1 capital)



b) Interest rate risk over time and distribution across banks under the steepening scenario

(left chart: Q1 2017-Q4 2021, percentages of CET1 capital; right chart: Q4 2021, number of banks per buckets of interest rate risk)



Sources: ECB (Supervisory Banking Statistics) and ECB calculations.

Notes: Panel a: the duration gap is computed for the euro area aggregate based on Esposito et al.* and a sample of 62 significant institutions. Panel b: the change in bank net worth is computed based on Esposito et al.* and a sample of 62 significant institutions. The left chart shows the change in net worth for euro area banks on aggregate under the interest rate scenario considered, while the right chart plots the distribution across individual banks.

*) Esposito, L., Nobili, A. and Ropele, T., "The management of interest rate risk during the crisis: Evidence from Italian banks", *Journal of Banking and Finance*, Vol. 59, October 2015, pp. 486-504.

The aggregate impact of higher interest rates on bank net worth would be moderately negative, but wide variations exist at the level of individual banks. The duration gap can be translated into sensitivity of bank economic value to changes in interest rates. For example, a steepening of the yield curve by 200 basis points at the longer end in the third quarter of 2021 would have reduced banks' aggregate net worth by around 4% of Common Equity Tier 1 (CET1) capital (**Chart A**, panel b).⁵⁸ More than 60% of the banks analysed would face a decline in their net worth under this scenario, while for 25% the net worth would decline by more than 7% of CET1 capital. This decline arises as, in the medium to long term, banks would have to pay higher funding costs to cover legacy low-yielding assets. Changes in banks' economic value of equity do not always translate into accounting losses, but they do shed light on banks' resilience to changes in interest rates over the long run.

An empirical analysis of bank characteristics and IRR indicates that the share of exposures with longer rate-fixation periods plays a prominent role in this relationship and shows that derivatives are used to hedge IRR. The analysis⁵⁹ finds that the decline in bank net worth under a scenario of rising rates is more pronounced when the share of lending with fixation periods in excess of ten years is higher. Furthermore, larger banks seem to face a smaller decline in their net worth, possibly reflecting reduced hedging capabilities of smaller banks.⁶⁰

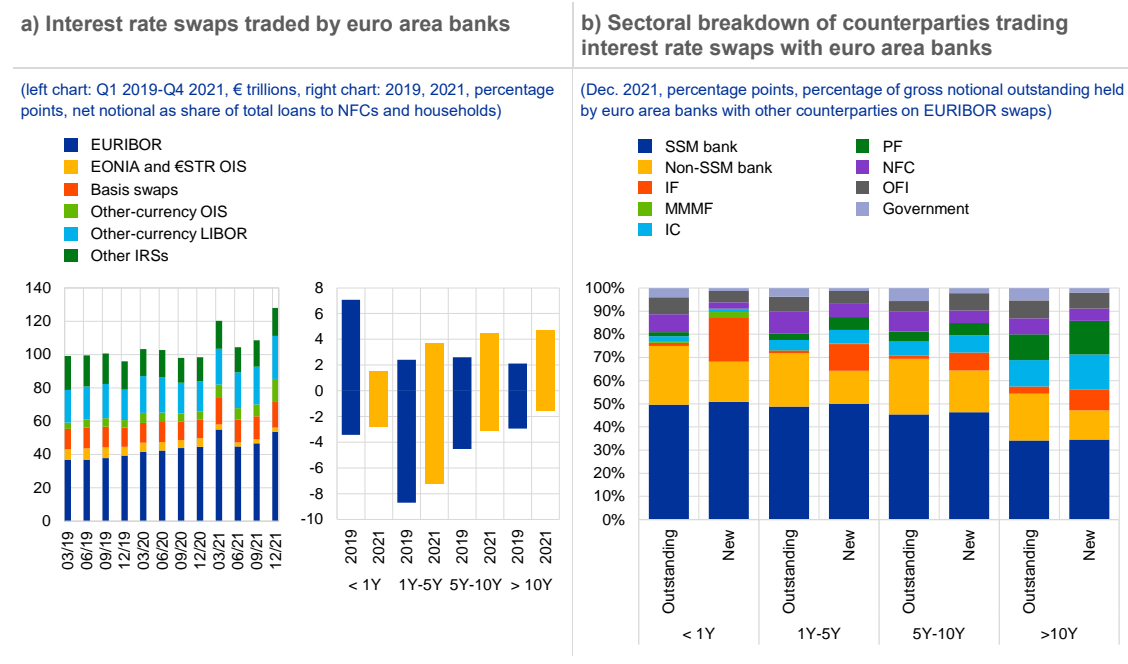
⁵⁸ This decline in net worth appears to be moderate overall, as the 2018 EBA guidelines on the management of interest rate risk in the banking book suggest that an institution is exposed to excessive IRR when its economic value of equity declines by more than 15% of its Tier 1 capital.

⁵⁹ The analysis is based on different panel regressions covering 62 banks over the time period from Q4 2016 to Q3 2021 with time and bank fixed effects and a set of bank control variables.

⁶⁰ Less significant institutions in Germany, such as savings banks and credit cooperatives, exhibited higher IRR than large banks; see "Financial Stability Review", Deutsche Bundesbank, November 2016.

Chart B

Banks actively manage interest rate risk exposures by changing the maturity profile of IRS trading



Sources: ECB (Supervisory Banking Statistics and European Market Infrastructure Regulation) and ECB calculations.
 Notes: Panel a: "Basis swaps" are IRS on floating interest rates, "EONIA and €STR OIS" are euro-denominated overnight index swaps, "Other-currency OIS" are overnight index swaps denominated in other currencies, "Other-currency LIBOR" includes GBP-, JPY-, CHF- and USD-denominated LIBOR swaps, "Other IRSs" includes fixed-to-fixed swaps, inflation swaps and other IRS. Right chart: net notional is aggregated in four maturity buckets. "NFCs" stands for non-financial corporations and "IRS" for interest rate swaps. Panel b: outstanding trades excluding intragroup transactions. Outstanding refers to outstanding contracts as of 31 December 2021, new refers to IRS trades initiated following March 2021. Trades with NCBs and counterparties with non-identifiable sectors are excluded and represent less than 2% of gross notional traded by euro area banks. Breakdown by sector: "IF" stands for investment funds, "MMMF" for money market mutual funds, "IC" for insurance companies, "PF" for pension funds, "NFC" for non-financial corporations, "OFI" for other financial institutions.

Euro area banks have held an increased volume of interest rate swaps over the last two years, suggesting more active hedging of interest rate risk. Banks enter into interest rate swaps in order to complement natural hedging, to take on more risk by means of directional exposures or to provide liquidity through market making. When they do so to mitigate risk, banks transform future cash flows generated from assets or liabilities from floating rates to fixed rates, or vice versa. By the end of 2021, the gross notional outstanding on interest rate swaps held by banks had increased to €128 trillion, while that on the most liquid euro-denominated contracts (EURIBOR swaps, EONIA OIS or €STR OIS) had risen by 30% since the start of 2019 to €56 trillion (**Chart B**, panel a). These contracts are more suited to reducing the volatility on banks' balance sheets prompted by the repricing of euro-denominated cash flows. Over the last three years, banks have reduced their net notional⁶¹ exposures to shorter-dated swap contracts (below one year), on which they pay fixed rates, and increased the volume of longer-dated contracts, on which they receive floating rates (**Chart B**, panel a). This evidence is consistent with the expectation of higher interest rates and the intention to hedge low-yielding assets against rate hikes.

Interest rate swaps are used to spread risk within the banking sector and to transfer it to insurance companies and pension funds. Focusing solely on euro-denominated interest rate swaps written on the euro interbank offered rate (EURIBOR), the overnight index average rate (EONIA) or the euro short-term rate (€STR), euro area banks trade most of these swaps with other banks. Concerning risk transfers to other sectors, banks' transactions are not evenly spread across maturity buckets: insurance companies and pension funds receive fixed-rate payments for maturities

⁶¹ Net notional is computed as the difference between notional bought (pay fix) and notional sold (pay float) by each bank, on each contract, on each bucket of maturities and on each floating tenor. Intragroup transactions are excluded from net notional computations.

over ten years given their aggregate negative duration gap, which makes them a natural counterparty for banks. For contracts initiated after March 2021, when inflation started to pick up, investment funds have assumed more risk for short maturities while, for longer maturities, the share of insurance companies and pension funds in swap trading has doubled (**Chart B**, panel b).

Banks' IRR exposure appears moderate on aggregate, but wide variations exist across individual institutions. While rising rates would negatively affect the net worth of more than half of the banks analysed, their exposure has declined since 2017. Interest rate swap exposures, and particularly the volume of longer-dated receiver floating swaps, have increased since inflation started to pick up in March 2021, suggesting that euro area banks are using derivatives as hedging instruments. A normalisation of monetary policy should not be a major concern in terms of aggregate impact on the net worth of the euro area banking system, although it could have a negative effect on banks exhibiting large IRR exposures.

3.3 Higher market funding costs and improved capital ratios

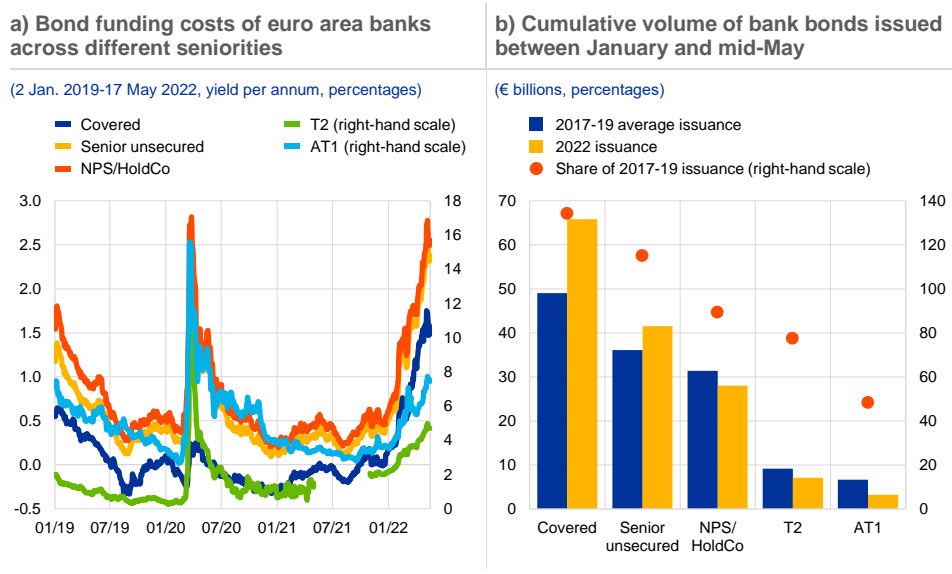
Low, stable deposit funding rates have insulated banks from the increase in funding costs associated with a notable rise in bank bond yields since the end of 2021. Higher risk-free rates, reflecting inflationary pressures, have brought the yields of covered bonds for the euro area on aggregate back to levels last seen in 2014, while yields for riskier instruments have remained below those observed at the start of the pandemic (**Chart 3.10**, panel a). This is because the risk premia embedded in the more junior instruments have remained relatively contained compared with March 2020. Low, stable deposit funding rates, coupled with an increase in deposit volumes, have helped to keep banks' overall funding costs favourable. Banks have reduced their issuance of bail-inable debt, mainly as a consequence of the substantial rise in market funding costs. For senior bail-inable bonds, the cumulative issuance volume in the first four and a half months of this year was almost 11% lower than the average observed in the period from 2017 to 2019, while for Tier 2 (T2) and Additional Tier 1 (AT1) instruments volumes were close to 23% and 52% lower (**Chart 3.10**, panel b). Although forward rates suggest that banks' bond funding costs could rise further, the impact on funding costs will be limited as the majority of maturing bonds were issued at higher yields (**Chart 3.11**, panel a).

The expected reduction of banks' Eurosystem funding is likely to return bank balance sheet size and the composition of liquid assets to pre-pandemic levels. Based on the median estimate obtained from the ECB Survey of Monetary Analysts⁶², €700 billion of repayments of targeted longer-term refinancing operations (TLTRO) are expected to be made by the end of December 2022. Since TLTRO repayments are likely to be made using excess liquidity, this implies that liquidity coverage ratios and the composition of high quality liquid assets (HQLA) will return to pre-pandemic levels, with the share of government bonds in HQLA rising from 25% to 45%.

⁶² For more details, see the [ECB Survey of Monetary Analysts](#), April 2022.

Chart 3.10

Banks' bond funding costs have increased substantially since end-2021 amid higher risk-free rates and have prompted banks to reduce their issuance of bail-inable debt



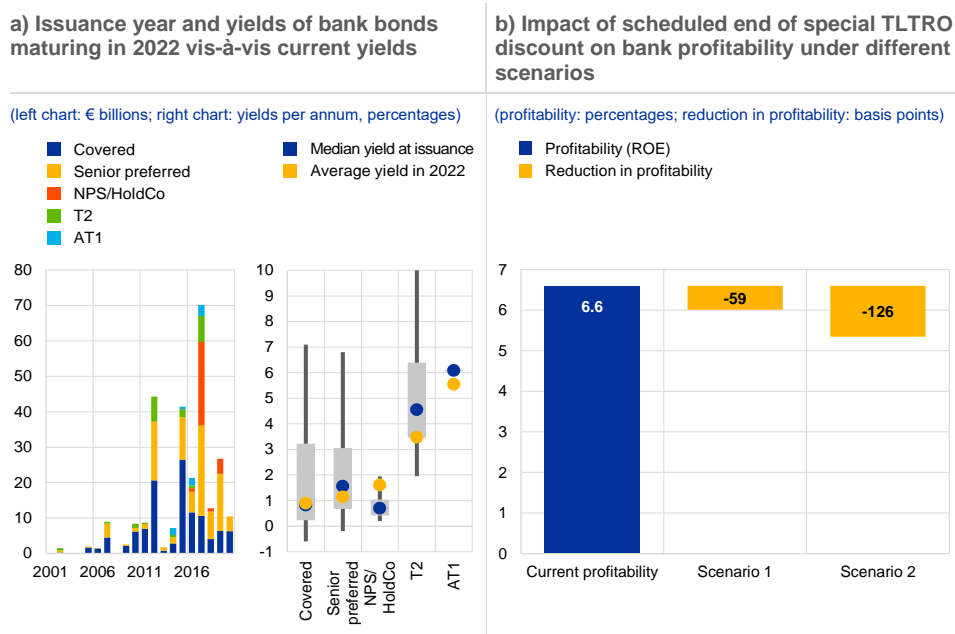
Sources: IHS Markit, Dealogic and ECB calculations.

Notes: NPS stands for non-preferred senior; HoldCo stands for holding company. Panel a: the T2 index shows no values between May and October 2021 since at that time there were no Tier 2 bonds matching the eligibility criteria for being included in the index. Panel b: the years 2020-21 are excluded from the benchmark of average issuance volumes shown as the blue bars since their values might be biased due to the pandemic.

The phasing-out of favourable TLTRO funding rates in June is likely to weigh on bank profitability in 2022. According to two scenarios which take into account the new TLTRO rates and the distribution of excess liquidity between Tier 1 and Tier 2 reserves, bank profitability could be adversely impacted by between 60 basis points and 130 basis points this year (Chart 3.11, panel b). In the first, most likely scenario, banks meet the lending threshold and benefit from a TLTRO rate of -0.5%. Depending on the magnitude of excess reserves, the net effect from the change in TLTRO funding costs would result in profitability which is around 60 basis points lower. In the more extreme scenario, banks fail to meet the lending threshold and receive a TLTRO rate of 0%, leading to a greater reduction in profitability. However, the expected earlier rise in interest rates compared to the beginning of the year appears to reduce the incentive for banks to repay TLTRO funding sooner, which is likely to reduce the resulting adverse impact on profitability.

Chart 3.11

Rolling over maturing bonds would not affect overall bank funding costs, but the phasing-out of special TLTRO discounts is likely to impact bank profitability in 2022



Sources: Dealogic, IHS Markit, ECB (Statistics Bulletin and Supervisory Banking Statistics) and ECB calculations.

Euro area banks’ regulatory capital ratios increased slightly in 2021 on the back of the de-risking initiated at the start of the pandemic. CET1 ratios for euro area significant institutions rose by 50 basis points in 2021 to 15.2%.⁶³ The positive contributions from retained earnings and lower average risk weights more than offset the negative impact of balance sheet expansion. The contribution from de-risking shrank in 2021, however, due to a pick-up in lending activities and the associated higher risk weights in the fourth quarter (Chart 3.12, panel a). The average CET1 capital requirement including Pillar 2 guidance amounted to 11.7% in the last quarter of 2021, with an average trigger point for automatic restrictions on distributions (maximum distributable amount, MDA) at around 10.6% (Chart 3.12, panel b).

The invasion of Ukraine has led to disruptions in energy and commodity markets and increased uncertainty around the outlook for euro area economic growth. A severe impact on euro area production, prices and demand could adversely affect euro area bank asset quality and solvency. A vulnerability analysis considering adverse and severely adverse economic scenarios over a three-year horizon indicates that, overall, the euro area banking sector is resilient, with the aggregate CET1 ratio estimated to total around 11% even under the severely adverse scenario (Box 6).

Analysis suggests that the euro area banking system should be largely resilient to any extreme macroeconomic risks emanating from the Russia-Ukraine war.

The invasion of Ukraine has led to disruptions in energy and commodity markets and increased uncertainty around the outlook for euro area economic growth. A severe impact on euro area production, prices and demand could adversely affect euro area bank asset quality and solvency. A vulnerability analysis considering adverse and severely adverse economic scenarios over a three-year horizon indicates that, overall, the euro area banking sector is resilient, with the aggregate CET1 ratio estimated to total around 11% even under the severely adverse scenario (Box 6).

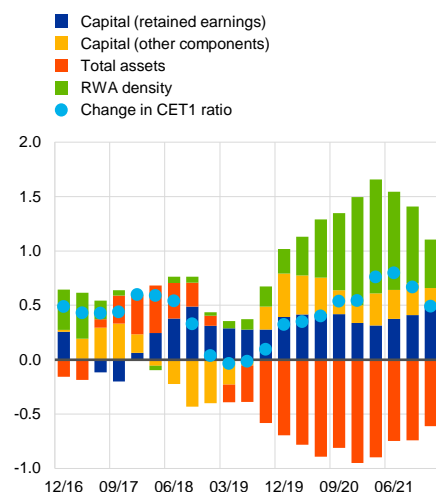
⁶³ In the Financial Stability Review, the four-quarter average of total equity is used in the denominator, while net income is annualised using trailing four-quarter sums. In addition, to avoid composition effects, a balanced sample of banks is used, which might result in a figure for headline profitability which is different from that in the published supervisory banking statistics.

Chart 3.12

Bank capital ratios rose slightly in 2021 and are, on aggregate, comfortably above requirements, while credit losses from macroeconomic consequences of the war in Ukraine will probably only have a limited impact

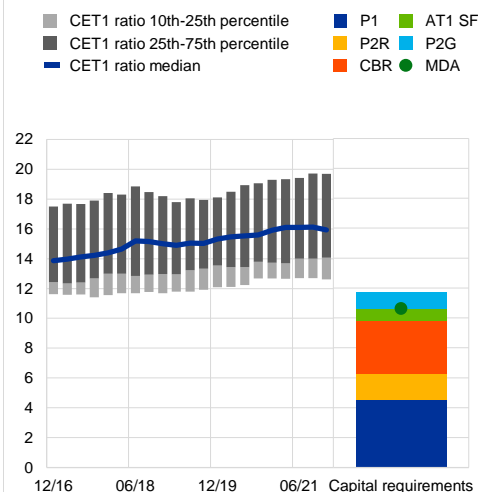
a) Decomposition of annual changes in euro area banks' aggregate CET1 ratio

(Q4 2016-Q4 2021, percentage points)



b) CET1 ratios and capital requirements of euro area significant institutions

(left chart: Q4 2016-Q4 2021, percentages; right chart: Q4 2021, percentages)



Sources: ECB (Supervisory Banking Statistics) and ECB calculations.

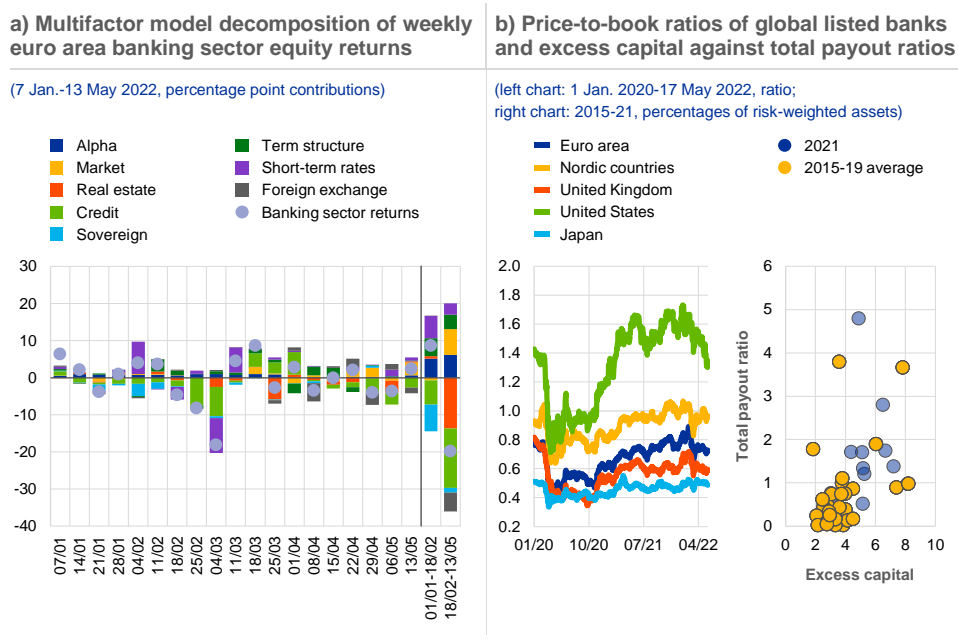
Notes: Based on a balanced sample of 89 significant institutions. Panel a: RWA stands for risk-weighted assets. Panel b: P1 stands for Pillar 1 requirement; P2R stands for Pillar 2 requirement; CBR stands for combined buffer requirement; AT1 SF stands for shortfall of Pillar 1 (AT1/T2) requirement; P2G stands for Pillar 2 guidance; MDA stands for maximum distributable amount.

Euro area banks' share prices rallied strongly towards the end of 2021 before dropping sharply due to the uncertainty arising from the war in Ukraine. Banks

benefited in early 2022 from the prospect of earlier rate hikes than previously anticipated but then, after the Russia-Ukraine war broke out, underperformed all other sectors over fears that higher credit risks would result. The declines in bank share prices since then were driven by the notion that higher inflation could potentially put the brakes on new mortgage lending, and amid higher credit and foreign exchange risks (Chart 3.13, panel a). Since the restriction on dividend payments expired and profitability, as well as market valuations, have exceeded pre-pandemic levels, banks with capital ratios above regulatory requirements have announced higher payouts (both dividends and buybacks) than banks which are closer to their capital thresholds (Chart 3.13, panel b).

Chart 3.13

Bank share prices suffered at the outbreak of war in Ukraine amid credit risks, but market valuations have improved and banks have increased payouts



Sources: Refinitiv, Bloomberg Finance L.P., S&P Global Market Intelligence, bank financial reports and ECB calculations.
Notes: Panel a: the calculations are based on the Datastream Eurozone Banks index. Panel b: left chart: based on simple averages of a sample of 32 listed euro area banks, 6 listed Nordic banks, 5 listed UK banks, 19 listed US banks and 12 listed Japanese banks; right chart: the total payout ratio is the sum of dividends and share buybacks as a percentage of risk-weighted assets in the respective financial year. Long-term averages (in yellow) are based on a sample of 36 listed euro area significant institutions. The blue dots refer to 15 banks that have already announced their distribution plans attributable to 2021 profits.

