

ASSESSMENT OF RISKS TO THE FRENCH FINANCIAL SYSTEM

JUNE 2022



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Overview

Russia's invasion of Ukraine is contributing to a downturn in the global macroeconomic environment by exacerbating pre-existing inflationary pressures and dimming growth prospects, which remain however positive in the baseline scenario of Banque de France macroeconomic projections. Price increases on commodity markets – particularly energy markets – are the main transmission channel in terms of both growth and inflation. The effects of the war in Ukraine are compounded by uncertainty over the Chinese economy, at a time when supply challenges in place since the health crisis continue to plague every link in the production chain.

Against this backdrop of higher inflation, rising interest rates in the euro area and elsewhere in the world, driven by monetary policy normalisation, represent the key factor of influence impacting the French financial system in the first half of 2022. It will be primarily through the lens of this shift and the outlook for interest rates that we review vulnerabilities of the French financial system in order to assess its risks.

French banks and insurers continue to boast high solvency and liquidity levels, enabling the former to absorb the economic consequences of the war connected with a deterioration in the credit quality of some exposures. These essentially include exposures to non-financial firms with the greatest sensitivity to higher commodity prices and inflation. The initial effects of the geopolitical shock to the French financial system were tempered by the system's modest direct exposure to Russia and Ukraine.

Normalisation, and thus an orderly increase in interest rates, should boost the net interest margin of French banks, although it may exert a negative impact on fair value portfolios during the transition phase. Higher interest rates will also improve the return on insurers' future investments, but could introduce an increased risk of investors surrendering life insurance investments to take advantage of higher rates of return. This risk has yet to materialise, and insurers enjoy a sufficiently solid liquidity position to cope should it arise.

Interest rates are going up at a time when the outstanding consolidated gross debt of French non-financial corporations (NFCs), despite shrinking since mid-2021, remains relatively high when considered in a Europe and international comparison. While market financing rates for French companies are rising, with yields for the lowest-rated companies showing an especially pronounced increase, volumes of issuances via the bond market do not indicate any particular difficulties in accessing market financing, apart from a slowdown in issuances by these speculative-grade NFCs. Since their debt maturity profile is spread over time and as much of their borrowing is at fixed rates, French NFCs should be resilient to additional interest rate increase.

The government deficit is expected to be on a downward trajectory in 2022 and 2023, although the size of the reduction will be restricted by new budget measures, particularly connected with cushioning the effects of the war in Ukraine. As sovereign yields rise, the debt burden is expected to go up steadily in France and all euro area countries, albeit with more marked growth for certain euro area sovereign debts. The Governing Council of the Eurosystem is particularly attentive to this risk of fragmentation, which will be mitigated by tools intended to ensure the adequate transmission of monetary policy.

On the whole, households continue to enjoy a favourable situation in terms of their financial savings. Short-term vulnerabilities for the household sector remain contained at this stage. The solvency risks to indebted households linked to higher interest rates remain extremely low, since virtually all home loans are at fixed rates in France. In addition, access to credit remains favourable. Despite the normalisation of benchmark market rates, interest rates on home loans remain historically low at this stage and new loan production is extremely high, while credit standards for home loans have been significantly strengthened through decisions taken by France's *Haut Conseil de Stabilité Financière* (HCSF – High Council for Financial Stability).

Given the geopolitical environment, vigilance is also being stepped up to guard against the risk of a systemically important cyberattack. A thematic chapter of this report is devoted to cyber risk and provides an overview of the threat before discussing its potentially systemic dimension and discussing regulatory and other responses.

A second thematic chapter looks at commodity markets, in view of their central role in the developments of the last six months. It describes the mechanisms underpinning the surge in prices for each commodity type, and discusses the importance of the role played by derivatives on commodity markets and the financial linkages

between different categories of participants on derivatives markets. The financial stability challenges connected with the functioning of these markets, notably in connection with the liquidity stress observed in March 2022 due to margin calls, are significant and require adequate responses, including at regulatory level, to protect against new shocks going forward. In this respect, current price developments in energy commodities highlight the macrofinancial risks linked to the transition to a carbon-neutral economy. The transition is expected to be accompanied by rising fossil fuel prices, with the Network for greening the financial system (NGFS) scenarios predicting that they will double at least; this increase will be compounded by pressures on availability and/or prices of commodities, such as ores, needed for the transition. The increase in commodity prices (and hence in inflation) will be even larger and on a par with the trends seen over the last six months if the transition is delayed or disorderly. The final portion of the cross-cutting analysis addresses these aspects by examining the climate challenges raised by current developments.

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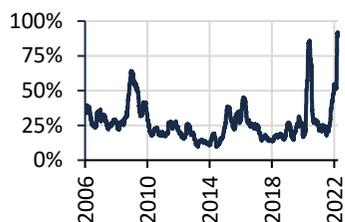
CYCLICAL

STRUCTURAL

Market risks linked to the macroeconomic downturn

- Elevated valuations
- Sensitivity to higher interest rates
- Leverage and difficulties in meeting margin calls

Energy price volatility



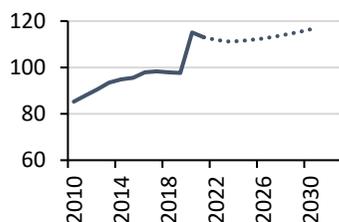
- Limited exposure to Russia and Ukraine
- Robust market infrastructures

➔ ST

Tensions in refinancing conditions

- Pressure on market interest rates
- NFC gross debt is high but features wide variations
- Very high government debt

Government debt projection



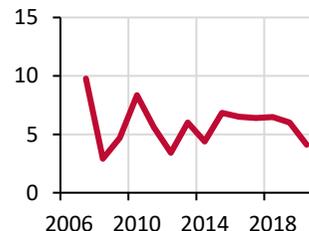
- Macroprudential measures addressing bank exposures to NFCs
- Limited nexus between banks and sovereign in France
- High solvency levels of financial intermediaries

➔ ST

Pressures on the profitability of financial intermediaries

- Exposures to energy-dependent sectors
- Effects of inflation and the slowdown
- Cost of the digital transition

Return on Equity, banks



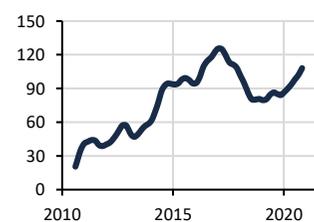
- Strong earnings posted by financial institutions
- Orderly interest rate increase

➔ ST

Cyber threats exacerbated by the geopolitical crisis

- Increased digital area of exposure
- Widespread risk in current geopolitical setting

Cyber risk trend on Twitter



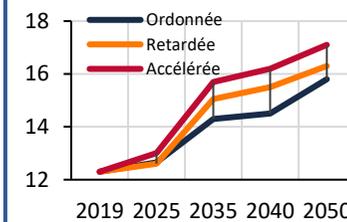
- Crisis exercises
- Regulatory work
- Operational preparations

➔ ST to LT

Climate change-related exposures

- Risk that the financial sector could be weakened by an insufficient response to an accelerated transition

Cost of risk



- Domestic efforts and European coordination
- Climate stress test exercises

➔ MT to LT

Measures taken by authorities

In response to the war in Ukraine and in coordination with the G7, the European Union (EU) has imposed six sets of sanctions on Russia. These apply to financial entities and include asset freezes on the Central Bank of Russia, several Russian commercial banks and over 500 oligarchs, a ban preventing several Russian and Belarusian banking groups from using the SWIFT interbank messaging network, restrictions on access to the European capital market, and a ban on transactions in certain financial instruments, such as Russian sovereign bonds. The sanctions also apply to the wider economy and include a ban on importing certain commodities, such as coal, iron, metal, wood and cement, and on exporting certain sensitive goods, including maritime, space and aviation technologies.¹ The sixth set of sanctions adopted in early June by the EU also includes a 90% reduction in imports of Russian oil by the end of 2022 and a ban on insuring ships that carry Russian oil. The ACPR is making sure that the entities under its supervision implement these measures properly and that they have arrangements in place to manage the risks connected with the conflict. The Banque de France, meanwhile, is providing technical and operational expertise to prepare and implement the sanctions. It is also taking part in international discussions, particularly within the G7, aimed at anticipating potential efforts to circumvent the sanctions, for example through increased use of crypto-assets, as well as the consequences of the sanctions for financial stability.

To respond to disruptions on the global energy market, the EU put forward its REPowerEU plan, which is designed to reduce energy dependence on Russia. It has three key components: i) step up energy efficiency targets, ii) diversify energy supply sources, notably by setting up an EU-wide joint purchasing mechanism, and iii) accelerate the energy transition, for example by doubling solar photovoltaic capacity through the EU Solar Energy programme.

In order to maintain medium-term price stability, the ECB announced that it will gradually normalise monetary policy while remaining on guard for fragmentation risks. One effect of Russia's invasion of Ukraine has been to sharply speed up the increase in energy prices, which is exacerbating pre-existing inflationary pressures, even if these remain milder in France than elsewhere in the euro area. The process of policy normalisation applies to all of the ECB's instruments. For example, net asset purchases under the [pandemic emergency purchase programme \(PEPP\)](#) implemented during the Covid-19 crisis ended in March. The ECB will conclude its net asset purchases under the [asset purchase programme \(APP\)](#) on 1 July. The special conditions applied to Targeted Longer-Term Refinancing Operations (TLTRO III) ended on 23 June 2022. Last but not least, the ECB announced its intention to raise policy rates by 25 basis points in July, and the Governing Council is planning a further hike in September 2022. To address the risk of bond market fragmentation, and in order to preserve the functioning of the monetary policy transmission mechanism, the Governing Council agreed at an ad hoc meeting on 15 June to apply flexibility in reinvesting redemptions coming due in the PEPP portfolio and to accelerate the completion of the design of a new anti-fragmentation instrument.

However, authorities are continuing to support non-financial participants as they cope with the economic shock caused by the war in Ukraine. The most heavily indebted entities may face financing pressures, notably following the increase in nominal interest rates due to the impact of inflation expectations. In April 2022, the French government presented a resilience plan to support the cash positions of companies affected by the war. These firms are entitled to access state-guaranteed "resilience" loans covering up to 15% of their average annual turnover over the previous three years. These loans may be taken out in addition to loans obtained through the state-guaranteed lending scheme set up during the Covid-19 crisis. Access to equity loans was extended to the end of 2023 in order to continue providing support to the equity of French companies. For households, the government set up a price shield capping the annual increase in electricity prices in 2022 at 4%, freezing gas prices over the winter and providing assistance to help cope with higher fuel prices, including a 15-centime discount excl. VAT per litre of fuel and EUR 100 energy vouchers.

¹ A full list of the goods and services subject to European import and export restrictions can be found [here](#).

The financial sector continues to be capable of coping with the vulnerabilities associated with increased debt. Banks and insurers enjoy robust levels of solvency. The revision of European regulations for banks and insurers, via European Commission proposals that are currently being discussed in European bodies and covering the CRR3/CRD6 Regulation and Directive for banks and the Solvency II Directive for insurers, should help to strengthen financial stability further still.

In France, the HCSF also decided at its March 2022 meeting to raise the countercyclical buffer (CCyB) from 0% to 0.5%. The HCSF judged that, after the exceptional circumstances linked to the Covid-19 crisis justified releasing the CCyB, so current economic and financial conditions now justified normalising the buffer by taking it back to its pre-crisis level. This followed the decision by the HCSF to extend the measure limiting the exposure of systemically important banks to the most heavily indebted major companies until June 2023, and the decision to turn the recommendation on credit standards for home loans into a legally binding standard from 1 January 2022. Specifically, the recommendation states that, in 80% of loan production, the debt-service-to-income ratio shall not exceed 35% and the credit period shall not exceed 25 years.²

The war in Ukraine has led to an increase in cyber risk, including for the financial system. The Banque de France and the ACPR are taking part in several international, European and domestic initiatives to bolster the resilience of the financial system, which is becoming more sensitive to cyber risk with the growing digitalisation of financial services. Oversight of SWIFT has been strengthened, with special attention being accorded to cyber risk. The draft Digital Operational Resilience Act (DORA) currently being negotiated at European level is intended to harmonise the management of cyber risk by participants in the financial system and to set up a framework for the direct oversight of critical IT services providers by the European Supervisory Authorities. At national level, the Marketwide Robustness Group, which is chaired by the Banque de France, conducts regular crisis exercises to improve coordination between participants. As part of cyber risk prevention, the Banque de France and the ACPR are in regular contact with France's *Agence nationale de la sécurité des systèmes d'information* (ANSSI – National Cybersecurity Agency) on developments in relation to the threat, and conduct regular documentary audits and on-site inspections at financial institutions to assess their management of the risk.

Regarding the implications of climate change for financial stability, the authorities are increasingly taking account of the adverse effects for the financial sector associated with physical and transition risks. In January 2022, the ECB announced [the launch of its first climate stress test for the banking sector](#), after naming climate risk as one of its prudential priorities for FYs 2022 to 2024. The results are expected to be published in July 2022. This initiative will supplement the findings obtained by the ACPR from its pilot climate stress test, whose results were published in 2021. The Banque de France is also supporting regulatory work on sustainable finance, including adoption of the Corporate Sustainability Reporting Directive (CSRD) and the European regulation establishing a label for green bonds (EuGBS), which will supplement the obligations set out under the Regulation on Sustainability-related Disclosures in the Financial Services Sector (SFDR). These different pieces of legislation, which are intended to increase the transparency of climate-related disclosures, will round out the classification created by the European regulation on a taxonomy for environmentally sustainable activities; they must help to do a better job of measuring the risks associated with climate change and mobilising the financing needed to support the transition, while at the same time limiting greenwashing risk.

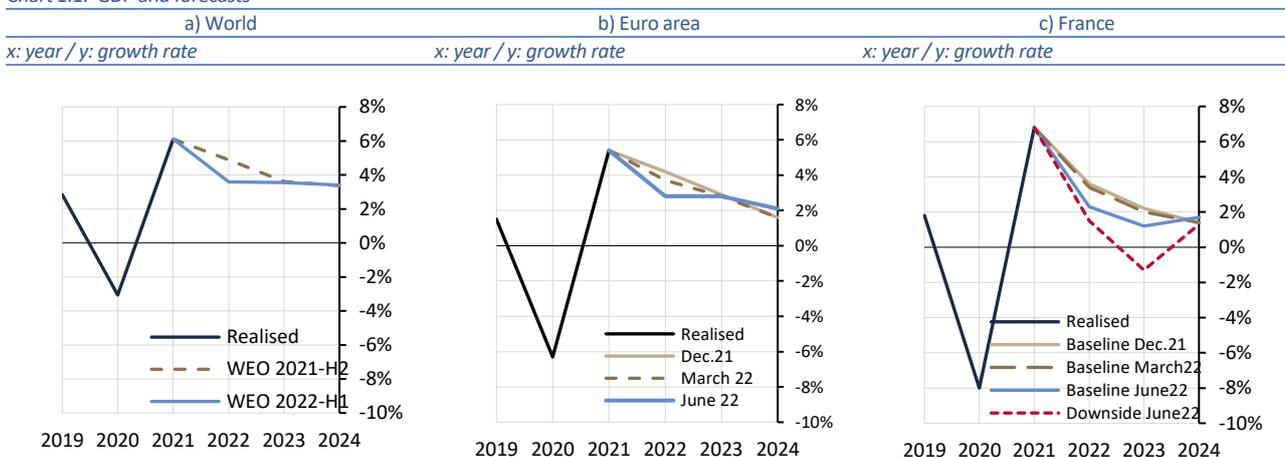
² [HCSF Decision of 29 September 2021](#)

1. Cross-cutting analysis of vulnerabilities

1.1 The war in Ukraine is weighing on macroeconomic trends

Russia's invasion of Ukraine is contributing to a downturn in the global macroeconomic environment by exacerbating pre-existing inflationary pressures and dimming growth prospects. The economic outlook was extremely bright prior to the conflict, with France recording a growth rate of 6.8% in 2021. With the outbreak of war, growth forecasts have been revised downwards. The International Monetary Fund (IMF) expects the global economy to expand by 3.6% in 2022, compared with 4.4% previously (cf. Chart 1.1). According to [ECB macroeconomic projections published in June](#), the euro area is expected to see an even sharper slowdown, with growth put at 2.8%, compared with a pre-war forecast of 4.2%. Meanwhile, the Banque de France's [baseline scenario published in June](#) is for the French economy to grow by 2.3% in 2022, down from the forecast of 3.6% at the start of the year. In the downside scenario, however, the growth rate drops to 1.5%³. The revisions are due to several factors. Besides the uncertainty created by the war, the surge in commodity and energy costs is depressing the outlook for activity. The prospects are being further impacted by supply chain disruptions, which have been made more acute by the reimposition of health-related restrictions in China (cf. Chart 1.2).

Chart 1.1: GDP and forecasts



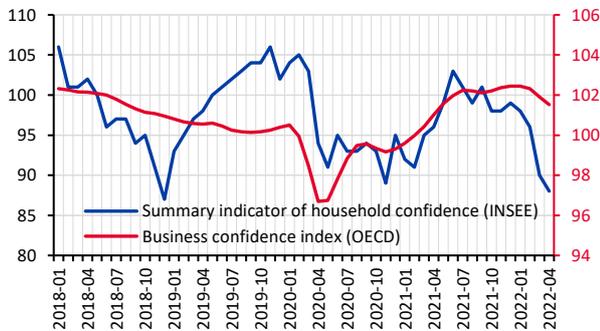
Source: (a) IMF World Economic Outlook, (b) ECB and (c) Banque de France.

The commodities market, particularly the energy market, is acting as the main transmission channel for the shock, given the heavy reliance on Russian exports for key commodities. Uncertainty linked to the war is being amplified by the dependence of parts of Europe on Russian exports of gas and, to a lesser extent, oil. Trade relations between France and Russia are relatively minor, with imports from Russia worth EUR 10.1 billion and exports to Russia totalling EUR 6.4 billion in 2021 according to [customs directorate general](#). For the euro area as a whole, imports from Russia make up 3.9% of non-euro area imports (0.9% of euro area GDP), while exports to Russia make up 2.9% of non-euro area exports (0.6% of euro area GDP). However, these trade exchanges are tightly focused on certain products, leading to specific but critical dependencies. For example, hydrocarbons make up over 70% of European imports from Russia (cf. Chart 1.3). Imports of Russian gas made up 43.9% of EU gas imports in 2020 and 46.8% in the first quarter of 2021, with wide variations across countries in terms of their reliance. In monetary value terms, imports from Russia of oil and related products were worth approximately EUR 72 billion in 2021 compared with just over EUR 21 billion for gas.

³ this downside scenario assumes that all European imports of Russian oil and gas would be brought to a complete halt as from the third quarter of 2022, and additional, exceptionally strong pressures on oil and gas prices. Furthermore, the prolongation of the conflict and its effects on uncertainty would also weigh on domestic demand as well as on international trade, financial conditions and food prices. Lastly, we also assume that policies will not change and do not take into account any additional measures that could be introduced by governments (aside from automatic stabilisers).

Chart 1.2: Household and business confidence indicator, France

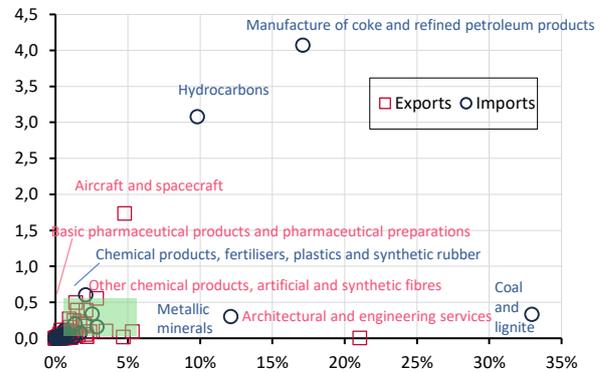
x: month / y: index



Source(s): INSEE, OECD.

Chart 1.3: French exports and imports, by sector in 2021

x: Russia's share of the affected sector, as a % /
y: transactions with Russia in EUR billion



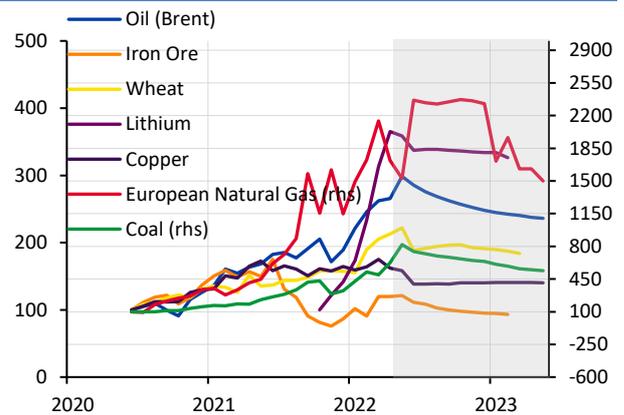
Note: The green box shows sectors with the fewest ties to Russia (less than EUR 500 million in transactions with Russia and less than 5% of all sector transactions)

Source(s): French customs; Banque de France calculations.