Box 6

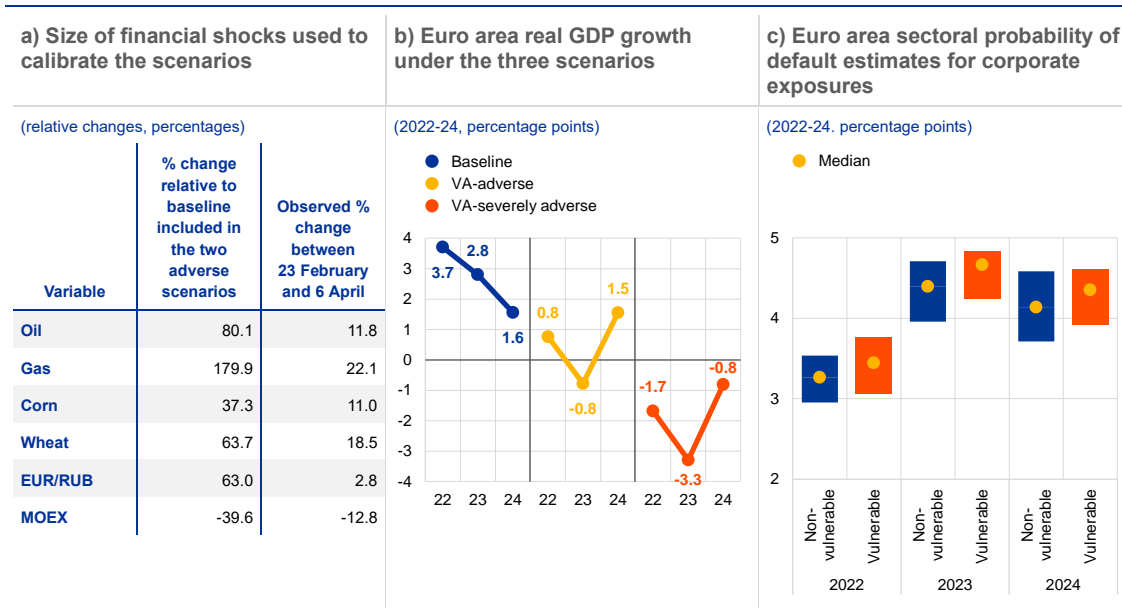
Assessing the resilience of the euro area banking sector in light of the Russia-Ukraine war

This box presents an assessment of the euro area banking sector's resilience to adverse macroeconomic scenarios in the light of the Russian invasion of Ukraine. While euro area banks' direct exposures to Russia are limited overall, disruptions in energy and commodity markets pose risks to economic activity in the euro area that could adversely affect banks' balance sheets. To examine these risks, the ECB has combined three macroeconomic scenarios (a baseline scenario, an adverse scenario and a severely adverse scenario) with stress-testing tools to perform an in-house assessment of the solvency of significant euro area banks. The resulting vulnerability analysis (VA) is a desktop exercise which does not include interactions with banks. The exercise estimates the impact on bank capital of potential losses arising from (i) exposures to euro area economic sectors which have strong trade links with Russia or are dependent on commodity imports from the region, (ii) broader macro-financial stress triggered by current events and (iii) revaluation risks related to increased market volatility and reduced liquidity. For this purpose, top-down models, which are consistent with the EBA 2021 Methodological Note⁶⁴, were used to assess banks' credit, market and profitability risks. The estimated impacts are contingent on the underlying scenario assumptions, which are characterised by a high degree of uncertainty.

⁶⁴ See the [EBA 2021 EU-Wide Stress Test Methodological Note](#) for details.

Chart A

Key macro-financial features of the scenarios and their impact on credit risk parameters



Sources: Bloomberg Finance L.P., March 2022 ECB staff macroeconomic projections, Oxford Economics, OECD Input-Output tables and ECB calculations. Notes: Financial shocks in panel a include shocks to commodities, the EUR/RUB exchange rate and the Russian stock market index (MOEX). Panel c shows the interquartile interval for the sectoral probability of default (PD) estimates for the severely adverse scenario.

Relative to a baseline scenario of a modest slowdown in growth, two alternative adverse economic scenarios explore the impact of additional commodity and equity price shocks.⁶⁵

Under the VA-adverse and VA-severely adverse scenarios, oil and gas prices rise by around 80% and 180% respectively (Chart A, panel a), while euro area equity prices fall by more than 20%, matching the sizeable drop observed in the immediate aftermath of the invasion.⁶⁶ However, the same financial shocks are assumed to affect the real economy differently: under the VA-adverse scenario investment and consumption are affected only temporarily, while under the VA-severely adverse scenario the effects last longer, giving rise to confidence shocks that further dampen economic activity and match the severity of the 2021 EBA EU-wide stress test. Annual GDP growth turns negative under the VA-adverse scenario in 2023, while the euro area economy is in recession in all three years under the VA-severely adverse scenario (Chart A, panel b). The macro-financial scenarios are fed into econometric models which capture the heterogenous exposure of euro area firms to these shocks, yielding different probability of default paths for corporate exposures to vulnerable⁶⁷ and non-vulnerable sectors (Chart A, panel c).

⁶⁵ The baseline scenario is anchored to the [March 2022 ECB staff macroeconomic projections for the euro area, which included a first assessment of the impact of the war](#). To account for the uncertainty surrounding the evolution of the conflict and its economic ramifications, two adverse scenarios were created. The three scenarios combined cover a wide spectrum of macroeconomic outcomes for the euro area to offer insights into potential feedback effects on the banking system, also once the baseline projections have been reappraised in the context of the Eurosystem staff macroeconomic projections for the euro area, which are due to be released in June.

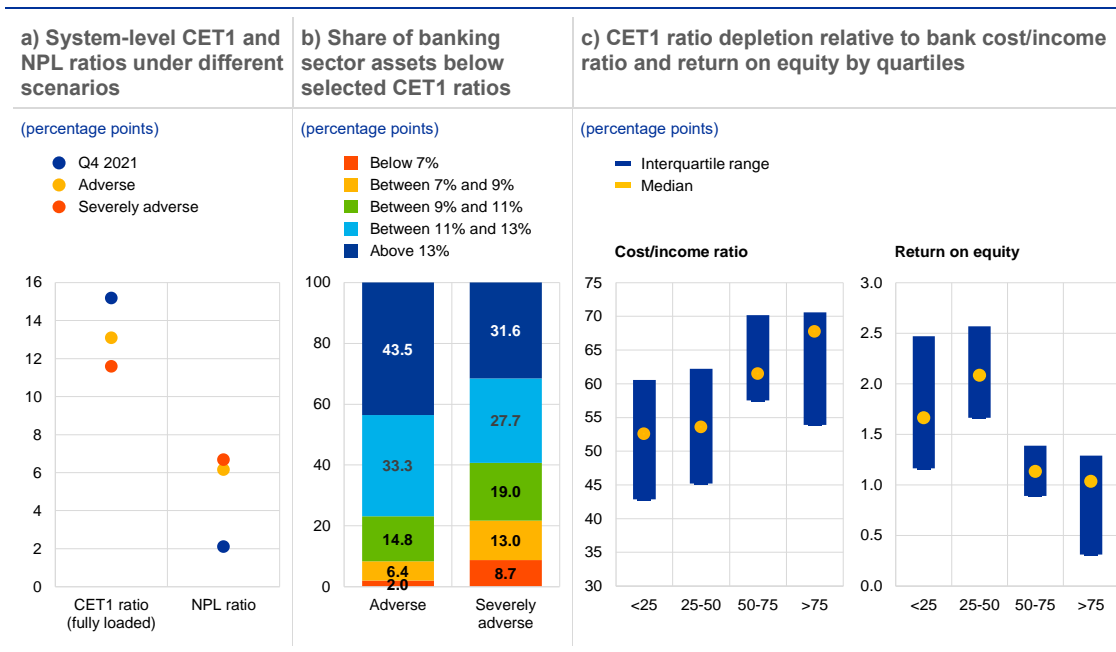
⁶⁶ Mechanically, the adverse scenarios take as their starting point shocks to commodity and stock market prices which are based on the actual increases observed in the immediate aftermath of the invasion. They are likely to incorporate financial markets' expectations that the shortages in the supply of Russian commodities in Europe would worsen further, with the additional possibility of a full-scale embargo (as reflected in financial market news in the early weeks of March).

⁶⁷ Sectors are identified as (non-)vulnerable by combining information from the OECD Input-Output tables and NACE 2-level projections of gross value added (GVA) at the country level produced by Oxford Economics for its 2022 war scenario. Sectors that are highly exposed to Russian trade or experience a negative GVA shock over the three-year horizon are classified as vulnerable in this exercise.

The results obtained from this exercise confirm that the euro area banking sector is resilient to the macroeconomic ramifications of the war in Ukraine. The system-level Core Equity Tier 1 (CET1) ratio (in fully loaded terms) is estimated at 13.1% under the VA-adverse scenario and 11.6% under the VA-severely adverse scenario (**Chart B**, panel a), with capital depletion amounting to around 2.1 percentage points and 3.6 percentage points respectively. CET1 ratios fall below 7% for just over 2% of banking sector assets under the VA-adverse scenario and for just over 8% under the VA-severely adverse scenario (**Chart B**, panel b). Credit risk is the main driver of capital depletion in both adverse scenarios, with sectoral concentration in vulnerable sectors⁶⁸ amplifying credit losses that materialise due to the macroeconomic shocks. In addition, the system's income generating capacity is weakened by funding cost increases, which also reflect the expiration of targeted longer-term refinancing operations under all scenarios. These increases offset the gains expected from rising rates on the asset side, resulting in an overall weakening of net interest income compared with the starting point. At the bank level, higher capital depletion correlates strongly with a lower return on equity and with higher cost/income ratios, reflecting the drag exerted by projected operating costs on capital ratios (**Chart B**, panel c).

Chart B

The banking sector is resilient overall to the second-round effects arising from the Russia-Ukraine war: capital depletion is higher for banks with ex ante higher operating costs and lower returns

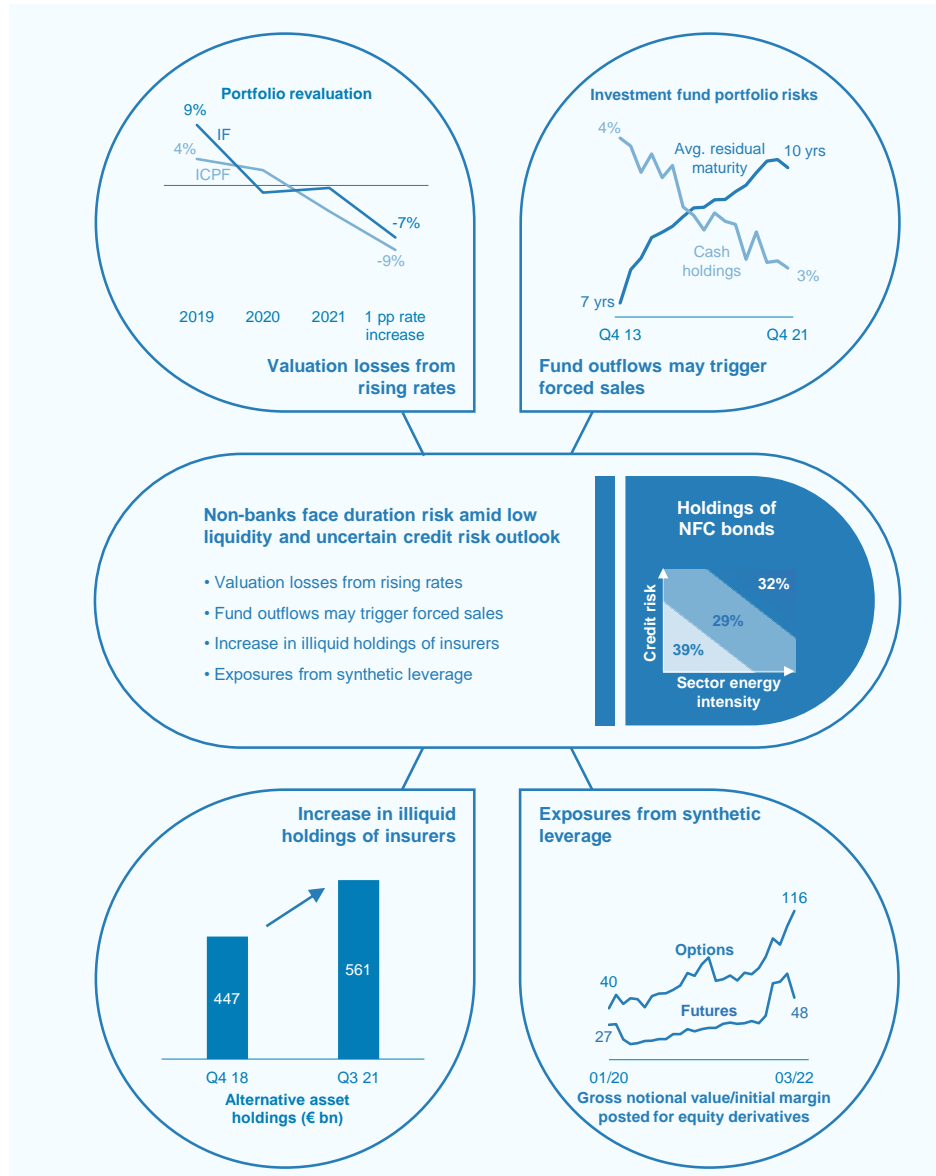


Sources: ECB (Supervisory Banking Statistics) and ECB calculations.

Notes: NPL stands for non-performing loans. Panel c shows results based on the severely adverse scenario and displays banks grouped by interquartile buckets, with <25 capturing banks with a CET1 ratio depletion below the 25th percentile, 25-50 capturing banks with a CET1 ratio depletion above the 25th percentile and below the median, 50-75 banks above the median and below the 75th percentile and >75 banks above the 75th percentile.

⁶⁸ Sectoral impairments are projected using a combination of (i) micro-econometric models for sector-level probabilities of default and (ii) proxies capturing bank-level concentration to vulnerable sectors.

4 Non-bank financial sector



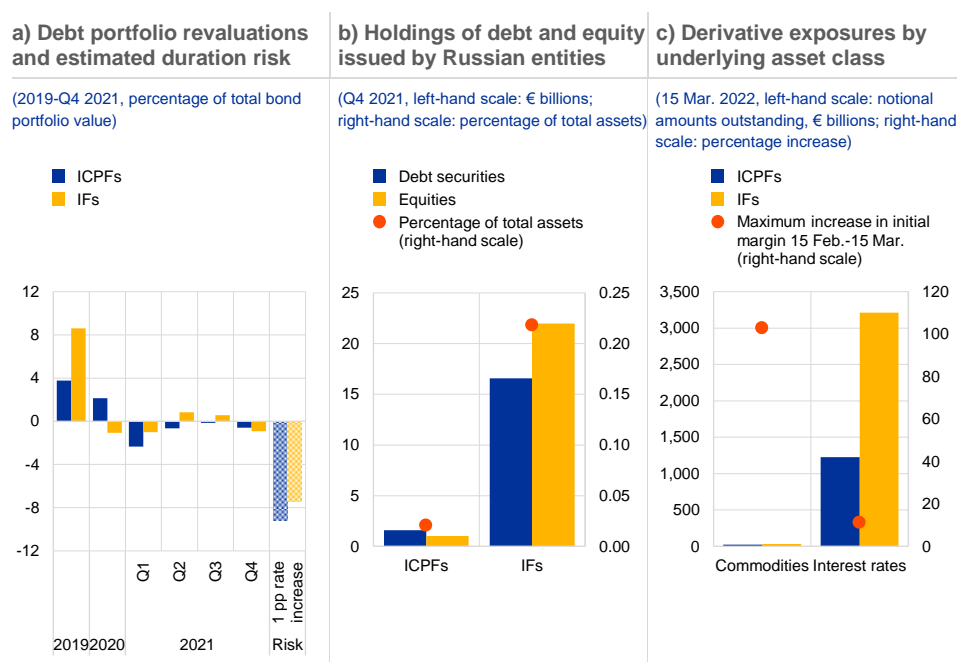
4.1 Non-bank financial sector faces higher credit risk as duration risk starts to materialise

Duration risk in the non-bank financial sector has started to materialise recently and valuation losses may increase further in an environment of rising interest rates. Yields have continued on their upward trend that started at the end of 2021. Over the course of the past year, rising rates have led to a decline in the value of bond portfolios of around 3.7% for insurance corporations and pension funds (ICPFs) and 0.4% for investment funds (IFs) (**Chart 4.1**, panel a). Given that the share of

interest rate sensitive assets in ICPF and IF portfolios remains high, in the absence of hedging strategies a further rise of 1 percentage point in all yield to maturity would imply additional bond portfolio valuation losses of around 9% for ICPFs and 7% for IFs. ICPFs and IF shareholders are therefore increasingly shifting their investments towards equities as well as towards alternative assets (Sections 4.2 and 4.3). In the medium term, however, rising interest rates could reduce the incentives for the non-bank sector to search for yield and could improve ICPFs' capital positions, mitigating overall financial stability risks.

Chart 4.1

Non-banks' debt portfolios face revaluation losses amid rising rates, while direct exposures to Russian assets and commodity derivatives are limited

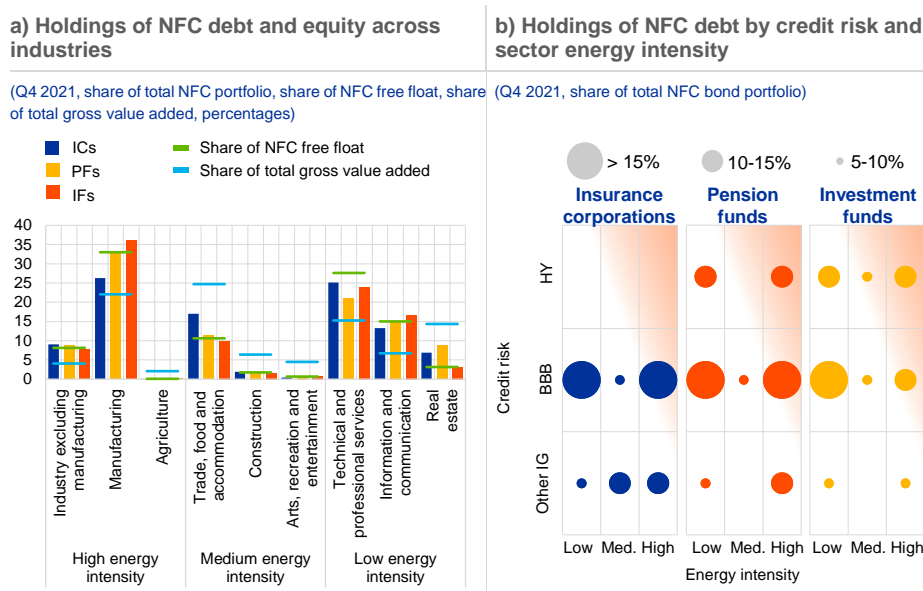


Sources: Eurostat, ECB (Securities Holdings Statistics and European Market Infrastructure Regulation) and ECB calculations. Notes: Panel a: estimated risk shown in the shaded bars assumes an increase of 1 percentage point in the yield to maturity of all securities held at the end of 2021. Estimated values are calculated as the sum of modified durations multiplied by the amounts held at the security level, multiplied by 0.01. Panel b: the chart includes all debt securities and equities issued by Russian-domiciled financial and non-financial corporations (NFCs), as well as Russian sovereign debt securities. Panel c: initial margins include all margins posted with euro area central counterparties.

The non-bank financial sector has so far proven to be resilient to increased uncertainty following the Russian invasion of Ukraine. At the end of 2021, euro area non-banks' direct exposures to debt securities and equities issued by Russian entities were below 1% of their total assets (Chart 4.1, panel b). While fund categories with higher Russian exposure have experienced significant outflows and some funds have had to be suspended, there have been no widespread redemptions or spillovers to the broader euro area non-bank financial sector (Sections 4.2 and 4.3). Furthermore, the increase in volatility in derivatives markets has remained contained to the commodity segment (Chapter 2), while margins on interest rate derivatives – the segment to which non-banks are significantly exposed – have been affected much less than those on commodity derivatives (Chart 4.1, panel c). Nevertheless, the non-bank financial sector could face second-round effects stemming from economic uncertainty and rising commodity prices.

Chart 4.2

Non-banks may be exposed to rising credit risk from NFCs in energy-intensive industries



Sources: Eurostat, ECB (Securities Holdings Statistics), OECD Trade in Value Added (TiVA) database (2018) and ECB calculations. Notes: Panel a depicts all broad non-financial sectors of the economy, ranked according to their average energy intensity. Firms in sectors above the 75th percentile of the energy intensity ratio are regarded as high energy consumers, firms in sectors below the 25th percentile are considered low energy consumers. For a detailed definition, see also Chart 3.4 panel a. Energy intensity may vary across subsectors within the broader sectors. Sector free float in NFC free float is the respective sector's amount of outstanding debt and equity securities as a percentage of total NFC debt and equity securities held in the euro area, excluding Eurosystem holdings, at the end of 2021. Sector gross value added shares are based on 2020 data. Panel b: energy intensity of sectors is defined as in panel a. "Other IG" includes all investment grade ratings except BBB (AAA to A). "HY" includes all high-yield ratings, i.e. ratings below BBB (BB to D). The chart excludes all bonds with no available rating.

Rising energy prices increase the vulnerabilities of non-bank financial institutions (NBFIs), as corporate bond and equity portfolios of pension funds (PFs) and investment funds are somewhat concentrated in energy-intensive industries.

While the economic recovery from the coronavirus (COVID-19) pandemic has mitigated NFC default risk in the euro area, there are new risks stemming from firms heavily reliant on energy. Non-banks' investments in NFCs are, overall, mostly proportional to the individual sectors' available free-float equity and debt securities outstanding (Chart 4.2, panel a). However, given the greater propensity of larger firms to issue equity and marketable debt, securities issued by a number of energy-intensive sectors (e.g. manufacturing) are overrepresented in capital markets relative to their share of euro area economic value added.⁶⁹ Non-banks' NFC portfolios may therefore be especially sensitive to heightened corporate credit risks resulting from rising energy prices.⁷⁰ This increases pre-existing vulnerabilities in the debt portfolios of PFs and IFs, as more than 10% of their holdings are already in the high-yield segment (Chart 4.2, panel b).

⁶⁹ For an analysis of the determinants of NFCs' decisions to issue debt, see also the article entitled "Market-based finance for corporations: Demand and supply of credit", *Economic Bulletin*, Issue 4, ECB, forthcoming.

⁷⁰ Exposures shown are based on broader non-financial sectors. The overall potential impact from rising energy prices may also vary depending on the allocation of portfolios across more or less energy-intensive subsectors within each sector.

4.2 Bond funds are vulnerable to rising yields and uncertain second-round effects from the war

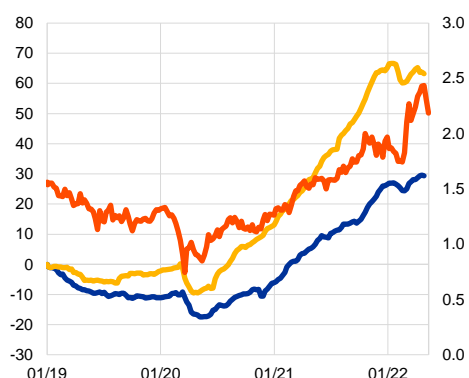
Recent fund flows reflect investors' expectations of higher inflation and financial fragmentation going forward. Although a higher interest rate environment can bring benefits for financial stability as incentives to take on risk are reduced, the transition to a new equilibrium could lead to losses on unhedged bond portfolios. Investors had already started to rotate away from bond funds before the Russian invasion of Ukraine, likely indicating concerns regarding duration and credit risk with an emphasis on the latter, as outflows occurred primarily from corporate bond funds (**Chart 3**, panel a, **Overview**). Inflation-linked bond funds, whose returns are hedged against rising inflation, saw renewed inflows after the invasion, which turned negative again in late April, in line with inflation expectations (**Chart 4.3**, panel a). The extent to which continued outflows from bond funds will affect non-financial corporations' financing needs remains to be seen, as their reliance on market-based and non-bank credit has increased substantially over the past decade.⁷¹ Beyond sizeable outflows from euro area bond markets, recent flows may also reflect an increase in the perceived risk of financial fragmentation (**Chapter 2**). The gap between global fund outflows from bond markets of lower-rated euro area countries compared with bond markets of higher-rated euro area countries widened at the beginning of February, at the same time as government bond spreads increased (**Chart 4.3**, panel b).

Chart 4.3
Fund investors reposition for higher inflation and financial fragmentation risks

a) Cumulative flows into inflation-protected bond funds

(2 Jan. 2019-11 May 2022, left-hand scale: percentage of total net assets, right-hand scale: percentages)

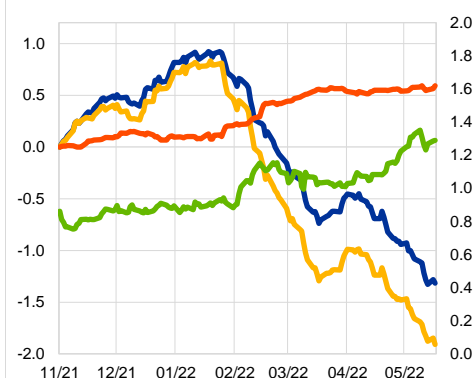
■ Euro area inflation-protected bond funds
■ US inflation-protected bond funds
■ 5-year euro inflation swap rate (right-hand scale)



b) Cumulative global fund flows into higher- and lower-rated euro area bond markets

(2 Nov. 2021-17 May 2022, left-hand scale: percentage of total net assets, right-hand scale: percentage points)

■ Higher-rated euro area countries
■ Lower-rated euro area countries
■ Difference
■ GDP-weighted government bond spread (right-hand scale)



Sources: EPFR Global, Bloomberg Finance L.P., Refinitiv and ECB calculations.

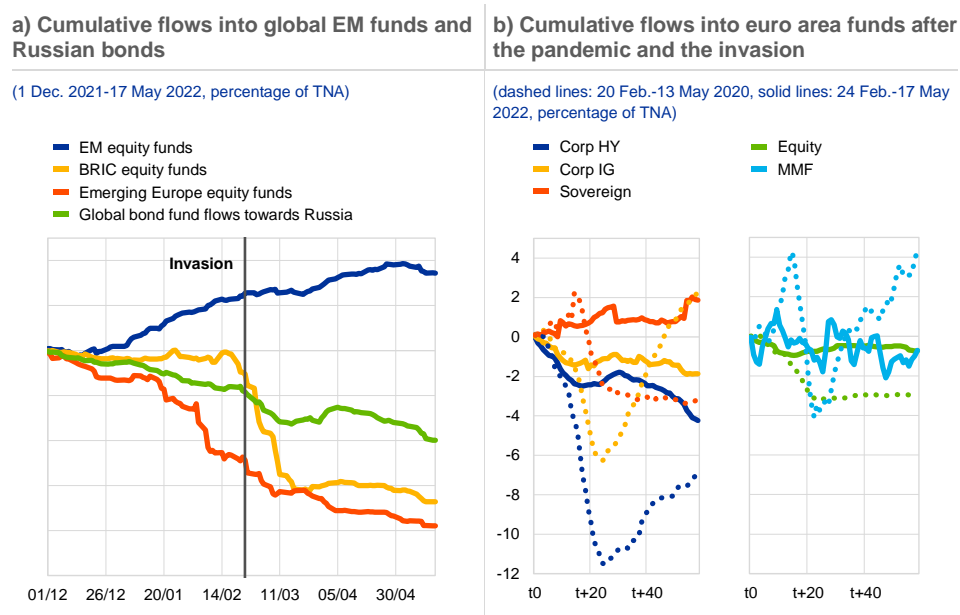
Notes: Panel a: inflation swap rates do not purely reflect inflation expectations, as they also include a risk premium. Panel b: a rating above/below AA- is defined as higher/lower. The GDP-weighted government bond spread is the difference between the GDP-weighted average of government bond yields of lower-rated countries and the GDP-weighted average of government bond yields of higher-rated countries. There are slight differences in country samples for fund flows and GDP government bond spread due to data availability.

⁷¹ See the box entitled “Measuring market-based and non-bank financing of non-financial corporations in the euro area”, *Financial Integration and Structure in the Euro Area*, ECB, April 2022.

The direct impact of the Russia-Ukraine war on the euro area investment fund sector has been limited so far, even though several funds have been suspended. The sector's overall direct exposure to Russian securities is negligible, standing at well below 1% of total assets as of the fourth quarter of 2021 (Section 4.1), although it is concentrated in funds with a focus on emerging markets (EMs). Russian equity holdings are also concentrated in specific funds, with only the top 1% of exposed funds holding more than half of their portfolio in Russian equities.⁷² The Russian invasion of Ukraine and the related financial sanctions triggered several suspensions as funds were not able to price and trade Russian securities. Most index providers also removed Russian securities from their indices, which meant that index-tracking funds had to dispose of or mark down their Russian exposures. Nevertheless, these developments did not cause a wider run on funds. Global EM funds investing in emerging Europe and BRIC countries experienced an acceleration of outflows after the invasion, which subsequently receded (Chart 4.4, panel a). More broadly, the wider euro area fund sector did not suffer from the kind of long-lasting or large-scale outflows seen at the start of the pandemic (Chart 4.4, panel b).

Chart 4.4

Spillovers from the war to the broader euro area investment fund sector have been limited so far



Sources: EPFR Global and ECB calculations.

Notes: Panel a: global bond fund flows towards Russia are estimated flows from global funds into Russian bonds, which differs slightly from the other categories which show flows into funds based on their respective investment focus. Panel b: cumulated flows into euro area-domiciled funds after the start of the COVID-19 market turmoil (dashed lines) and after the Russian invasion of Ukraine (solid lines). x-axis indicates business days after 20 February 2020 and 24 February 2022 (t0). TNA stands for total net assets; Corp HY stands for corporate high-yield bond funds; Corp IG stands for corporate investment-grade bond funds; MMF stands for money market funds.

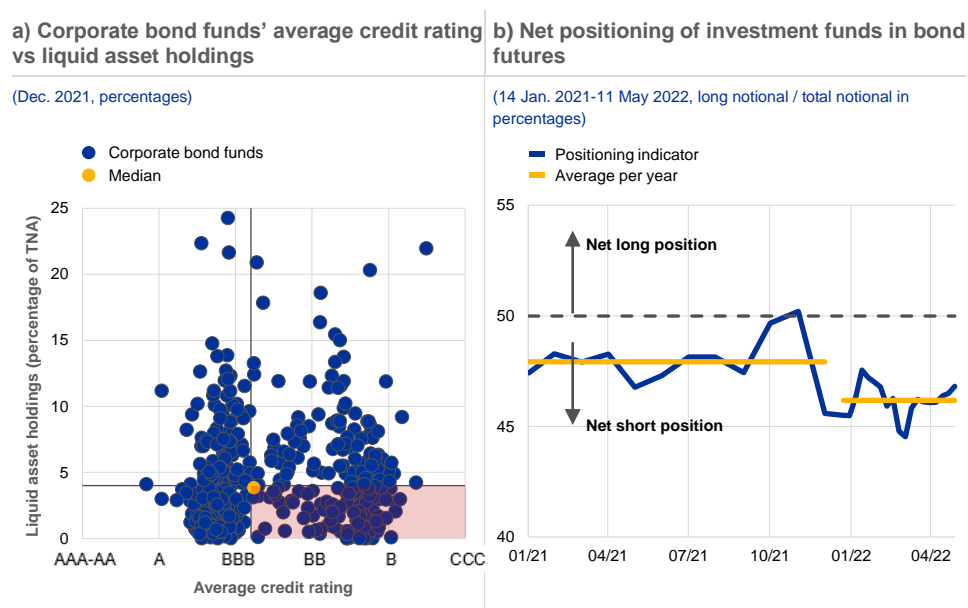
Investment funds are vulnerable to uncertainty and second-round effects stemming from the Russia-Ukraine war, which may exacerbate pre-existing

⁷² 77 funds in a sample of 9,624 funds with a Russian exposure greater than 0 in December 2021 (Refinitiv Lipper).

risks. A broader range of funds could face valuation losses and renewed outflows, should economic sentiment deteriorate. Second-round effects related to increasing energy prices and lower economic growth, for example, might result in valuation losses for funds that hold debt securities issued by companies with a high energy intensity and low credit quality (Chart 4.2, panel b). A reassessment of longer-term inflation and credit risk, coupled with rising risk-free rates, could also lead to a reallocation to cash and low-risk assets, triggering outflows from riskier fund types. Some funds with high directional exposures through derivatives might also face liquidity challenges from margin calls and could be forced to deleverage, should market volatility spike more broadly (Chapter 2). In adverse scenarios, money market funds (MMFs) could experience large outflows, as institutional investors might redeem their fund shares to service margin calls.⁷³ This underscores the need to strengthen the regulation of MMFs (Chapter 5.2).

Chart 4.5

Bond funds remain vulnerable to losses from credit and duration exposures amid low liquid holdings



Sources: Refinitiv, ECB (Centralised Securities Database and European Market Infrastructure Regulation) and ECB calculations.
Notes: Panel a: the scatter plot shows a sample of 458 corporate bond funds domiciled in the euro area irrespective of invested credit quality. One dot represents one fund. Liquid assets include cash, cash equivalents, and government, supranational and central bank bonds from euro area issuers or from other issuers, if the rating is at least AA-, similar to Level 1 high-quality liquid asset (HQLA) bonds according to Basel liquidity coverage ratio requirements for HQLA (Commission Delegated Regulation (EU) 2015/61*). 12 funds were removed from the chart as outliers as they had negative liquid asset holdings or liquid asset holdings above 25%. Grey lines represent median liquid asset holdings and median average credit rating. Panel b: monthly data for 2021 and weekly data for 2022. The yellow line indicates the average for the monthly values in 2021 and for the weekly values in 2022. The dashed grey line indicates 50%, the neutral position for which long and short notional are of same size.
*) Commission Delegated Regulation (EU) 2015/61 of 10 October 2014 to supplement Regulation (EU) No 575/2013 of the European Parliament and the Council with regard to liquidity coverage requirement for Credit Institutions Text with EEA relevance (OJ L 11, 17.1.2015, p. 1).

Investment funds remain vulnerable to shocks stemming from duration and credit risk amid low liquidity buffers.

Investment funds' duration exposure has remained elevated in recent quarters. As a result, bond funds continue to be vulnerable to losses stemming from increases in yields. Corporate bond funds are

⁷³ See the box entitled "Interconnectedness of derivatives markets and money market funds through insurance corporations and pension funds", *Financial Stability Review*, ECB, November 2020.

also exposed to credit risk, while median liquid holdings remain low. Funds with low credit quality and low liquid asset holdings – around a quarter of funds in the sample observed – are especially vulnerable (**Chart 4.5**, panel a). Risks to such funds could amplify adverse market developments going forward if the funds had to engage in forced asset sales due to their low liquid holdings being insufficient to cover large-scale redemptions triggered by portfolio losses. At the same time, the investment fund sector has had a small, but increased, net short position in bond futures since the beginning of the year. This indicates that direct portfolio revaluation losses from higher interest rates might be partly mitigated by hedging strategies (**Chart 4.5**, panel b).⁷⁴

Some funds exhibit additional vulnerabilities from investments in crypto-assets or heavy use of synthetic leverage. Asset managers have started to move into Bitcoin and other crypto-assets in response to growing demand from their clients. Should such exposures grow further, risks stemming from this asset class could spill over to other financial institutions (**Special Feature B**). Funds can also take on further risks by leveraging up their positions, either financially through borrowing or synthetically through derivatives. Synthetic leverage, which is difficult to quantify, can materialise through margin calls and uncovered counterparty exposure during periods of high market volatility. In particular, while margining provides coverage for counterparty exposure in derivative positions, a significant rise in margin calls can result in a gap in such coverage and can also lead to potential liquidity stress (**Box 7**).⁷⁵ The potential for spillover effects from the investment fund sector to the wider financial system and real economy amid high liquidity mismatch and pockets of leverage highlights the need to strengthen its resilience from a macroprudential perspective (**Chapter 5**).

Box 7

Synthetic leverage and margining in non-bank financial institutions

Prepared by Annalaura Ianiro, Christian Weistroffer and Sebastiano Michele Zema⁷⁶

Synthetic leverage has become an important feature of the financial system. It refers to the exposure embedded in derivative contracts. These instruments enable market participants to take on synthetic market exposure, sometimes at little cost (for certain types of derivatives and underlying assets), and allow them to amplify gains at the risk of magnifying losses. Leverage tends to be less strictly regulated in parts of the non-bank financial sector than it is for banks, and non-bank institutions are able to increase leverage synthetically at little cost. During events such as the failure of Long-Term Capital Management and the collapse of AIG, and more recently Archegos, losses on derivative exposures spread to bank counterparties.

⁷⁴ This does not rule out the possibility of individual funds taking a stronger net short position or other interest rate derivatives such as swaps also being used for hedging purposes.

⁷⁵ Further to the analysis on equity derivatives in Box 7, there is evidence that some euro area bond funds and hedge funds are highly leveraged (see the special feature entitled “[Towards a framework for calibrating macroprudential leverage limits for alternative investment funds](#)”, *Financial Stability Review*, ECB, November 2016 and “[EU Alternative Investment Funds](#)”, *Annual Statistical Report*, ESMA, February 2022).

⁷⁶ The authors express their gratitude to Linda Fache Rousová and Lorenzo Capiello for their contributions and valuable feedback.

There are multiple ways of measuring the amount of leverage in the financial system.

Traditional leverage ratios at entity level do not fully capture the contingent commitments associated with derivative positions, as future gains and losses can substantially exceed the market value at which derivatives are recorded on the balance sheet. A generally accepted method used to capture synthetic leverage applies the concept of cash-equivalent portfolios,⁷⁷ which also forms the basis of leverage metrics in EU fund regulation.⁷⁸ Another approach, which is the focus of this box, considers the derivative contracts themselves and assesses the extent to which such contracts can be used to take positions which embed leverage.⁷⁹

This box explores the link between synthetic leverage and margining from two angles. First, we look at the ratio of derivatives' gross notional value (GNV) to initial margins (IMs) posted, which may be viewed as the level of synthetic leverage in a particular type of contract.⁸⁰ Low levels of IMs allow financial institutions to increase their market exposure via derivatives with very little initial funding. During periods of elevated price volatility, IMs tend to increase relative to the GNV – this offers the benefit of better protection against counterparty risk in stressed market conditions. However, this can also intensify liquidity needs in a procyclical manner and create incentives for deleveraging, which could contribute to the amplification of price declines. Second, we calculate the ratio of the daily absolute flows of variation margins (VMs) to IMs, which may be seen as a proxy for the amplification of profits and losses on a derivative portfolio.⁸¹ For a highly leveraged portfolio, this ratio would increase more in times of high market volatility. Daily ratios greater than 1 suggest – ex post – that the capital committed as IM would not have been sufficient to fully protect against losses if the counterparty had failed. These two metrics are calculated for portfolios of equity derivatives held by non-bank financial institutions to capture risks similar those faced by Archegos.⁸²

The high GNV/IM multipliers for equity derivatives suggest that these instruments could entail potentially high leverage-like risk. Multipliers range between 10 and 80 across instruments during most of the period covered, with equity options displaying the largest multipliers (**Chart A, panel a**). Although the GNV/IM ratio decreased for equity futures during the March 2020 market turmoil, it did not decline significantly for swaps and options, the difference probably stemming from the models used to calculate IMs.⁸³ Following this episode, the GNV/IM ratio for both options and futures rose throughout most of 2020 and 2021, with the increase accelerating in the fourth quarter of 2021. The increase in the ratio for options seems to have been driven by a decrease in IMs as the associated GNV remained relatively stable during this period. The GNV/IM ratio for swaps was relatively stable.

The ratios between daily absolute VM flows and IMs at the instrument level increased significantly in March 2020, reaching over 1 for some NBFIs (Chart A, panel b). While the

⁷⁷ See Breuer, P., "Measuring off-balance-sheet leverage", *Journal of Banking and Finance*, Vol. 26 (2-3), 2002, pp. 223-242.

⁷⁸ For example, the "commitment approach" in the Undertakings for Collective Investment in Transferable Securities (UCITS) Directive and the Alternative Investment Fund Managers Directive (AIFMD). Other common metrics include gross notional over net asset value and value-at-risk concepts. See the box entitled "[Synthetic leverage in the investment fund sector](#)", *Financial Stability Review*, ECB, May 2015.

⁷⁹ See Frazzini, A. and Pedersen, L.H., "Embedded Leverage", *NBER Working Papers*, No 18558, November 2012.

⁸⁰ This recalls the standard definition of the leverage ratio, which is market exposure (the GNV captures the synthetic market exposure) over unit of committed capital (here represented by IMs).

⁸¹ By definition, the leverage ratio amplifies returns on equity: $r(E) = L \cdot r(A)$.

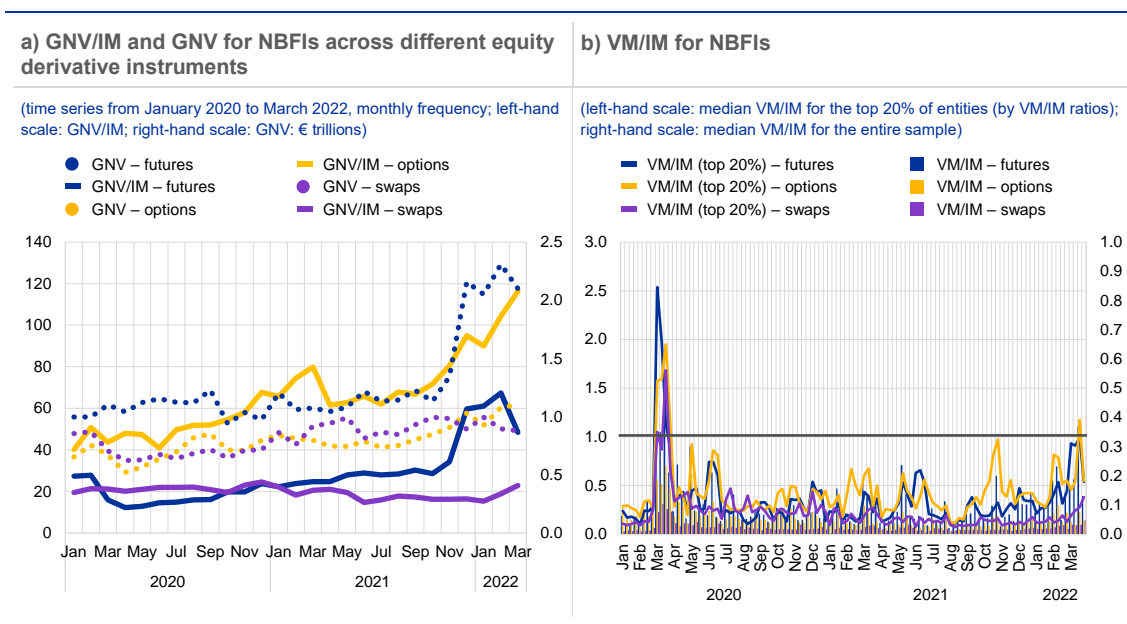
⁸² Gross notional and margin data are obtained from the EMIR dataset. The sample comprises a broad range of institutions including investment funds, pension funds, insurance companies and other financial institutions. The bulk of such derivatives are held by investment funds.

⁸³ The differences between the models used to compute IMs depend heavily on the calibration choices made by central counterparties (for centrally cleared transactions – mostly options and futures in our sample) or counterparties (for non-centrally cleared transactions – swaps in our sample). In particular, the models used by the latter are less responsive to short-term fluctuations in market volatility. For further information, see the box entitled "[Lessons learned from initial margin calls during the March 2020 market turmoil](#)", *Financial Stability Review*, ECB, November 2021.

majority of NBFIs posted more IM than the amount of VM calls, for a significant number of non-banks VM calls exceeded IM during the March 2020 market turmoil, suggesting that some counterparties would not have been fully covered by IM if the other counterparty had defaulted. Focusing on NBFIs with high exposures to market volatility, the median VM/IM ratio in the top 20th percentile ranged from 1.7 to 2.5 during March 2020 across all instruments considered. The significant rise of VM calls also points to potential liquidity stress arising from derivative positions. The median ratio for futures and options also increased in February and March 2022, reflecting higher volatility, although the levels reached were not comparable with those of March 2020. This also reflected the fact that recent events had affected energy and commodity derivatives to a greater extent than equity derivatives.

Chart A

The GNV/IM ratio is a proxy for the synthetic leverage of a derivative portfolio, while the VM/IM ratio captures the amplification of profit and losses at the portfolio level



Sources: ECB (European Market Infrastructure Regulation) and authors' calculations.

Notes: Non-bank financial institutions (NBFIs) have been identified through internal sector enrichment classification codes.⁸⁴

In panel a), the GNV/IM ratio is computed for derivative portfolios containing only equities as underlying instruments. Mixed portfolios containing asset classes other than equities have been excluded from the sample. Consequently, GNV and IM in the charts do not represent the exposure of NBFIs to all equity derivative positions. Coverage ranges from 60% to 80% in terms of the overall notional over time.

In panel b), ratios are computed at the entity level for all NBFIs transacting futures, options and swaps on equities. Very small positions characterised by zero margin posted and low levels of notional have not been considered for the computation of leverage.

Leverage risk can materialise through margin calls and uncovered counterparty exposure during periods of high market volatility.

One of the key risks associated with leverage embedded in derivative portfolios is the resulting procyclical margin calls during periods of market stress.

Moreover, the IM might not always be sufficient to cover possible counterparty risk in times of very high market volatility. Higher levels of IM in quieter periods could be beneficial from a financial stability perspective as they could reduce the procyclicality of margin calls, as well as leverage-like risk in derivative portfolios. However, there are trade-offs to consider, including the possible indirect impact derivatives may have on users through higher liquidity and funding needs.⁸⁵

⁸⁴ See Lenoci, F.D. and Letizia, E., "Classifying Counterparty Sector in EMIR Data", in Consoli, S., Reforgiato Recupero, D. and Saisana, M. (eds.), *Data Science for Economics and Finance*, Springer, 2021.

⁸⁵ See Section 5.2 for a broader discussion of policies used to address leverage risk in the non-bank financial sector.

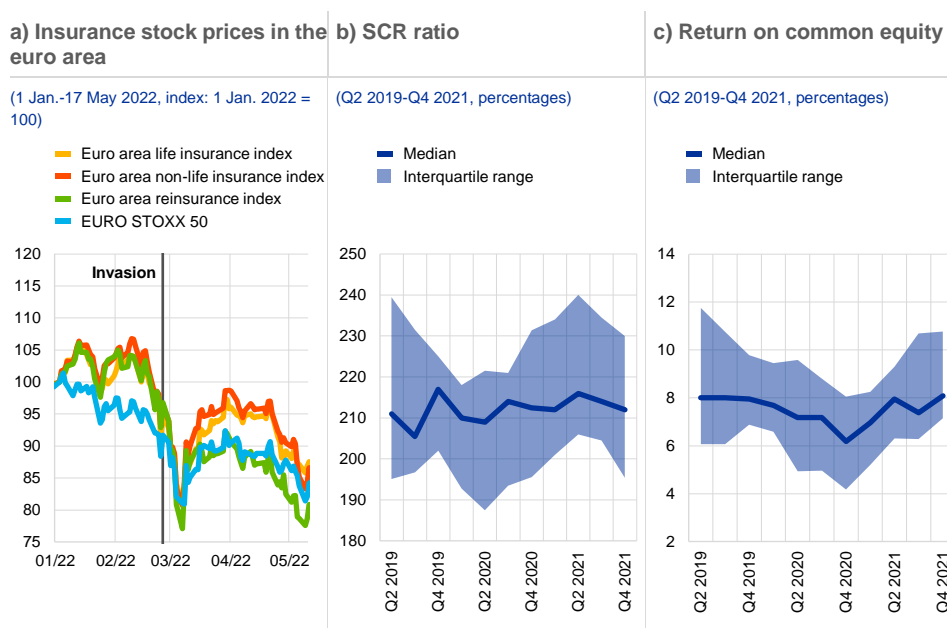
4.3 Insurers face near-term headwinds from inflation, while benefiting from rising interest rates

Euro area insurers are indirectly affected by the Russia-Ukraine war and associated sanctions amid pre-existing elevated vulnerabilities.

In the weeks preceding the Russian invasion of Ukraine, insurance companies' stock prices had started to decline on the back of growing uncertainty and continued to do so after the event (**Chart 4.6**, panel a). As was the case for other financial sectors, insurers' equity prices fell by more than the broad market before temporarily recovering in mid-March and falling again amid high market uncertainty. While aggregate direct exposures to Russian assets are very limited (**Chart 4.1**, panel b), the war has exacerbated inflation risks (**Chapter 2**), increased uncertainty and could be a catalyst for broader asset repricing, especially in energy-intensive sectors (**Chart 4.2**, panel a). These developments could dampen insurers' near-term profitability and solvency.

Chart 4.6

Insurers' equity prices declined by more than broad market indices, but profitability and solvency positions remain solid



Sources: Refinitiv, Bloomberg Finance L.P. and ECB calculations.

Notes: Panel a: the chart shows daily observations. Panels b and c: the charts are based on a sample of 25 large euro area insurers offering life and non-life products.