The war in Ukraine has amplified pre-existing pressures on energy and commodity markets. Driven by the vigorous economic recovery in 2021, energy and commodity prices had already risen considerably before the war, with increases in 2021 of 15% for agricultural commodities, 22% for metals, 73% for energy, including 56% for Brent and 290% for European natural gas⁴. Prices surged even further with the invasion of Ukraine, owing to Russia's presence on energy and commodity markets (cf. Chart 1.4). Prices went up sevenfold for European natural gas and by a factor of 1.6 for Brent between March 2021 and March 2022, climbing to EUR/Megawatt-hour 129 and USD/barrel 114 respectively on the 27th of June 2022. Setting these developments in a historical perspective, for now the oil price swings remain smaller than those observed during the 1973 and 1979 oil shocks.⁵

Chart 1.4: Commodity prices

x: year / y: 1 January 2020 = 100



Note: Energy, commodity and agricultural product prices. The curves in the greyed area show the value of forward sales on the futures market.

Source(s): Bloomberg.

If the war in Ukraine drags on, or in the event of additional sanctions, prices could be higher and more volatile for longer than currently expected. Russian natural gas additionally plays a key role in the manufacture of fertilisers, of which Russia and Ukraine are both significant exporters: higher fertiliser prices (220% increase between April 2020 and March 2022) could have an amplifying effect on food prices (84% increase over the same period: oil & flour components (+122%), grains (+68%), other foods (+55%)), with major humanitarian and economic consequences (cf. below on emerging countries). A thematic chapter is devoted to commodity markets.

The effects of the war in Ukraine are compounded by uncertainties linked to Chinese economic conditions, in an environment that continues to be marked by the health crisis.

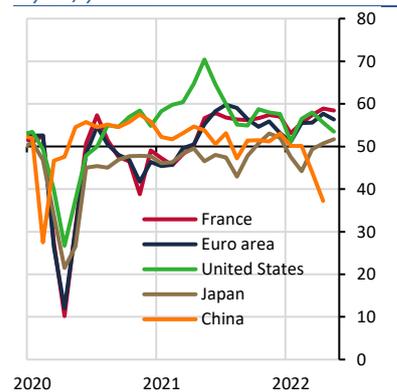
⁴ World Bank (2022), « Commodity Markets Outlook », April.

⁵ At the height of those crises, prices quadrupled during the first shock and jumped by a factor of 2.7 during the second.

Activity indicators in China (purchasing managers indices) have been contracting since March (cf. Chart 1.5), owing to lockdown measures, although they picked up in May. In its [last macroeconomic projections](#), the IMF revised its growth forecasts for China to 4.4% in the first quarter of 2022, compared with 5.6% previously. This reflected the deterioration in the health situation, with, in particular, the decision by Chinese authorities to lock down several major cities, including Shanghai, and also the real estate crisis, which has the potential to trigger a major economic slowdown. In addition, lockdowns in the first half of 2022 in China may have exacerbated the strain on supply chains, according to the last [Banque de France survey on business conditions in France](#) (cf. Section 1.3 on French businesses), to a degree that is so far uncertain, pushing growth down and inflation up elsewhere in the world.

Chart 1.5: Composite purchasing managers index

x: year / y: index



Source: Markit.

The war in Ukraine and lockdown measures in China have also magnified and expanded the surge in producer prices that was initially stoked by higher energy and commodity prices, causing it to spread to consumer prices.

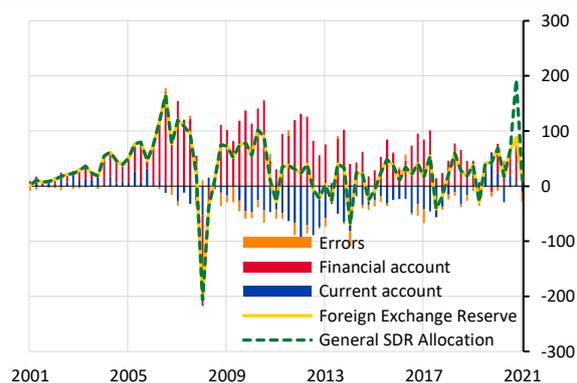
Slacker growth and rising inflation are creating a slow-flationary⁶ shock, whose scale and duration remain highly uncertain at this stage. Besides a more moderate rebound for the euro area economy, the baseline scenario also includes stronger and more persistent inflation, set at 6.8% in 2022, 3.5% in 2023 and 2.1% in 2024. For France, the inflationary numbers are slightly less unfavourable, at 5.6% in 2022, 3.4% in 2023 and 1.9% in 2024, owing to the price shield measures introduced by the government in early 2022, which include a cap on the increase in energy prices (4% maximum for electricity and gas prices frozen over the winter). Even so, the major medium-term risk for price stability has changed radically in the past few months: the main risk is no longer that inflation will be too low for too long but rather that it might be too high for too long.

For many emerging countries, the war in Ukraine represents a shock that is compounding tighter US monetary policy.

The supply-side shock caused by reduced exports from Russia and Ukraine affects emerging countries in differing ways, with serious food security consequences for the countries that are most dependent on Russian and Ukrainian grain exports (cf. chapter on commodities). This shock could exacerbate inflationary pressures that were already present in 2021. At the same time, domestic and external financing conditions are tightening due to the impact of inflation and higher interest rates on reference markets. For now, however, the initial policy rate hikes and expectations of additional tightening, especially in the United States, have not had significant impacts in terms of a contraction in capital flows to emerging economies as a whole.

Chart 1.6: Aggregate balance of payments, emerging countries (excl. China)

x: year / y: USD billion



Sources: IMF IFS database, Banque de France calculations. Most recent values, Q4 2021.

Finally, given the geopolitical environment, vigilance is also being stepped up to guard against the risk of a systemically important cyberattack, at a time when the growing digitalisation of the economy and financial services has been accompanied by new vulnerabilities over the last decade. The frequency and costs of cyber incidents have been rising in recent years, yet risk measurement is plagued by multiple difficulties. The financial

⁶ Economic state characterized by slow growth and high inflation

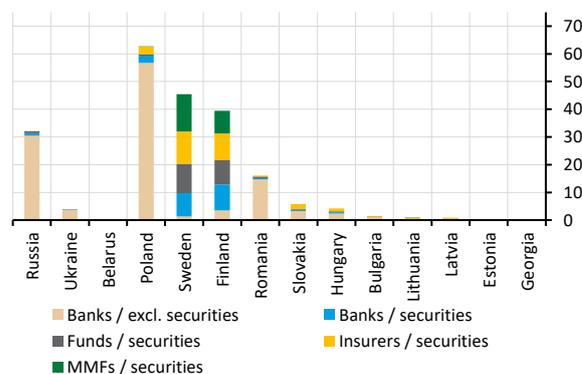
sector is a preferred target for malicious actors. A chapter in this report on cyber risk explains to what extent cyber risk could in certain circumstances have a systemic impact on the financial sector and describes recent and ongoing regulatory developments aimed at addressing the related challenges.

1.2 The French financial system has stood up to the shock

The initial effects of the geopolitical shock on the French financial system were tempered by the system's modest direct exposure to Russia and Ukraine. In the first quarter of 2022, the direct exposures of French banks to Russia (Ukraine) totalled approximately EUR 29 billion (EUR 2.4 billion) - cf. Chart 1.7, or 0.3% (0.03%) of the total consolidated exposures of French banks and approximately 30% of the [exposures of European banks](#). In April, Société Générale sold its Russian retail banking subsidiary, Rosbank, which reduced the direct exposures of the French banking sector. At end-2021, exposures to Russia and Ukraine stood at less than EUR 1 billion for French insurers and less than EUR 1 billion for French funds⁷. However, indirect exposures also need to be considered, such as exposure to customers that are themselves exposed to risk in relation to Russia (cf. below).

Chart 1.7: Exposures of the French financial sector to eastern and northern European countries

x: country / y: EUR billion



Source(s): SHS-S, Banque de France calculations.

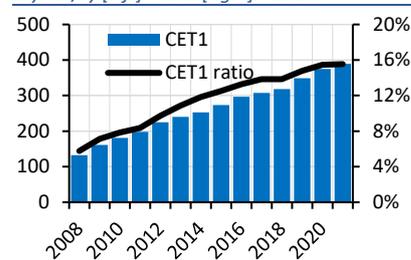
Note: Exposures of French financial institutions to securities issued in eastern and northern European countries, by issuer category, end-2021.

French banks continue to boast high solvency and liquidity levels.

The aggregate Common Equity Tier 1 (CET1) solvency ratio of France's six main banking groups⁸ stood at 15.5% at end-2021, slightly up on the end of 2020 (cf. Chart 1.8). The 4.0% increase in CET1 in 2021, driven by dividend retention in 2020 and the application of IFRS 9 transitional provisions, among other factors, offset the 3.4% increase in risk-weighted assets (RWA). However, with the rise in interest rates, the aggregate CET1 ratio changed course in the first quarter of 2022 in connection with capital losses on bond portfolios taken directly to equity. The aggregate solvency ratio stood at over 14.8%, or still well above the regulatory requirement.

Chart 1.8: CET1 ratio of France's six main banking groups

x: year / y [left]: CET1 [right]: CET1 ratio



Source: Financial reporting, ACPR calculations.

Note: The 2020 values were revised. The 2021 values are forecasts.

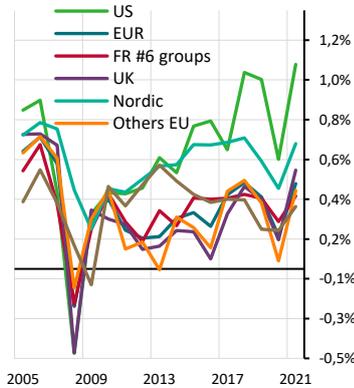
Furthermore, the average annual liquidity coverage ratio (LCR) increased over FY2021 (cf. Chart 1.11). Also, over FY2021, French banks' net income climbed by 60.5% to EUR 35.9 billion. The growth, which was partly due to increased revenue and a decrease in the cost of risk, enabled French banks to report a higher return on assets (RoA). Taking an international perspective, however, the RoA of French banks, although on a par with that of other European countries (not including Nordic countries), still lags behind that of US banks (cf. Chart 1.9). Financial data reported by the four large French banking groups on their earnings in the first quarter of 2022 point to an increase in net banking income, chiefly on the back of corporate & investment banking and retail banking performances. Net income also increased and RoA was steady.

⁷ before application of the look-through approach

⁸ BNP Paribas, Groupe Crédit Agricole, Société Générale, Banque Populaire – Caisse d'Épargne, Groupe Crédit Mutuel, La Banque Postale

Chart 1.9: RoA

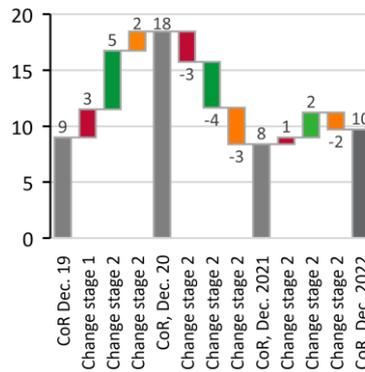
x: year / y: %



Source: Financial reporting, ACPR calculations.

Chart 1.10: Contribution of IFRS 9 categories to the cost of risk at France's six main banking groups

x: / y:

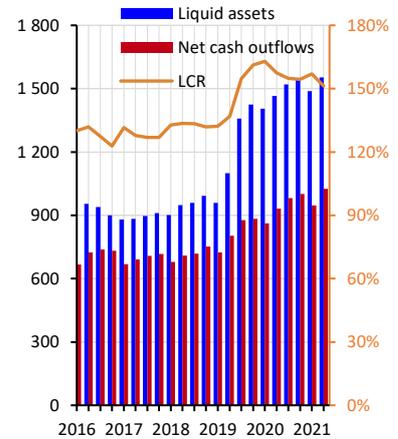


Source: ACPR, FINREP.

Note: for a precise definition of the cost of risk, see [Box 1 of Analyses et synthèses No. 104 published by the ACPR](#)

Chart 1.11: CET1 ratio of France's six main banking groups

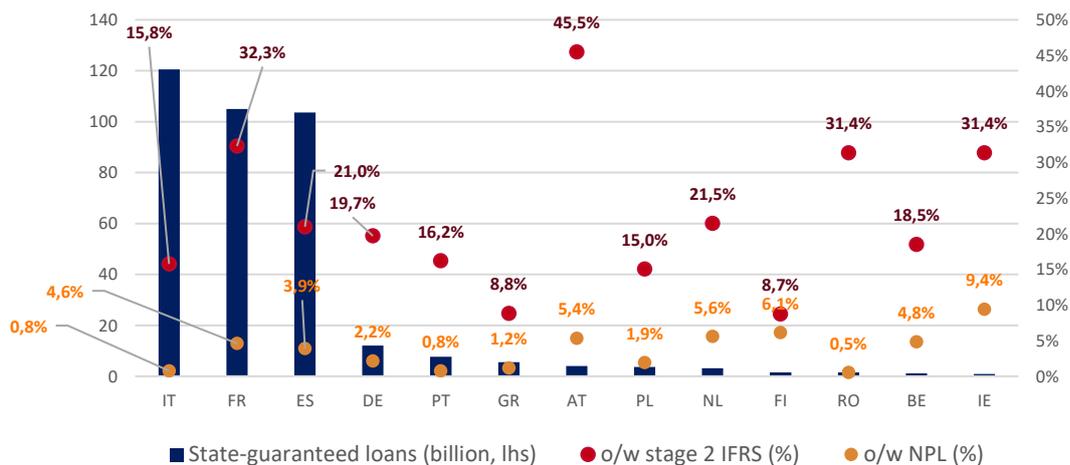
x: year / y:



Source: Financial reporting, ACPR calculations.

Over FY2021, the cost of risk declined across all IFRS 9 loan stages, while non-performing loans (NPLs) fell by value and volume. After almost doubling between 2019 and 2020, the cost of risk fell in 2021 (cf. Chart 1.10), with especially marked reductions for stage 1 and 3 loans.⁹ At the same time, the proportion of NPLs shrank to 3.4%, although there were sizeable disparities across sectors of activity. For example, NPL volumes in the accommodation and food services sectors have increased by 60% since the end of 2019. Looking at the EUR 100 billion or so in outstanding state-guaranteed loans, about one-third of loans were downgraded to stage 2, while the NPL ratio was 4.6% at end-2021 (cf. Chart 1.12).

Chart 1.12: Comparison of outstanding state-guaranteed loans of European banks (based on the country of residence of the lead company in the group) at end-2021 – by volume (EUR billion) and quality (NPL ratio and % classified as IFRS 9 stage 2)



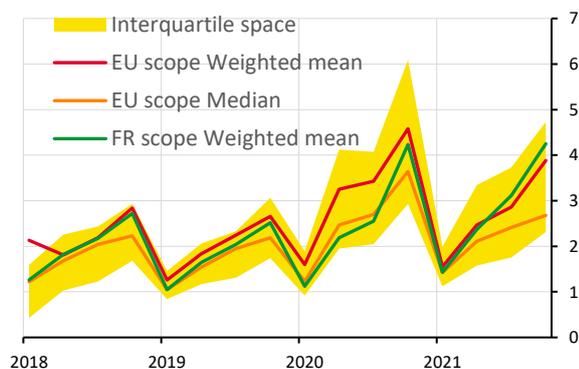
Source: EBA KRI, ACPR calculations.

⁹ The three IFRS 9 loan stages denote, respectively, loans whose credit risk has not deteriorated since they were granted, loans whose credit risk has deteriorated significantly since they were granted and loans that are totally or partially impaired.

Conversely, the proportion of loans downgraded under IFRS 9 (reclassified as stage 2 or 3) has risen since March 2021. This points to an increase in the vulnerability of the loans held by French and European banks (cf. Chart 1.13).

Chart 1.13: Banking vulnerability indicator: Proportion of loan downgrades under IFRS 9

x: year / y: Transition of outstanding stage 1 loans to stages 2 or 3 (as a %)

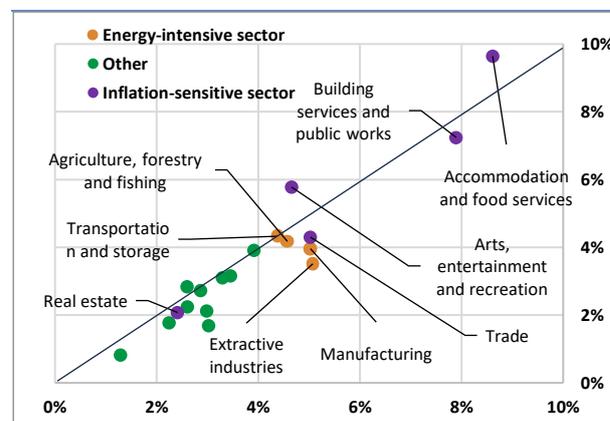


Note: cf. Methodological annex.

Source: ACPR.

Chart 1.14: Loans and advances to NFCs, by energy-intensive sector, seven largest French banking groups

x: % of NPL in 2020 / y: % of NPL in 2021



Source: FINREP reporting, ACPR restatements.

Following Russia's invasion of Ukraine, credit risks have increased for banks as growth prospects have cooled, especially for borrowers that are heavily dependent on energy supplies. French banks' exposures to sectors identified as being the most vulnerable to the conflict, including energy-intensive businesses (particularly air transport, agriculture and automotive construction) and companies that are sensitive to a stagflation shock,¹⁰ exceed their direct exposures to Russia. Loans to NFCs belonging to the most energy-intensive sectors account for over 20% of loans granted by the seven largest French banking groups.¹¹ NPL ratios among these firms remain moderate at around 4%, while those in inflation-sensitive sectors are higher and less uniform (cf. Chart 1.14). French banks are also exposed to participants that trade in energetic and agricultural products markets (1.69% of the RWA of the seven largest French banks), the energy producers (2.02% of RWA) and the utilities markets (2.06% of RWA), notably through debt instruments, loan commitments and financial guarantees (cf. chapter on commodities). Even so, the war in Ukraine did not drive a significant increase in the cost of risk in the first quarter of 2022, while banks recorded an increase in income relative to the first quarter of 2021, essentially on the back of strong performances in corporate & investment banking and retail banking.

As interest rates start rising again, banking supervisors are keeping an even closer watch on bank exposures to the most heavily indebted companies. In the first quarter of 2022, leveraged loans accounted for about 10.7% of NFC loans by the five large French banking groups, up from 9.5% at end-2019. The total outstanding amount (drawn and undrawn) increased by 29% over the period, although chiefly in 2020. It now stands at EUR 183 billion, compared with EUR 1.712 trillion in total NFC lending. The NPL ratio for these outstanding leveraged loans rose from 4.4% in late 2019 to 4.7% in the first quarter of 2022, after peaking at 5.4% in the third quarter of 2020. It exceeds the NPL ratio for non-leveraged loans to NFCs, which is 3.2%. After climbing over the first half of 2021 to peak at EUR 9.9 billion in the second quarter of 2021, NPL volumes for leveraged loans then shrank to EUR 8.6 billion in the first quarter of 2022. The provision coverage ratio for leveraged loans was 64%, compared with 51% for non-leveraged loans to NFCs.

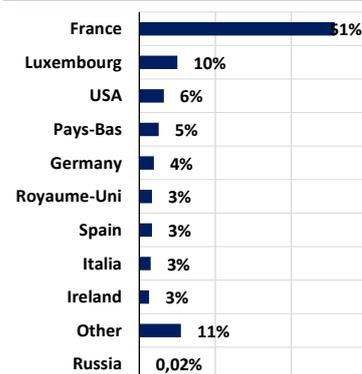
¹⁰ Stagflation refers to an economic situation where activity is stagnating but inflation is high.

¹¹ BNP Paribas, Groupe Crédit Agricole, Société Générale, Banque Populaire – Caisse d'Épargne, Groupe Crédit Mutuel, La Banque Postale, HSBC Continental Europe.

No French insurer has significant investment exposure to Russia. The total exposure of the insurance sector to Russian risk is tiny and amounted to less than EUR 500 million at end-2021, or 0.02% of the portfolio after application of the look-through approach to collective investment schemes (cf. Chart 1.15). Exposure to European funds that are themselves heavily exposed to Russia and that were suspended is also very small, at approximately EUR 50 million. Meanwhile, exposure to countries situated close to the conflict is higher but still moderate at EUR 55 billion, or around 2% of investments. These investments are concentrated in Sweden, Finland, Norway and Poland. Considered individually, some insurers are more exposed to this broad scope but exposure never exceeds 10% of the portfolio. In fact, looking at their activities outside France, few insurance groups appear to do a significant share of their business internationally. Those that are building up the international side do not have branches in Russia and do not earn premium income in Russia. In credit insurance specifically, the aggregate exposure of insurers based in France covering export credit activities involving Russian businesses amounted to less than 1% of total international exposures at end-2021.

Chart 1.15: Geographical exposure of insurers' investments

x: % / y: country



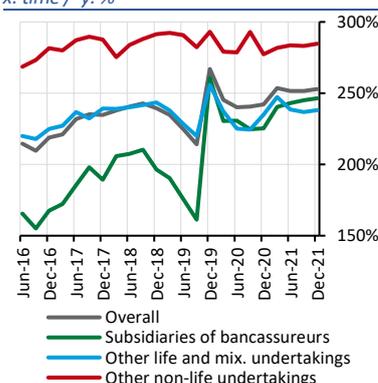
Source: Financial reporting, ACPR calculations.

In any case, the insurance sector's capital requirements are comfortably covered, although coverage levels vary considerably across undertakings.