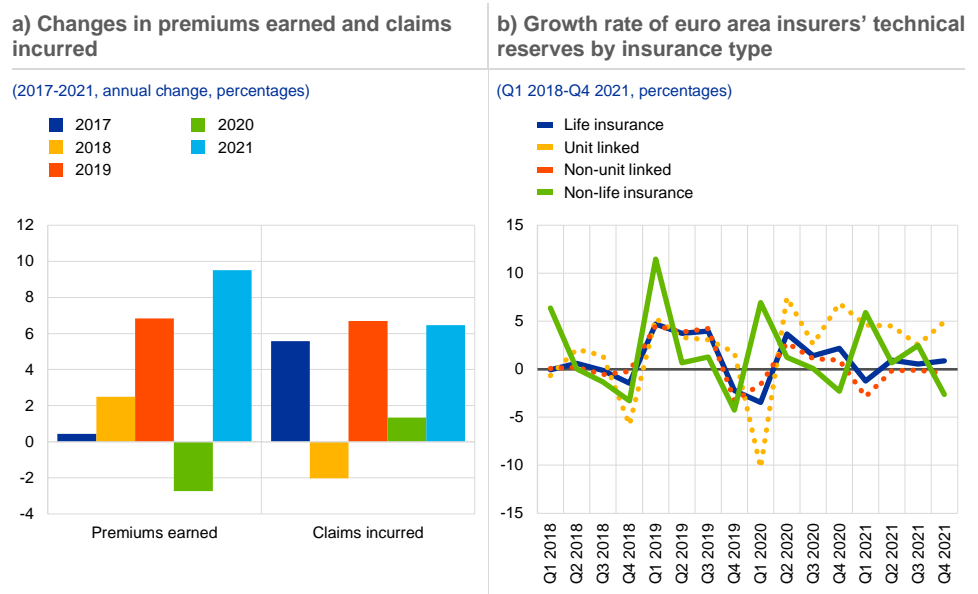
Despite these threats, insurers' solvency and profitability remain strong. At the end of 2021, euro area insurers' Solvency Capital Requirement (SCR) ratio remained well above the regulatory minimum of 100% (**Chart 4.6**, panel b), despite a small decrease in the second half of 2021 amid more general risk-off sentiment. The SCR ratio is likely to decrease further in the first months of 2022 on account of lower equity valuations and higher credit spreads. This decline might be offset by rising interest rates and the volatility adjustment.⁸⁶ Profitability was above pre-pandemic levels at

⁸⁶ A regulatory mechanism that allows insurers to moderate the effect of falling bond prices on their capital under Solvency II.

the end of 2021 (**Chart 4.6**, panel c), despite a small decline in the third quarter of 2021 attributable to increased insured losses from natural catastrophes.

Chart 4.7

Insurers' profitability is exposed to inflated claims and claim normalisation in the aftermath of the pandemic



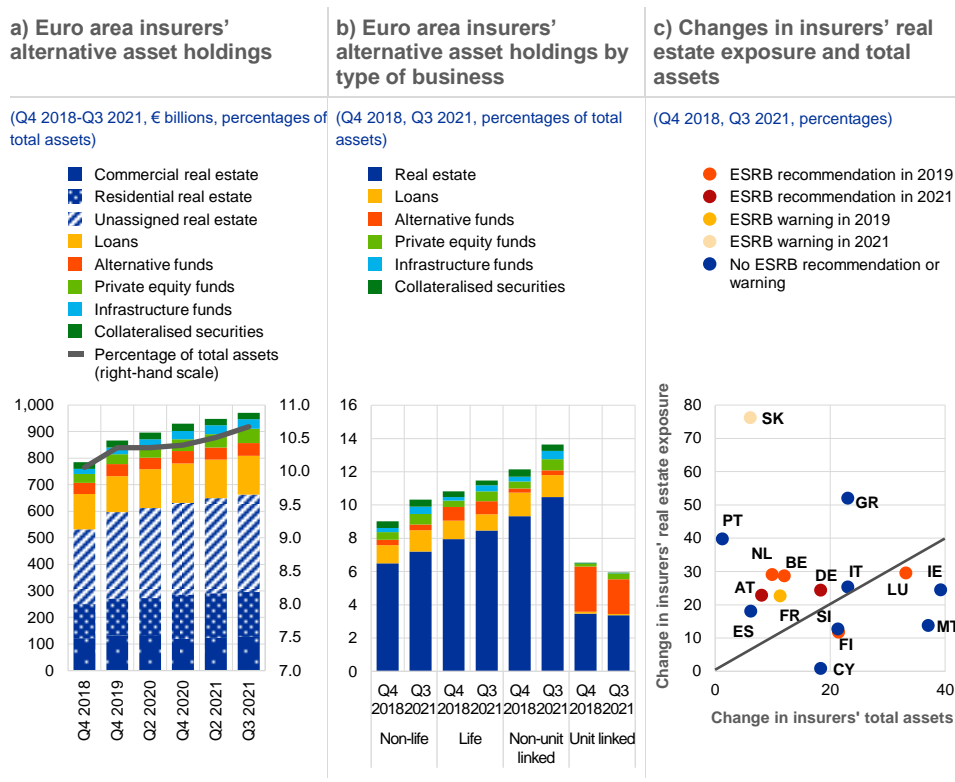
Sources: ECB (Insurance Corporations Statistics and Insurance Corporations Operations) datasets and ECB calculations.
Notes: Panel b: insurance technical reserves consist of the actuarial reserves covering all outstanding potential claims by policyholders. Technical reserves constitute the largest share of insurers' liabilities.

While insurers face challenges from increased inflation risk and rising claims frequency, they could benefit from higher interest rates. In the short term, inflationary pressures could affect profitability because of higher than anticipated future claims payments (for example, if claims costs increase by more than insurers estimated when calculating their reserves). This might be particularly relevant for those segments of the non-life insurance sector facing more intense competition and rising claim frequencies as economies reopen (**Chart 4.7**, panel a). While only representing around 10% of total insurance technical reserves⁸⁷, euro area non-life insurers decreased their reserves in the last quarter of 2021 (**Chart 4.7**, panel b). Furthermore, persistent higher inflation could affect insurance affordability, which would influence new business and increase lapse rates. That said, higher inflation is likely to be associated with higher long-term interest rates. This is particularly relevant for life insurers, where higher interest rates reduce investment risks and make rate guarantees to policyholders easier to service. More broadly, a gradual shift towards a higher interest rate environment would benefit the insurance sector overall thanks to negative duration gaps, meaning that reductions in insurers' liabilities would normally more than offset asset valuation losses.

⁸⁷ See [Euro area insurance corporation statistics: fourth quarter of 2021](#).

Chart 4.8

Exposures of euro area insurers to alternative assets, particularly to real estate, have continued to increase across all types of business



Sources: EIOPA and ECB calculations.

Notes: Panels a, b and c: the charts are based on aggregate asset exposure statistics published by EIOPA (solo Solvency II reporting; template S.06.02). The "real estate" category includes exposures to residential and commercial properties (excluding those for own use), mortgages, corporate bonds and the equity of real estate-related corporations and real estate funds. Panel b: the chart is based on a set of 14 euro area countries for which a split between exposures of life and non-life insurers is available. Panel c: data points for Estonia, Latvia and Lithuania are not shown.

While interest rates may rise going forward, prolonged low interest rates in recent years have affected insurers' business activities. Low rates fuelled an increase in insurers' holdings of alternative assets, which now represent about 10.5% of insurers' total assets (Chart 4.8, panel a).⁸⁸ Increased exposure to alternative assets is common across different types of insurer (Chart 4.8, panel b) but is more pronounced for non-unit linked life insurers, which faced the greatest squeeze in the low interest rate environment. Investment in alternative assets can help insurers tackle profitability concerns and diversify their portfolio if they maintain a sufficient level of liquidity. However, exposure to higher-yielding and illiquid alternative assets might also contribute to wider financial sector exuberance in markets such as real estate. Real estate-related investments (both residential and commercial) account for more than two-thirds of insurers' alternative asset exposures and have grown by over 25% since 2018. This expansion has outpaced growth in insurers' total assets in most euro area countries, including those that received an ESRB recommendation linked

⁸⁸ See also the box entitled "Insurers' investment in alternative assets", *Financial Stability Review*, ECB, May 2019.

to real estate in December 2021 ([Chart 4.8](#), panel c).⁸⁹ Property price corrections are more likely to occur in overvalued markets, increasing the risk of material valuation losses in insurers' portfolios in such countries ([Chapter 1](#)).

Over the longer term, insurers will continue to face several structural vulnerabilities, such as climate change and cyber security. Estimated global insured losses of USD 111 billion made 2021 one of the costliest years ever in terms of natural catastrophes, particularly for some euro area countries.⁹⁰ Last summer's floods in Belgium, Germany and the Netherlands generated economic losses of more than USD 40 billion and insured losses of USD 13 billion, putting the insured loss potential from a single flood on a par with losses from primary peril events such as earthquakes or winter storms. The rising frequency of severe flood events due to climate change and the growing magnitude of associated losses have also pushed up reinsurance prices. This adds to the profitability challenges faced by non-life insurers and might widen protection gaps (the proportion of economic losses that are not covered by insurance), with potential adverse consequences for the wider macroeconomy.⁹¹ Insurers are also struggling to provide coverage against cyber risk amid growing demand driven by the increased frequency and severity of ransomware incidents in 2021. In addition, the war in Ukraine may increase the risk of large cyberattacks. Available insurance capacity for cyber risk currently appears to be limited by lack of expertise, data availability issues and inappropriate modelling.⁹²

⁸⁹ See [ESRB issues new warnings and recommendations on medium-term residential real estate vulnerabilities](#), ESRB, February 2022.

⁹⁰ See, for example, *Natural catastrophes in 2021: the floodgates are open*, Swiss Re Institute, March 2022.

⁹¹ See Fache Rousová et al., "[Climate change, catastrophes and the macroeconomic benefits of insurance](#)", *Financial Stability Report*, EIOPA, July 2021.

⁹² See the special theme entitled "[Cyber risk and the European insurance sector](#)", *Financial Stability Report*, EIOPA, December 2021.

5 Macprudential policy issues



5.1 Setting the appropriate pace of policy action to address medium-term vulnerabilities

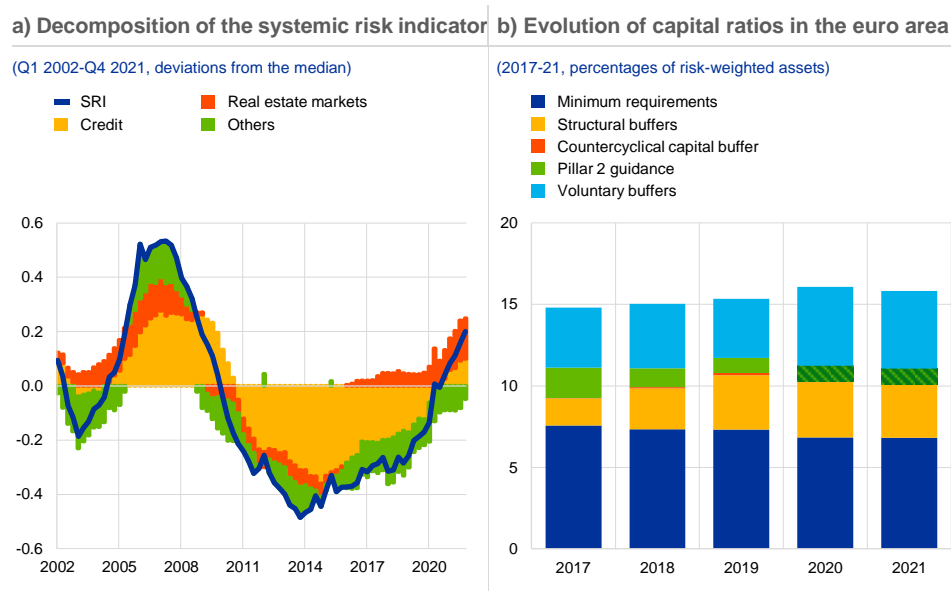
Several euro area macroprudential authorities had already started to tighten some of their policies prior to the outbreak of war in Ukraine. At the end of 2021 and beginning of 2022, the near-term economic outlook revolved around the strong recovery continuing, on the back of robust labour markets and gradually receding pandemic headwinds. At the same time, vulnerabilities with macroprudential policy relevance continued to build-up. This was especially significant for residential real estate markets, but also occurred more broadly, on the back of robust credit growth and increasing indebtedness in the non-financial private sector (**Chart 5.1**, panel a).⁹³

⁹³ See “[Vulnerabilities in the residential real estate sectors of the EEA countries](#)”, ESRB, February 2022 and the associated recommended further policy actions in a number of European countries.

Against this background, several macroprudential authorities have taken action and tightened capital-based and/or borrower-based measures of late.⁹⁴

Chart 5.1

Cyclical risks continued to accumulate during the pandemic while banks' capital headroom remains sizeable



Sources: Eurostat, ECB, ECB (Supervisory Banking Statistics) and ECB calculations.
Notes: Panel a: the systemic risk indicator (SRI) measures the build-up of risks from credit developments, real estate markets, asset prices and external imbalances; it has better early warning properties for financial crises in European countries than the Basel credit-to-GDP gap. The SRI is based on Lang et al.* "Credit" includes contributions of the two-year change in the bank credit-to-GDP ratio and the two-year growth rate of real total credit; "Real estate markets" denotes the contribution of the three-year change in the price-to-income ratio for residential real estate; "Others" includes the contributions of the current account-to-GDP ratio, the three-year change of real equity prices and the two-year change in the debt-service ratio. Panel b is based on a large sample of significant and less significant institutions, consolidated at the euro area level. Minimum requirements include P1 CET1 + P1 shortfall AT1/T2 + P2R, while structural buffers include CCoB + O-SII/G-SII + SyRB. The bars displaying the P2G buffer for 2020 and 2021 are shaded to indicate the full usability of the P2G buffer during the pandemic.
*) Lang, J.H., Izzo, C., Fahr, S. and Ruzicka, J., "Anticipating the bust: a new cyclical systemic risk indicator to assess the likelihood and severity of financial crises", *Occasional Paper Series*, No 219, ECB, 2019.

While building further resilience in a timely manner remains a robust policy strategy, the timing and pace of the prudential response needs to take country-specific economic conditions into account.

Banks have ample capital headroom on top of their regulatory requirements (Chart 5.1, panel b). Moreover, a vulnerability analysis specifically assessing the consequences of the war in Ukraine indicates that the euro area banking system remains resilient under the scenarios considered (Box 6). Nevertheless, authorities should closely monitor the potential repercussions of the heightened uncertainty. Macroprudential policy action should seek to further enhance resilience against risks materialising from vulnerabilities that have already accumulated. At the same time, the macroprudential policy response should consider near-term headwinds to economic growth, including those related to energy price developments and broader confidence effects, and should not result in

⁹⁴ Authorities have decided to increase the countercyclical capital buffers (Bulgaria, Germany and France), activate a sector-specific systemic risk buffer (Germany, Lithuania and Slovenia) or strengthen the application of borrower-based measures (France, Latvia, Portugal and Finland). In addition, the ECB has also communicated that on the basis of ample headroom above capital and the leverage ratio requirements, banks are expected to operate above Pillar 2 guidance from January 2023 and to include central bank exposures in the leverage ratio once again from April 2022 (see the ECB Banking Supervision [press release](#) of 10 February 2022).

an unintended tightening of credit conditions. If economic conditions were to deteriorate markedly, macroprudential authorities could still act swiftly to provide banks with the necessary flexibility, although additional macroprudential tools could further enhance the toolkit, including for exceptional circumstances.⁹⁵

Notwithstanding the uncertainty, macroprudential authorities should continue to address existing vulnerabilities, as conditions allow. Prior to the outbreak of the war, conditions for addressing the continued build-up of vulnerabilities in several euro area countries appeared to be favourable. The economic cost (via the impact on credit conditions) of activating additional capital buffers appeared to be low, especially set against the benefits of enhancing resilience sufficiently early to counter identified vulnerabilities (without necessarily reducing them in the near term) and to facilitate the response to the materialisation of systemic risk (**Box 8**). Moreover, capital buffers are important complements to borrower-based measures when addressing real estate vulnerabilities,⁹⁶ in particular over the short term, as the additional resilience benefits of the borrower-based policies accumulate only gradually over time. Accordingly, authorities should stand ready to respond promptly to accumulated vulnerabilities, taking into account the uncertainty surrounding the economic developments. The associated calibration of instruments should balance risk signals, uncertainty in risk measurement and the possible costs of policy action in terms of reduced credit supply. Overall, existing bank capital generation capacity and headroom should mitigate a detrimental impact on credit supply from increasing capital buffers, as long economic conditions do not deteriorate significantly. Moreover, there are also costs associated with delayed action, in particular if uncertainty persisted into the medium term and vulnerabilities remained unaddressed or continued to build.

Over the medium term, the resilience of the financial system would be reinforced by creating more macroprudential space through an increase in the amount of releasable buffers, complemented by enhancing the effectiveness of the existing countercyclical capital buffer (CCyB). Recent experience, including from the coronavirus (COVID-19) pandemic, shows that at the onset of severe stress episodes, banks that have limited capital space above regulatory buffers relative to their peers tend to adjust their balance sheets by reducing lending.⁹⁷ In its recent response to the European Commission's call for advice on the review of the macroprudential framework, the ECB called for more macroprudential policy space in the form of a higher amount of releasable capital buffers. It argued that this would further improve banks' capacity to absorb losses while maintaining the provision of key services in a downturn. The policy options identified in the ECB response were (a) a fully or partially releasable capital conservation buffer (CCoB); (b) a positive

⁹⁵ The policy chapters of the ECB's Financial Stability Reviews in 2020 and 2021 provide an overview of the substance and the sequencing of prudential support measures during the pandemic. On the need to enhance the macroprudential toolkit, see the [ECB response to the European Commission's call for advice on the review of the EU macroprudential framework](#).

⁹⁶ Borrower-based measures have been called for in the context of addressing the build-up of vulnerabilities in real estate markets (see the above ESRB report on vulnerabilities in residential real estate or the [Financial Stability Review](#), ECB, November 2021).

⁹⁷ See the special feature entitled "[Bank capital buffers and lending in the euro area during the pandemic](#)", *Financial Stability Review*, ECB, November 2021; and Couaillier et al., "[Caution do not cross! Capital buffers and lending in Covid-19 times](#)", *Working Paper Series*, No 2644, ECB, 2022.

neutral rate for, or more active use of, the countercyclical capital buffer (CCyB); (c) a core rate for the releasable systemic risk buffer (SyRB); or a possible combination of the three.⁹⁸ In addition, the response suggested that flexibility in the CCyB framework be increased to foster timely policy action in both the activation and the release phases. This could be achieved by adjusting the design or the calibration of existing buffers.⁹⁹

Box 8

Transmission and effectiveness of capital-based macroprudential policies

Prepared by Markus Behn, Jan Hannes Lang and Eugen Tereanu

One important lesson learned from the use of capital-based macroprudential policies in recent years is that tightening such policies during boom phases is unlikely to have a notable impact on credit supply and the build-up of imbalances, while the accumulated resilience and the release of buffers in downturns produces large benefits. Capital-based policies are particularly relevant to the ECB since they are a focal point for the ECB's macroprudential tasks as enshrined in European legislation.¹⁰⁰ A prime example of a capital-based tool is the countercyclical capital buffer (CCyB). This instrument was designed in the aftermath of the global financial crisis to enhance the resilience of the financial system and reduce procyclicality.¹⁰¹ Enacting capital-based policies such as the CCyB directly enhances banking system resilience by inducing banks to increase their capital ratios. Further transmission to the real economy by way of effects on bank credit supply depends on overall economic conditions and the relevance of capital constraints in the banking sector. While such constraints are unlikely to be binding when capital buffers are activated during economic booms, the coronavirus (COVID-19) pandemic has shown that the release of buffers and other requirements in a downturn can ease binding constraints and effectively support credit supply and economic activity.¹⁰²

During periods of solid economic activity, an appropriate tightening of macroprudential capital buffer requirements is unlikely to lead to binding bank capital constraints and should

⁹⁸ The ECB is aware that creating more macroprudential policy space and facilitating the effective use of released buffers may also require additional work at the international level to better address shocks that may go beyond the unwinding of domestic imbalances and to ensure a global level playing field.

⁹⁹ This can be achieved by moderating the dominant role of the credit-to-GDP ratio in the CCyB rate-setting practices of national authorities and by allowing for a shorter transitional period than one year for the implementation of CCyB decisions.

¹⁰⁰ For an overview of the ECB's macroprudential policy framework, see the chapter entitled "[Topical issue: The ECB's macroprudential policy framework](#)", *Macroprudential Bulletin*, Issue 1, ECB, 2016; for an overview of macroprudential policy and powers within the Eurosystem, see the box entitled "[Macroprudential policy and powers within the Eurosystem](#)", *Financial Stability Review*, ECB, November 2019.

¹⁰¹ For a comprehensive discussion of the objectives and the rationale of the capital buffer framework, see, for example, the article entitled "[Macroprudential capital buffers – objectives and usability](#)", *Macroprudential Bulletin*, ECB, October 2020.

¹⁰² For an analysis on the effects of capital release measures during the pandemic see, for example, the special feature entitled "[Bank capital buffers and lending in the euro area during the pandemic](#)", *Financial Stability Review*, ECB, November 2021. Besides the CCyB, which made up only 0.1% of risk-weighted assets in the banking union before the COVID-19 pandemic, the analysis also considers the release of other buffers (such as the Systemic Risk Buffer) and the one-off change in the composition of microprudential Pillar 2 requirements (which effectively decreased banks' CET1 capital requirements). The coupling of capital release measures with monetary policy action in the form of liquidity provision can help to further ease binding constraints and enhance banks' risk-bearing capacity. See, for example, Altavilla, C. et al., "[The great lockdown: pandemic response policies and bank lending conditions](#)", *Working Paper Series*, No 2465, ECB, September 2020, for an analysis of the complementarities between monetary policy and prudential policy.

therefore not have a large dampening effect on credit supply or the build-up of imbalances.¹⁰³

Banks usually respond to higher capital buffer requirements by increasing their capital targets and capital ratios.¹⁰⁴ This directly enhances their overall resilience, as more capital will be available in the banking system for a given set of exposures. Furthermore, capital-based measures may affect bank credit supply and the build-up of imbalances over the cycle. This occurs if banks pass on higher funding costs to customers by raising lending rates (“price channel”, resting on the observation that bank capital is usually considered more costly than debt) or if they directly limit the quantity of credit when they are unable to meet higher capital requirements (“quantity channel”). When economic conditions are favourable, banks tend to have a high capacity for internal capital generation through retained earnings and can also raise new equity in markets, both of which reduce the likelihood of banks being subject to binding capital constraints. Moreover, available capital headroom allows banks to smooth adjustments to higher capital ratio targets over time. Therefore, transmission via both the price channel and the quantity channel is expected to be limited in economic booms,¹⁰⁵ and tightening capital buffers during upswings is likely to have low costs in terms of reduced economic activity (via the limited impact on credit supply), with correspondingly limited effects on the build-up of imbalances (**Chart A**, panel a).

In periods of crisis, the availability of and ability to release macroprudential capital buffers can ease bank capital constraints and effectively support credit supply and economic activity.

The materialisation of systemic risk is usually associated with high economic uncertainty and sizeable bank losses. These, in turn, depress capital ratios closer to prudential requirements and hamper banks’ internal capital generation capacity as well as their ability to raise new equity. This means that banks are more likely to become capital-constrained and react by reducing credit supply via the quantity channel, with potentially large negative repercussions for the real economy. In such situations, releasing capital buffers that were built up in good times increases capital headroom and eases regulatory pressure on banks, enabling them to absorb losses while continuing to provide key financial services. This channel is particularly relevant for banks that have little capital headroom and would therefore become capital-constrained without the releases (**Chart A**, panel b).¹⁰⁶ The support to bank credit supply through the release of capital buffers can, in turn, help cushion the economic downturn and avoid additional losses in the banking sector.

These transmission mechanisms offer important lessons for the effectiveness of capital-based measures and the design of the macroprudential capital buffer framework. First, building capital buffers in good times will be effective in that it will increase banking system resilience, but the muting effect on the build-up of financial imbalances is likely to be limited. Second, and related to the first point, the economic cost of building capital buffers is likely to be low when the economy is experiencing an upswing or when banking sector conditions are favourable. The possible magnitude

¹⁰³ On the state dependence of the effects of changes in capital requirements on lending, see the box entitled “[A macroprudential perspective on replenishing capital buffers](#)”, *Financial Stability Review*, ECB, November 2020, which also provides an overview of the academic literature on this topic.

¹⁰⁴ See, for example, Couaillier, C., “[What are banks’ actual capital targets](#)”, *Working Paper Series*, No 2618, ECB, December 2021.