Underwriting profitability generated in the past has enabled undertakings to strengthen their capital. As a result, they hold significant surplus capital to cover capital requirements, with an average ratio of 253% at the end of 2021 (cf. Chart 1.16). In Q1 2022, the average solvency capital requirement (SCR) coverage ratio was 263%, up 10 points compared with the fourth quarter of 2021, supported by higher interest rates, which had the effect of increasing the capital used to calculate the CSR.

Chart 1.16: Insurers' capital requirement coverage ratio

x: time / y: %

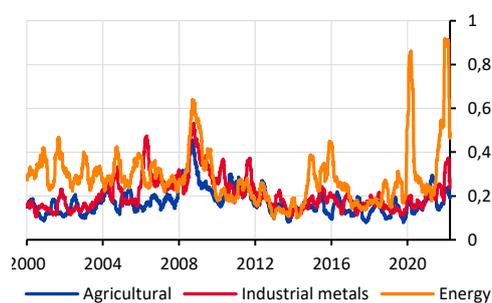


Source: Financial reporting, ACPR.

Besides the direct and indirect exposures of the financial system, the shock created by the war in Ukraine has severely impacted energy and commodity derivatives markets, creating significant liquidity stress. Energy and commodities are essentially traded on futures markets. Futures contracts enable commodity producers and users to protect themselves against future price changes when the time comes to sell their production or buy commodities. The functioning of these markets in standardised derivatives, which are traded on organised markets and are subject to multilateral clearing via central counterparties (CCPs), ensures that buyers and sellers are protected against counterparty risk. CCPs require initial margin and daily (or intraday) variation margin to be exchanged, as a function of the volatility of the underlying asset (cf. Chart 1.17) and its price, in order to ensure that trades are properly completed. Initial margins, measured on an aggregate basis,¹² virtually doubled in early March 2022 compared with end-2020, while variation margins increased by a factor of 2 or even 3 for some participants, forcing them to act swiftly to mobilise large amounts of highly liquid assets. The liquidity

Chart 1.17: Market vulnerability indicator: commodity price volatility

x: year / y: 90-day annualised volatility



Note: cf. Methodological annex.

Source: Bloomberg.

¹² Specifically, initial margin requirements on centrally cleared markets (all derivatives), for two sets of margins: (i) margins required by EU CCPs from all counterparties and (ii) margins required by non-EU CCPs from EU-based clearing members.

requirements associated with these margin calls and the resulting risks are explained in detail in the chapter on commodities.

Surging commodity prices and the expected shock to economic activity have also strengthened correlations between different asset classes, reflecting the broader spread of the shocks. Before the outbreak of the war, asset classes were relatively independent of each other (cf. Chart 1.18). Amid the market stress linked to the Ukrainian crisis, and unlike during the Covid-19 crisis, commodities have shifted to occupy a far more central position in the network (cf. Chart 1.19), owing to new negative correlations between (i) certain commodities (aluminium, oil, gold, silver, wheat and soy beans) and (ii) equity markets, particularly in Europe (Germany, France, Italy, Netherlands and the United Kingdom). Precious metals, such as gold and silver, seem to be playing a safe haven role during this period of mounting risk aversion. Another feature of the war in Ukraine is that the shock has spread more globally, with the number of significant correlations between asset classes increasing, although correlations within asset classes have weakened.

Chart 1.18: Network of interconnections, start of 2021 to February 2022

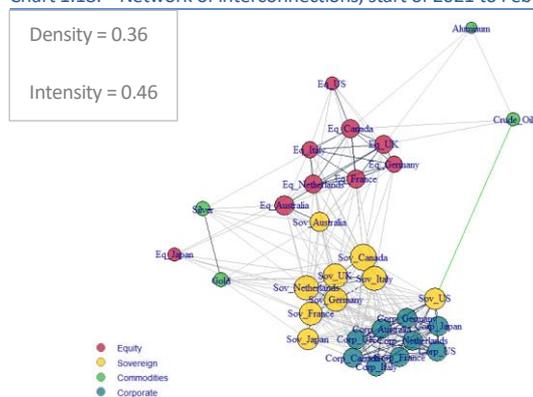
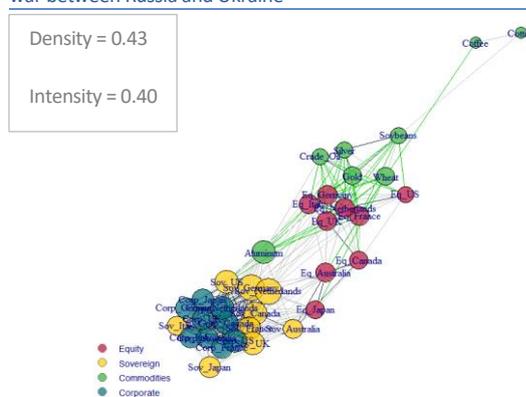


Chart 1.19: Network of interconnections during the early weeks of the war between Russia and Ukraine



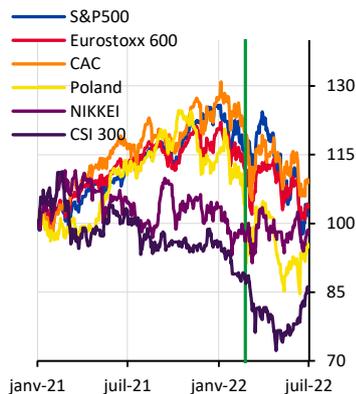
Guide: Each node represents an asset; its closeness to other nodes depends on its bilateral links (adjusted statistically significant correlations at a 0.001 level and whose intensity exceeds 0.3 in absolute terms); size depends on the total number of associated links. A node is displayed only if it has at least two significant links to other assets. The black and grey lines indicate whether the correlation is positive (above or below 0.6 respectively). The green lines indicate negative correlations.

Notes: Daily price changes between 2021 and 2022. The period of stress began on 24 February 2022 and extended until 25 March.

Sources: Refinitiv Datastream; Banque de France calculations.

Equity markets have been highly volatile and on a downward trend since the start of the year. In 2021, most equity indices in Europe and around the world made strong gains. The CAC 40 and EuroStoxx 600 put on 30% and 24% respectively over the year (reinvested dividends). Starting in January 2022, this trend went into reverse, with most equity indices giving up ground in the slow-inflation environment (cf. Chart 1.20). Interest rate increases, which were expected from the start of the year and which gathered momentum throughout the half, also put an automatic damper on equity prices, as investors value companies by discounting expected future profits using the interest rate on a risk-free asset and a risk premium. This effect was more or less pronounced depending on the company's sector of activity and level of maturity. Tech sector equities, in particular, have more distant dividend horizons than firms in other sectors, making them more sensitive to changes in interest rates. As a result, tech sector valuations have seen an especially pronounced year-to-date decline. Conversely, the energy sector has comfortably outperformed global indices (cf. below and Chart 1.21). Coming against this overall backdrop, Russia's invasion of Ukraine accentuated the equity market correction. Although markets did not experience an abrupt downturn, they priced in dimmer growth prospects, which chiefly affected countries with the greatest exposure to the conflict (cf. Chart 1.20).

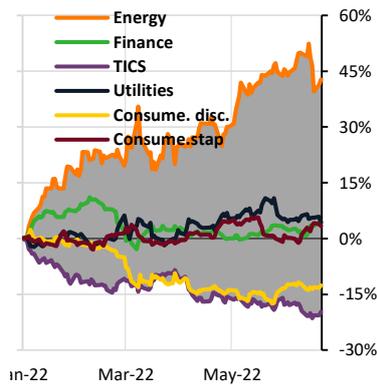
Chart 1.20: Correction on the main equity indices
x: month / y: 01/01/21 = 100



Source(s): Bloomberg, Banque de France calculations.

Note: CSI 300 Chinese Securities Index.
Most recent value: 27/06/2022.

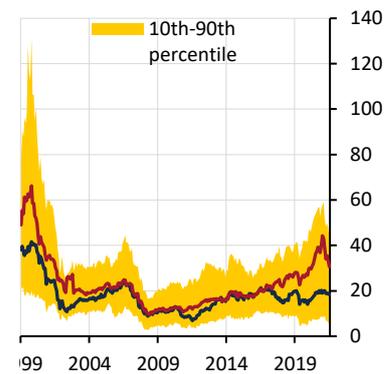
Chart 1.21: Return relative to MSCI Europe
x: month / y: %



Source(s): Bloomberg, Banque de France calculations.

Most recent value: 27/06/2022.

Chart 1.22: Distribution of CAC 40 equity valuations (CAPE ratio)
x: year / y: CAPE ratio



Sources: Refinitiv Eikon, Banque de France calculations.

Notes: The red curve shows the change in the (capitalisation-) weighted mean of individual valuations. The blue curve shows the change in the CAC 40 median valuation. The light blue (dark blue) area shows the spread between the 90th (60th) and 10th (40th) percentiles of individual valuations.

However, the correction varied within indices. Firm-level valuation indicators show that corrections varied widely within the CAC 40 index (cf. Chart 1.22), with dispersion even within sectors of the index. The overvaluation assessment stems from a handful of highly valued stocks from the luxury and technology sectors, whose weight in the index pulled the weighted mean valuation upwards. Conversely, the median CAC 40 valuation is in line with its historical trend. Such a concentration of high valuations for a small number of companies with a significant weight in the CAC 40 index may lead, in the event of severe volatility, to liquidity problems for participants that have taken leveraged positions on these entities (cf. Box 1.1 of [the December 2021 Assessment of risks to the French financial system](#), Transmission of a market shock to the financial system).

Russia's invasion of Ukraine did not generate major outflows, but did spur reallocations within investment funds on a global level. Amid expectations of monetary tightening and economic uncertainty, investments have been reallocated to equities and sovereign bonds and out of money market funds and corporate funds since the start of the year. Responding to higher inflation and increased inflationary expectations, investors initially preferred assets that are more inflation-proof, i.e. equities. As a result, equity investment funds recorded inflows of USD 109 billion between the start of the year and 23 February, with USD 83 billion going into USD-denominated funds and USD 26 billion to EUR-denominated funds. Funds then flowed out of EUR-denominated equity funds amid macroeconomic uncertainty connected with the war in Ukraine (cf. Chart 1.23.C) although overall flows remained positive over the year. The increase in the risk-free rate subsequently improved the risk/reward profile of investment grade (IG) sovereign assets. Accordingly, IG sovereign investment funds have attracted inflows of USD 60 billion year-to-date, with USD 45 billion going to USD-denominated funds and USD 15 billion to EUR-denominated funds. These inflows form part of a broader portfolio rotation that is hurting money market funds (MMFs), which recorded outflows of USD 280 billion (cf. Chart 1.23.B and 1.23.C), with USD-denominated funds particularly affected, and fixed income investment funds investing in risky assets, i.e. high yield (HY) corporate bonds, which saw outflows of USD 47 billion over the period. EUR-denominated IG corporate bond funds also reported outflows of USD 16 billion. In the wake of these rotation movements, French investment funds have seen significant outflows since the start of the year from the money market segment (EUR 35 billion) and multi bonds (EUR 5 billion) and the equity sector has also recorded outflows of EUR 4 billion.

Chart 1.23.C: Major rotation of portfolio assets in advanced economies into equities and IG sovereign bonds

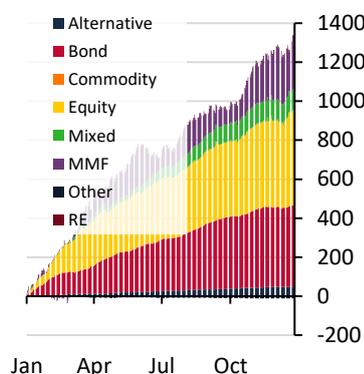
Chart 1.23.A: Cumulative flows into funds in 2021

Chart 1.23.B: Cumulative flows into funds in 2022

x: month / y: EUR billion

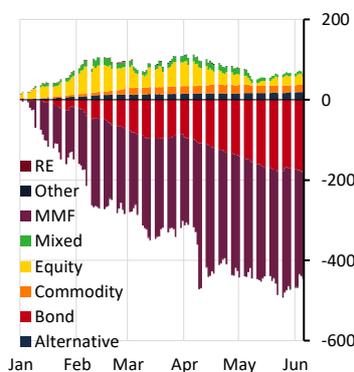
x: month / y: EUR billion

x: month / y: EUR billion



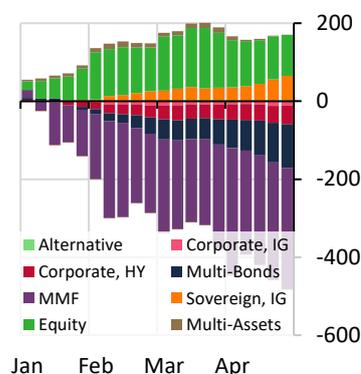
Note : scope comprises world funds

Source : Lipper, Banque de France calculations.



Note : scope comprises world funds

Source : Lipper, Banque de France calculations.



Note : scope comprises advanced economies funds

Source : EPFR, Banque de France calculations.

Meanwhile, recent developments on crypto-asset markets (cf. Box 1.1) may not have had a systemic impact, but they underline the vulnerabilities of these assets and make the case for strictly regulating the financial system's exposure to these products. The development of crypto-assets and the emergence of so-called stablecoins were described in the last [Assessment of risks to the French financial system](#) in a thematic chapter, which looked particularly at the rise of decentralised finance. Increased risk aversion and interest rate normalisation have led to a marked correction for all assets in the crypto-asset ecosystem (cf. Charts H and I). Steadier assets, i.e. so-called stablecoins, have also been swept up in this correction, which has been coupled with severe volatility.

Second-generation crypto-assets emerged to address the volatility of first-generation assets. They are backed by a reserve fund consisting of real assets, such as financial securities or sight deposits, making it possible to stabilise their value – hence their name, stablecoin – and facilitating their use as a settlement asset. They are widely used for payments in the crypto-asset ecosystem, including in decentralised finance, and to convert crypto-assets into fiat money and vice-versa. They have various vulnerabilities: like constant NAV MMFs, stablecoins backed by a reserve fund are exposed to the risk of massive redemptions, while algorithmic stablecoins are vulnerable to problems affecting smart contracts that use blockchain technology as well as to the extreme volatility of crypto-assets. Systemic risks could potentially materialise through excessive leverage, asset/liability liquidity mismatches or interconnectedness with decentralised finance.

Box 1.1: The collapse of Terra confirmed concerns about the overall stability of the crypto-asset ecosystem

Until recently, Terra (UST) was the third-largest stablecoin by market capitalisation (EUR 17.5 billion) and was supposed to be pegged 1:1 to the USD. However, it lost 90% of its value during the week of 9 May 2022 when the peg was broken by a speculative attack. The collapse took place amid a broader decline affecting crypto-assets in recent months connected with US monetary policy normalisation.

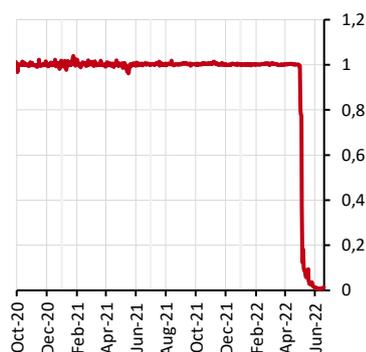
Terra is an algorithmic stablecoin that is principally backed by Luna, a crypto-asset.¹³ Beginning in March 2022, Terra's managers decided to increase the share of bitcoin in the assets used to back Terra, going so far as to publicly state that they held over EUR 1 billion in bitcoin.¹⁴ This statement was designed to send a signal about the liquidity that was actually available in the reserves backing Terra.

¹³ Cf. [White paper explaining how Terra works](#)

¹⁴ [Luna Foundation Guard further bolsters stablecoin reserve by raising \\$1.5 billion in bitcoin \(cnbc.com\)](#)

Chart A: Terra price

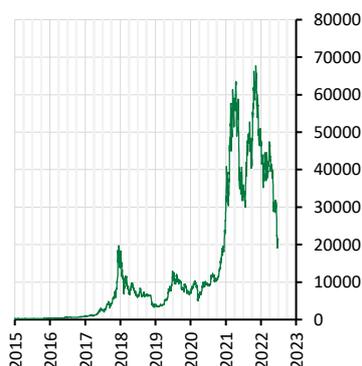
x: month / y: USD



Source: Bloomberg.
Most recent value: 27/06/2022

Chart B: Bitcoin price

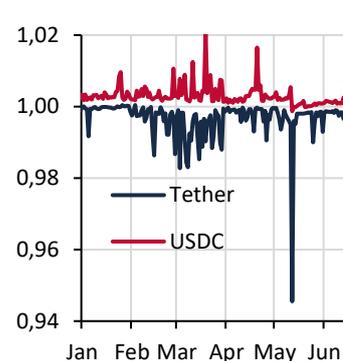
x: year / y: USD



Source: Bloomberg.
Most recent value: 27/06/2022

Chart C: Prices of other leading stablecoins

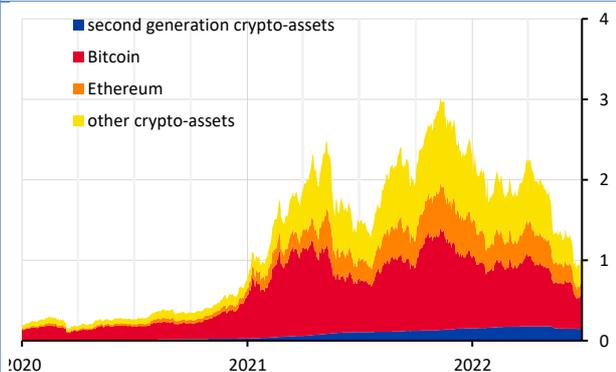
x: month / y: USD



Source: Bloomberg.
Most recent value: 27/06/2022

Chart D: Capitalisation of first-generation crypto-assets

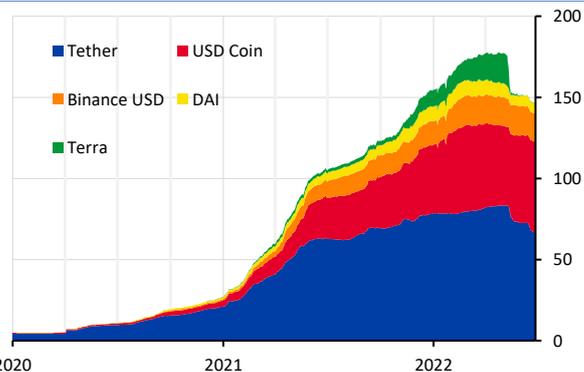
x: year / y: USD trillion



Source: Bloomberg, Banque de France calculations.
Most recent value: 27/06/2022.

Chart E: Capitalisation of second-generation crypto-assets

x: year / y: USD trillion



Source: Bloomberg, Banque de France calculations.
Most recent value: 27/06/2022.

According to some market commentaries, Terra was targeted by a speculative attack designed to break its dollar peg. To maintain the peg, the algorithm buys Terra by drawing on the reserve assets, especially bitcoin. Massive sales of Terra by speculators caused Terra to become unpegged from the dollar, while at the same time, the Terra algorithm helped to push the value of bitcoin downwards (by approximately 10% on 9 May 2022). Alerted by the initially temporary loss of the peg, other Terra holders also began to sell, triggering a run that ultimately caused the peg to be broken for good.

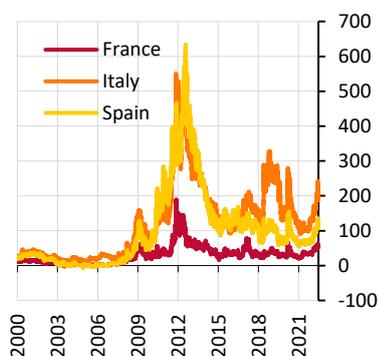
By its construction, Terra, which is backed by a crypto-asset without any intrinsic value, was more fragile than crypto-assets backed by short-term securities denominated in fiat money. However, all stablecoins are exposed to liquidity risk and in the absence of total transparency and/or oversight by independent authorities of the mechanisms used to maintain the peg, and of the quality and quantity of reserves on hand to meet their objectives, their stability may be called into question.

1.3 The current interest rate trajectory does not pose major risks to the French financial system

By continuing to send prices higher, the geopolitical shock is translating into a pronounced increase in interest rates

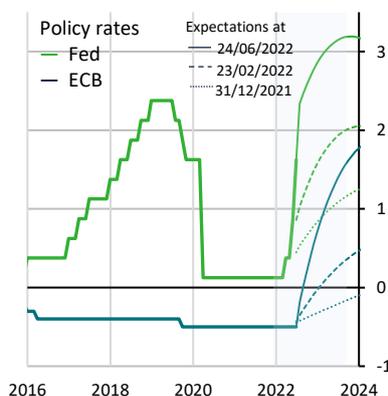
As a corollary to higher inflation, market interest rates are rising more swiftly than was expected at the end of 2021. Since the start of 2022, euro area interest rates have risen significantly against a backdrop of persistent inflation (cf. Chart 1.24). Expectations of policy rate hikes are nuanced, suggesting that US policy will be tightened more than European policy (cf. Chart 1.25). The interest rate spread between the United States and Europe is weighing on the euro. The single currency has already depreciated by over 7% since the beginning of the year, which has played a part in increasing the imported component of inflation. That being said, the yield on French 10-year government bonds rose from virtually zero at end-2021 to 2.08% on the 27th of June 2022. Euro area spreads over the German bund widened in mid-June but remain considerably smaller than those of central European countries (cf. Chart 1.26). The Eurosystem has said that combating the risk of fragmentation is a priority and on 15 June reaffirmed its pledge to act against this risk.¹⁵

Chart 1.24: evolution of 10Y sovereign spreads versus German Bund since 2000
x: year / y: basis points



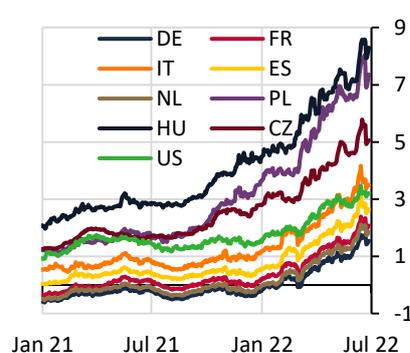
Source: Bloomberg, Banque de France calculations.
Most recent value: 27/06/2022.

Chart 1.25: Policy rate expectations
x: year / y: %



Source: Bloomberg, Banque de France calculations.

Chart 1.26: Euro area and central European sovereign spreads
x: month / y: %



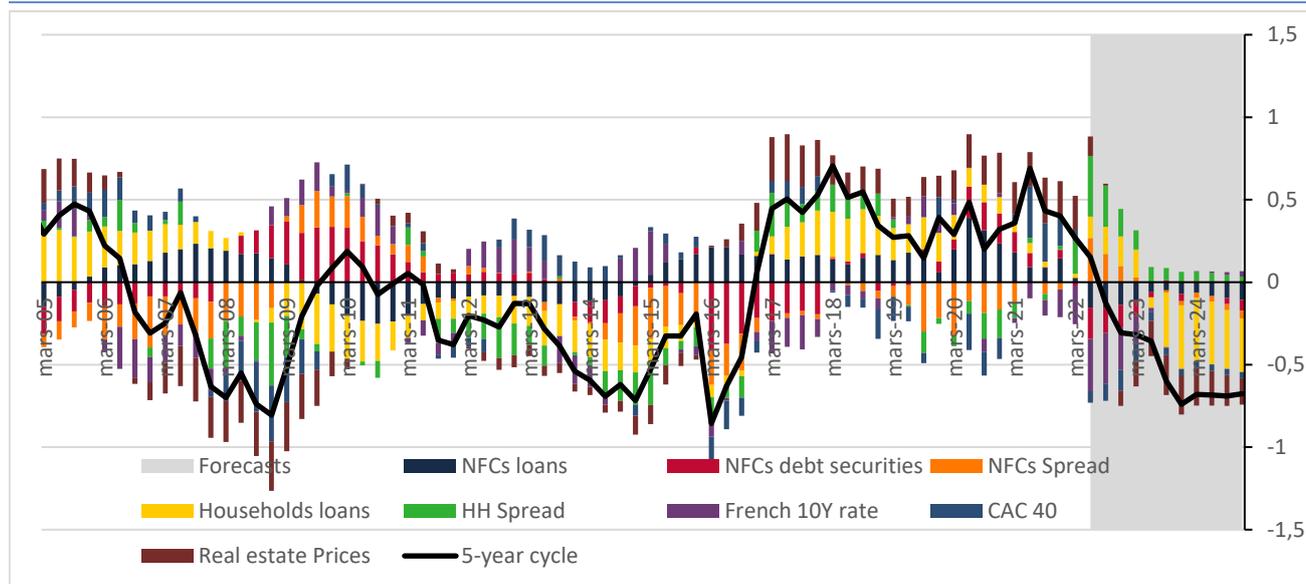
Note: DE : Germany ; IT : Italy ; NL : Netherlands ; HU : Hungary ; US : United States ; FR : France ; ES : Spain ; PL : Poland ; CZ : Czech Republic.
Sources: Bloomberg, Banque de France calculations.
Most recent value: 27/06/2022.

The shock created by the war has occurred at a time when the French financial cycle is contracting after peaking in the second quarter of 2021 (cf. Chart 1.27). After being driven by vibrant growth in equity markets, real estate prices, debt security issues and lending to companies, the cycle began to contract slightly from the third quarter of 2021. This gradual landing is a consequence of the normalisation and scaling-back of support measures, coupled with expectations of interest rate normalisation. Note however that the spread between the yield on French 10-year government bonds and household and NFC lending rates is narrowing and continues to support the financial cycle, owing to the delayed and hence as-yet incomplete transmission of the increase in sovereign yields. As a result, financing conditions remain broadly accommodative, even if gradual transmission effects are expected in the coming quarters.

¹⁵ <https://www.ecb.europa.eu/press/pr/date/2022/html/ecb.pr220615~2aa3900e0a.en.html>

Chart 1.27: Financial cycle

x : date / y : index



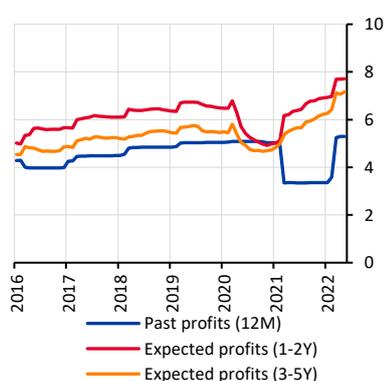
Note : The financial cycle indicator is constructed from eight underlying variables: the change over two years in outstanding loans to domestic NFCs by domestic monetary financial institutions; the change over two years in outstanding debt securities issued by domestic NFCs; the change over two years in outstanding loans to resident households and non-profit institutions serving households by domestic credit institutions; the growth over one year in real estate prices; the change over one year in 10-year sovereign yields; the annual return on the CAC 40; the spread between the average interest rate on NFC loans and French 10-year government bonds

Source: Banque de France calculations.

The rise in lending rates is not stopping companies from accessing financing, but high debt levels remain an area to watch

Chart 1.28: NFC profits, by sector

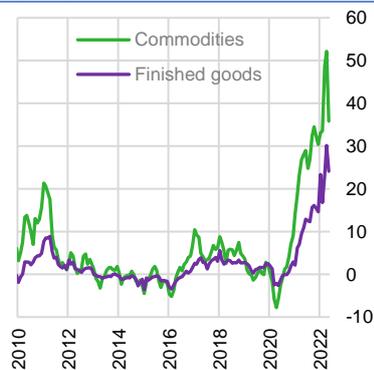
x : year / y : % of total



Source: Eikon.

Chart 1.29: Opinion of business leaders on price increases

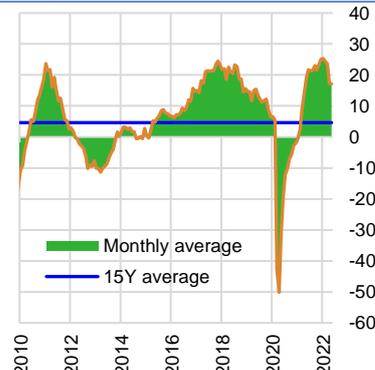
x : year / y : index



Source: Banque de France.

Chart 1.30: Level of order books (industry)

x : year / y : index



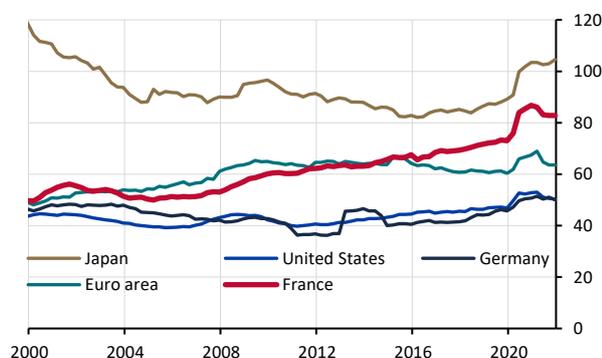
Source: Banque de France.

Following the pick-up in economic conditions in 2021, the prospects for an additional rebound in the activity of French NFCs have waned since the start of this year. FY2021 saw NFCs in a swathe of sectors report outstanding earnings; in the first quarter of 2022, results were not severely impacted by the crisis in Ukraine, although there were differences across sectors. According to [the most recent business survey \(June 2022\)](#), activity increased in May in industry, market services and construction. The order books of French NFCs have recorded a slight correction since March 2022 but remain well above their 15-year average (cf. Chart 1.30). Supply challenges remained high in May, but price increases were slightly weaker in May than in April. They were significant in the automotive, machinery, aerospace and electronics sectors. As a result, pronounced price increases are expected for commodities and to a lesser extent for finished goods (cf. Chart 1.29). Business failures rose with the partial

unwinding of support schemes in autumn 2021. On average, there were about 35% more failures in early 2022 than at the start of 2021, but numbers have not begun drifting upwards and remain more than 30% below the levels recorded in 2019 (cf. Chart 1.33).

Chart 1.31: Corporate vulnerability indicators: NFC consolidated gross debt ratios

x: year / y: %



Note: cf. Methodological annex.

Source(s): Bloomberg, Banque de France calculations (webstat).

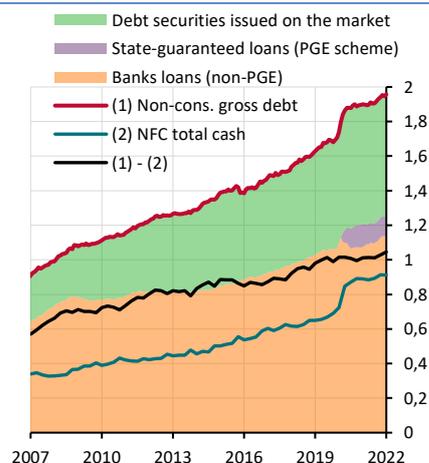
Although it has decreased since mid-2021, the outstanding consolidated gross debt of French NFCs remains relatively high when considered in a [cross-country comparison](#). In France, consolidated gross debt hit 82.8% of GDP in the fourth quarter of 2021, compared with an average of 63.6% in the euro area (cf. Chart 1.31). In France, NFC debt levels are higher than those in the United States, Germany, Italy and Spain, but lower than in Japan. Furthermore, the gross debt of French NFCs has shrunk by less since mid-2021 than the gross debt of euro area NFCs as a whole (by 0.3 points of GDP, compared with an average of 1 point in the euro area), after increasing by more during the Covid-19 crisis.

NFC debt and cash flows continued to normalise after the exceptional amounts recorded in 2020.

However, according to last [Banque de France publication on financial situation of businesses and households](#) at the end of April, net debt has been rising since December 2021 (from EUR 1 029 à 1 059 billion at the end of April 2022), although this may be due to investment and growth strategies and does not necessarily reflect poorer corporate health. At end-2021, NFC net debt had grown by less than 4% in two years, or just under 2% on an annualised basis – about half the average rate of growth in debt observed over the previous two decades (cf. Chart 1.32). However, NFC net debt has seemingly been growing again at a more sustained pace since December 2021. In fact, 93% of the increase in net debt over 2021 took place in December alone, while net debt rose by more than 3% (6.9%) during the first four months of 2022 (between end-2019 and April 2022) due to a combination of cash outflows (- EUR 10 billion over this period) and increased bank borrowing (+ EUR 25.6 billion over this period). However, these overall results conceal differences between sectors and between companies.

Chart 1.32: French NFC debt

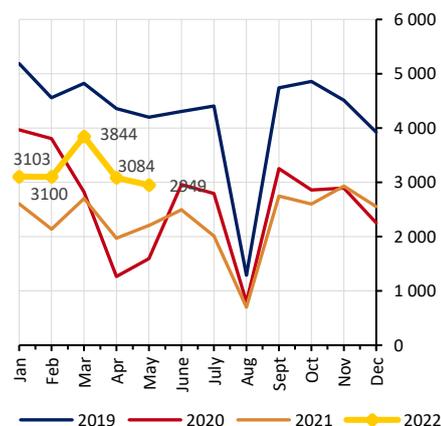
x: year / y: EUR trillion



Note: NFC = non-financial corporations, Cons. = consolidated, PGE = state-guaranteed loans. Total cash including bank deposits and securities held in money market funds. Most recent value: April 2022.
Source: Banque de France (webstat).

Chart 1.33: Monthly NFC failures in France

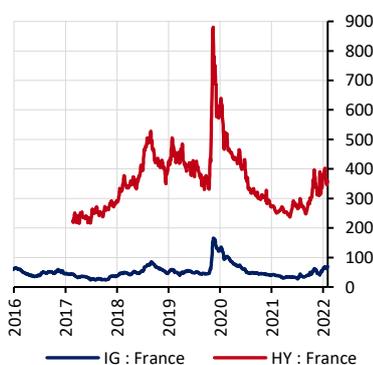
x: year / y: number



Source: Banque de France.

In addition, lending rates for French NFCs began going up in early 2022, although conditions for accessing financing remain favourable. According to Banque de France quarterly survey on NFCs loan rates published in April¹⁶, the average rate charged on overdrafts used by French NFCs increased by 64 basis points (2.90% for the first quarter of 2022 vs. 2.26% the previous quarter), while the average rate on equipment loans was more or less unchanged (1 bps increase to 1.14% vs. 1.13%). In the case of debt securities, tighter conditions primarily reflect the increase in inflation and monetary policy normalisation expectations rather than concerns over NFC credit quality, with spreads following an upward but contained path. That said, there are differences based on credit quality, with the HY segment seeing a more pronounced upward movement than the IG segment (cf. Chart 1.34). Whereas over 2021, virtually all IG-rated NFCs enjoyed refinancing rates of below 1%, almost no companies have been able to access such low rates since March 2022, for the first time in at least four years. Meanwhile, rates for HY-rated companies are returning to levels seen in 2018-2019 (cf. Charts 1.35 and 1.36). After the wave of downgrades for energy sector NFCs at the start of the year, the latest data do not point to continued downgrades in Europe or France (cf. Chart 1.40). In fact, some French NFCs, particularly in the transportation sector, actually received upgrades.

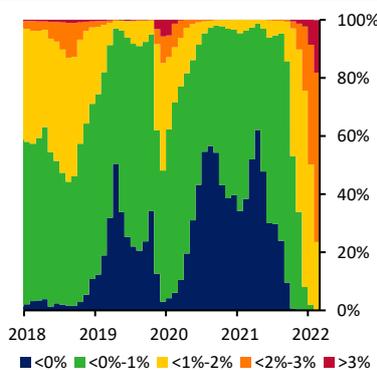
Chart 1.34: Asset swap spreads, French NFCs
x: year / y: basis points



Most recent value: end-May 2022.

Source: Eikon, Banque de France calculations.

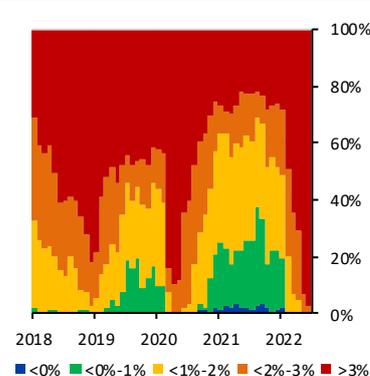
Chart 1.35: Breakdown by yield, debt of IG French NFCs
x: year / y: %



Note: Eikon data are taken from a commercial database that provides a partial but relatively representative picture of the market. Most recent value: May 2022.

Source: Eikon, Banque de France calculations.

Chart 1.36: Breakdown by yield, debt of HY French NFCs
x: year / y: %



Note: Eikon data are taken from a commercial database that provides a partial but relatively representative picture of the market. Most recent value: May 2022.

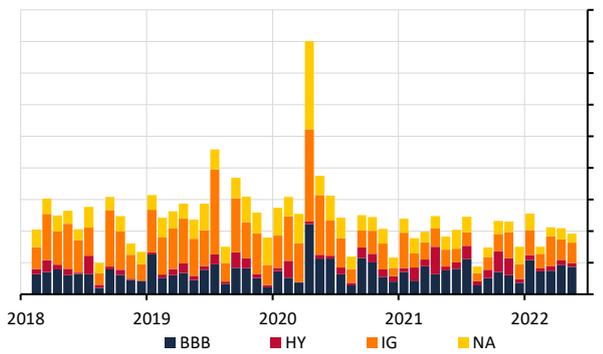
Source: Eikon, Banque de France calculations.

For the time being, tighter financing conditions have not had a major impact on access to bank loans and market financing. The annual growth rate of outstanding bank loans to NFCs stood at 5.5% in April 2022, driven by investment loans. Bond issuance by French NFCs, meanwhile, remains in line with historical averages. Monthly issuance of debt securities in April-May 2022 was consistent with the average range observed since early 2018 (between EUR 50 billion and EUR 60 billion in Europe, of which around EUR 20 billion in France) (cf. Chart 1.37). Overall, the total outstanding bond debt of French NFCs fell slightly over the first four months of the year. It stood at approximately EUR 680 billion in May 2022, or EUR 10 billion less than at the end of 2021. Conversely, in the euro area excluding France, the overall outstanding amount rose slightly from early 2022 to reach approximately EUR 945 billion at the end of May, or EUR 30 billion more than at the end of 2021.

However, the equity financing of euro area listed NFCs hit a low point in the first quarter of 2022, with total issues of EUR 9 billion, including initial public offerings and capital increases. Average quarterly equity issuance was EUR 19 billion over the 16 previous quarters, with the last low point at EUR 6 billion in the first quarter of 2020, while total issuance over 2021 came to EUR 131 billion (cf. Chart 1.38).

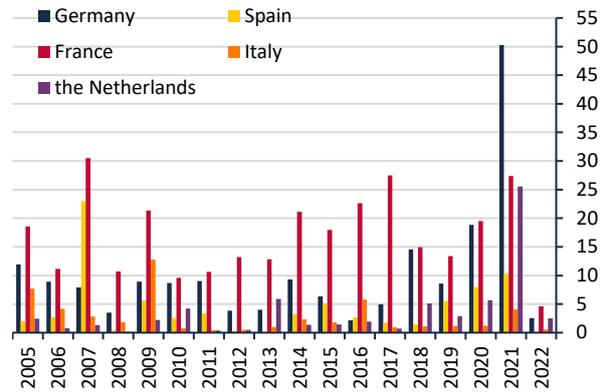
¹⁶ <https://www.banque-france.fr/statistiques/credit/credit/taux-des-credits-aux-entreprises>

Chart 1.37: Monthly issuance of debt securities by French NFCs
x: year / y: EUR billion



Sources: Eikon, ECB (CSDB), Banque de France calculations.

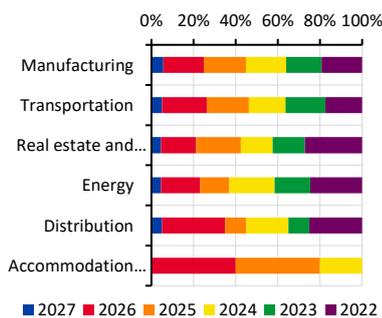
Chart 1.38: Change in outstanding equities of European NFCs (excluding changes in equity prices)
x: time / y: EUR billion



Sources: ECB (SDW), Banque de France calculations.
Most recent value: end-April 2022

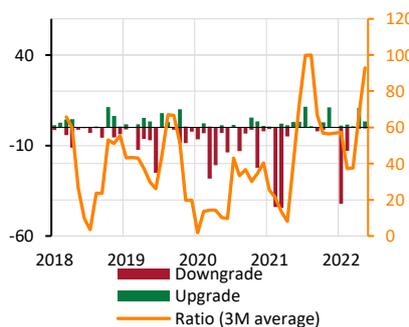
Since their debt maturity profile is spread over time and as much of their borrowing is at fixed rates, French NFCs should be resilient to an additional increase in interest rates. In most economic sectors, corporate debt securities are set to mature according to a relatively even pattern over the coming five years (cf. Chart 1.39) although a refinancing peak will occur in 2026 (cf. Chart 1.41). On aggregate (bank loans and debt securities), one-quarter of the debt matures in one year or less (chiefly bank loans). Moreover, two-thirds of the debt of French NFCs is at fixed rates (about 65% of bank loans and over 90% of debt securities). On average, between 2005 and 2019, bank loans made up 86% of total debt (bank, bond, lease) at small and medium-sized enterprises, 76% at mid-tier firms and 33% at large companies. Given this, and relative to the economic situation in March 2022, the annual interest expense of NFCs on bank loans and securities would increase on aggregate from EUR 33 billion to EUR 55 billion over three years in the event of an immediate 200 bps increase in interest rates. The additional expense would be concentrated with bank loans. This EUR 22 billion (60%) increase is based on an aggregate view; individual company exposures may vary. All in all, companies should be able to absorb the additional cost on aggregate, thanks to their high cash levels.¹⁷

Chart 1.39: Maturity profile of corporate debt securities, by sector
x: % / y: sector



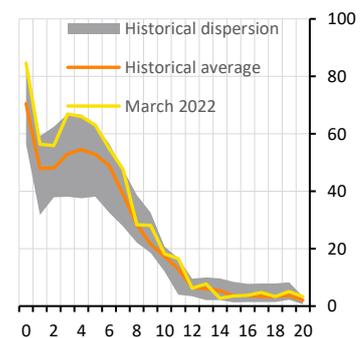
Most recent value: end-May 2022.
Source: ECB (CSDB), Banque de France calculations.

Chart 1.40: monthly amounts of debt securities with rating changes, French NFCs
x: year / y [left]: EUR billion; [right]: ratio in %



Most recent value: end-May 2022.
Source: ECB (CSDB), Banque de France calculations.

Chart 1.41: Outstanding NFC debt securities, by residual maturity
x: time horizon / y: EUR billion



Note: This chart compares the structure of NFC debt maturing in the next 20 years in 2021 with the average and the spread between 2015 and 2020. Hist. = historical. 2021 curve based on data to end-September 2021.
Source: ECB (CSDB), Banque de France calculations.