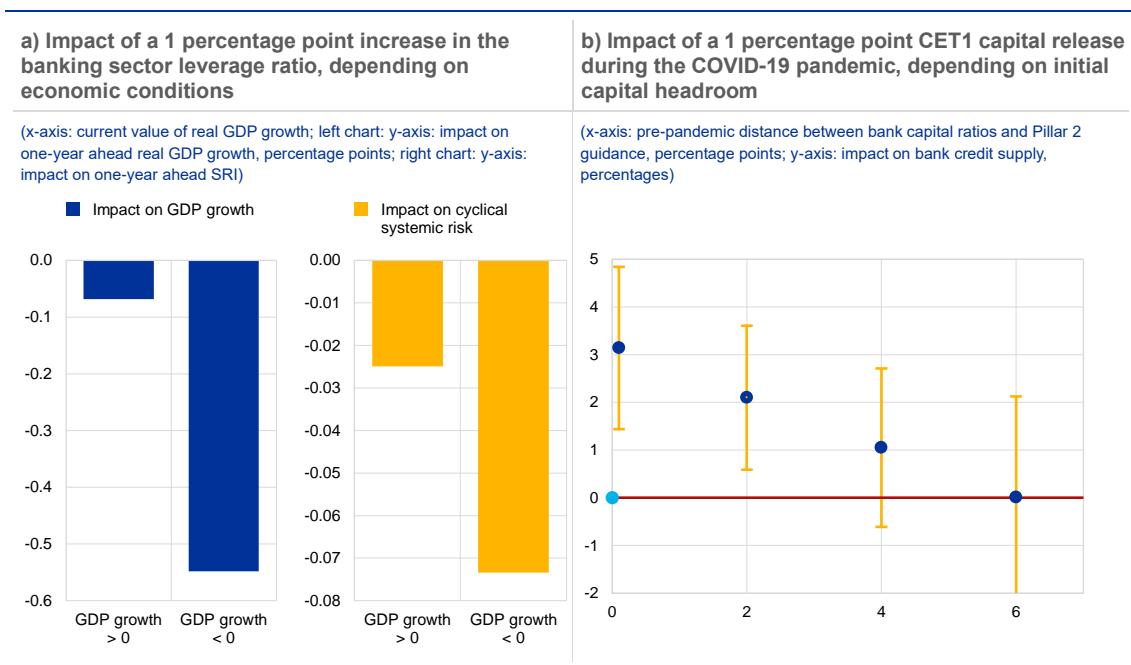
¹⁰⁵ Under the assumptions of a full pass-through of funding costs to lending rates, constant lending spreads, a constant equity premium and a constant risk weight, the change in lending rates is given by $\Delta i_{t+1} = \Delta CR_{t+1} \cdot \rho \cdot RW$, where ΔCR is the policy-induced change in the capital requirement, ρ is the constant equity premium and RW is the risk weight. For a 10% equity premium and a 50% risk weight, a 1 percentage point increase in the capital ratio should therefore increase bank lending rates by only 5 basis points. Such an increase in lending rates corresponds to just one-fifth of a standard monetary policy tightening step and is unlikely to lead to a large drop in credit demand based on standard elasticity estimates from the literature. This is consistent with many empirical findings showing that lending rates only increase by a few basis points in response to a 1 percentage point increase in capital requirements; see, for example, Dagher, J. et al., “[Benefits and costs of bank capital](#)”, *Staff Discussion Note*, No 16/04, IMF, 2016 or Budnik et al., “[The benefits and costs of adjusting bank capitalisation: evidence from euro area countries](#)”, *Working Paper Series*, ECB, No 2261, April 2019.

¹⁰⁶ See the special feature entitled “[Bank capital buffers and lending in the euro area during the pandemic](#)”, *Financial Stability Review*, ECB, November 2021.

of economic costs is an important consideration when macroprudential policies need to address vulnerabilities under heightened uncertainty, as is the case in the current environment. Third, the availability and release of capital buffers during crises can effectively support credit supply and economic activity by alleviating potential bank capital constraints. Overall, therefore, enhancing the role of releasable capital buffers within the macroprudential framework, which includes building them up when times are good, appears to be a robust policy strategy. This message is reinforced by the fact that the measurement of cyclical systemic risk is subject to uncertainty, and the pandemic has illustrated that large systemic shocks may occur independently of a country's position in the financial cycle. A higher amount of releasable capital buffers would therefore strengthen the ability of macroprudential authorities to act countercyclically when adverse shocks materialise.¹⁰⁷

Chart A

During expansions, increasing capital buffers has little impact on economic activity and the build-up of imbalances, but the release of capital can support credit supply in downturns, particularly for banks for which capital requirements are binding because they have little capital headroom



Sources: Eurostat, ECB (AnaCredit and Supervisory Banking Statistics) and ECB calculations.

Notes: Panel a: results are based on panel local projections for euro area countries from Q1 1970 to Q3 2021. The dependent variables are annual real GDP growth and the systemic risk indicator (SRI) proposed by Lang et al.* The projection horizon is one year ahead. The impulse is a 1 percentage point increase in the banking sector leverage ratio, measured as total capital divided by total assets. The effect of the impulse differs according to whether current real GDP growth is positive or negative. Additional controls include current values of real GDP growth, the output gap, inflation, the SRI, the Country-Level Index of Financial Stress (CLIFS) and the ten-year government bond spread. Changes in the banking sector leverage ratio are not necessarily related to exogenous changes in prudential requirements, but controlling for a large set of current macro-financial variables in the regressions helps to isolate the impact of changes in the leverage ratio that are not related to these current macro-financial conditions. Panel b: the results are from bank-firm level regressions including firm fixed effects to control for credit demand, several bank-specific controls and monetary and fiscal policy measures (including, among other things, the percentages of post-event credit from bank *i* to firm *k* that are subject to government moratoria or government guarantees). The dependent variable is the change in the logarithm of loans from bank *i* to firm *k* between Q3-Q4 2019 and Q3-Q4 2020. The coefficients displayed (blue dots in the chart) are from an interaction between the CET1 capital release measure (the combined buffer requirement (CBR) release together with the change in Pillar 2 requirement (P2R) composition, the latter bringing forward a legislative change that was initially scheduled to come into effect in January 2021 as part of the latest revision of the Capital Requirements Directive) and the pre-pandemic (Q4 2019) distance to the Pillar 2 guidance (P2G). Yellow whiskers indicate two standard deviation confidence intervals around the estimated coefficients.

*) Lang, J.H., Izzo, C., Fahr, S. and Ruzicka, J., "Anticipating the bust: a new cyclical systemic risk indicator to assess the likelihood and severity of financial crises", *Occasional Paper Series*, ECB, No 219, February 2019.

The current review of the EU macroprudential framework provides an important opportunity to improve the overall design and functioning of the buffer

¹⁰⁷ The ECB response to the European Commission's call for advice on the review of the EU macroprudential framework includes additional considerations and policy options regarding ways in which the role of the releasable buffers in the current capital framework can be strengthened further. See, in particular, the detailed discussion on possible policy options in Annex 2 of the response document.

framework and address missing and obsolete instruments, internal market considerations and global risks.¹⁰⁸ The ECB has proposed actions to fill other gaps in the policy toolkit, promote the enhanced use of instruments at the national level (including supporting national authorities in using borrower-based measures by enhancing the comparability of both risk assessments and policy actions across jurisdictions, achieved by harmonising lending standards indicators), enhance information-sharing, streamline the activation and coordination procedures of macroprudential measures and address global risks. The set of legislative proposals potentially resulting from the review would aim to make the regulatory framework more consistent and streamlined, which would allow macroprudential authorities to react to emerging risks to financial stability in a more effective, flexible and timely manner.

Timely macroprudential policy action complements a data-dependent approach to monetary policy normalisation. If the need to counter inflation leads to gradual monetary policy normalisation under fragile economic conditions, medium-term risks could materialise earlier than anticipated. In this context, timely and cautious macroprudential policy action can help to build the necessary additional resilience against the materialising risks when needed, while avoiding procyclical effects if economic conditions deteriorate. Over a longer-term horizon, risks to financial stability could decline under monetary policy normalisation, as some of the factors driving the build-up of vulnerabilities, such as historically low borrowing costs or search-for-yield behaviour, could be mitigated. However, such potential longer-term developments should not preclude macroprudential action in the short to medium term if conditions allow, as this may be needed to address vulnerabilities that have already built up or may continue to build going forward.

5.2 Addressing both liquidity mismatch and leverage in the non-bank financial sector

It is essential to develop the policy framework for non-bank financial intermediation from a macroprudential perspective if structural vulnerabilities are to be tackled and the sector's resilience strengthened. In particular, risks related to liquidity mismatches, leverage and margining practices have become evident during periods of market stress over recent years, including during the March 2020 market turmoil.¹⁰⁹ Given the increasing role played by non-bank financial institutions in financing the real economy¹¹⁰ and their interconnections with the wider

¹⁰⁸ See the [ECB response to the European Commission's call for advice on the review of the EU macroprudential framework](#). The European Commission is required to review the macroprudential provisions in the European legislation by June 2022 and is expected to prepare a legislative proposal by December 2022. In this context, the Commission addressed a call for advice to the European Systemic Risk Board (ESRB), the European Banking Authority (EBA) and also the ECB, acknowledging the important role the ECB plays in macroprudential policy in the banking union.

¹⁰⁹ See, for example, "[Holistic Review of the March Market Turmoil](#)", Financial Stability Board, 17 November 2020.

¹¹⁰ See the box entitled "[Measuring market-based and non-bank financing of non-financial corporations in the euro area](#)", *Financial Integration and Structure in the Euro Area*, ECB, April 2022.

financial system¹¹¹, these vulnerabilities need to be tackled to mitigate system-wide risks.

During the past year, important progress has been made on reforming money market funds (MMFs), which came under severe stress in March 2020. The Financial Stability Board (FSB) has issued policy proposals aimed at tackling vulnerabilities in MMFs internationally.¹¹² These proposals aim to increase the resilience of MMFs by reducing liquidity mismatches and cliff effects arising from possible breaches of regulatory thresholds. In response to a consultation launched by the European Securities and Markets Authority (ESMA), a discussion of the reform proposals from the Eurosystem was also published in 2021¹¹³, followed by a similar document from the ECB earlier this year.¹¹⁴ The Eurosystem supports increasing the share of liquid assets and better diversifying liquidity buffers through minimum public debt requirements, which would strengthen MMF resilience. These proposals are also reflected in the recent ESRB recommendation¹¹⁵, which serves to inform the European Commission's ongoing review of the EU's Money Market Fund Regulation.¹¹⁶

The focus of the international policy agenda has now shifted to structural liquidity mismatches in the broader investment fund sector. During 2022, the FSB will assess the effectiveness of its 2017 recommendations on liquidity mismatch in open-ended funds and consider what additional steps may be needed to address potential shortcomings.¹¹⁷ A key priority should be to better align asset liquidity with redemption terms. There are various ways to achieve this, depending on the type of fund or underlying assets involved. These include mandating minimum notice periods, implementing lower redemption frequencies and requiring a certain level of portfolio liquidity by setting limits on less liquid assets or stipulating liquidity buffers. Liquidity management tools, such as swing pricing, anti-dilution levies, gates and suspensions, can usefully complement such measures, but they might be less effective in reducing systemic risk and mitigating the build-up of structural vulnerabilities before the event.¹¹⁸

The recent sharp increases in margin calls related to energy and commodity derivatives have further underlined the need to review margining practices. Clearing members and their clients faced high margin calls both following recent

¹¹¹ See the box entitled "[The role of bank and non-bank interconnections in amplifying recent financial contagion](#)", *Financial Stability Review*, ECB, May 2020.

¹¹² See "[Policy Proposals to Enhance Money Market Fund Resilience – Final report](#)", Financial Stability Board, 11 October 2021.

¹¹³ See "[Eurosystem contribution to the European Securities and Markets Authority \(ESMA\) consultation on the framework for EU money market funds](#)", 30 June 2021.

¹¹⁴ See "[Mind the liquidity gap: a discussion of money market fund reform proposals](#)" and "[Assessing the impact of a mandatory public debt quota for private debt money market funds](#)", *Macprudential Bulletin*, Issue 16, ECB, 21 January 2022.

¹¹⁵ See "[Recommendation of the European Systemic Risk Board of 2 December 2021 on reform of money market funds](#)", ESRB, published 25 January 2022.

¹¹⁶ See "[Targeted consultation on the functioning of the Money Market Fund Regulation](#)", European Commission, 12 April 2022.

¹¹⁷ See the [letter](#) of the FSB chair to G20 finance ministers and central bank governors, 14 February 2022.

¹¹⁸ See the article "[Macprudential liquidity tools for investment funds - A preliminary discussion](#)", *Macprudential Bulletin*, Issue 6, ECB, 3 October 2018.

increases in volatility in energy and commodity prices and previously during the March 2020 market turmoil with respect to a broader set of underlying assets.¹¹⁹ Although the recent episode has not yet resulted in a wider dash for cash, it has once again highlighted the need to advance international work on margining practices as a matter of priority. This work should focus in particular on increasing the transparency of initial margin models, evaluating the initial margin model's responsiveness to market stress and enhancing the preparedness of non-banks from a liquidity risk perspective.^{120, 121}

The use of leverage in a highly interconnected global financial system is a key financial stability concern which needs to be tackled using a comprehensive set of measures across entities and activities. Excessive leverage in the non-bank financial sector can increase the likelihood of default, with possible spillovers to banks and the broader financial system. The default of the Archegos family office in March 2021, and associated losses for banks, highlighted the close interconnections across bank and non-bank financial institutions globally. It also underlined how derivatives can be used to create leverage synthetically, including the important role of margining (**Box 7**). Furthermore, leverage in open-ended investment funds, even at moderate levels, can have a procyclical effect on the behaviour of asset managers and investors and thereby amplify other vulnerabilities, such as those arising from liquidity mismatches.¹²² Given the complexities of addressing risks stemming from non-bank leverage, the policy framework should be enhanced along three main dimensions – a non-bank (“client”), a bank and an activity dimension.

- First, policies should aim at ensuring a consistent approach to leverage rules for non-bank entities, such as across the Alternative Investment Fund Managers Directive (AIFMD) and the Undertakings for the Collective Investment in Transferable Securities (UCITS) Directive. Supervisors should also take an active role in identifying excessively leveraged institutions and tackling the resulting risk. These measures would help to limit systemic risk from leveraged non-bank entities, while allowing for differentiated levels of permissible leverage, depending on the type of institution.¹²³ It is also important for such issues to be further discussed at the global level as part of the FSB agenda.
- Second, it is important to enhance risk management practices and regulation for dealer banks which either lend to non-bank financial institutions facing lighter or no leverage constraints or act as counterparties in derivatives transactions which embed synthetic leverage. Such rules usually aim at safeguarding banks from

¹¹⁹ See the box entitled “Lessons learned from initial margin calls during the March 2020 market turmoil”, *Financial Stability Review*, ECB, November 2021.

¹²⁰ See “Review of margining practices”, *BCBS, CPMI and IOSCO consultative report*, Bank for International Settlements, October 2021.

¹²¹ At European level, ESMA is consulting on central counterparty anti-procyclicality measures; see “Consultation Paper – Review of RTS No 153/2013 with respect to procyclicality of margin”, ESMA, 27 January 2022.

¹²² See Molestina Vivar, L., Wedow, M. and Weistroffer, C., “Burned by leverage? Flows and fragility in bond mutual funds”, *Working Paper Series*, No 2413, ECB, May 2020.

¹²³ For example, ESMA published guidelines aimed at addressing leverage risk in the alternative investment fund sector; see “Final Report – Guidelines on Article 25 of Directive 2011/61/EU”, 17 December 2020. Other rules apply to investment funds under the UCITS Directive.

concentrated exposures and should be calibrated to the clients' total risk position, including from leverage.

- Third, policies around haircuts and margins should reflect the possible indirect impact on synthetic leverage in derivatives portfolios. For instance, if initial margin requirements are set at very low levels in “good times”, this can allow entities that face limited leverage restrictions to magnify their exposure at low cost and with little additional funding. In this respect Archegos was a case in point. A higher level of initial margin in good times would increase the funding needs for leveraged positions, ultimately reducing the attractiveness of such trades while strengthening counterparty protection. In addition, further measures taken by central clearing counterparties or clearing members could be assessed in terms of their effectiveness in avoiding the build-up of large unbalanced positions. Any exploration of such policy options should also consider broader effects, including any possible side effects on the users of derivatives, such as limiting hedging opportunities, acknowledging the concentrated CCP market structure.

Moreover, globally consistent metrics and better data are needed to monitor synthetic leverage across the system, which should complement the International Organization of Securities Commissions' (IOSCO) previous work on investment funds.¹²⁴ This may be supported by better international mechanisms for sharing data on leverage and derivatives across authorities.

5.3 Other ongoing policy initiatives that support euro area financial stability

Policy initiatives on climate change and crypto-assets

Topic	Recent initiatives
Climate change	<p>European and global initiatives are ongoing to develop consistent sustainability disclosures for corporates via the Corporate Sustainability Reporting Directive (CSRD) and the International Financial Reporting Standards (IFRS) Foundation. In addition, the European Commission is working on the EU green bond standard and the EU Ecolabel for Retail Financial Products. The ECB Opinion on the EU green bond standard flags that, while the proposal represents a first step towards the design of harmonised standards across jurisdictions, a clear commitment to making the standard mandatory within a reasonable period of time and an enhancement of issuer/fund accountability would help to reduce the risk of greenwashing, while supporting the transition to a low-carbon economy.</p> <p>The Basel Committee on Banking Supervision (BCBS) and the EBA have launched initiatives to explore whether the current regulatory framework for banks can sufficiently capture the unique features of climate risks. With regard to disclosure rules, the EBA has recently published binding standards on Pillar 3 disclosures on ESG risks and the BCBS is exploring the use of the Pillar 3 framework to promote a common disclosure baseline for climate-related financial risks. Regarding supervision, the BCBS has launched a public consultation on principles for the effective management and supervision of climate-related financial risks and the EBA has released a Report on management and supervision of ESG risks for credit institutions and investment firms. For the non-bank financial sector, the European Insurance and Occupational Pensions Authority (EIOPA) and ESMA are promoting the integration of sustainability risks in the prudential framework for insurers and investment funds, while supporting adaptation to climate change and mitigation of climate-related risks. In addition, further work is ongoing to assess the role of insurance in mitigating the macroeconomic costs of climate-related catastrophes and designing effective related policies. Since the systemic nature of climate-related risks calls for a macroprudential and system-wide perspective, the FSB is investigating whether the authorities can address climate-related risks to financial stability in a more effective manner. In the context of the review of the macroprudential framework in the EU,</p>

¹²⁴ See “[Recommendations for a Framework Assessing Leverage in Investment Funds](#)”, *Final Report*, No 18/2019, IOSCO, December 2019.

Topic	Recent initiatives
	the ECB has highlighted in its response that existing macroprudential tools may already be able to contribute to limiting the build-up of systemic climate risks and to increasing banks' resilience against the materialisation of such risks. In this regard, the European Commission's draft amendments to the EU Capital Requirements Directive has already clarified that the existing systemic risk buffer framework can be used to address climate risks.
Crypto-assets	Amendments to the proposed EU Regulation on Markets in Crypto-assets (MiCA Regulation) addressing some of the concerns voiced in the ECB opinion are being discussed by the European Council and the European Parliament. Given the dynamic development of crypto-assets and increasing risks, the MiCA Regulation urgently needs to be finalised and implemented. At the international level, the FSB is carrying out further work on unbacked crypto-assets, global stablecoins and decentralised finance. The standard-setting bodies are making progress on standards related to crypto-assets. One example of this is the work being done by the BCBS on the prudential treatment of banks' crypto-asset exposures, regarding which a second consultation paper is planned for mid-2022.

Updates on policy initiatives related to Basel III, the banking union and the capital markets union and Solvency II for reinsurance companies

Topic	Recent initiatives
Basel III implementation	On 27 October 2021 the European Commission proposed a banking package including amendments to the Capital Requirements Regulation (CRR) and the Capital Requirements Directive (CRD IV), aimed at implementing the outstanding Basel III reforms in the EU. In response to the European Commission's request for a consultation on the proposed amendments, on 24 March 2022 and 28 April 2022 the ECB published opinions on the proposed amendments to the CRR and CRD IV respectively. Finalising the EU implementation of the Basel III reforms in a timely, full and faithful manner will reinforce the EU Single Rulebook and enhance the prudential framework for credit institutions in various areas.
Banking union	In the first half of 2022 the Eurogroup will be starting work on a gradual, time-bound work plan which will encompass all outstanding elements needed to complete the banking union. Setting up a fully-fledged European deposit insurance scheme, improving the crisis management framework (especially for smaller and medium-sized banks), ensuring better market integration and further reducing the risks on banks' balance sheets are key to achieving a complete and more resilient banking union.
CMU (recent legislative package on MIFIR, ESAP, ELTIF, AIFMD)	On 25 November 2021 the European Commission published a package of legislative proposals that aim to deliver on several key commitments from the Capital markets union 2020 action plan . First, the package includes a proposal for a European Single Access Point (ESAP) for easy public access to financial and sustainability-related information about EU companies and investment products. Second, the package comprises a review of the European Long-term Investment Fund (ELTIF) Regulation that aims to encourage long-term investments, including by retail investors. Third, the package includes a review of the Markets in Financial Instruments Regulation (MiFIR) and the associated Directive (MiFID) that increases market transparency in particular by creating a European "consolidated tape" to provide investors with a comprehensive view of trading conditions. In response to the European Commission's request for a consultation on the proposal, the ECB is preparing an Opinion on the proposed amendments to MiFIR and MiFID. Fourth, the package includes amending provisions to fill regulatory gaps in the functioning of the Alternative Investment Fund Managers Directive (AIFMD), such as different national regulatory standards and practice, to ensure that a coherent approach is taken to dealing with the risks that alternative investment funds pose to the financial system, to facilitate their integration into the EU financial market and to provide a high level of investor protection. These proposals should generally improve access to capital market funding for firms, broaden investment opportunities for investors and support the integration of European capital markets.
Review of Solvency II for (re)insurance companies	The European Parliament and European Council are currently reviewing the "Solvency II review package" ¹²⁵ . It is important that the package maintains the new tools with a macroprudential impact, which would help to increase the resilience of the sector. Further amendments could, however, be warranted, including the introduction of a symmetric volatility adjustment. ¹²⁶ The current design of this tool allows capital to be released in periods of stress, but buffers are not built up in good times, which is not in line with the need to build ex ante resilience. ¹²⁷

¹²⁵ See the proposed [amendments to the Solvency II Directive](#) and the introduction of a new [insurance recovery and resolution directive](#), adopted by the Commission in September 2021.

¹²⁶ For further proposed amendments, see the ESRB [letter](#) to the European Parliament, 2 February 2022.

¹²⁷ See also the [ECB response to the European Commission's call for advice on the review of the EU macroprudential framework](#), March 2020.

Special Features

A Climate-related risks to financial stability

Prepared by Tina Emambakhsh, Margherita Giuzio, Luca Mingarelli, Dilyara Salakhova and Martina Spaggiari¹²⁸

The ECB is continuing its work on incorporating climate-related risks into assessments of financial stability. This includes a new analysis of disclosure, pricing and greenwashing risks in financial markets, as well as continued monitoring of financial institutions' exposure to transition and physical risks. There is some encouraging evidence of better disclosure by non-financial corporations and increasing awareness of climate-related risks in financial markets. Progress made by banks, however, has been more limited. Established and newer metrics show no clear evidence of a reduction in climate-related risks, revealing instead a potential for amplification mechanisms stemming from exposure concentration, cross-hazard correlation and financial institutions' overlapping portfolios. These findings can inform evidence-based international and European policy debates around climate-related corporate disclosure, standards for sustainable financial instruments and climate-related prudential policies. More generally, amid high uncertainty around governments' transition policies in an environment of volatile energy prices, further investments in the transition to a net-zero economy would also have a positive impact on medium-term growth and energy security.

Introduction

Climate change has, for a number of years, been identified as a source of systemic risk, with potentially severe consequences for financial institutions and financial markets alike.¹²⁹ As our awareness of this risk has grown, the ECB has enhanced its approaches to understanding, monitoring and assessing the nature of climate risks and how such risks are evolving over time. Furthermore, the recent price increases and volatility seen in energy markets have underlined the wider value of supporting the transition to a net-zero economy. This special feature presents the latest developments, starting with a focus on green financing, which is needed to support

¹²⁸ This special feature has benefited from input received from Olimpia Carradori, Alberto Grassi, Giulio Mazzolini and Allegra Pietsch.