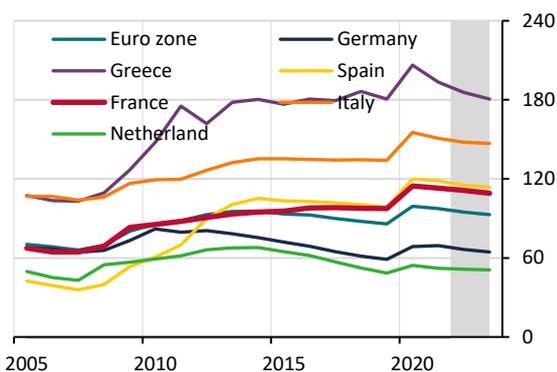
¹⁷ Aggregate cash levels in April 2022 were similar to those recorded at the end of 2020, a year in which the aggregate cash position rose by 30%.

Government deficits must be controlled to limit the risks to financial stability linked to government debt financing requirements

The support measures introduced during the health crisis caused government deficits and debt to increase sharply. The health crisis made it necessary to introduce measures to support the economy. These drove the government deficits in 2020 and 2021 to 8.9% and 6.4% of GDP respectively. Despite these large deficits, the debt/GDP ratio decreased over 2021, falling from 114.6% at the end of 2020 to 112.5%, owing to the elevated pace of growth and a catch-up effect that saw output regain pre-crisis levels during the third quarter of 2021 (cf. Chart 1.42).

Chart 1.42: Government debt (as defined by the Maastricht Treaty) as a share of GDP

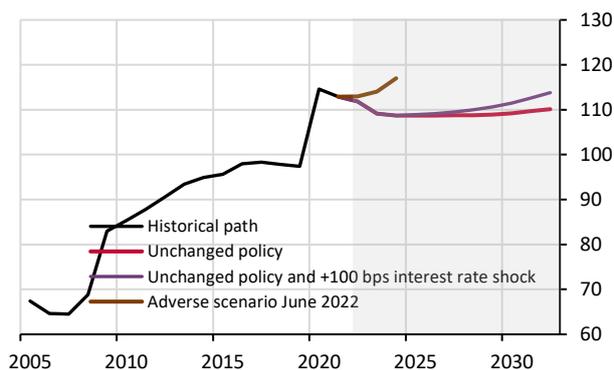
x: year / y: %



Sources: Eurostat, European Commission projections (2022-2023)

Chart 1.43: Sovereign vulnerability indicators: debt/GDP ratio projection

x: year / y: %



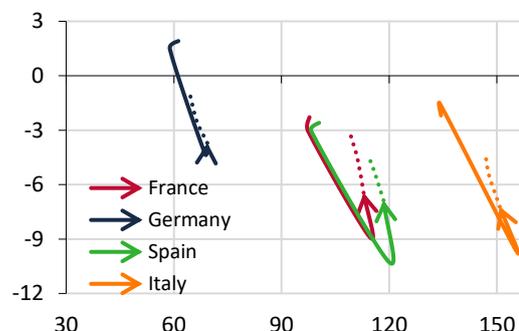
Sources: INSEE until 2020, Banque de France June 2022 projections, Banque de France simulations (DSA method) from 2023 onwards.

In 2022, despite the strong economic rebound, the government balance is projected to decline to -5.0% of GDP according to latest Banque de France forecast in June, owing to measures to support households' purchasing power to cope with rising energy prices and the ongoing deployment of stimulus measures. The government balance is projected to improve in 2023-2024, on the back of the end of temporary measures and continued strong growth. Public debt is projected to stabilize somewhat below 110 percent of GDP in 2023-24.

The trajectory will also depend on the effects of inflation on government spending and revenue dynamics. Higher inflation increases revenue, interest expense and primary spending in proportions that depend on the source of the inflationary shock, on the one hand, and the structure of government spending and revenue and inflation-indexing mechanisms, on the other. Government revenue responds immediately to an increase in inflation. Government spending may react slightly more slowly to higher inflation, as some spending items may be indexed to past inflation, while other items may be frozen (as is currently the case for the points system used in the French civil service). Further out, however, and with some inertia, spending will go up with the increase in inflation, and the effect of higher inflation on the government deficit in the medium term is neutral overall.

Chart 1.44: Government deficit and debt trajectories (as a % of GDP) since 2018

x: debt/GDP ratio / y: deficit as a % of GDP



Note: the dotted lines show the European Commission's projection through to 2023.

Source: European Commission.

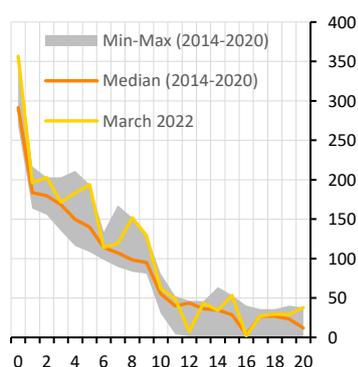
The sensitivity of the government debt trajectory to macroeconomic and financial conditions increases the need to keep the public finances under control. The level of the primary deficit that is compatible with a stable debt/GDP ratio depends on the differential between the nominal growth rate (g) and the nominal average interest rate (i) on the debt. Both of these variables are sensitive to the current inflationary environment. First, while inflation generally has a positive role on the nominal growth rate of GDP, this effect may be mitigated in the current setting, where a portion of the overall price increase is imported. Second, while the average interest rate on the debt generally increases gradually and less swiftly than increases in sovereign bond yields owing to the progressive refinancing of government debt, inflation-linked bonds may moderately accelerate the increase in the apparent rate of debt. It is critical to bring down the level of government debt in France in order to reduce the debt burden and associated risks and to rebuild the leeway needed to cope with future crises and shocks.

Inflation and the resulting increase in interest rates could also push up the debt burden. As long as inflation persists, market interest rates will go up due to planned monetary policy normalisation, which is necessary to ensure price stability. Some of France's sovereign bonds (about 11% in 2021) are linked to inflation, which, in a setting of rising prices, contributes directly to increasing the cost of government debt. Over FY2021, this led to a 17% increase in interest expense for general government as a whole (at 1.4% of GDP in 2021). A one percentage point increase in inflation causes interest expense to rise by approximately EUR 2.5 billion in the same year, because of these inflation-linked bonds.

The increase in sovereign yields highlights a fragmentation risk for euro area sovereign markets, which the ECB is taking into account. For the most heavily indebted countries, the risk perceived by investors could cause spreads to widen significantly, leading to a material increase in the debt burden and potentially disrupting government debt trajectories, which have stabilised in the short term (cf. Charts 1.26 and 1.44). This could result in an increase in financing costs that is potentially disconnected from borrower fundamentals, not just for sovereigns, but also for companies, which would interfere with the proper transmission of monetary policy. Given the risk of fragmentation, the ECB said on 9 June 2022 that it reserved the right to adjust PEPP purchase volumes. To preserve the functioning of the monetary policy transmission mechanism, the Governing Council agreed at an ad hoc meeting on 15 June to apply flexibility in reinvesting redemptions coming due in the PEPP portfolio and to accelerate the completion of the design of a new anti-fragmentation instrument. This move should prevent excessive widening of spreads.

Chart 1.45: Outstanding French sovereign debt reaching maturity

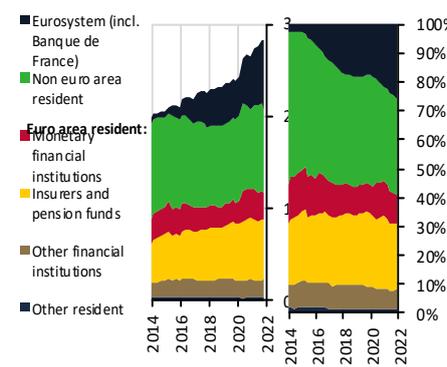
x: year / y: amount in EUR billion



Notes: This chart compares the structure of sovereign debt maturing in the next 20 years in 2021 with the average between 2015 and 2020.
Sources: ECB (CSDB), Banque de France calculations.

Chart 1.46: Holdings of French government debt

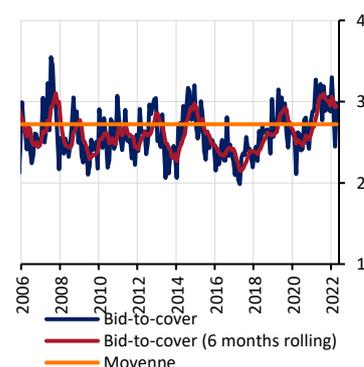
x: time (years) / y: amount in EUR trillion and as a %



Notes: Holdings of government debt (including central government and various general government entities including social security and local authorities) by type of agent. The Eurosystem's holdings are proxied by considering only the Banque de France. Detail for certain categories: (i) Other financial intermediaries: financial participants other than monetary financial institutions, insurers and pension funds. These are chiefly non-money market CIS; (i) Other residents: participants in the real economy (general government, non-financial corporations and households). Most recent value: June 2021.
Sources: ECB (SHS and SDW).

Chart 1.47: Bid-to-cover ratio during primary issuance

x: year / y: %



Note: A reading of 3 indicates that demand for securities during the primary auction exceeded the paper available by a factor of three. Most recent value: end-December 2021.
Source: Banque de France.

Despite the uncertain environment, France's sovereign credit quality remains sound. French sovereign debt is viewed by investors as a high quality asset and is unlikely to suffer from an excessive spread shock, although the

differential over the bund has widened slightly in the recent period. Primary issues of French debt always do well (cf. Chart 1.47), and the relatively diversified ownership structure prevents concentration risks (cf. Chart 1.46). Furthermore, the exposure of French banks to domestic sovereign debt has declined since 2014 relative to their equity and total assets, unlike in other euro area countries, which tempers the risk of the bank-sovereign nexus being activated (cf. Box 1.1 in the June 2021 *Assessment of Risks to the French Financial System*). Finally, renewal requirements are relatively spread out over time, with no major refinancing peaks.

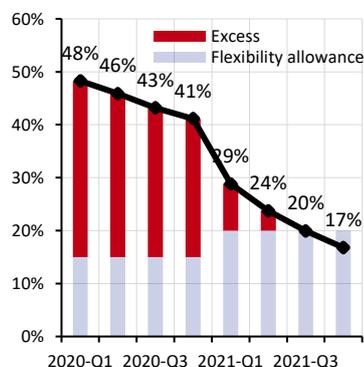
Inflation has negative effects on consumption and household purchasing power. However, the impact of higher interest rates is mitigated by the fact that most household debt is at fixed rates

On the whole, households continue to enjoy a favourable situation in terms of financial savings as they exit the health crisis. Total excess household financial saving between the first quarter of 2020 and the fourth quarter of 2021, measured as the difference between observed saving flows and the flows that would have occurred if pre-Covid trends were extended, stood at [EUR 175 billion](#). In addition, households continue to benefit from a firming labour market, with the unemployment rate sitting at its lowest level since 2008 (7.4% in the fourth quarter of 2021).¹⁸

Short-term vulnerabilities for the household sector remain contained at this stage, thanks notably to the significant strengthening of credit standards for home loans. However, inflation is eroding household purchasing power, especially for the most vulnerable people, calling for careful monitoring. Debt levels remain high and came to 101.8% of household gross disposable income in the third quarter of 2021, an increase of 5.2 pp over two years. This trend is primarily attributable to growth in home loans (up 6.8% in March 2022), which account for 84% of total outstanding loans to households. Year-on-year home loan production came to a record EUR 232 billion in March 2022, 19.9% higher than the amount observed at the end of 2019. However, limits placed by the HCSF on the debt-service-to-income ratio (35%) and credit period (25 years) for home loans, first in December 2019 in the form of recommendations and subsequently as a binding regulatory decision in January 2022, have helped to significantly improve credit standards. The share of loans that were not compliant with these limits was just 14% in the first quarter of 2022, down 15pp since the beginning of 2021, taking the share below the tolerance threshold of 20% (cf. Chart 1.48). The increase in market rates observed since January, and notably in French 10-year government bond yields, which stood at 1.28% in April, or 97 bps higher than in January 2022, has so far fed through marginally to the rates on new home loans, which remain historically low (1.17% in April 2022, cf. Chart 1.49). However, an econometric analysis of the relationship between these two variables shows a significant medium-term correlation, with transmission of changes in sovereign yields of around 78 bps per 100 bps of increase over a two-year horizon, other things being equal.¹⁹

Chart 1.48: Share of home loans that are non-compliant with HCSF measures

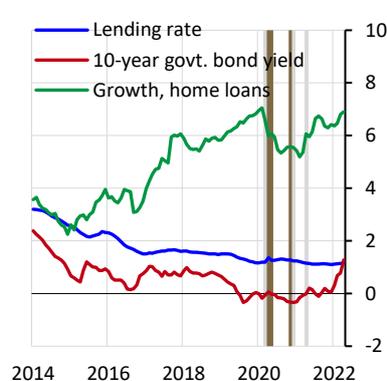
x: quarter / y: %



Source: [ACPR](#).

Chart 1.49: Interest rates and annual growth in home loans

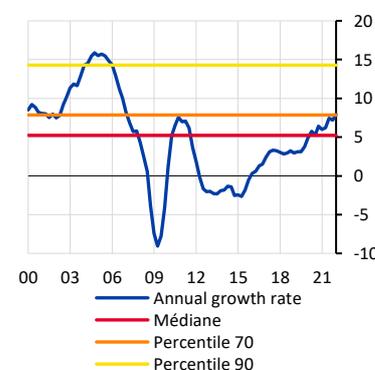
x: year / y: %



Source: [Banque de France](#).

Chart 1.50: Price index, existing homes

x: year / y: %



Source: [INSEE](#).

¹⁸ [Source](#)

¹⁹ See Chapter 2 of the December 2021 *Assessment of Risks to the French Financial System* at: https://publications.banque-france.fr/sites/default/files/medias/documents/ers_2021-s2_vfclean4.pdf

Note: Share of quarterly production made up of new loans that are non-compliant with HCSF measures on credit standards.

Notes: The greyed areas indicate the lockdown periods. The lending rate is the average rate on new home loans.

Note: The yellow, orange and red lines show the median, the 70th percentile and the 90th percentile, respectively.

With home lending rates still historically low and loan production remaining strong, housing demand among households is not showing any significant signs of cooling at this stage. Prices for existing homes recorded especially robust growth in 2021, reaching 7.2% in the final quarter, or significantly higher than the average annual growth rate observed over the last 20 years (5.2%, cf. Chart 1.50). However, alongside this vibrant growth, a two-speed market has emerged, with growth on the individual homes segment far outpacing that of the apartments segment (9% vs. 4.6% in the fourth quarter of 2021), in further evidence of the shift in preferences observed in late 2020 following the health crisis. After spiking once the lockdowns were lifted, deal numbers stabilised at historically high levels from summer 2021 onwards (1.175 million transactions in the 12 months to March 2022). Hot real estate markets have been a feature of several countries in the euro area, where prices grew year-on-year by 9.5% on average in the fourth quarter of 2021, the fastest rate seen in 20 years. Besides shifting preferences, persistently low lending rates, excess saving linked to the health crisis, and real estate's perception as a safe haven against inflation account for the sustained strength of demand. These observations corroborate the analysis in the [December 2021 Assessment of Risks to the French Financial System](#), which highlighted a swift and resilient recovery on the real estate market since early 2021.

The household solvency risks connected with higher interest rates remain extremely low since virtually all home loans are at fixed rates in France (99.4% of annual production in 2021 and 97.3% of outstanding loans at 31/12/2021). The risks associated with slower growth, against a backdrop of sustained inflation, notably via a deterioration in the income outlook for households and reduced purchasing power, are also contained. This is because the French home lending model is based on a prudent assessment of borrower solvency, ensuring that debt-service-to-income ratios are controlled. The thresholds established by the HCSF's decision have helped to strengthen the model further, reducing the probability of default in the event of negative income shocks. However, in a situation where demand adjusts to new financing conditions, higher home loan interest rates should lead to a decrease in loan production, which could stabilise at around EUR 44 billion per quarter a year from now. This would still be historically high, but below the levels seen in recent quarters (around EUR 60 billion, excluding repurchases and renegotiations). Higher lending rates and a reduction in new loan volumes could play a part in cooling the growth trend observed on the housing market. However, if house price growth were to slow, impacts on the repayment burden for borrowers would be limited insofar as loans are granted based on income, rather than the value of the financed asset.²⁰

The number of excess debt cases submitted to the Banque de France is trending downwards, with 29,437 cases filed over the first three months of 2022, compared with 33,520 over the same period in 2021, a decline of 12%.

Because of how their balance sheets are structured, French banks should be resilient to higher rates, even if the cost of risk is expected to go up

An across-the-board downturn in economic prospects exceeding the deterioration projected in the forecasts could affect French banks through a broad decline in the quality of loans to businesses and households. This could push up the cost of risk for banks, notably via adjustments to the forward-looking scenarios used to determine the probability and cost of defaults, and through an increase in the share of loans classified as stage 2,²¹ which includes loans whose credit risk has deteriorated significantly since they were granted.

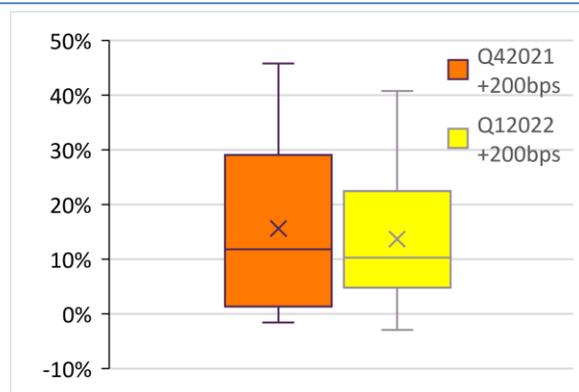
²⁰ Mortgage loans have historically accounted for a small share of lending and made up just 23% of total loan production in December 2021.

²¹ The risk linked to these loans must be covered by provisions until maturity. By contrast, stage 1 loans are covered by provisions based on their 12-month risk.

An orderly increase in interest rates would boost the net interest margin of French banks, even if it could simultaneously have a negative impact on their mark-to-market portfolios and equity investments in insurance subsidiaries.

While prolonged low interest rates have helped to support economic activity, they have also had negative effects on bank profitability. An upside interest rate shock, however, should be positive overall for French banks, virtually all of which would record an increase in net interest income (cf. Box 1.2 and Chart 1.51). In the event of a 200 bps shock, this increase would average about 15%, albeit with sizeable differences between institutions. However, this could also lead to a decline in banks' equity and earnings, owing to impairment of debt securities and loans booked at fair value.

Chart 1.51: Distribution of the impact of a 200 bps interest rate shock on net interest income across all maturities
y: increase in net interest income (as a %)



Source: ACPR.

Two types of effects need to be distinguished, namely those that are recognised directly through profit or loss, and those that impact CET1:

- In the first quarter of 2022, debt securities and loans/advances booked in portfolios at fair value through profit or loss accounted for around 12% of the total assets of France's six main groups (EUR 1,022 billion vs. EUR 8,659 billion). Assuming like-for-like portfolios and excluding hedging strategies, an increase in interest rates would lead to a decrease in the value of these portfolios, which would be recognised directly through profit or loss.
- In the first quarter of 2022, debt securities and loans/advances booked in portfolios at fair value through other comprehensive income accounted for 2.8% of the total assets of France's six main groups (EUR 226 billion vs. EUR 8,659 billion). Capital losses here impact banks' CET1 directly. Capital losses on the bond portfolios held by bank's insurance subsidiaries affect their equity via the same mechanism.

Note that the second of these effects impacted the aggregate CET1 ratio of French banks in the first quarter of 2022 (cf. Chart 1.8), causing a 14 bps reduction, while the aggregate ratio was down by 69 bps overall.

Box 1.2: Resilience of French banks' net interest margin

An analytical decomposition at end-2021 of the aggregate balance sheet of the French banking system by type of instrument reveals an excess of fixed-rate assets over fixed-rate liabilities, but also, more unusually, a large volume of variable-rate assets, resulting in a balance sheet structure in which the excess fixed- and variable-rate assets are financed by non-interest-bearing liabilities, i.e. whose cost is insensitive to changes in interest rates, such as sight deposits.

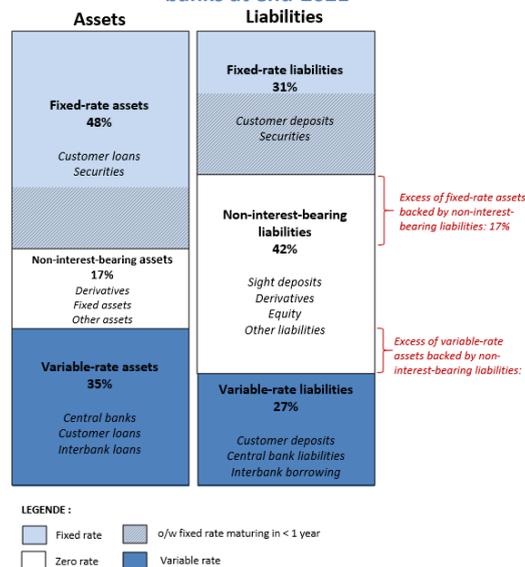
This situation is a consequence of monetary policy measures taken after the crisis, which created a surplus of variable-rate cash assets in bank assets, whose corresponding liabilities were primarily made up of deposits that were mostly non-interest-bearing in the low interest rate environment.

Interest margin, which was around EUR 70 billion in 2021, is the primary component of net banking income (44%) and has been relatively stable over the last five financial years. Taking the aggregate situation at end-2021 as the starting point, interest income and expense may be projected under various scenarios featuring higher interest rates, with slower credit creation, gradual normalisation of Eurosystem monetary policy, and the transfer of sight deposits to interest-bearing accounts. These projections show that net interest margin is expected to remain in a range of between EUR 65 billion and EUR 105 billion over the next five financial years and will feature a pronounced upward trend over the long run.

The increase in interest income is driven by the instant pass-through from higher short-term interest rates to variable-rate assets held by banks but more especially by the issuance of new loans at higher rates to replace repaid loans. To a lesser extent, interest expense also goes up with higher rates and with the transfer of deposits to interest-bearing accounts, or, in a roughly equivalent manner, with their potential transfer to other euro area countries, requiring them to be refinanced.

The projections illustrate the positive momentum for the net interest margin of French banks in the event of higher interest rates, owing to the structure of their balance sheets. The ability of banks to generate highly positive net interest margin is also corroborated by reverse stress tests based on a scenario generator that simultaneously varies the main factors being modelled.

Chart 1: Aggregate balance sheet structure of French banks at end-2021

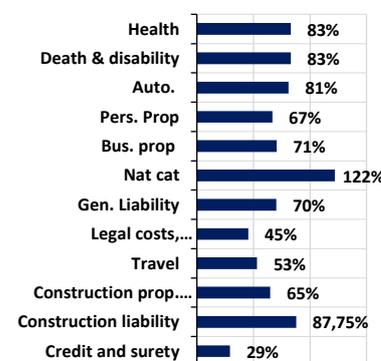


French insurers enjoy a solid overall position, although individual institutions are exposed to differing levels of vulnerability to inflation and higher interest rates

Inflation is a source of risk primarily for non-life insurers. This is particularly true for those doing business in segments that offer long-term guarantees, such as construction, liability (general or auto) and death & disability, where prices cannot be revised on a regular basis.

Thus, while traditionally recording loss ratios of below 100% (cf. Chart 1.52), these activities could see a significant increase in the cost of claims and hence in their loss ratios. More generally, higher inflation could lead to underwriting risk in both life and non-life insurance, by reducing saving capacity and purchasing power among policyholders. Meanwhile, if market interest rates adjust to inflation, this could be beneficial to life insurers, whose liabilities have greater duration than assets. In such a situation, higher interest rates would have a positive impact on the capital requirements coverage ratio.

Chart 1.52: Loss ratio in non-life insurance*
x: %/y: Type of claims



Source: ACPR.

Chart 1.53: Insurance vulnerability indicators: Return on Assets (RoA)
x: year / y: %



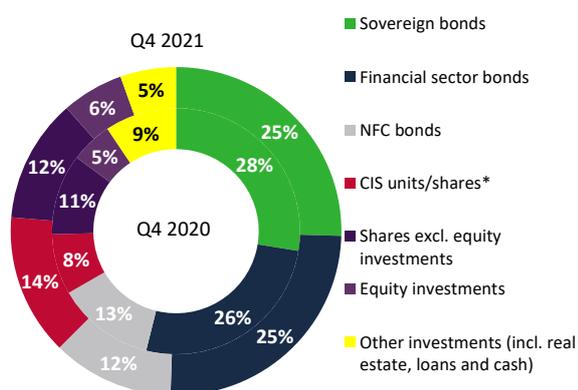
Source: ACPR.

Despite the current increase in interest rates, the recurring portion of the return on insurers' assets other than unit-linked products, which is mainly made up of bond coupons, is still on a downward path. This is due to the replacement of high-yield bonds acquired a number of years ago by bonds earning lower yields. In 2021, strong performances on financial markets enabled insurers to make up for this decline by generating capital gains.

Life insurers are affected by the interest rate shift because, to meet their commitments, they prioritise investments in safe and liquid bonds. Historically, holders of life insurance contracts have had a marked preference for euro-denominated products, which are characterised by a capital guarantee. In terms of the assets used to back these liabilities, at 31

December 2021, sovereign bonds accounted for 25% of investments (before applying the look-through approach to indirect holdings), ahead of financial sector bonds and NFC bonds, whose shares amounted to 25% and 12% respectively (cf. Chart 1.54). Highly-rated bonds (from AAA to AA-) made up 55% of the portfolio of insurers at 31 December 2021, while bonds rated below BBB- accounted for less than 1% (cf. Chart 1.55). Insurers have not materially changed this asset allocation.

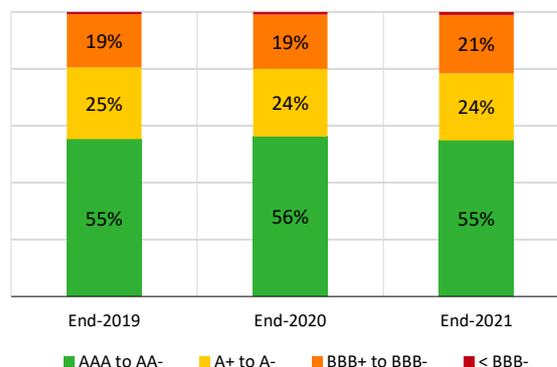
Chart 1.54: Decomposition of insurers' assets



Source: ACPR.

Note: Before applying the look-through approach to collective investment schemes.

Chart 1.55: Breakdown of insurer bond holdings, by rating
x: year / y: %

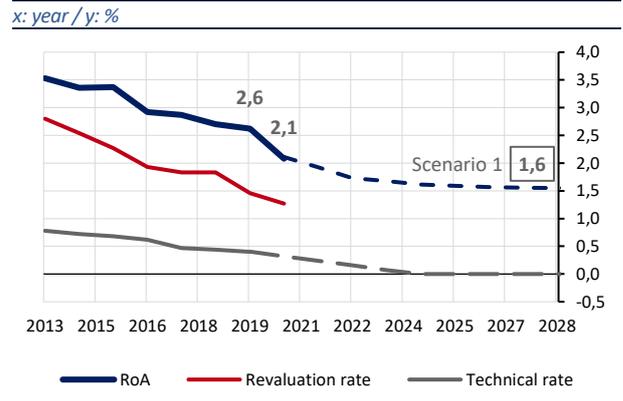


Source: ACPR.

Note: as a % of rated securities, before applying the look-through approach to collective investment schemes.

The risk posed by higher interest rates will depend to a large extent on the speed of increase. The downtrend in interest rates over recent years has put downside pressure on insurers' financial income, especially bond coupons. The average return on assets (RoA) fell from 3.5% to 2.1% between 2013 and 2020. If interest rates were to rise suddenly, insurers would be affected due to the inertia of their portfolios, which would make it hard for them to keep pace with the increase and offer customers commensurately higher returns. While for now surrenders are in line with their long-term average and net inflows have not been significantly impacted on the downside, insurers could be faced with the risk of massive surrenders by policyholders and competition from new market entrants. Assuming that market rates increase to 2% from 2022, the reinvestment of maturing bonds would see the RoA of insurers flatten out at just 1.6% on a ten-year horizon (cf. Chart 1.56).²²

Chart 1.56: Ten-year RoA projection



Source: ACPR.

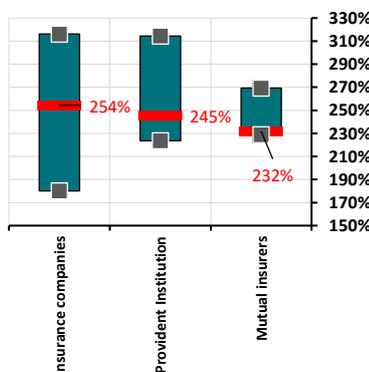
Note: Projections from 2021 (excl. capital gains or losses for the RoA).

Scenario 1 = French 10-year government bond yield to rise to 2% from 2022

Most of the securities held by insurers can be quickly and easily converted into cash under normal market conditions. Although it has not materialised for now, the risk of massive surrenders could also put pressure on the liquidity of insurers' assets in a scenario where they were forced to sell assets to honour their commitments to policyholders. However insurers mainly hold highly rated and extremely liquid assets. In fact, life insurers have a liquidity ratio of close to 50%²³ (cf. Chart 1.58). Assets can therefore be accessed easily in the event of massive surrenders.

Chart 1.57: Insurers' capital requirement coverage ratio

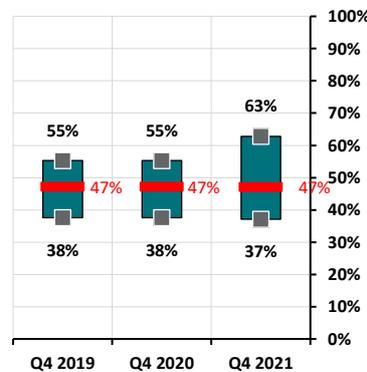
x: categories / y: 1st and 3rd quartiles and median



Source: ACPR.

Chart 1.58: Insurers mostly hold liquid assets (12-month period)

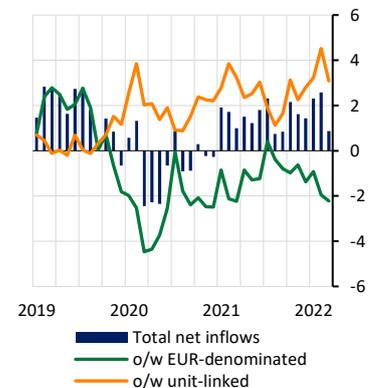
x: time / y: 1st and 3rd quartiles and median



Source: ACPR.

Chart 1.59: Net cumulative life insurance flows

x: year / y: EUR billion



Source: ACPR.

Insurers have the equivalent of three full years of revaluation in reserves. A more gradual increase in rates would allow insurers to manage the risk, to reinvest in higher-earning assets when their old investments mature and thus to continue to build their profit-sharing reserves. Insurers use these reserves to smooth over time the impact of cyclical conditions on the revaluation of insurance contracts, particularly in an environment when rates are rising.

²² In addition to interest rate scenarios, RoA projections also assume zero net inflows to euro-denominated instruments.

²³ The calculation method for this ratio is inspired by the standards developed by the Basel Committee under the Basel III framework, which introduced a liquidity coverage ratio (LCR) whose purpose is to promote banks' short-term resilience to liquidity risk. This ratio, which is used for example by the European Insurance and Occupational Pensions Authority (EIOPA), represents the share of unencumbered high quality liquid assets (HQLA) that may be converted into cash quickly and easily in private markets in the event of a liquidity crisis lasting three calendar days, relative to all investments.

Total reserves stood at 5.1% of outstanding amounts held by policyholders at end 2020, i.e. the equivalent of more than three full years of revaluation.

In addition to building up reserves for euro-denominated products, insurers are also promoting investments in unit-linked products, whose market risk is borne essentially by retail investors, in return for potentially higher returns. For some years, life insurers have thus reduced the revaluation rates applied each year to policyholders' euro-denominated products, which fell below 1.3% in 2020. As a result, despite French households' historical preference for the most liquid savings products, euro-denominated life insurance products, most of which may be surrendered at any time, have seen outflows on an almost continuous basis since the end of 2019. Net outflows came to approximately EUR 5 billion²⁴ in the first quarter of 2022, as compared with net inflows of around EUR 11 billion into unit-linked products (cf. Chart 1.59).

French bond funds have seen their duration increase in recent years, but a gradual rise in interest rates would limit their vulnerability to this shift

In a setting featuring prolonged low interest rates, a hunt for yield and a steady increase in investments by European residents, investment funds have increased the risk in their portfolios (cf. cross-cutting analysis of the June 2021 [Assessment of Risks to the French Financial System](#)). European residents' holdings of investment fund securities have risen steadily since 2013, with investments climbing from EUR 5.100 trillion to EUR 10.661 trillion. Insurers and pension funds (EUR 1.857 trillion), other financial institutions (EUR 1.845 trillion) and households (EUR 1.317 trillion) have driven the EUR 5.557 trillion increase. The duration of the debt securities held by investment funds has increased over the same period (cf. Chart 1.61), implying greater exposure to interest rate risk.

Funds with high exposure to bond securities could see the value of their assets decrease more strongly with a sudden increase in market interest rates, exacerbating existing vulnerabilities in the event of a massive exit by their investors. Investors might be prompted to move out of investment funds if fund values fall, forcing asset managers to sell their securities in order to generate enough cash to honour exit demands. This scenario has two major implications for financial stability: i) security sales, potentially in challenging conditions (volatility, large price swings, low market liquidity), could amplify movements and trigger procyclical effects; ii) low liquid asset levels²⁵ at investment funds might be insufficient to honour exit demands.

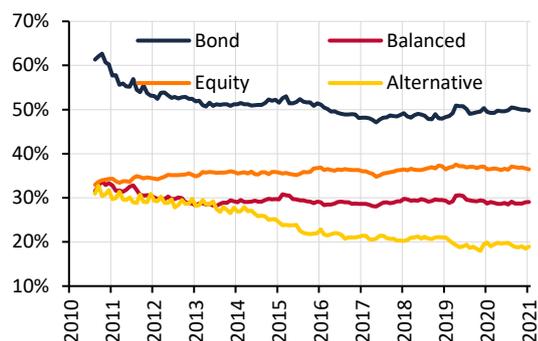
In the face of these increased vulnerabilities, investment funds appear to be resilient to interest rate developments, provided these lead to an orderly market correction. The level of liquid assets held by investment funds has decreased in recent years (cf. Chart 1.60), increasing the vulnerabilities of investment funds. However, in a setting of rising interest rates and significant asset reallocations (cf. Chart 1.23 C), bond funds have shown resilience since the start of the year. Fund resilience has been strengthened by the fact that investors do not have the same sensitivity to interest rates, with some having to deal with asset/liability duration management issues. The increase in fund duration is particularly borne by insurers and pension funds, which are less sensitive to interest rate movements and therefore less likely to exit funds on a massive scale (cf. Chart 1.61).

²⁴ Net inflow/outflow statistics after recognising net switching between products.

²⁵ The liquid asset ratio as presented in Chart 1.60 is based on criteria of nature and credit quality of securities (criteria inspired by the HQLA (High Quality Liquid Assets) concept applied to banks but not necessarily adapted to insurance companies and investment funds) and could be improved by taking into account the depth of markets and trading volumes

Chart 1.60: Ratio of liquid assets held by funds

x: year / y: share of total assets held

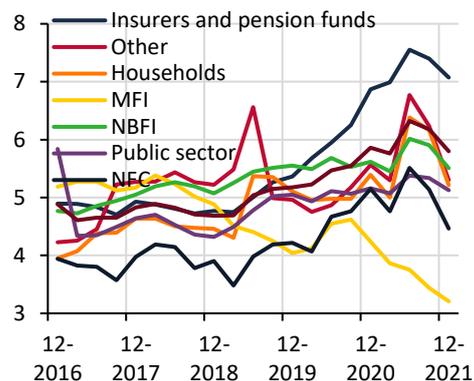


Note: This indicator seeks to assess the quantity of liquid assets held by French investment funds as a percentage of assets under management. It looks at both the nature (cash, equities, covered bonds, corporate bonds, sovereign bonds) and the quality (product or issuer ratings, equities included in an international index) of securities held in the portfolios of investment funds. cf. Methodological annex.

Source: Banque de France.

Chart 1.61: Duration of French bond investment funds, by holding sector

x: year / y: modified fund duration



Note: the modified duration illustrates the effect of a 100 bps (1%) change in interest rates on the price of a bond. MFI: Monetary financial institution; NBFi: Non bank financial institutions

Source: CSDB, Banque de France, Banque de France calculations

Liquidity levels vary according to fund type. Liquidity levels can be used to partially determine the ability of an investment fund to cope with substantial redemptions by investors. Chart xx shows that liquidity levels vary structurally according to fund types. Balanced and alternative funds appear to be less liquid than equity and bond funds. A dynamic analysis of fund liquidity levels between 2011 and 2022 also points to declining liquidity for bond funds and alternative funds and a trend increase for equity funds.

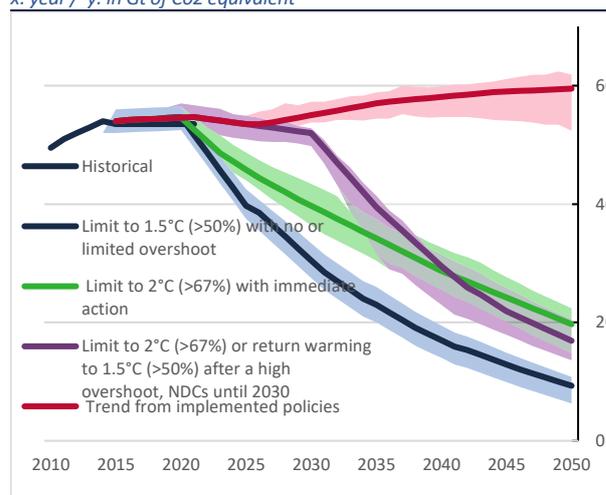
1.4 The risks of a disorderly climate transition are increasing with the war in Ukraine

The situation in eastern Europe and the strain that it is putting on energy prices are a stark reminder of the heavy reliance of the world's economies on fossil fuels. This dependence is well known, while the need to set the clean energy transition in motion as soon as possible has been clearly identified. The NGFS Net Zero 2050 scenario illustrates the magnitude of the task still ahead: renewables account for just over 15% of the energy mix today at the global level, but this will have to be raised to over two-thirds by 2050. Higher relative prices for fossil fuels, coupled with greater awareness about dependence on them, could help to accelerate the energy transition, particularly in Europe. Major choices are set to be made now that will also have a bearing on the financial risks associated with climate change.

To achieve the 1.5°C target set out in the Paris Agreement, aggressive action must be taken between now and 2025.

The most recent reports by working groups II and III of the Intergovernmental Panel on Climate Change (IPCC), published in February and April 2022 respectively, anticipate that, based on currently implemented policies, greenhouse gas (GHG) emissions will continue to increase beyond 2025, leading to average warming of 3.2°C in 2100 (see Chart 1.62). A temperature increase of more than 3°C would have major economic and financial implications. The IPCC stresses in particular that progress in aligning finance flows with Paris Agreement targets remains slow, with sizeable disparities between regions and sectors. Finance flows aimed at transition investments are between three and six times short of the levels needed by 2030 to be aligned with the Paris Agreement.

Chart 1.62: GHG emissions reductions according to different trajectories
x: year / y: in Gt of CO₂ equivalent



Source: Most recent IPCC report.

According to the IPCC, to meet the 1.5°C target, global GHG emissions must start decreasing by 2025, be roughly halved by 2030, and hit net zero before 2050.

Under IPCC scenarios, the transition can be achieved in time, but this will require more ambitious government action. Increasingly competitive prices for renewables (85% down since 2010), at a time when fossil fuel prices are under pressure, should help to accelerate the transition. But the transition could also have unexpected effects on other markets or take place in a less supportive environment, with insufficient coordination owing to gaps in current climate policies and possible amplification effects, which significantly increase the risks of a disorderly transition.

The war in Ukraine is forcing Europe to make structural choices in the very short term

The war in Ukraine, the economic and financial sanctions imposed on Russia and Russia's instrumentalisation of oil and gas exports are sources of losses and risks to financial stability. The current observed user energy cost levels are in fact a similar increase to that simulated by the NGFS after a transition. Thus, oil prices double by 2030 and those of gas triple in most scenarios. In the case of a Net Zero 2050 scenario of orderly transition, this increase is progressive over the next 10-15 years. In the case of a delayed transition, this increase is concentrated at the end of the period²⁶. The current increase in fossil fuel prices, similar in magnitude, is however more abrupt and concentrated over 2-3 quarters. Such a development is, in itself, fraught with risk. Beyond the effect of the war on prices, the situation is making all of the infrastructures that allow these fossil fuels to be imported from Russia (in particular, oil and gas pipelines) obsolete in the very short term (with a corresponding destruction of economic value and financial losses on the balance sheet of their owners).

From this situation, Europe faces an alternative with very different consequences. It can reduce its dependence on Russian oil and gas imports by looking for other sources of supply and by investing massively to adapt the continent's energy infrastructures (liquefied natural gas regasification terminals, adaptation of refineries to the characteristics of these new products) and/or by prolonging the use of coal. Alternatively, Europe can seek to accelerate its transition to carbon neutrality by rapidly making the necessary investments in energy savings, renewable energy production, storage and adaptation of distribution networks to the new energy situation.

The search for new sources of fossil resource supply would likely delay the transition, thereby contributing to an increase in physical risks in the medium to long term, and/or risks of a disordered and delayed transition in the short to medium term. In addition, making new investments with payback horizons that are not consistent with meeting the Paris Agreement targets implies an increase in the volume of assets that are likely to become stranded as the transition proceeds. The NGFS scenarios illustrate well the adverse economic and financial consequences of a delayed transition: GDP would be 5% lower by 2050 compared to an orderly transition, and

²⁶ On the other hand, in the first case (ordered transition), electricity prices rise in the first period and then fall towards a new equilibrium due to the decarbonization of the electricity mix and economy of scale effects, while in the second case, the rise is also later but there is no subsequent fall

the increase in the probability of default in the most exposed sectors would be later but about five to six times larger. The economic and financial losses would be further aggravated in the absence of a transition. This response to the energy crisis induced by the war in Ukraine would therefore contribute to an increase in financial risks related to climate change.