¹²⁹ This special feature builds on the analysis presented in previous editions of the Financial Stability Review published since 2019 (see the special feature entitled “[Climate change and financial stability](#)”, *Financial Stability Review*, ECB, May 2019, and the special feature entitled “[Climate-related risk to financial stability](#)”, *Financial Stability Review*, ECB, May 2021). It complements recent ECB initiatives, including the decision to disclose climate-related information relating to Eurosystem central banks' investments in non-monetary policy portfolios by the first quarter of 2023 (see the [press release](#) of 4 February 2021), the consideration of climate-related factors in the monetary policy strategy review (see the [press release](#) of 8 July 2021), the need for a macroprudential response (see *Macroprudential Bulletin*, Issue 15, ECB, October 2021) and the supervisory assessment of the progress made by European banks in considering climate and environmental risks (see “[The state of climate and environmental risk management in the banking sector](#)”, ECB, November 2021, and “[Supervisory assessment of institutions' climate-related and environmental risks disclosures](#)”, ECB, March 2022).

the transition to a net-zero economy. The subsequent sections then provide updated assessments of bank and non-bank exposures to climate risks, by introducing aspects such as the link between climate risk and financial risk in exposures, concentration of exposures and correlations between hazards.

Increasing role of green finance in supporting the transition to a low-carbon economy

Sustainable markets continued to grow globally in 2021, mostly thanks to an increased volume of euro area ESG funds and green bonds (Chart A.1, panel a).

Their growth has accelerated over the last two years, with euro area sustainable assets doubling since 2019, although sustainable markets still only account for 10% of the euro area investment fund sector and 3% of outstanding bonds. These developments reflect the expected green investment through the EU recovery fund (NextGenerationEU), and the sharp increase in the number of financial institutions that have made net-zero commitments.¹³⁰ However, maintaining such momentum requires that decisive regulatory action be taken to strengthen capital markets beyond the sustainable finance segment and help channel investments towards green projects.¹³¹

¹³⁰ See the [Glasgow Financial Alliance for Net Zero \(GFANZ\)](#), which encompasses the UN-convened [Net-Zero Banking Alliance](#), [Net-Zero Asset Owner Alliance](#), and [Net-Zero Insurance Alliance](#), and the [Net Zero Asset Managers initiative](#). The GFANZ aims at mobilising the necessary capital to build a global net-zero economy and deliver on the goals of the Paris Agreement. In addition, see the [“Supervisory assessment of institutions’ climate-related and environmental risks disclosures”](#), ECB, March 2022.

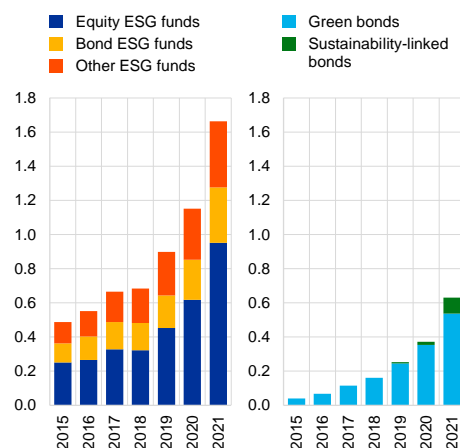
¹³¹ See [“Towards a green capital markets union: developing sustainable, integrated and resilient European capital markets”](#), *Macroeprudential Bulletin*, Issue 15, ECB, October 2021.

Chart A.1

Sustainable financial markets continue to grow, while firms are increasingly disclosing climate information

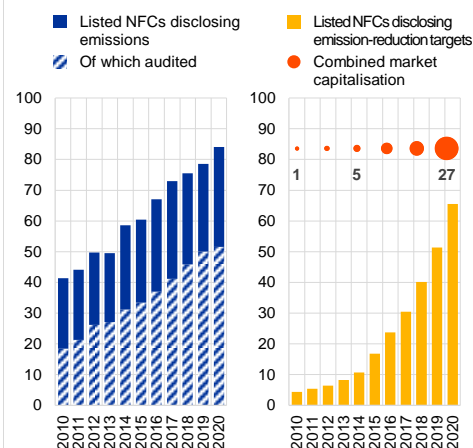
a) Outstanding amount of green and sustainability-linked bonds, and assets under management of ESG funds in the euro area

(2015-21, left chart: outstanding amounts for bonds; right chart: assets under management for funds; € trillions)



b) Disclosure of NFCs' GHG emission data by type of emitter

(left chart: share of listed NFCs disclosing GHG emissions, share of audited disclosures, percentages; right chart: share of NFCs disclosing emission-reduction targets, percentages, market capitalisation, USD trillions)



Sources: Bloomberg Finance L.P., Urgentem, Refinitiv and ECB calculations.

Notes: Panel a: ESG funds correspond to all sustainable funds identified using Morningstar intentions attributes based on information provided in funds' prospectuses. Panel b: the sample includes NFCs listed in the S&P 500 and STOXX Europe 600 indices. "GHG" stands for greenhouse gas, "NFCs" stands for non-financial corporations.

Empirical evidence suggests that (green) finance supports green investment and the reduction of emissions, with some differences across financing instruments and firm types.¹³²

While research has suggested that a higher share of equity financing is associated with greater reductions in countries' carbon footprints, debt is the primary source of external financing for NFCs in the EU and is also used to support the development and adoption of new (greener) technologies. An analysis of changes in emissions at over 4,000 European carbon-intensive firms between 2013 and 2019 provides evidence that, up to a certain point, debt has a positive impact on environmental performance in subsequent years: firms reduce their emissions by investing in green technologies, without reducing economic activity. However, when a firm is too indebted, higher leverage is associated with higher emissions as firms then tend to invest less in energy efficiency.¹³³

In recent years, more firms have been disclosing both their exposure to transition risk and their emission reduction targets, but gaps in disclosure

¹³² See De Haas, R. and Popov, A., "Finance and carbon emissions," *Working Paper Series*, No 2318, ECB, September 2019; Fatica, S. and Panzica, R., "Green bonds as a tool against climate change?," *Business Strategy and the Environment*, March 2021; and Flammer, C., "Corporate green bonds," *Journal of Financial Economics*, Vol. 142, Issue 2, November 2021, pp. 499-516.

¹³³ The ECB analysis covers the sample of 4,000 European carbon-intensive NFCs that are included in the European Union Transaction Log database and are subject to the EU Emissions Trading System. The database includes information on verified GHG emissions. Firms' revenues, profitability, and the age and number of plants with carbon-intensive activities, alongside country-specific factors such as fossil fuel subsidies, are also found to influence their ability to reduce emissions by investing in new green technologies.

practices remain significant, signalling the need for international standards.

More NFCs have been disclosing data on GHG emissions and setting emission-reduction targets over time, with high-emitting firms disclosing the most data, likely reflecting their greater exposure to public scrutiny (**Chart A.1**, panel b). Although a large part of this disclosure is verified by a third party, the risk of greenwashing remains high in the absence of global mandatory reporting requirements. In addition, although there has been an improvement in the climate-related disclosures of European banks since 2020, banks are not fully meeting supervisory expectations and gaps remain, especially regarding banks' emission-reduction targets and interim milestones.¹³⁴ The prompt adoption of international disclosure standards across jurisdictions would allow investors to price and measure transition risk more effectively, while also supporting the transition to a low-carbon economy.¹³⁵ In particular, although there is evidence that firms which set an emission-reduction target have a lower credit risk and tend to reduce emissions more than other firms in subsequent years, the credibility of firms' targets and their alignment with the Paris Agreement goals are difficult to assess.¹³⁶

Against this background, capital markets remain susceptible to greenwashing, and only the most credible green bonds seem to benefit from cheaper funding.

The growth of green bond markets could help stimulate the integration of European capital markets.¹³⁷ But the credibility of green bonds and/or their issuers appears to determine whether green bonds trade at a greenium – with lower spreads than for conventional bonds – in secondary markets (**Chart A.2**, panel a). Only green bonds with an external review, issued by firms in green sectors (e.g. alternative energy) or by banks which are members of the United Nations Environment Programme Finance Initiative (UNEP FI) exhibit a greenium. As ESG and green funds keep attracting new investors, the demand for green bonds and the greenium has also increased over time (**Chart A.2**, panel b).¹³⁸ New instruments, such as sustainability-linked bonds, which link borrowing costs to specific company-level sustainability targets, partly address investor concerns about greenwashing in the green bond market. Greenwashing also poses a risk to financial stability because it could lead to an undervaluation of transition risk and to potential fire-sales of green bonds. A common regulatory standard that requires regular standardised reporting, impact assessment and review by approved external reviewers, as proposed under the EU Green Bond Standard, would provide assurance that green bonds effectively finance the transition and alleviate risks to financial stability. Implementing this standard and making it mandatory within a reasonable period of time could enhance investor confidence in

¹³⁴ See the [Supervisory assessment of institutions' climate-related and environmental risks disclosures](#), ECB, March 2022.

¹³⁵ The climate change-related disclosure standards under the proposed European Union's Corporate Sustainability Reporting Directive is expected to be used by companies for the first time in 2024, for the 2023 financial year.

¹³⁶ See Carbone, S., Giuzio, M., Kapadia, S., Krämer, J., Nyholm, K. and Vozian, K., "[The low-carbon transition, climate commitments and firm credit risk](#)", *Working Paper Series*, No 2631, ECB, December 2021.

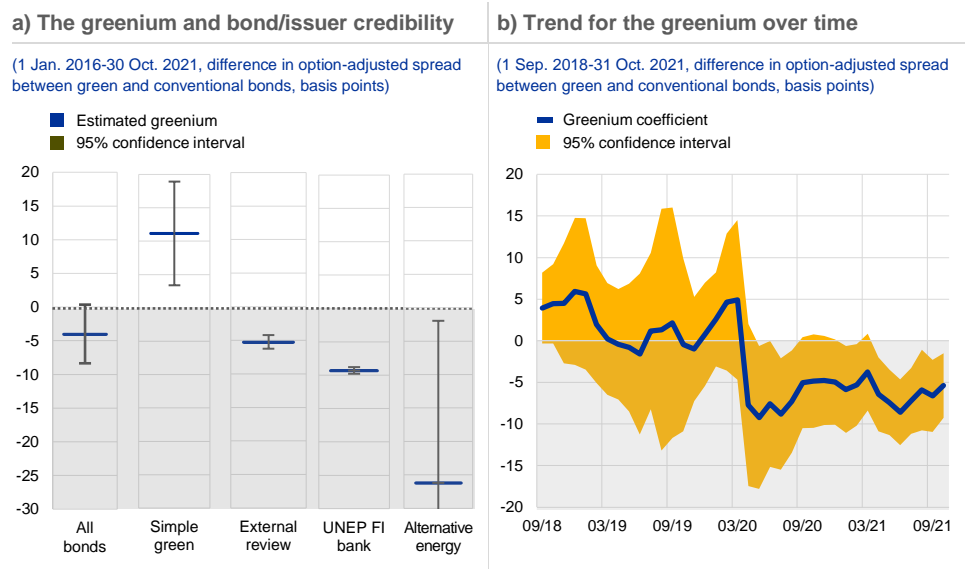
¹³⁷ See the box entitled "[Home bias in green bond markets](#)", *Financial Integration and Structure in the Euro Area Report*, ECB, April 2022.

¹³⁸ From Pietsch, A. and Salakhova, D., "Pricing of green bonds – drivers and dynamics of the greenium", *Working Paper Series*, ECB, forthcoming.

this asset class, reinforce flows of funding to the transition and reduce risks to financial stability.¹³⁹

Chart A.2

The greenium depends on bond and issuer credibility and has evolved over time



Sources: Bloomberg Finance L.P., CSDB, and Pietsch and Salakhova.
 Notes: Panel a: negative values indicate a greenium, as indicated by the shaded area. "All bonds" refers to all euro area bonds satisfying the International Capital Market Association (ICMA) use-of-proceeds principle, "Simple green" refers to bonds that are classified as green but have not been third-party reviewed, "External review" refers to only those bonds that satisfy all principles promoted by the ICMA and which have been externally reviewed, "UNEP FI bank" refers to bonds issued by banks that are members of the UNEP FI, and "Alternative energy" refers to bonds issued by the alternative energy sector. The estimated greenium is derived from a regression of the daily closing option-adjusted spread of each bond on multiple control variables and a green bond indicator equal to 1 if a bond is green. Negative estimates of the coefficient on the green bond indicator show a greenium as green bonds trade at tighter spreads. Panel b: the coefficient of this indicator is depicted for monthly sub-samples.

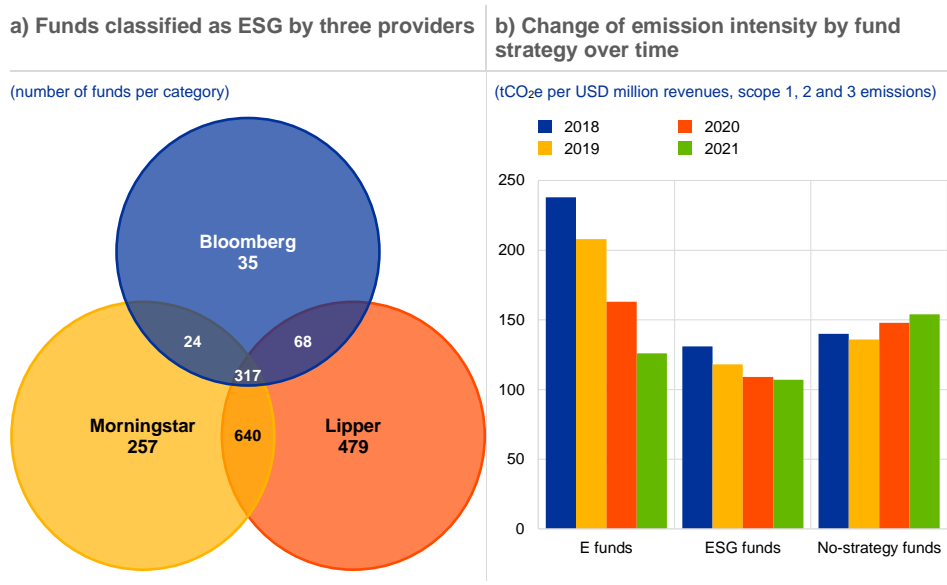
ESG – and particularly environmental – funds seem to have reduced their carbon footprint over time, but divergent ESG fund classification across data providers points towards greenwashing risks in the sector. In the absence of an ESG label and a common definition of ESG and environmental funds, investors rely on self-disclosure by asset managers and classifications from commercial data providers. The level of disagreement between these classifications is high (**Chart A.3**, panel a): the three main data providers agree in less than 20% of cases that a fund is ESG (317 funds out of more than 1,800 funds which are defined as ESG by at least one data provider). In this context, well-designed labels could materially reduce the risk of greenwashing. At the same time, environmental and other ESG funds do appear to have reduced the emission intensity¹⁴⁰ of their portfolios by more than non-ESG funds over the last four years (**Chart A.3**, panel b). But the extent to which this is driven by simply reshuffling portfolios towards already low-carbon sectors or by firms decarbonising – possibly due to supportive financing and activist pressure from impact investors – remains unclear, despite being important for the ultimate goal of transitioning to a net-zero economy.

¹³⁹ Opinion of the European Central Bank of 5 November 2021 on a proposal for a regulation on European green bonds (CON/2021/30) 2022/C 27/04 (OJ C 27, 19.1.2022, p 4).

¹⁴⁰ The emission intensity of a portfolio is measured as the exposure-weighted emission intensity of respective firms, with firm's emission intensity being absolute emissions scaled by revenues.

Chart A.3

Agreement of data providers on ESG designation of funds is limited, although ESG funds have tended to reduce the emission intensities of their portfolios



Sources: Morningstar, Bloomberg Finance L.P., Refinitiv Lipper for Investment Management and ECB calculations.

Notes: Panel a: each bubble represents the number of different funds classified as ESG according to the providers (Morningstar, Bloomberg and Lipper). The numbers in the overlapping areas of the bubbles correspond to the funds identified either by two or by all three providers. Panel b: the chart shows average emission intensity of funds in each category. Categories are identified using Morningstar intentions attributes based on information provided in funds' prospectuses. E funds are identified using environmental attributes; ESG funds correspond to all sustainable funds; "tCO₂e" stands for tonnes of carbon dioxide equivalent.

Limited change in financial system exposures to transition risk

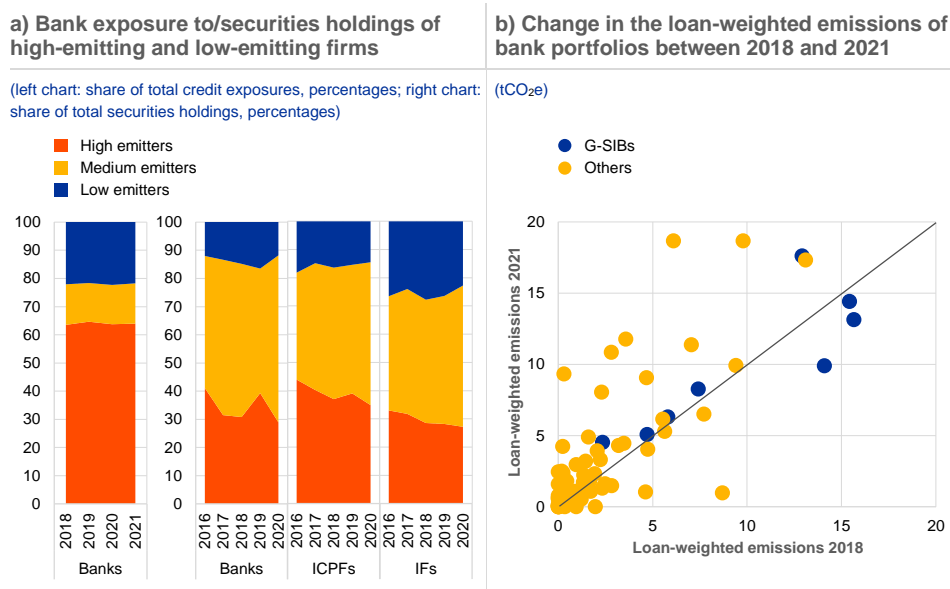
While firms' emissions have been decreasing, exposures of euro area banks to currently high-emitting firms have remained broadly stable. Around two-thirds of the corporate credit exposures held by euro area banks are still directed towards high-emitting firms, which are mainly concentrated in the manufacturing, real estate and retail sectors (Chart A.4, panel a).¹⁴¹ Also, around 30% of both bank and non-bank holdings of securities issued by NFCs with known emission levels are currently issued by high-emitting firms, a share which has only decreased slightly over the last five years. At the same time, the recent increases and volatility in energy markets have underlined the urgency of supporting the transition to a net-zero economy.

Metrics commonly used to assess corporate sector climate risks point to a small increase in carbon intensity in bank portfolios. Only a few (mainly large and highly exposed) banks have significantly decarbonised their credit portfolios since 2018, as measured by the loan-weighted emissions of the respective borrowers (Chart A.4, panel b). By contrast, two-thirds of banks have increased their loan-weighted emissions. The measures may still be missing the interaction between climate risk and financial risk of loans.

¹⁴¹ High-emitting firms are defined here as firms with reported emission intensity in the top 33% of the distribution as of end-2020, i.e. firms with 2020 emission intensity in excess of 556 tCO₂e/USD million.

Chart A.4

While firms' emissions have been decreasing, the financial system's exposures to high-emitting firms have remained broadly stable



Sources: AnaCredit, Securities Holdings Statistics by Sector, Urgentem and ECB calculations.

Notes: Panel a: high/low emitters are defined here as firms with reported emission intensity in the top/bottom 33% of the distribution across euro area bank borrowers as of end-2020, i.e. firms with an annual emission intensity registered in 2020 above 556 tCO₂e/USD million and below 47 tCO₂e/USD million. "ICPFs" stands for insurance corporations and pension funds; "IFs" stands for investment funds. Panel b: "G-SIBs" stands for global systemically important banks.

Information on carbon emissions can be combined with the existing probability of default (PD) so a corporate borrower can provide a credit risk-adjusted metric of transition risk. The resulting score can be computed at bank level by aggregating loan-weighted borrowers' emissions multiplied by their PDs over the bank's entire corporate portfolio.¹⁴² The PDs are included as a measure of credit risk and the GHG emissions are included as a measure of vulnerability to transition risk. Overall, the higher a firm's contribution to the transition risk score, the higher its contribution to the bank's financial risk induced by the combination of credit and transition risk, as long as PDs have not already accounted for the latter.¹⁴³

¹⁴² The credit-risk-weighted metric of transition risk for a bank j is defined as:

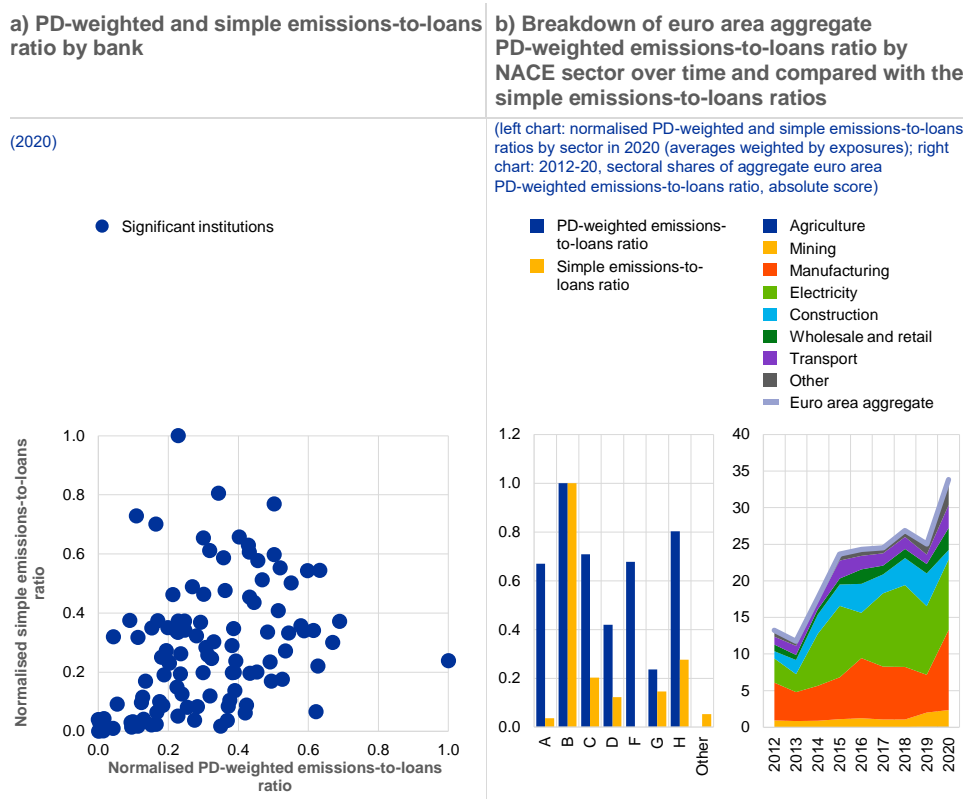
$$\sum_i GHG\ emissions_i \cdot PD_{ij} \cdot \frac{loans_{ij}}{\sum_i loans_{ij}},$$

where i is (one of) the borrower(s), $GHG\ emissions$ is the level of (relative or absolute) GHG emissions produced by the borrower and PD is the probability of default assigned to the borrower by the bank concerned. An alternative for the credit risk component would be to use loan loss provisions as a proportion of loans instead of PD. In the present case, PDs are used because they capture credit risk from a more forward-looking perspective. An alternative for the climate risk component would be to use emission targets alongside or instead of current emission levels. This choice would also improve the forward-looking power of the metric.

¹⁴³ Transition risk can materialise in the form of higher operating expenditures and investment requirements for firms, the purpose being to reduce their emissions. These higher monetary costs can manifest themselves in transitional risk metrics (e.g. credit risk parameters such as PDs), although it is assumed that banks do not currently explicitly account for the contribution of transition risk to firms' credit risk.

Chart A.5

PD-weighted measures of emissions can capture the financial component of banks' climate risks and round out the picture provided by emissions-to-loans ratios



Sources: AnaCredit, Urgentem, Register of Institutions and Affiliates Database and ECB calculations.

Notes: Emissions refer to firm-level relative and absolute (loan carbon intensity) scope 1, 2 and 3 emissions. Panel b) uses two different underlying firm samples. The bar chart comprises inferred emissions for around 2.5 million firms in 2018, covering around 80% of total AnaCredit exposures. The capital letters refer to NACE codes as follows: A – Agriculture; B – Mining; C – Manufacturing; D – Electricity; F – Construction; G – Wholesale and retail trade; H – Transport. The time series covers both inferred and reported emissions for 1,250 firms, which comprise on average 10% of AnaCredit exposures over time. "NACE" stands for Nomenclature statistique des activités économiques dans la Communauté Européenne (Statistical classification of economic activities in the European Community).