The circumstances are right for accelerating the transition to carbon neutrality, a preferable choice in terms of short, medium and long-term risks. Given the levels currently reached, the price of fossil fuels should limit the use of these energies and favor the deployment of decarbonized production capacities. As such, it represents an opportunity to accelerate the transition to a carbon neutral economy.

However, the option of investing massively in the transition to a low-carbon economy is not without risk either. This strategic choice, which would require a stronger involvement of the public authorities because of its rapid nature, could lead to higher energy prices. The NGFS transition scenarios thus assume substantial increases in the price of fossil fuels, but also in the short term of decarbonized sources (see above). In addition, demand for the raw materials necessary for the electrification of the energy mix, such as copper, lithium, cobalt or certain rare earths, is expected to grow rapidly. According to the International Energy Agency (IEA)²⁷, global demand for lithium (needed for electric car batteries, among other things) is expected to increase by a factor of around 40 by 2040, and for nickel and cobalt (needed for the development of the wind power sector, among other things) by a factor of around 20, with potential impacts on prices. A recent IMF study²⁸ estimates that the price of various metals could reach historical peaks for prolonged periods.

Finally, the war in Ukraine has also resulted in a marked deterioration in multilateral collaboration. Thus, besides the emergence of new challenges on the international scene, it now looks less likely that the conditions needed to strengthen international coordination and cooperation, which are in turn required to steer an orderly transition in a sufficiently quick timeframe, will be achieved. **Ultimately, the probability of a delayed and/or disorderly transition has therefore increased over the last year and particularly in the past six months.**

²⁷ See the International Energy Agency (IEA) report published in 2021, "The Role of Critical Minerals in Clean Energy Transitions"

²⁸ See Lukas Boer, Andrea Pescatori et Martin Stuermer (2021), « Energy Transition Metals »

2. Cyber risk

Driven by the ever-growing digitalisation of the economy and the financial system, cyber risk is increasingly emerging as a high-probability risk with the potential to have a major impact. The health crisis led to more widespread use of remote working tools, which has enlarged the area of exposure to IT attacks, while the war between Russia and Ukraine has given the threat renewed topical significance. Although the French financial system has not yet suffered a critical incident, now, more than ever, cyber risk needs to be monitored with the utmost care.

Cyber risk is a risk that is linked to information systems and forms a subset of operational risk. It can be defined as any risk of financial loss, business disruption or damage to the reputation of a company caused by a failure of information technology systems. These risks can materialise in a variety of ways, including deliberate and unauthorised breaches of secure systems, unintentional or accidental breaches or operational incidents caused by failed internal processes. While malicious attacks do not cause all cyber incidents, they are nonetheless at the root of most major incidents. The potentially malicious original intent and the speed and scale of propagation distinguish cyber risk from other kinds of operational risk, although the consequences may be the same.

Part one of this chapter gives an overview of cyber risk, part two considers the aspects that give cyber risk its systemic dimension, and part three reviews recent developments and describes the regulatory responses introduced to address these challenges.

2.1 Cyber risk is a growing threat to the economy and the financial sector

The economic impact of cyber risk seems to be rising, although measuring the risk remains a challenge

Available measures suggest that the frequency of cyberattacks is increasing overall and point to elevated costs, which have risen significantly in recent years.

A textual analysis of transcripts of quarterly earnings conference calls shows a rise in references to cyber risk, coupled with increasingly negative sentiment.²⁹ An analysis of messages about cyber risk on Twitter, a social media platform, may also provide a way to track developments.³⁰ Since 2011, the number of extreme events³¹ measured using this method has surged, with a peak in 2017 (Chart 1.1). The index's long-term trend, i.e. stripped of extreme events, also reveals growing attention to the theme, with renewed interest from 2020 onwards amid the health crisis. In one paper, Hiscox, a specialist insurer, found that the proportion of companies in its survey panel that reported attacks rose from 38% in 2020 to 43% in 2021, with almost one-quarter being targeted more than five times over the year. The cost consequences vary widely, but of the companies that were hit by an attack, one in six said that its survival was threatened.³² While many cyberattacks result in small losses, some are extremely costly for companies and a few have material economic impacts. A 2019 report by Accenture put the average annual cost of cyber crime³³

Chart 1.1: Messages about cyber risk on Twitter
x: Date / y: (left: number of extreme events), (right: cyber risk trend)



Sources: Lhuissier, Tripier, *Measuring Cyber Risk*, August 2021.

Notes: The bar displays the yearly number of cyber risk extreme events from 2011 to 2020 (left-hand scale). The red line shows the daily trend of the cyber risk index from January 2011 to March 2021 (right-hand scale).

²⁹ Jamilov, Rey & Tahoun, "The Anatomy of Cyber Risk", National Bureau of Economic Research, 2021.

³⁰ Lhuissier, Tripier, *Measuring Cyber Risk*, August 2021.

³¹ An extreme event is characterised by heavy media attention.

³² Hiscox, *Cyber Readiness Report*, 2021.

³³ The term "cyber crime" refers to cyber attackers who are motivated by profit and who are not state sponsored.

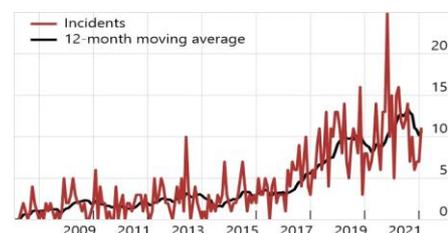
for a large corporation at USD 13 million.³⁴ For example, Sopra Steria, which was hit by a Ryuk ransomware attack in October 2020, estimated its losses at EUR 50 million.³⁵ The most damaging cyberattack to date was the 2017 NotPetya attack,³⁶ which was initially directed against Ukraine. It caused damages estimated at more than USD 10 billion, or just over 10% of Ukraine's GDP at the time.³⁷ In terms of aggregate losses, a 2020 study by the Center for Strategic and International Studies and McAfee, a cybersecurity company,³⁸ found that the cost of cyber crime had increased by over 50% in two years and was now worth approximately 1% of global GDP. Overall, cyber crime is estimated to cause USD 945 billion in financial losses annually.

Incident-related costs are further increased by the required spending on cybersecurity, which adds to the economic burden of cyber risk. According to Gartner, a consultancy, global spending on cybersecurity and risk management is set to exceed USD 167 billion in 2022. Yet cyber budgets still account for just 6% of the IT budgets of large French companies across all sectors, according to a recent study by Wavestone, a consulting firm.³⁹

Looking specifically at the financial sector, according to an IMF paper, average annual losses due to cyberattacks are equivalent to 9% of banks' net income (i.e. USD 97 billion) for countries in the sample, with the percentage rising to 26% (USD 268 billion) in a more severe scenario where the frequency of attacks is twice the peak recorded in 2013, without contagion effects.⁴⁰ Another modelling exercise, in which contagion effects are included and that compares three models with different sets of assumptions, shows how sensitive results are to the selected parameters. Depending on exposure assumptions (Value at Risk estimate by the Securities and Exchange Commission) and model parameters, including country, financial exposures and type of attack, total GDP costs range from USD 799 billion to USD 22.5 trillion.⁴¹ These costs include not only the direct costs of attacks (data theft) but also indirect costs such as loss of confidence, contagion of other companies, data loss or the introduction of new security systems.

Chart 2.2: Number of cyber incidents targeting financial institutions

x: Date / y: Number of incidents



Sources: Financial Stability Board.

These estimates illustrate the increase in risk. However, the frequency and costs of cyber incidents continue to be extremely tricky to estimate.

In the first place, reporting of incidents and associated losses is still very patchy, notably because of reputation or security sensitivity issues, and has been based until now on sector-specific obligations (especially in the telecom and medical industries). These sector differences are compounded by the materiality question: companies in the financial sector are not required to report incidents if they are not classified as major or do not have a material impact. Since even this definition is not standardised, it is hard to gain a harmonised view of incidents, whether within the financial sector or across several sectors.

In addition, as with other operational risks, the true cost of cyberattacks needs to factor in indirect costs such as reputational risk, impairment of intellectual property or the impact on future cyber insurance premiums. It takes several years for this cost to become apparent, complicating ex ante estimates of the potential long-term costs of incidents.⁴² Accordingly, the prevalence and cost of cyberattacks, although uncertain, are probably underestimated. Given the evolving nature of cyberattacks and the lack of empirical data, cyber risk, unlike financial risk, cannot easily be modelled or measured based on past experience.

³⁴ Accenture, "Ninth annual cost of cybercrime study", 2019.

³⁵ [Sopra Steria expects €50 million loss after Ryuk ransomware attack \(bleepingcomputer.com\)](https://www.bleepingcomputer.com/news/sopra-steria-expects-50-million-loss-after-ryuk-ransomware-attack/)

³⁶ A sabotage attack that targeted the information systems of Ukrainian institutions and companies before spreading to other countries.

³⁷ Walker, "The Economic Impact of Cyberattacks", Goldman Sachs Economics Research, March 2022.

³⁸ <https://www.csis.org/analysis/hidden-costs-cybercrime>

The CSIS is a US think tank that conducts strategic research and analyses on political, economic and security issues around the world.

³⁹ www.wavestone.com/fr/communiqués-de-presse/cybersecurite-ou-en-sont-les-grandes-organisations-francaises/

⁴⁰ Bouveret, "Cyber risk for the financial sector: a framework for quantitative assessment", *IMF Working Paper*, 2018.

⁴¹ Dreyer et al, "Estimating the global cost of cyber risk", 2018.

⁴² "Cyber Risk, Market Failures and Financial Stability", *IMF Working Paper*, 2017.

⁴³ Be that as it may, the cost estimates exceed the current size of the cyber insurance market by several orders of magnitude, as less than USD 5 billion of cyber losses are insured globally, according to Swiss Re.⁴⁴

Box 2.1: Cyber risk insurance: a market that is still maturing

With cyberattacks on the rise, cyber insurance can provide a way to protect against the risk. The US cyber insurance market is more mature than the European one, which is still in the construction phase. In France, a [report](#) published in May 2021 by the *Association pour le management des risques et des assurances de l'entreprise* (AMRAE – Association for risk management and corporate insurance) noted that premium volumes increased by 49% in 2020, or considerably less than the amount of claims paid, which tripled.⁴⁵

Market expansion is coming up against uncertainty among insurers, which are fearful of being exposed to excessive risk. This stems partly from the lack of reliable databases, risk modelling challenges and low risk pooling capacity. Furthermore, cyber insurance products and coverage on the market vary widely.

Ongoing work at national and European levels aims to develop more effective measurement of cyber risk and exposures and to clarify the scope of insurance coverage, which should pave the way for more mature French and European cyber insurance solutions to emerge. This is a major issue because just 8% of mid-tier firms have taken out cyber insurance, according to AMRAE. A broader range of cyber insurance products and services would help to set up a virtuous circle, with insurance providing prevention and protection tools and better support for insured parties, encouraging them to bolster their cybersecurity practices and defences.

France is currently debating the question of paying ransoms after cyberattacks.⁴⁶ A parliamentary report in October 2021 proposed introducing legislation to ban insurers from covering such payments, while the *Comité juridique de la place financière de Paris* (HCJPP – a high level committee set up to consider legal issues affecting the Paris financial markets) said that a ban would not stop cyber crime and might actually hurt companies and communities.⁴⁷

Other issues involved with cyber insurance include the risk of implied coverage of cyber risk in standard insurance, as well as the potential need to clarify possible exclusions when the claim-generating event constitutes an act of cyber warfare.

⁴³ Institute of International Finance, “Cyber Security & Financial Stability: How cyber-attacks could materially impact the global financial system”, 2017.

⁴⁴ S&P Global, “Cyber risk in a New Era: Insurers Can Be Part Of The Solution”, 2020.

⁴⁵ AMRAE, “Lumière sur la cyber-insurance”, 2021.

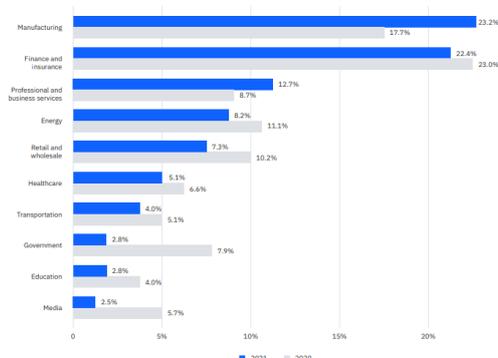
⁴⁶ Source: G. Poupard (ANSSI), parliamentary report on cyber insurance by V. Faure-Muntian (October 2021), p. 8.

⁴⁷ Parliamentary report on cyber insurance by V. Faure-Muntian, October 2021; *Haut Comité Juridique de la Place financière de Paris*, “Rapport sur l’assurabilité des risques cyber”, January 2022.

The financial sector is a prime target

Chart 2.3: Breakdown of attacks by industry
x: Percentage / y: Industry

Breakdown of attacks on the top 10 industries, 2021 vs. 2020
(Source: IBM Security X-Force)



Sources: IBM X-Force Threat Intelligence.

The growing digitalisation of the economy and financial services represents a structural trend that is driving increased cyber risk.

The health crisis did not create new entry points but considerably expanded the potential attack surface owing to broader use of work-from-home arrangements and procedures that were set up quickly in order to support business continuity. For example, organisations found themselves forced to increase the number of internet-exposed services, to urgently deploy large numbers of mobile work stations and to quickly boost remote access capabilities. Research identified a strong link between the prevalence of work-from-home arrangements and the incidence of cyberattacks between February and June 2020, with the financial sector ranking high on both accounts.⁴⁸ The presence of high value added assets and data further explains why the financial sector attracts cyber criminals looking to make financial gains.

IBM estimates that the global financial sector was the target for 22% of all cyberattacks and incidents observed in 2021, ranking second behind manufacturing, whereas it represents about 8% of GDP. Of these attacks, 70% targeted banks.⁴⁹ According to another paper, the financial sector is exposed to a greater number of attacks but sustains smaller losses on average thanks to proportionally larger investments in information system security.⁵⁰ Losses due to cyber risk make up just a tiny share of operational losses, but could account for up to one-third of total operational Value at Risk (VaR), according to a research paper by the Bank for International Settlements.⁵¹ In continental Europe, financial institutions are responsible for the largest number of cyber insurance claims (29% increase in 2020), although other sectors are not far off, reporting elevated rates of incidence.⁵²

Many established financial sector participants have already been hit by successful attacks. In 2016, the Central Bank of Bangladesh's SWIFT payment terminal was hacked and fraudulent messages were sent, resulting in the theft of USD 81 million. In 2018, hackers targeted the ATM server of Cosmos Bank in India and stole USD 13.5 million through fraudulent transactions. In August 2020, disruptions on the New Zealand stock exchange caused by a series of attacks led trading to be halted due to market integrity concerns. Other types of firms have also been affected, including digital asset service providers (USD 80 million stolen from Qubit Finance in January 2022) and credit rating agencies (data stolen from US firm Equifax in 2017).

Box 2.2: Growing scrutiny from credit rating agencies

In 2019, S&P, a credit rating agency, downgraded Bank of Valletta after a cyberattack increased concerns about the robustness of the institution's operational risk management framework. Using images taken from France's *Autorité des marchés financiers* (AMF – Financial Markets Authority) the phishing attack sought to steal funds through fraudulent credit transfers. The Maltese bank managed to stop the transfers and avoid losing almost EUR 13 million.

While cyberattacks have had limited effects on the credit ratings of financial institutions so far, the growing frequency and complexity of attacks could lead to more rating events in the future. Credit rating agencies now look at whether a robust cybersecurity framework and cyber governance standards are in place when they assess credit ratings, even before considering incidents. Agencies say they are exploring new ways of assessing the exposure of entities to cyber risk, notably through collaborations with companies that specialise in

⁴⁸ "Covid-19 and cyber risk in the financial sector", *BIS Bulletin* No. 37, 2021.

⁴⁹ X-Force Threat Intelligence Index, 2022.

⁵⁰ Aldasoro, Gambacorta, Giudici, Leach, "The drivers of cyber risk", *BIS Working Papers*, 2020.

⁵¹ Aldasoro, Gambacorta, Giudici, Leach, "Operational and cyber risks in the financial sector", *BIS Working Papers*, 2020.

⁵² Marsh, CMS Law, Kivu, Microsoft, "The Changing Face of Cyber Claims", October 2021.

cybersecurity. An analysis by rating agency Fitch, for example, points out that banks with the highest credit ratings typically score best in cybersecurity, but that financial size is not necessarily a good indicator of cyber maturity, since large banks are more likely to have a complex legacy IT infrastructure.

In the event of a cyberattack, swift detection and resolution can help to prevent damage to a company's credit profile. Credit ratings may be sensitive to cyber incidents that have pronounced or long-lasting impacts on business operations, hurt the issuer's reputation or undermine customer trust, result in fines or large settlements or affect the issuer's financial profile in some way, e.g. profitability, liquidity or leverage.⁵³

A multifaceted and evolving threat

Attackers use a variety of infection vectors to access the information systems of financial and non-financial entities. Opportunistic attackers may try to infiltrate company information systems (IS) by exploiting protocol, software or other vulnerabilities that they have identified or bought on dark marketplaces, by conducting massive phishing campaigns or by purchasing access to IS that have been compromised by other parties. Other attackers using more sophisticated methods carry out in-depth reconnaissance in order to compromise specific entities. Social engineering is becoming more and more elaborate, with attackers going so far as to reach out directly to employees that they have identified on social media in order to win their trust. In one example, between 2018 and 2019, APT38, a hacking group⁵⁴ thought to be linked to North Korea, posted a fake job offer on LinkedIn that tricked applicants (IT staff at financial institutions) into downloading fake job application software that infected their computers. The IS for Chile's interbank ATM network, Redbanc, was compromised in this way.⁵⁵

Supply chain attacks are used to circumvent the cybersecurity measures set up by end targets by infiltrating a trusted resource, such as a piece of software, or by going through the IS of a sub-contractor to which the end target is connected. For example, in December 2020, hackers exploited vulnerabilities in the file transfer application software of Accellion, a security software publisher, to install malicious code. Beginning in January 2021, a number of Accellion's corporate clients, including the Central Bank of New Zealand and Morgan Stanley, received emails threatening to publish exfiltrated data from the compromised application on a leak site unless a ransom was paid.

No matter which infection vector they employ, attackers likely to target the financial sector are mainly motivated by financial profit, the desire to cause disruption or, to a lesser degree, espionage goals. State-sponsored attackers may also target the financial sector with the aim of making financial gains.⁵⁶ Some, such as the Cobalt Gang or the APT38 Group (aka Bluenoroff), plan targeted attacks for several months in a bid to compromise banks' information systems, infiltrate their ATM or card management systems, break into their access interface to the SWIFT interbank messaging service, or make fraudulent withdrawals or credit transfers. In recent years, however, with the rise of crypto-asset trading venues, some attackers are switching their approach to focus on these systems, which are supposedly easier and more profitable to compromise than traditional bank information systems. Extortion attacks have been rising sharply since 2018, underpinned by the industrialisation of the cyber crime ecosystem,⁵⁷ although these attacks do not solely concern the financial sector. The most common attacks involve exfiltrating data, potentially with file encryption (ransomware), and then issuing a ransom demand and threatening to disclose the information on a dedicated website if the ransom is not paid.

See for example S&P Global, "Cyber Risk in a New Era: The Increasing Credit Relevance Of Cybersecurity", July 2021; Moody's, Cyber Risk 2022 Outlook – "Workplace shifts open new attack channels, while insurance costs rise and coverage narrows", November 2021; Fitch, "Bigger Not Always Better for Bank Cyber Risk Scores", April 2021.

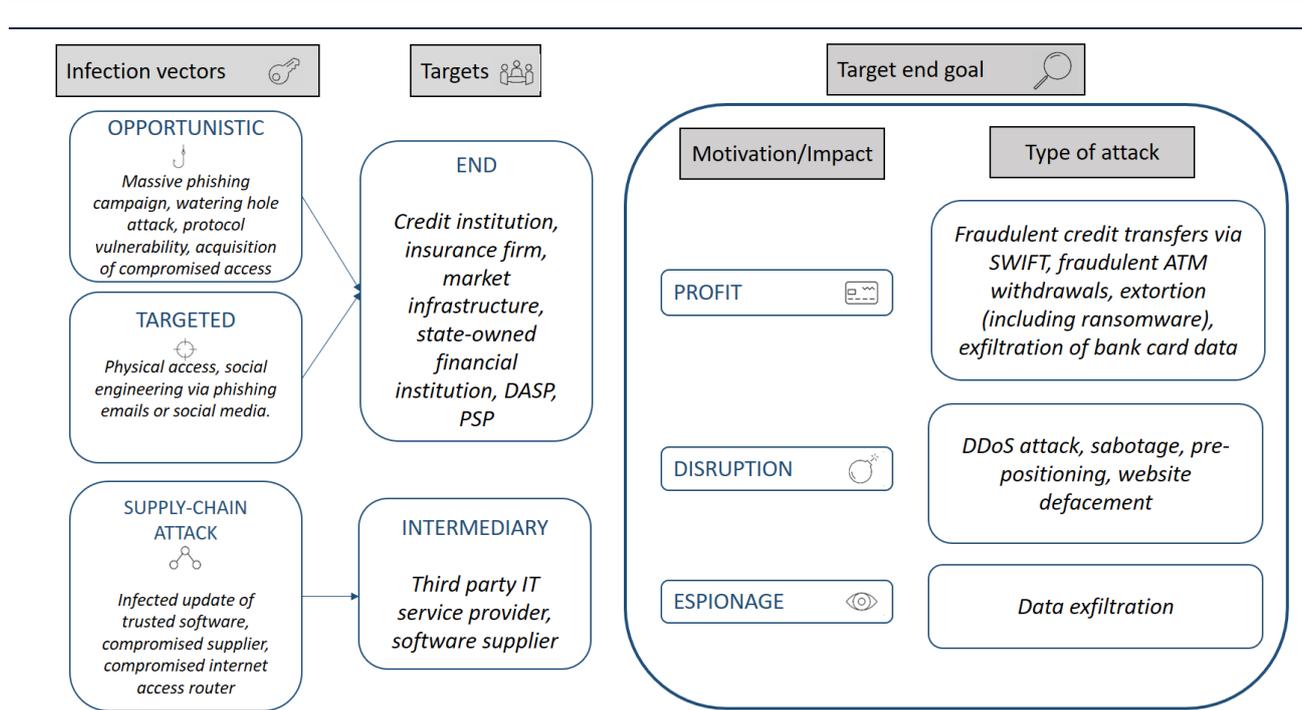
⁵⁴ According to ANSSI's definition, a hacking group is a specific group made up of identified or identifiable individuals that claim to belong to an organisation. A hacking group may use one or more operating methods.