The credit risk-adjusted measure supports signals obtained from emissions-to-loans ratio measures indicating that risk has increased over time.¹⁴⁴

Once adjusted for financial risk using borrowers' PDs, estimated transition risk has increased since 2012, with significant increases in sectors that face more underlying transition risk. This has some correlation with the signals from unadjusted measures of transition risk (Chart A.5, panel a). Exposures to the mining, manufacturing and electricity sectors together account for around 70% of the euro area aggregate (Chart A.5, panel b). Some of these sectors make an almost negligible contribution to the emissions-to-loans ratio but they play an important role when the financial risk component is considered.

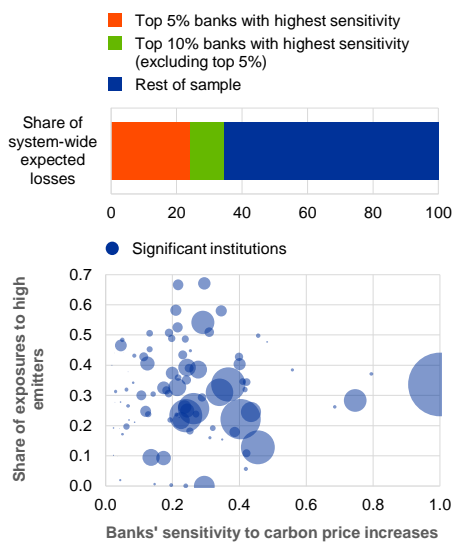
¹⁴⁴ The bank-level emissions-to-loans ratio is computed by aggregating borrowers' emissions and dividing this figure by the total value of the bank's corporate loan portfolio.

Chart A.6

Climate-related concentration risk is a new form of concentration risk simultaneously affecting multiple, seemingly unrelated, exposures

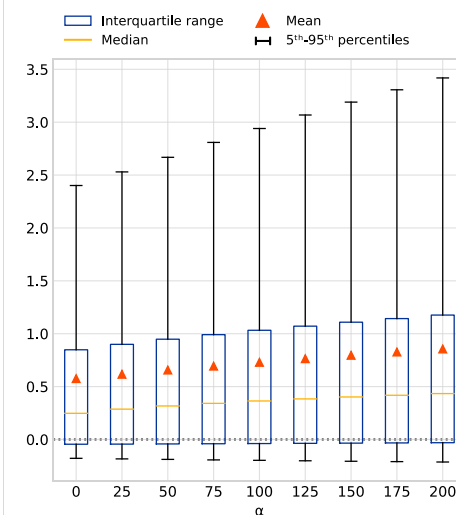
a) Correlation between banks' sensitivity to carbon price increases, expected losses and climate-risk concentration

(2020-50, upper chart: percentages, lower chart: bubble size: absolute expected losses)



b) Distribution of default correlations for increasing transition risk intensity α

(y-axis: percentages)



Sources: AnaCredit, Urgentem, NGFS, Moody's Credit Edge and ECB calculations.

Notes: Panel a: corporate loan portfolios of euro area significant institutions which represent 60% of total AnaCredit exposures. Panel b: euro area sample based on 500,000 Monte Carlo iterations. The parameter $\alpha = (1 - \beta)T$ incorporates both the transition risk shock T ($\text{€}/\text{tCO}_2$) as well as a pass-through factor β capturing the degree to which firms can pass the cost of a transition risk shock on to consumers (Belloni et al., see footnote 146).

Since climate-related risks simultaneously affect multiple seemingly unrelated exposures, their concentration in individual institutions plays a significant role.

Climate-related concentration risks can arise from exposures that share similar sensitivities to physical risks (e.g. due to their location or activity) or transition risks (e.g. due to their sector allocation or level of emissions). Focusing on transition risk and assuming a disorderly transition scenario,¹⁴⁵ it appears that higher concentrations of exposures to firms with high emission intensity coincide with higher expected losses at bank level over a 30-year period (Chart A.6, panel a). Around 35% of system-wide expected losses are incurred by the 10% of banks with the highest sensitivity to carbon price increases. In addition, carbon price shocks trigger a

¹⁴⁵ This exercise measures a bank's sensitivity to carbon price increases under the NGFS Phase I disorderly transition scenario over a 30-year period, leveraging on model parameters developed in the ECB economy-wide climate stress test (see "ECB economy-wide climate stress test", Occasional Paper Series, No 281, ECB, September 2021). The increase in banks' expected losses stemming from carbon price increases is calculated for each of its credit exposure as

$$\text{bank's sensitivity to carbon price increases} = \frac{\text{expected losses}_{t_0}}{\text{EAD}_{t_0}} [\beta_p \Delta(\text{profitability})_t + \beta_L \Delta(\text{leverage})_t]$$

where β_p and β_L are coefficients determining the extent to which borrower PDs react to changes in profitability and leverage.

significant increase in firms' default correlations.¹⁴⁶ For a transition risk intensity of 200€/tCO₂, capturing the cost due to increases in the cost of carbon borne by firms causes estimated average (median) correlations to double (**Chart A.6**, panel b). Transition risk not only leads to a source of novel correlation between previously uncorrelated or weakly correlated firms in general, but also increases correlations for high emitters¹⁴⁷ by ten times more than it does for low emitters.

Systemic amplifications could result from interconnected physical risks arising from climate change

Financial stability risks arising from physical hazards are exacerbated by the fact that some investors hold assets which are vulnerable to multiple hazards.

The occurrence of natural hazards is characterised by interactions between hazards in the form of either correlations or causal links (**Chart A.7**, panel a) which can generate self-reinforcing or feedback mechanisms. For example, the joint combination of thunderstorms and droughts (both captured by the “Heat stress” category in **Chart A.7**, panel a) can cause wildfires which, in turn, both increase the likelihood of more wildfires and exacerbate heat stress.¹⁴⁸ Future intensification of climate risk, especially when clustered hazards occur, may create hard-to-price tipping points and impair options for diversification, potentially posing financial stability risks, especially for securities with wider protection gaps.

In addition to the direct exposure to physical risk, the impact of physical hazards could be amplified by fire-sale dynamics. In the event of a sudden reassessment of risks affecting portfolios, the liquidation of securities exposed to potential hazards may affect market prices. This could result in contagion losses spreading by way of the common holdings of different market participants and, in worst-case scenarios, spiralling deleveraging pressures.¹⁴⁹ Constructing estimates of the common asset holdings (overlapping portfolios) exposed to the different physical risks¹⁵⁰ of different market participants (**Chart A.7**, panel b) reveals a range of estimates running from 2% of overlapping portfolios for the hurricanes and typhoons category to an average of 45% for portfolios weighted for wildfires.¹⁵¹ In addition, the

¹⁴⁶ Firms' default correlations are estimated using a multi-firm Merton model calibrated on historical data for a large sample of euro area firms. Via 500,000 Monte Carlo iterations, the model simulates the default events of thousands of firms for which the asset value process is modelled as correlated geometric Brownian motions. The transition risk intensity $\alpha = (1 - \beta)T$, capturing the fraction of transition cost borne by firms for each tonne of CO₂ emitted, incorporates both the transition risk shock T (€/tCO₂) and a pass-through factor β capturing the degree to which firms can pass the cost of a transition risk shock on to consumers, and impacts the value of assets (see Belloni, M., Kuik, F. and Mingarelli, L., “Euro area banks' sensitivity to changes in carbon price”, *Working Paper Series*, No 2654, ECB, March 2022). Under the simplifying assumption that firms would bear the full cost of an increase in carbon prices ($\beta = 0$), the transition risk intensity would be equivalent to this increase in the cost of carbon, i.e. $\alpha = T$.

¹⁴⁷ Firms with emission intensities above (below) the sample's 75th percentile are referred to as high (low) emitters.

¹⁴⁸ Another example is typhoons and rainfall, which can trigger ground subsidence. This has the potential to start landslides which can, in turn, cause flooding.

¹⁴⁹ Cont, R. and Schaanning, E., “Monitoring indirect contagion”, *Journal of Banking and Finance*, Vol. 104, Issue C, July 2019, pp. 85-102.

¹⁵⁰ Firm-level risk scores for over four million firms worldwide, from Moody's Four Twenty Seven, are used.

¹⁵¹ The degree to which the share of portfolios exposed to natural hazards will concretely be at risk is unclear as firms can implement physical risk-mitigation measures to reduce impacts.

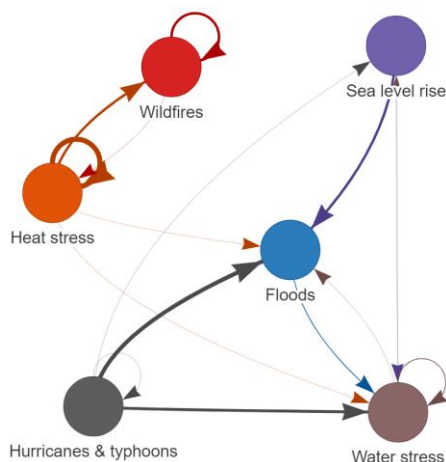
concentration of overlapping portfolios in specific sectors may further exacerbate such risks, as in the case of financial corporates, which are much more exposed to wildfires than other sectors.

Chart A.7

Interdependencies between natural hazards and financial sectors could lead to hard-to-price tipping points triggering concurrent revaluations affecting different investors

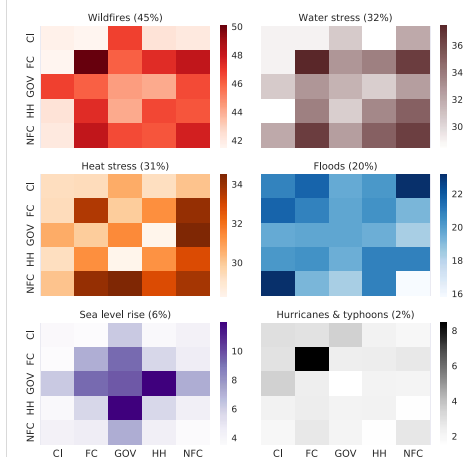
a) Natural hazard interdependencies

(arrows based on hazard correlations and causal relations)



b) Physical risk-weighted overlapping portfolios

(as a share of common asset holdings, percentages; mean in parenthesis)



Sources: Gill and Malamud*, ECB (securities holdings statistics), Moody's 427 and ECB calculations.

Notes: Panel a: links refer to both correlations and causal links. Arrow thickness is proportional to a score capturing either increased probability or causal trigger of hazards, in terms of both spatial overlaps and temporal likelihood. Aggregated from Gill and Malamud*. Self-loops refer to the increased likelihood of a given hazard conditional on the materialisation of the hazard itself due to associated self-reinforcing mechanisms. Panel b: overlapping portfolios weighted by physical hazard scores as a share of common asset holdings by aggregate sectors. The physical-risk-weighted overlapping portfolios between sectors i and j are reported as a share of common asset holdings, that is $\hat{O}_{ij}/O_{ij} = \sum_k \Pi_k (S_{ik} \wedge S_{jk}) / \sum_k (S_{ik} \wedge S_{jk})$ where S_{ik} denotes the holdings by sector i of security k , and Π_k the physical risk weight associated with the issuer of security k . Sectors considered are credit institutions (CI), financial corporations (FC), governments (GOV), households (HH), and non-financial corporations (NFC). Securities include both bonds and equities. Note that a different scale applies to each hazard (right-hand scale of each heatmap, percentages). Group averages (in parentheses) give a sense of the relative importance of each hazard at system-wide level.

*) Gill, J.C. and Malamoud, B.D., "Reviewing and visualizing the interactions of natural hazards", *Reviews of Geophysics*, Vol. 52, Issue 4, 2014, pp. 680-772.

Climate-related tipping points may translate into a financial tipping point in the form of a sudden repricing which would strain investors with overlapping portfolios. In the event of a sudden reassessment of risk following clustered hazard events, common holdings may cause several different investor segments to face large mark-to-market losses at once, which could be amplified by fire-sales and other portfolio rebalancing actions. This system-wide risk highlights the relevance of a macroprudential approach to prudential responses aimed at mitigating the impact of climate change on financial stability. This risk runs in parallel with the insurance protection gap relating to climate-related catastrophes.¹⁵²

¹⁵² See "Climate change, catastrophes and the macroeconomic benefits of insurance", *Financial Stability Report*, EIOPA, July 2021, pp 105-123.

Conclusions and policy implications

This special feature contributes to the ECB's monitoring of climate risks by examining the role of green finance in supporting the transition to a low-carbon economy, the currently limited financial adaptation to transition risk and the financial system amplifiers of physical risk. While further progress on consistent climate data is required, especially for forward-looking metrics, granular physical risk exposures and insurance coverage, there is encouraging evidence of greater disclosure by NFCs and an increasing awareness of climate-related risks in financial markets. Yet the risk of greenwashing remains a concern and may be rising fast – in both the green bond market and the investment fund sector – given the absence of well-designed, consistent standards for sustainable financial instruments. The dynamic exposures of financial institutions to transition and physical risks, together with their risk metrics, show no clear evidence of financial institutions experiencing a significant reduction in risk. In addition, exposure concentration, cross-hazard correlation and institutions' overlapping portfolios are shown to act as amplifiers of such risks.

This analysis can contribute to the policy debate around disclosures, standards for sustainable financial instruments and climate-related prudential policies.

The development of consistent sustainability disclosures via the Corporate Sustainability Reporting Directive and the IFRS Foundation, as well as the convergence of these requirements in common minimum international standards, are important factors allowing firms, investors and financial institutions to effectively measure and manage transition risk. Regulatory standards on sustainable financial instruments, such as the EU GBS and ESG/environmental fund labels, are key to reducing the risk of greenwashing and thus helping to scale up sustainable financing. Finally, based on the systemic aspect and possible amplification mechanisms originating from climate-related physical and transition risks, there should be further reflection on how to close any material gaps in the prudential framework.¹⁵³ Future work will focus on the extent to which existing macroprudential tools, including the systemic risk buffer, could be readily deployed to capture climate risks. New tools, such as concentration risk measures, may also be needed to address climate-related risks from a systemic perspective.¹⁵⁴

¹⁵³ See Baranović et al., “The challenge of capturing climate risks in the banking regulatory framework: is there a need for a macroprudential response?”, *Macroprudential Bulletin*, ECB, October 2021.

¹⁵⁴ See “ECB response to the European Commission's call for advice on the review of the EU macroprudential framework”, March 2022.

B Decrypting financial stability risks in crypto-asset markets

Prepared by Lieven Hermans, Annalaura Ianiro, Urszula Kochanska, Veli-Matti Törmälehto, Anton van der Kraaij and Josep M. Vendrell Simón¹⁵⁵

The stellar growth, volatility and financial innovation currently seen in the crypto-asset ecosystem, as well as the rising involvement of institutional investors, show how important it is to gain a better understanding of the potential risks that crypto-assets could pose to financial stability if trends continue on this trajectory. Systemic risk increases in line with the level of interconnectedness between crypto-assets and the traditional financial sector, the use of leverage and lending activity. It is important to close regulatory and data gaps in the crypto-asset ecosystem to mitigate such systemic risks.

Introduction

Crypto-assets are currently the subject of intense policy debate. The different segments of crypto-asset markets include unbacked crypto-assets (such as Bitcoin), decentralised finance (DeFi) and stablecoins.¹⁵⁶ Crypto-assets lack intrinsic economic value or reference assets, while their frequent use as an instrument of speculation, their high volatility and energy consumption, and their use in financing illicit activities make crypto-assets highly risky instruments. This also raises concerns over money laundering, market integrity and consumer protection, and may have implications for financial stability.

Despite the risks, investor demand for crypto-assets has been increasing. This exuberance stems from, among other things, perceived opportunities for quick gains, the unique characteristics of crypto-assets (for instance programmability) compared with conventional asset classes, and the benefits perceived by institutional investors with regard to portfolio diversification. Major players in the payments industry have also stepped up their crypto-asset-based services, enabling easier retail access. While crypto-asset markets currently represent less than 1% of the global financial system in terms of size, they have grown significantly since the end of 2020. Despite recent declines, they remain similar in size to, for example, the securitised sub-prime mortgage markets that triggered the global financial crisis of 2007-08.

Risks to financial stability in the euro area stemming from crypto-assets were seen as limited in the past.¹⁵⁷ This special feature provides an update on crypto-asset market developments and a general overview of risks stemming from unbacked crypto-assets and DeFi, given the way in which they have evolved and their specific characteristics and risks. This article therefore abstracts from a specific

¹⁵⁵ The authors are grateful to France Marie Alix De Pradier d'Agrain, Lorenzo Pangallo and Antonella Pellicani for data support.

¹⁵⁶ See the definitions used in “[Crypto-assets and Global ‘Stablecoins’](#)”, Financial Stability Board, last updated February 2022.

¹⁵⁷ For previous assessments, see the box entitled “[Financial stability implications of crypto-assets](#)”, *Financial Stability Review*, ECB, May 2018.

discussion on risks and developments in stablecoins which, as shown by the recent TerraUSD crash and Tether de-peg, are not as stable as their name suggests and cannot guarantee their peg at all times.¹⁵⁸ Following a deep dive into crypto-asset leverage and crypto lending, we conclude that if the present trajectory of growth in the size and complexity of the crypto-asset ecosystem continues, and if financial institutions become increasingly involved with crypto-assets, then crypto-assets will pose a risk to financial stability.

Market developments in recent years

The crypto-asset universe has increased dramatically in both size and complexity since the end of 2020, expanding beyond Bitcoin. Despite recent market developments, the overall market capitalisation of the crypto-asset class is still around seven times bigger than it was at the start of 2020, having reached a high of over €2.5 trillion on aggregate in late 2021 (**Chart B.1**, panel a). Although the crypto-asset universe is still relatively small compared with the biggest stock exchanges (e.g. around 10% of STOXX Europe 600 market capitalisation), by November 2021 Bitcoin and Ether were among the largest assets globally (**Chart B.1**, panel b). Trading volumes for the most representative crypto-assets (including Bitcoin, Ether and Tether) have at times been comparable with or even surpassed those of the New York Stock Exchange or euro area sovereign bond quarterly trading volumes. There are now more than 16,000 crypto-assets in existence (ten new crypto-assets are launched every day on average), although only around 25 crypto-assets have a market capitalisation comparable with that of a large cap equity. At the same time, selected subsegments within the crypto-asset ecosystem such as stablecoins, non-fungible tokens (NFTs) and DeFi grew particularly strongly in 2021, indicating that the potential functionalities of crypto-assets are expanding.

However, crypto-asset markets also continue to be characterised by high levels of volatility. Over the last few years, the historical volatility of crypto-assets has continued to dwarf the volatility of the diversified European stock and bond markets. For example, while the volatility of the Bitcoin price has declined over the years, it is still significantly higher than for commodities such as silver and gold. Despite volatile movements and bouts of speculation (**Chart B.1**, panel a), crypto-assets trended upwards throughout most of 2021, leading to all-time-high prices for most individual crypto-assets. However, since early November the price of Bitcoin, as well as that of the other main unbacked crypto-assets, has more than halved amid a changing environment (US monetary tightening and increasing geopolitical tensions).

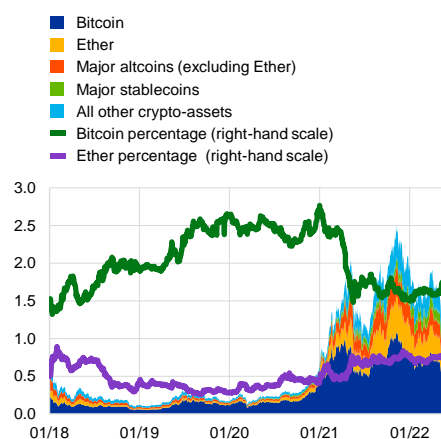
¹⁵⁸ For a discussion on the risks of the third segment of crypto-asset markets (stablecoins) and their interconnectedness with the general crypto-asset ecosystem and the traditional financial sector, see, for example, the article entitled “[The expanding functions and uses of stablecoins](#)”, *Financial Stability Review*, ECB, November 2021; and the article entitled “[A regulatory and financial stability perspective on global stablecoins](#)”, *Macroeprudential Bulletin*, No 10, ECB, May 2020.

Chart B.1

The market value and complexity of the crypto-asset ecosystem has increased dramatically

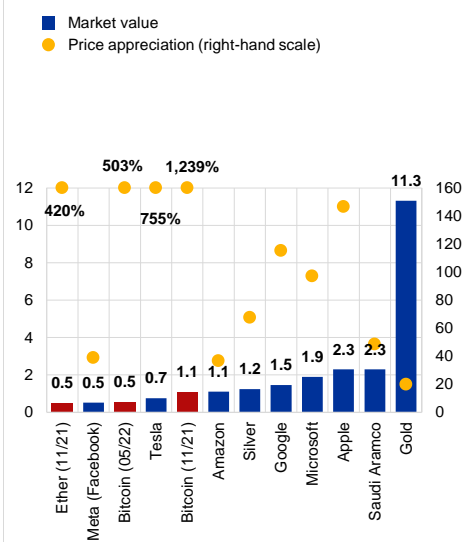
a) Market capitalisation of crypto-assets

(Jan. 2018- May 2022, € trillions; percentages)



b) Bitcoin and Ether market value and price appreciation since March 2020 vs largest assets by market cap

(16 Mar. 2020-17 May 2022, € trillions, percentages)



Sources: Bloomberg Finance L.P., Crypto Compare and ECB calculations.

Notes: Crypto-asset market capitalisation is calculated as the product of circulating supply and the price of crypto-assets. If the circulating supply were adjusted for the lost bitcoins which are proxied by those that have not been used for longer than seven years, it would be around 20% lower. The selected major altcoins are Cardano (ADA), Bitcoin Cash (BCH), Dogecoin (DOGE), Link (LINK), Litecoin (LTC), Binance Coin (BNB), Ripple (XRP), Polkadot (DOT) and Solana (SOL). The selected major stablecoins are Gemini USD (GUSD), True USD (TUSD), USD Coin (USDC), Tether (USDT), Binance USD (BUSD) and Pax Dollar (USDP). Algorithmic stablecoins were excluded.

The increasing correlation of crypto-asset prices with mainstream risky financial assets during episodes of market stress casts doubt over their usefulness for portfolio diversification. There was an increase in the correlation between crypto-asset returns and stock returns during (and following) the market stress of March 2020, as well as during the December 2021 and May 2022 market sell-offs. This may suggest that, during periods of risk aversion across wider financial markets, the crypto-asset market has become more closely tied to traditional risk assets – a trend that may be due in part to the increased involvement of institutional investors.¹⁵⁹ Conversely, the correlation with gold has turned negative during a period of rising inflation expectations and geopolitical tensions.

Interconnectedness with the wider financial system has been growing. Linkages between crypto-assets and the euro area banking sector have been limited so far, although market contacts indicate there was growing interest in 2021, mainly via expanded portfolios or ancillary services associated with digital assets (including custody and trading services). Major payment networks have also stepped up their support of crypto-asset services, leveraging their retail networks and making

¹⁵⁹ See also Tara, I., “Cryptic Connections: Spillovers between Crypto and Equity Markets”, *Global Financial Stability Notes*, No 2022/01, IMF, January 2022; and Szalay, E., “Bitcoin’s weekend tumble hints at Wall Street traders’ growing sway”, *Financial Times*, December 2021.

crypto-assets more easily accessible to consumers and businesses. Some institutional investors (hedge funds, family offices, some non-financial firms and asset managers) are now also investing in Bitcoin and crypto-assets more generally.¹⁶⁰ In addition, market intelligence suggests that the growing involvement of asset managers is largely in response to demand from their own clients.

Demand from institutional investors in Europe has also risen. For example, 56% of European institutional investors surveyed by custody and execution services provider Fidelity Digital Assets¹⁶¹ indicated that they have some level of exposure to digital assets – up from 45% in 2020 – with their intention to invest also trending upwards. One reason could be that measures taken by the public authorities may have been interpreted as endorsing crypto-assets, even though the latter remain largely unregulated. For example, since July 2021 German institutional investment funds have been allowed to invest up to 20% of their holdings in crypto-assets. This is further aided by the increasing availability of crypto-based derivatives and securities on regulated exchanges, such as futures, exchange-traded notes, exchange-traded funds and OTC-traded trusts, which have increased in popularity over the last few years in Europe and the United States. These products, together with clearing facilities, have made crypto-assets more accessible to investors as they can be traded on traditional stock exchanges, with the end user no longer having to deal with the complexities of custody and storage. However, the European crypto-asset management landscape is still relatively limited and is home to only 20% of total global crypto-assets funds in terms of primary office location.

Retail investors represent a significant part of the crypto-asset investor base. Recent results from the ECB's Consumer Expectations Survey (CES)¹⁶² for six large euro area countries¹⁶³ indicate, based on experimental questions, that as many as 10% of households may own crypto-assets (**Chart B.2**, panel a). Most crypto-asset owners reported holding less than €5,000 in crypto-assets, with a slight predominance of smaller holdings (below €1,000) in this group. At the other end of the spectrum, around 6% of crypto-asset owners confirmed that they held more than €30,000 in crypto-assets (**Chart B.2**, panel b). Looking at the income quintiles of the respondents, the pattern is largely U-shaped: the higher a household's income, the more likely it is to hold crypto-assets, with lower-income households more likely to hold crypto than middle-income households (**Chart B.2**, panel c). On average, young adult males and highly educated respondents were more likely to invest in crypto-assets in the countries surveyed. With regard to financial literacy, respondents who scored either at the top level or the bottom level in terms of financial literacy scores were highly likely to hold crypto-assets.

¹⁶⁰ See Fletcher, L., "Hedge funds expect to hold 7% of assets in crypto within five years", *Financial Times*, June 2021. A recent survey of 100 hedge fund CFOs by fund administrator Intertrust Group found that they expected to allocate, on average, 7.2% of their assets to crypto-assets by 2026. A Goldman Sachs survey carried out in 2021 showed that 15% of family offices have exposures to crypto-assets, while nearly half of all family offices are interested in taking on exposures.

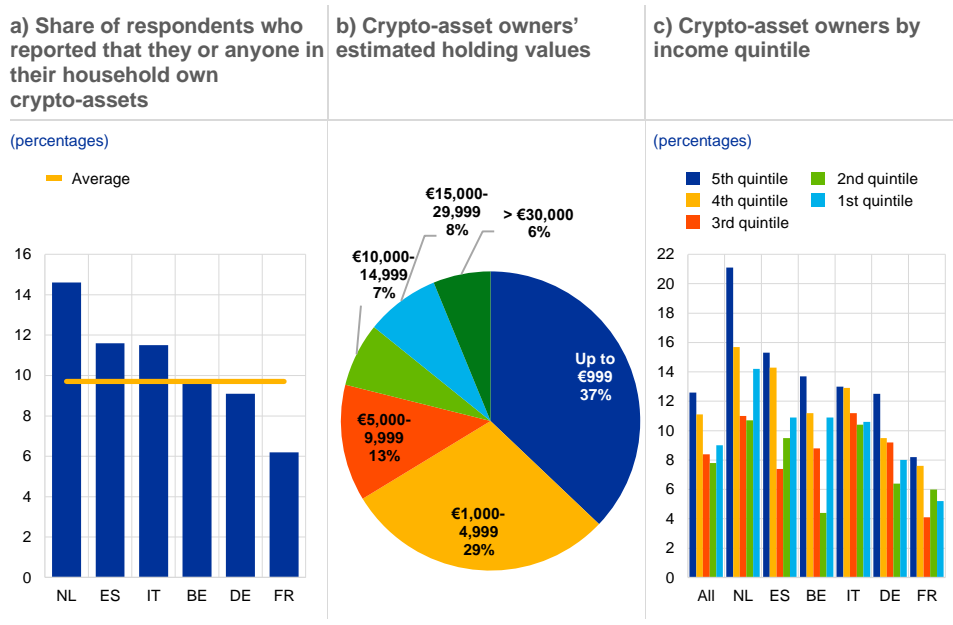
¹⁶¹ See "Institutional Investor Digital Assets", *Fidelity Digital Assets*, 2021.

¹⁶² The CES collects high-frequency information on the perceptions and expectations of households in the euro area, as well as on households' economic and financial behaviour.

¹⁶³ Belgium, Germany, Spain, France, Italy and the Netherlands.

Chart B.2

Surveys point to material household holdings of crypto-assets in large euro area countries



Source: ECB (Consumer Expectations Survey – CES).

Notes: The CES conducted in November 2021 included some experimental questions concerning crypto-assets. Specifically, respondents, aged 18-70 years, were asked if they or anyone in their household owned financial assets in various categories including crypto-assets (e.g. "Bitcoin or other"). Respondents were also asked to estimate the total value of such assets. Other surveys exist that aim to gather information on retail holdings of crypto-assets. They may differ in terms of the scope of the questions asked or coverage, which may lead to higher or lower figures for crypto-asset ownership or crypto-asset related activities in the countries covered.

Risks stemming from crypto-assets

The relevant authorities have ascertained that crypto-assets pose risks from an investor protection and market integrity perspective.¹⁶⁴ The European

supervisory authorities have recently reiterated their warning that crypto-assets are highly risky and speculative. Crypto-assets are not suitable for most retail investors (either as an investment or store of value, or as a means of payment) who could lose a large amount (or even all) of the money they have invested. Consumer protection risks include (i) misleading information, (ii) the absence of rights and protections such as complaints procedures or recourse mechanisms, (iii) product complexity with leverage sometimes embedded, (iv) fraud and malicious activities (money laundering, cyber crime, hacking and ransomware), and (v) market manipulation (lack of price transparency and low liquidity).

The significant volatility of crypto-assets in recent months has not resulted in contagion or any notable defaults by financial institutions, but the risks of these are increasing. Greater involvement of financial institutions could fuel the growth of

crypto-assets still further and increase financial stability risks. Any principal-based crypto-asset exposures on the part of systemic institutions, especially if the assets involved are unbacked, could put capital at risk, with potential knock-on effects on

¹⁶⁴ See the [warning](#) issued by the EU financial regulators on 17 March 2022.

investor confidence, lending and financial markets if the exposures are of a sufficient scale. Financial institutions themselves could face reputational risks as well as climate transition risks. Some international banks (including euro area banks) are already trading and clearing regulated crypto derivatives, even if they do not hold an underlying crypto-asset inventory. Market intelligence suggests that other EU banks and financial institutions are interested in offering custody, trading and market-making services once regulatory uncertainty diminishes with the entry into force of the Markets in Crypto-Assets (MiCA) Regulation. This will further increase interconnectedness.

If current growth and market integration trends persist, then crypto-assets will pose a risk to financial stability. Unbacked crypto-assets can have financial stability implications through four main transmission channels: wealth effects, confidence effects, financial sector exposures and the use of crypto-assets as a form of payment.¹⁶⁵ While all these channels are increasing in size and complexity, they lack internal shock absorbers that could provide liquidity at times of stress. For example, the wider involvement of financial institutions or the use of crypto-assets as a form of payment would increase the potential for spillover to the wider economy, particularly if leverage were employed.

Although EU regulation has been proposed to mitigate the risks posed by crypto-assets, agreement on this is yet to be reached. In the EU, the Commission's proposal for the MiCA Regulation, first published in September 2020, has not yet been agreed by EU co-legislators. This means the Regulation will not be applied before 2024 at the earliest, as it is not expected to be applied until 18 months after it enters into force. Given the speed of crypto developments and the increasing risks, it is important to bring crypto-assets into the regulatory perimeter and under supervision as a matter of urgency. In addition, it will be important to review the sectoral regulations to ensure that any financial stability risks posed by crypto-assets, particularly those arising from their interconnectedness with traditional financial institutions, are mitigated.

Significant informational and data shortcomings persist, hindering the proper assessment of financial stability risks. These shortcomings include not only quantitative issues but also the reliability and consistency of data, and the fact that a significant proportion of activities take place outside the regulatory perimeter. Most publications from crypto-asset service providers (including platforms, exchanges and data aggregators) are not verifiable and should be treated with caution, while the limited regulatory data currently available (e.g. data for derivatives and alternative investment funds) offer only a partial (and potentially inaccurate) picture. As long as there continue to be no official statistics on crypto-assets or reporting of underlying data to a supervisory or oversight authority, the reliability of the metrics from the above sources and the full extent of possible contagion channels with the traditional

¹⁶⁵ See the updated "[Assessment of Risks to Financial Stability from Crypto-assets](#)", Financial Stability Board, February 2022; and Chapter 2 entitled "[The Crypto Ecosystem and Financial Stability Challenges](#)", *Global Financial Stability Report*, IMF, October 2021.

financial system cannot be fully ascertained.¹⁶⁶ This is particularly relevant for the assessment of the risks stemming from the use of leverage or the reuse of collateral in crypto lending.

Assessing the role of leverage in crypto-asset markets

Financial stability risks could be amplified by the growing options offered by crypto exchanges for investors to increase their exposure through leverage.

Products such as leveraged tokens,¹⁶⁷ futures contracts and options can allow investors to synthetically increase their exposure to crypto-asset returns (and risk). Some crypto exchanges offer ways to increase exposures by as much as 125 times the initial investment (**Table B.1**). However, the total volumes of leveraged contracts in crypto-asset markets and the extent to which leverage is actually used on these trading platforms are generally not reported. Furthermore, some investors use borrowed funds to purchase their exposure (margin trading), thus increasing the risks to financial stability.

Table B.1
Leverage amount offered by major crypto-asset exchanges

Exchange	Maximum amount of leverage offered	Products used to provide leverage
BitMEX	100x	Perpetual swaps
Kraken	5x	Crypto-assets
FTX	20x	Futures, leveraged tokens
eToro	2x	Contracts for differences
Bitblex	100x	Options
Bybit	100x	Perpetual swaps and futures
Binance	125x	Leveraged tokens

Source: Exchange websites.

Estimates suggest there has been a slight increase in crypto-asset leverage in recent years.¹⁶⁸ Measures based on both Bitcoin and Ether futures indicate that aggregate leverage has been increasing since 2020 (**Chart B.3**, panel a), with a wider dispersion on individual exchanges for Bitcoin than for Ether. The rise in leverage in the Ethereum blockchain could be related to the growth of DeFi and associated activities where funds borrowed in one transaction can be reused as collateral in others. Even if leverage is currently limited at an aggregate level for the main unbacked crypto-assets, any concentration of high leverage in a few key market participants could still prompt stress.

¹⁶⁶ Some issues with measuring crypto-asset phenomena using “classic metrics” have been described in the article entitled “[Understanding the crypto-asset phenomenon, its risks and measurement issues](#)”, *Economic Bulletin*, Issue 5, ECB, 2019.

¹⁶⁷ Leveraged tokens allow their holder to take a leveraged position on a crypto derivative (e.g. a perpetual future on BTC).

¹⁶⁸ One popular indicator used to estimate crypto-asset leverage is calculated as the open interest of derivatives on a specific crypto-asset relative to the amount of crypto-assets held in reserve by the exchanges offering those derivatives. The open interest conveys a measure of the total (crypto) assets, while the reserves held by exchanges may be seen as the equity. In this way, the ratio used to measure leverage in crypto-assets recalls the standard leverage ratio: assets over equity.

Another useful dimension to consider when analysing leverage in crypto-asset markets is the volume of long and short liquidations. In the face of adverse price movements in the underlying there can be significant spikes in the volume of liquidations, which could cause further price declines. Drops in Bitcoin prices have been exacerbated by the increasing liquidation volumes associated with long positions in Bitcoin futures (**Chart B.3**, panel b), as the several spikes in long liquidation volume follow an initial price drop and precede the dipping points in the return series. This provides confirmation that leverage is contributing to the volatility observed in crypto-asset markets.

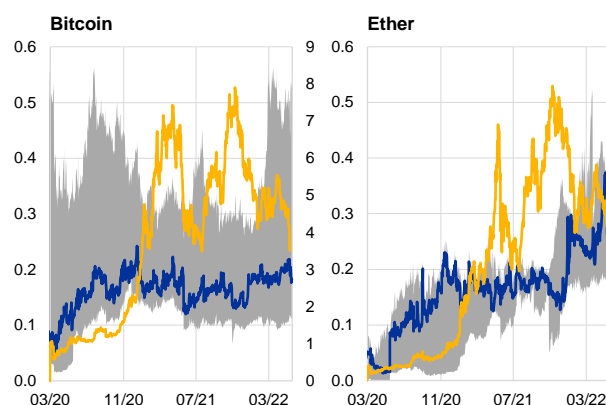
Chart B.3

Increased use of leverage points to higher risk-taking

a) Leverage estimates and indexed price growth of Bitcoin and Ether **b) Short and long liquidations in Bitcoin positions**

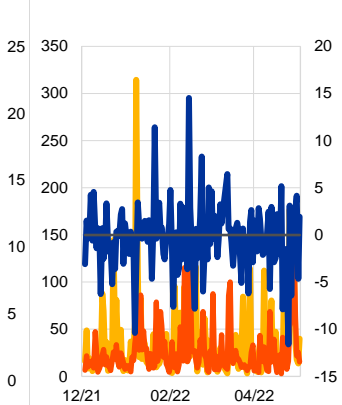
(Mar. 2020-May 2022, ratio, percentages)

■ Median leverage
■ Indexed price growth (right-hand scale)
■ Interquartile range



(Dec. 2021-May 2022, € millions; percentages)

■ Bitcoin returns (right-hand scale)
■ Long liquidations
■ Short liquidations



Sources: Glassnode, Laevitas and ECB calculations.

Notes: The estimated leverage ratio is calculated as (open interest of the exchange) / (reserve of the exchange). The following exchanges are covered for Bitcoin: Binance, Bitfinex, BitMEX, FTX, Huobi, Kraken and OKEx; and for Ether: Binance, Bitfinex, Huobi, Kraken and OKEx. The result shows how much leverage traders are using on average. A higher ratio indicates that more investors are taking higher leverage risks.

Crypto lending in the search for yield

Although crypto lending¹⁶⁹ (borrowing fiat money or other crypto-assets by using crypto-assets as collateral) is still limited, it has grown considerably.

Investors can earn interest on their digital asset holdings, usually at a higher rate than they can obtain from a bank (**Chart B.4**, panel b), by lending their assets out or

¹⁶⁹ See also the definition given in Table 1 of the updated “[Assessment of Risks to Financial Stability from Crypto-assets](#)”, Financial Stability Board, February 2022: “By using smart contracts, users can become lenders or borrowers on DeFi platforms. Users typically post crypto-assets as collateral and then can borrow other crypto-assets”.

borrowing against their digital asset holdings through overcollateralisation.¹⁷⁰ This crypto lending is offered by both centralised and decentralised service providers and usually takes place without any formal supervision or regulatory checks and balances, such as the need to provide a credit score. Loan-to-value (LTV) ratios, which are voluntarily set by the holders of the governance tokens of a DeFi application, are set quite low to mitigate risks (typically in the range of 25-50%) considering the high volatility of crypto. Crypto credit on DeFi platforms grew by a factor of 14 in 2021, while the total value locked¹⁷¹ was hovering at around €70 billion (**Chart B.4**, panel a) until very recently, on a par with small domestic peripheral European banks. Crypto lending has spurred “yield farming” investment strategies such as incentivising investors to lend their crypto-assets to a pool that helps provide liquidity to DeFi systems, while offering potential investors the highest possible returns at all times. Currently, the crypto-asset deposit/lending industry is still quite small compared with traditional banking, although it could continue to grow rapidly.

Crypto lending may fall under existing financial regulation and has come under increased regulatory scrutiny. In the United States, the Securities and Exchange Commission (SEC) fined the centralised BlockFi service USD 100 million for failing to register the offers and sales of its retail crypto lending product as required under US securities law.¹⁷² Previously, Coinbase dropped the launch of a new lending product following SEC warnings that it constituted an unregistered security. Although such cases are still unknown in the EU, these developments show that regulation is, in principle, technology-neutral. DeFi platforms that mimic traditional financial services would do well to ensure they comply with existing EU financial regulation before offering their services to EU clients to avoid the risk of any legal action.

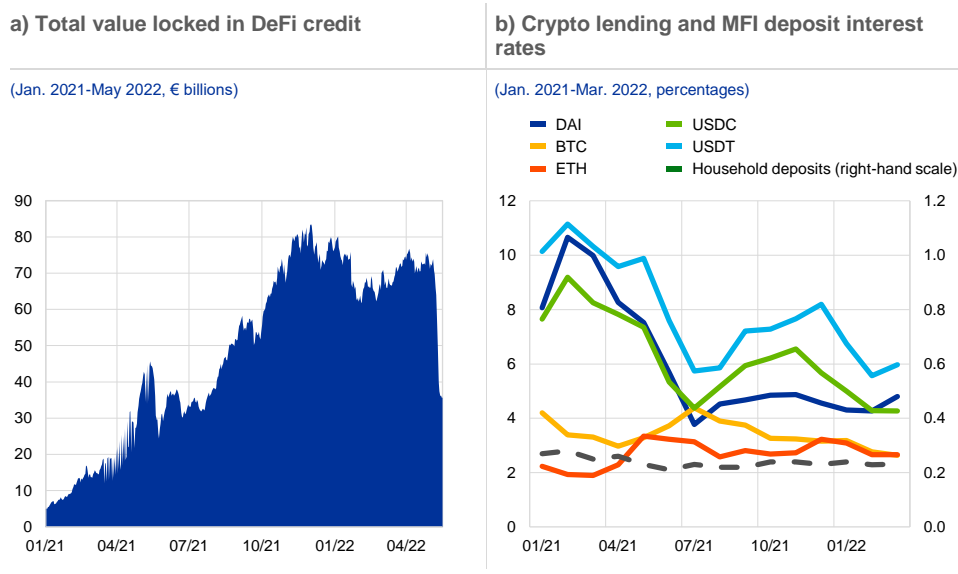
¹⁷⁰ Although it seems rather counterintuitive, users facing unforeseen funding needs may prefer not to sell their holdings, as they expect the crypto-asset to increase in value in the future. Another advantage of borrowing is potentially avoiding or delaying the payment of capital gains taxes. Lastly, individuals can use funds borrowed via such platforms to increase their leverage on certain trading positions.

¹⁷¹ Total value locked represents the sum of all assets deposited in DeFi protocols earning rewards, interest, new coins and tokens, fixed income, etc.

¹⁷² See the press release entitled “[BlockFi Agrees to Pay \\$100 Million in Penalties and Pursue Registration of its Crypto Lending Product](#)”, US Securities and Exchange Commission, 14 February 2022.

Chart B.4

DeFi credit is currently small but is growing rapidly as investors search for yields above bank deposit rates



Sources: DefiLlama, Compound, DeFi Rate, ECB MFI MIR and ECB calculations.
Notes: Panel a: total value locked might be overestimated due to reuse of tokens. Panel b: crypto lending rates are calculated as the average of the 30-day average offered interest rate in 13 DeFi and CeFi (centralised) platforms. Not all platforms offer lending for all of the selected crypto-assets. Abbreviations are as follows: stablecoins: Tether (USDT), Dai (DAI) and USD Coin (USDC); unbacked crypto-assets: Bitcoin (BTC) and Ether (ETH). The deposit rate is the average interest rate offered by monetary financial institutions (MFIs) in the euro area to households and non-profit organisations.

Rehypothecation (where collateral for a loan can be re-pledged in order to obtain another loan)¹⁷³ increases the chances of a breach of LTV limits and could cause liquidity to vanish very quickly in the case of a big shock. The high volatility of crypto-assets means that LTV limits may be exceeded in a market downturn and that more collateral needs to be posted by borrowers, who could potentially lose that collateral. In addition, if borrowers are not able to pay back their loans, investors may seek to withdraw their funds in a panic, potentially leading to an investor run. The likelihood of such a run could be exacerbated by the high degree of concentration in liquidity provision in decentralised protocols. As they are outside the regulatory perimeter, there is no guarantee in such instances that investors would get their money back (or borrowers their collateral) as they would in the case of a bank deposit, given the existence of deposit guarantee schemes. This reflects the lack, in many cases, of investor protection regulation, the highly technical and fast-moving nature of the market segment, and the use of different tokens in terms of assets purchased, collateral posted or interest paid. Although the risks are currently small, they could rise significantly if platforms started to offer services to the real economy, instead of remaining confined to the crypto universe. In such a scenario, a decline in value of the collateral could lead to margin calls, borrower/lender defaults and reduced borrowing, potentially affecting economic activity (particularly if crypto-assets were used as collateral for consumer and business loans).

¹⁷³ As an example, borrowers can pledge crypto to obtain a stablecoin loan. This loan can be used as collateral in another liquidity pool in exchange for liquidity pool tokens, which are, in effect, a form of derivative. The liquidity pool tokens can be pledged in yet another liquidity pool to obtain another stablecoin loan, and so on.

Conclusions

The nature and scale of crypto-asset markets are evolving rapidly, and if current trends continue, crypto-assets will pose risks to financial stability.

While interconnectedness between unbacked crypto-assets and the traditional financial sector has grown considerably, interconnections and other contagion channels have so far remained sufficiently small. Investors have been able to handle the €1.3 trillion fall in the market capitalisation of unbacked crypto-assets since November 2021 without any financial stability risks being incurred. However, at this rate, a point will be reached where unbacked crypto-assets represent a risk to financial stability.

Systemic risk increases in line with the level of interconnectedness between the financial sector and the crypto-asset market, the use of leverage and lending activity. Based on the developments observed to date, crypto-asset markets currently show all the signs of an emerging financial stability risk. It is therefore key for regulators and supervisors to monitor developments attentively and close regulatory gaps or arbitrage possibilities. As this is a global market and therefore a global issue, global coordination of regulatory measures is necessary.

It is important to close regulatory and data gaps in the crypto-asset ecosystem.

In the EU, the MiCA Regulation should be approved by the co-legislators as a matter of urgency to ensure it is applied sooner rather than later. However, MiCA is only a first step. The sectoral regulations will need to be reviewed to ensure financial stability risks posed by crypto-assets are mitigated. Any further steps that allow the traditional financial sector to increase its interconnectedness with the crypto-asset market space should be carefully weighed up, and priority should be given to avoiding financial stability risks. This holds in particular when considering interconnections with parts of the financial system that are strictly regulated and benefit from a public safety net. Data gaps should be closed. The challenges faced in monitoring financial stability risks from crypto-assets developments and interconnectedness with the traditional financial sector will persist as long as there are no standardised reporting or disclosure requirements.¹⁷⁴

¹⁷⁴ The Financial Stability Board's 2022 Data Gaps Initiative envisages the development of prospective data collections for crypto-assets. Some statistical initiatives are also geared towards the appropriate treatment and possible identification of crypto-asset activities and players.

Acknowledgements

The Financial Stability Review assesses the sources of risks to and vulnerabilities in the euro area financial system based on regular surveillance activities, analysis and findings from discussions with market participants and academic researchers.

The preparation of the Review was coordinated by the ECB's Directorate General Macprudential Policy and Financial Stability. The Review has benefited from input, comments and suggestions from other business areas across the ECB. Comments from members of the ESCB Financial Stability Committee are gratefully acknowledged.

The Review was endorsed by the ECB's Governing Council on 18 May 2022.

Its contents were prepared by Katharina Cera, Nander de Vette, John Fell, Sándor Gardó, Benjamin Klaus, Julian Metzler, Benjamin Mosk, Tamarah Shakir, Manuela Storz, Eugen Tereanu, Josep M. Vendrell Simón and Jonas Wendelborn.

With additional contributions from Luca Bacciarelli, Emil Bandoni, Markus Behn, Paul Bochmann, Othman Bouabdallah, Lorenzo Cappiello, Olimpia Carradori, Dimitris Drollas, Michal Dvořák, Linda Fache Rousová, Maciej Grodzicki, Margherita Giuzio, Matilda Gjirja, Lieven Hermans, Paul Hiebert, Barbara Jarmulska, Sujit Kapadia, Jan Hannes Lang, Francesca Lenoci, Marco Lo Duca, Giulio Mazzolini, Barbara Meller, Luca Mingarelli, Seán O'Sullivan, Lorenzo Pangallo, Rita Periquito da Fonseca, Allegra Pietsch, Aurea Ponte Margues, Petya Radulova, Ellen Ryan, Julius Schneider, Martina Spaggiari, Mika Tujula, Dominik Vu, Michael Wedow, Christian Weistroffer and Balázs Zsámboki.

Editorial, multimedia and production assistance was provided by Anna Heckler, Will Knowles, Peter Nicholson, Katie Ranger, Simon Spornberger and Sophia Suh.

© European Central Bank, 2022

Postal address 60640 Frankfurt am Main, Germany
Telephone +49 69 1344 0
Website www.ecb.europa.eu

All rights reserved. Reproduction for educational and non-commercial purposes is permitted provided that the source is acknowledged.

For specific terminology please refer to the [ECB glossary](#) (available in English only).

PDF ISSN 1830-2025, QB-XU-22-001-EN-N
HTML ISSN 1830-2025, QB-XU-22-001-EN-Q