⁵⁵ INTEL, "Disclosure of Chilean Redbanc Intrusion Leads to Lazarus Ties", 15 January 2019 (<https://www.flashpoint-intel.com/blog/disclosure-chilean-redbanc-intrusion-lazarusties/>).

⁵⁶ Particularly North Korea, in a bid to circumvent financial sanctions imposed on it (see [FASTCash 2.0: North Korea's BeagleBoyz Robbing Banks | CISA](#)).

⁵⁷ The cyber crime ecosystem comprises buyers and sellers of goods (malicious code, compromised access, stolen personal data, etc.) and services (hiring of denial of service or anonymisation infrastructure, etc.) that enable attackers to outsource a large share of the resources and tools needed to carry out malicious operations. This facilitates their activities.

Chart 2.4: Attack typology



Notes: DASP, digital asset services provider; PSP, payment services provider; DDoS attack, Distributed Denial of Service attack.

Sources: ACPR.

Disruptive attacks, which are less widespread than profit-motivated attacks, vary in terms of their source and nature. They may include DDoS attacks⁵⁸ by hacktivists,⁵⁹ such as the June 2016 Operation Icarus attack by the Anonymous and Ghost Squad Hackers groups on several stock exchanges, including NYSE Euronext.⁶⁰ They may also be led by state-sponsored actors, as seems to have been in the case in February 2022, when several state-owned Ukrainian banks suffered DDoS attacks in the lead-up to and at the start of the Russian/Ukrainian war.⁶¹ Sabotage attacks also occur, such as in December 2016, when the servers, network equipment and backup system components of Ukrainian financial institutions were damaged.

Insurers appear to be a preferred target of data exfiltration attacks conducted for espionage purposes, according to France's *Agence Nationale de Sécurité des Systèmes d'Information* (ANSSI – National Cybersecurity Agency), because they hold and manipulate large volumes of various kinds of data, including personal, financial and intellectual property information. In 2014, US insurers Anthem, Premera, Carefirst and Excellus were compromised by attackers seemingly looking for information on the movements, medical details, responsibilities and sensitive information access of various executives.⁶² In addition, with a growing number of insurers offering cyber coverage, these firms now hold data about the cybersecurity systems of insured companies. As a result, some insurers are being spied on as intermediate targets by cyber crime groups⁶³ trying to gain information about the IS security policies of client firms.

With the war in Ukraine, the risk of disruptive or espionage attacks has become particularly topical. While no major incident has been detected so far, the threat to European information systems remains elevated. Multiple threats exist, including i) hacktivist attacks, ii) offensive actors with indirect ties to the warring parties that have already tried to exploit the situation to conduct targeted phishing activities, iii) a portion of the cyber crime ecosystem that has taken positions in the war and that would be capable of targeting French entities in the near

⁵⁸ An attack designed to make it impossible to access a server, causing a service to be interrupted or severely degraded.

⁵⁹ Hackers with activist goals.

⁶⁰ Daily Mail, "Hackers Attack the Stock Exchange: Cyber Criminals Take Down Website", 5 June 2016

⁶¹ Forbes, "Ukrainian Government And Banks Hit By New Wave Of Cyberattacks", 23 February 2022.

⁶² California Department of Insurance, "Investigation of Major Anthem Cyber Breach Reveals Foreign Nation behind Breach", 6 January 2017.

⁶³ The Record, "I Scrounged through the Trash Heaps... Now I'm a Millionaire: Interview with REvil's Unknown", 16 March 2021 (<https://therecord.media/i-scrounged-through-the-trash-heaps-now-im-a-millionaire-interview-with-revils-unknown/>).

future to gather intelligence or to retaliate against European sanctions. In this environment of geopolitical conflict and multiple threats, financial institutions must be on their guard and be proactive in implementing – and then maintaining – defensive measures.⁶⁴

2.2 Some cyber risk scenarios could entail a systemic threat to the financial system

Besides the specific vulnerabilities of each entity, cyber risk could trigger instability at the level of the financial system as a whole. While no cyber incident so far has had system-wide effects, the incidence of large-scale incidents is rising, highlighting the diverse range of targets and potential contagion channels.

Multiple trigger events and transmission channels could lead to a system-wide incident

Cyberattacks could threaten financial stability through their impact on a given organisation or multiple components of the financial system simultaneously. The disruption caused could trigger various channels of financial contagion and fuel negative feedback loops in extreme scenarios. The European Systemic Risk Board (ESRB) has shown that a cyber incident could develop from an operational failure into a liquidity crisis⁶⁵ that could in turn unleash a system-wide crisis, notably in the event of significant real or anticipated financial losses or a marked loss of trust in the financial system.⁶⁶ The affected targets and the nature of the transmission channels are decisive when assessing the potential magnitude of an incident. For example, a cyberattack that is deliberately designed to disrupt the financial system could translate more easily into a confidence shock than an attack motivated simply by financial gains.

A major disruption of critical infrastructure or economic functions represents one set of potential high-impact scenarios. Critical financial services include securities custody, central clearing and payment services. Real-time gross settlement systems (RTGS) and the SWIFT messaging system, for example, are vital to cash and securities payments and settlements and are considered to be potential “single points of failure” in the payment infrastructure globally.⁶⁷ Payment system disruptions could lead to uncertainty about the finality of settlements linked to payment obligations, which could have broad repercussions along complex chains of affected participants.⁶⁸ According to a “pre-mortem” analysis by the New York Fed, a cyberattack on the wholesale payment network of one of the five most active participants in the US payment system would result in 38% of the network (as a percentage of bank assets) being affected on average, while a cascade scenario, in which banks respond strategically to the deterioration in their balances over the day by proactively forgoing payments and hoarding liquidity, results in foregone transactions that represent from 5%-35% of total daily payment value, or equivalent to between one and 11 times daily US GDP.⁶⁹ One study estimates that US systemically important financial institutions have sufficient high quality liquid assets to cover withdrawals by wholesale investors in the event of a relatively significant cyber run⁷⁰ but suggests that this does not guarantee that the payment system will continue to process payments sufficiently quickly to avoid damage to the real economy.⁷¹

A massive attack on data integrity is another potential scenario that could severely disrupt financial markets and the real economy. For example, in the event of simultaneous data corruption at a custodian bank and one of the large central securities depositories, it would be difficult to reconcile or reconstruct common operations between these entities, which could negatively impact processing and prices of affected securities, transactions and confidence more generally.⁷² Similarly, a hypothetical scenario considered by the ESRB looks at the

⁶⁴ “Rapport Menaces et Incidents” by the *Centre gouvernemental de veille, d’alerte et de réponse aux attaques informatiques* (Government centre for IT attack monitoring, alerts and responses), 12 April 2022.

⁶⁵ For example, on 27 June 2014, First Investment Bank (FIB), Bulgaria’s largest bank, was hit by a run following a series of fake emails and social media messages suggesting that FIB was experiencing a liquidity shortfall.

⁶⁶ ESRB, “Systemic cyber risk”, 2020.

⁶⁷ World Economic Forum, “Understanding Systemic Cyber Risk”, 2016.

⁶⁸ Institute of International Finance, op.cit.

⁶⁹ Eisenbach, Kovner and Lee, “Cyber Risk and the US financial System: a Pre-Mortem Analysis”, *Fed Staff Report*, 2020.

⁷⁰ A cyber run is a scenario in which a cyberattack triggers a bank run and a liquidity crisis.

⁷¹ Duffie and Younger, “Cyber Runs”, *Hutchins Center Working Paper*, 2019.

⁷² Institute of International Finance, op. cit.

simultaneous manipulation of the price feeds of several commodities and futures markets, as well as information provided by a central counterparty. As uncertainty spreads about the reliability of prices and positions, liquidity and prices drop, triggering a self-reinforcing spiral of forced sales, which causes severe losses for multiple market participants.⁷³ In general, loss of data integrity may require delicate tradeoffs between the need to recover data quickly and the need to ensure that recovered data are safe and accurate in order to avoid spreading risks within the system.⁷⁴

The failure of a widely used technological component or a dominant service provider could simultaneously affect several major portions of the financial system, potentially triggering multiple chain reactions. Confidentiality breaches or large or high-frequency thefts could also be a source of financial instability if they undermine confidence in the financial system. In an extreme scenario, this type of incident could lead to severe price volatility on markets, reduced trading volumes or runs, creating liquidity challenges for financial institutions.

Finally, a cyber incident affecting non-financial infrastructures on which the financial system relies, such as power or telecommunications providers, could also pose a threat to financial stability. Depending on the scope and duration of the attack, flows transiting through affected financial institutions or market infrastructures could be severely delayed or even halted outright. A study by Lloyds has estimated that an attack on the power grid in the northeastern United States that plunges 15 US states into darkness would result in economic damages of between USD 250 billion and USD 1 trillion.⁷⁵

Complex interconnections between participants both within and outside the financial system could play a major amplifying role

Vulnerabilities in the information systems of financial entities create risks that go beyond the scope of the institutions themselves taken in isolation. Operational interdependencies could potentially help attacks to spread, as an infected financial institution acts as the entry point to reach other institutions to which it has ties. The growing complexity of the financial sector has expanded the potential attack surface and the risk of contagion between sector participants, especially since not all participants are at the same level of maturity in terms of their cybersecurity. These interconnections are also financial in nature, as the scenarios above show. However, critical nodes within the financial system, i.e. the key points used by the most important transactions and functions of systemically important participants, have been only partially identified.

Studies covering specific areas of these interconnections illustrate the potential scale of contagion from cyber incidents. One paper shows how the effects of the 2017 NotPetya attack spread downstream through supply chain relations to the customers of companies hit by the malicious code, significantly impacting their productive capacities and profits and forcing them to draw on liquidity buffers and increase borrowing.⁷⁶ The study's authors estimated the loss in profits at affected corporate customers at USD 7.3 billion, or quadruple the losses reported by companies that were directly hit by the cyberattack. Likewise, evidence was found to suggest that cyber incidents negatively impact not just the return on equity (RoE) of affected companies but also the RoE of unaffected companies from the same industry and country.⁷⁷

Growing use of third party service providers is creating new interdependencies. Faced with the growing complexity of information technologies and the massive investments needed to harness them, many firms from the financial sector are stepping up their use of outside IT service providers. More and more attackers are targeting this digital supply chain, taking advantage of the trust between suppliers and customers and the preferred access that many suppliers have to the information systems of their customers. According to the most recent CESIN

⁷³ ESRB, op. cit.

OFR, "Cybersecurity and Financial Stability: Risks and Resilience", 2017.

⁷⁵ Lloyd's and the University of Cambridge's Centre for Risk Studies, "Business Blackout", 2015.

Crosigni et al., "Pirates without Borders: The Propagation of Cyberattacks through Firms' Supply Chains", 2020.

⁷⁷ Jamilov et al., "The Anatomy of Cyber Risk", 2020; Kamiya et al., "Risk management, firm reputation, and the impact of successful cyberattacks on target firms", 2021.

survey on the cybersecurity of companies in France, indirect attacks via service providers increased by 5% to affect 21% of respondent firms in 2021.⁷⁸

On some market segments, the small number of service providers has created a highly concentrated situation, as a growing number of entities depend on these firms, including increasingly for critical services. The failure of one such provider could trigger simultaneous problems across a wide swathe of the financial sector. Recent attacks that were based on compromising tools distributed by IT service providers to a large number of financial and non-financial sector participants, such as the cases involving IT management software providers SolarWinds in December 2020 and Kaseya in July 2021, offer a good illustration of this risk. The risk is further exacerbated by the fact that these points of concentration are often either poorly identified or not identified at all; many SolarWinds customers were not even aware that they were using its software.⁷⁹ In particular, while cloud computing services may help to significantly enhance the resilience of institutions considered individually, the potential concentration of the supply of these services could create systemic effects in the event of a large-scale operational failure or insolvency.⁸⁰ Four participants account for around two-thirds of the global market for the provision of cloud services.⁸¹ A study by Lloyds estimates that a cyber incident causing one of the top three US cloud providers to go offline for three to six days would result in total losses of between USD 7 billion and USD 15 billion.⁸² Based on a stylised model applied to the clearing members of a central counterparty, an analysis by the European Securities and Markets Authority (ESMA) suggests that the high concentration of cloud providers could create risks for financial stability if a failure at one provider were to affect many of the firm's customers, by increasing the probability of simultaneous failures.⁸³

New intermediaries and new technologies are creating potential zones of exposure in connection with financial institutions. The rapid technological development of fintechs⁸⁴ has been accompanied by a new array of financial services and transactions, such as touchless mobile payments. A larger number of distinct entities may be involved in providing a single product or service, creating complex networks of operational dependencies.⁸⁵ New financial services based on the use of digital assets, or crypto-assets, have also emerged. But weak guarantees covering the custody of these assets make them vulnerable to cyberattacks (cf. hacks at Mt. Gox in 2014 and Poly Network in 2021). Centralised platforms are not the only ones affected: out of the USD 3.2 billion in crypto-assets stolen in 2021 (around six times more than was stolen in 2020), approximately USD 2.3 billion was misappropriated from decentralised finance (DeFi) platforms⁸⁶ (see Banque de France, *Assessment of Risks to the French Financial System*, December 2021). One study found that the average cost of cyber incidents linked to crypto-assets was markedly higher and also identified a strong positive correlation between the price of bitcoin and the intensity of attacks on crypto-asset trading platforms.⁸⁷ Cyberattacks on suppliers have traditionally been followed by significant withdrawals by customers, with the lack of DeFi deposit insurance fuelling the perception that all deposits are at risk.⁸⁸ Growth of the DeFi sector could lead to increased holding of this type of asset, with an associated rise in wealth effects, exposures of financial institutions and impacts on confidence in the event that vulnerabilities materialise. While direct connections between crypto-assets, systemically important financial institutions and the main financial markets remain limited for the time being, they are nevertheless increasing rapidly and should be monitored closely.⁸⁹

⁷⁸ [www.cesin.fr/uploads/files/Barome%CC%80tre%20de%20la%20cyberse%CC%81curite%CC%81%20des%20entreprises%20vague%207-Opinionway-CESIN_Janv2022\(1\).pdf](https://www.cesin.fr/uploads/files/Barome%CC%80tre%20de%20la%20cyberse%CC%81curite%CC%81%20des%20entreprises%20vague%207-Opinionway-CESIN_Janv2022(1).pdf)

⁷⁹ David E. Sanger, Nicole Perlroth and Julian E. Barnes, "As Understanding of Russian Hacking Grows, So Does Alarm", *New York Times*, 2 January 2021. Financial Stability Board, "Third-party dependencies in cloud services: Considerations on financial stability implications", 2019.

⁸¹ Feyen, Frost, Gambacorta, Natarajan and Saal, "Fintech and the digital transformation of financial services: implications for market structure and public policy", *BIS Papers*, July 2021.

⁸² "Cloud Down", 2018.

⁸³ Asensio, Bouveret, Harris, "Cloud outsourcing and financial stability risks", *ESMA Report on Trends, Risks and Vulnerabilities*, 2021.

⁸⁴ Fintech, a contraction of "financial technology", refers to small firms that use innovative solutions to provide financial services.

⁸⁵ Feyen et al., op.cit.

⁸⁶ Chainalysis, "The 2022 Crypto Crime Report", February 2022.

⁸⁷ Aldasoro, Gambacorta, Giudici, Leach, "The drivers of cyber risk", *BIS Working Papers*, 2020.

⁸⁸ "Fast-Moving FinTech Poses Challenge for Regulators", *IMF Blog*, April 2022.

⁸⁹ Financial Stability Board, "Assessment of Risks to Financial Stability from Crypto-assets", February 2022.

2.3 Efforts to strengthen the operational resilience of the financial system must be kept up

Recent or planned regulatory developments and the introduction of a supervisory framework will strengthen the operational resilience of the financial sector

With the digital transformation of the financial sector, a regulatory and supervisory framework that goes beyond the existing technical standards (such as the US cybersecurity framework set up by the National Institute of Standards and Technology) **is needed to control cyber risk**. Accordingly, initiatives have proliferated in recent years at domestic, European and international level. Certain legislation on cyber risk and operational resilience has cross-sector application that extends beyond the finance industry: for example, the European Network and Information Security (NIS) Directive,⁹⁰ which is currently under revision, and France's Military Spending Act of 18 December 2013 establish IT security rules for Essential Service Operators (OSEs) and Operators of Vital Importance (OIVs), which include some financial sector participants.

At European level, between 2019 and 2021, the European Supervisory Authorities (ESAs) published guidelines⁹¹ on IT risk and operational resilience. These soft law instruments paved the way for the draft Digital Operational Resilience Act (DORA, cf. Box 2.3), which is currently under negotiation and is set to come into force in late 2022/early 2023. The new legislation will apply to the vast majority of financial sector participants and should promote greater harmonisation of cyber risk management rules. France's ACPR has said that it is compliant with ESA guidelines on IT risk. To achieve this, the regulatory framework⁹² had to be adjusted, and the ACPR published notices explaining the rules and providing industry with information on areas to watch and best practices. As regards market infrastructures, the Banque de France is examining procedures for adopting the European Threat Intelligence-based Ethical Red Teaming (TIBER-EU) framework, which aims to harmonise execution practices for the most advanced security tests. Discussions are under way on whether to deploy this framework at national level with supervision by the ACPR.

Box 2.3: The draft Digital Operational Resilience Act (DORA)

In April 2019, at the request of the European Commission, the European Supervisory Authorities (ESAs) published joint advice on the need for legislative improvements relating to ICT risk management requirements in the European financial sector. This led to publication by the European Commission of a proposal for a Digital Operational Resilience Act (DORA) in September 2020. The proposed legislation is organised around four key areas:

- In terms of managing IT risk, DORA will require entities to formally map out IT assets and associated risks, and have governance arrangements that are appropriate to the management of cyber risk. All participants will also have to implement measures to protect systems and data as well as processes to detect anomalies.
- Financial entities will have to set up processes for managing ICT-related incidents, which will be required to be classified using common criteria. DORA requires entities to notify the supervisor of major incidents, using a harmonised reporting framework.
- All entities will have to implement an operational resilience testing policy. DORA also sets rules on performing threat-led penetration tests (TLPTs) for critical systems.
- In terms of third party risk management and oversight of critical service providers, the draft legislation contains outsourcing-related requirements, including the creation of a register of service providers and requirements relating to contractual arrangements. It also sets up a novel system to provide direct oversight of critical third

⁹⁰ Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016.

⁹¹ For the banking sector, EBA Guidelines on ICT and security risk management (EBA/GL/2019/04), internal governance (EBA/GL/2021/05) and outsourcing arrangements (EBA/GL/2019/02). For the insurance sector, EIOPA Guidelines on outsourcing to cloud service providers (EIOPA-BoS-20-002).

⁹² For the banking sector, the Order of 3 November 2014 on internal control. For insurance, Articles L. 354-1 to L. 354-3 of the Insurance Code.

party providers (CTPPs), including the creation of an oversight framework for ICT-related services provided by CTPPs to entities from the EU financial sector.

Chart 2.5: Main cybersecurity authorities for the financial sector



Source: Banque de France.

Financial supervisory authorities and information security authorities are cooperating at national and European levels on cyber risk (see diagram). In France, ANSSI is in charge of cyber risk across all sectors of activity, while financial supervisors incorporate cyber risk in their inspections and work, with a view to crisis prevention but also management. At European level, the European Central Bank (ECB) supervises the largest banks within the framework of the Single Supervisory Mechanism (SSM). This supervision includes cyber risk. The challenges facing supervisors include gaining a better understanding of operational incidents, being able to monitor the most critical service providers and preventing regulatory shopping between European jurisdictions. Europe's cybersecurity agency, ENISA, is tasked with encouraging authorities to cooperate and share best practices. The ESRB works on systemic issues arising from cyber crises. The topic of cyber risk is also being addressed by many international initiatives, some of which involve industry input. For example, in March 2021, the Basel Committee published harmonisation principles covering operational resilience and management of operational risk.⁹³

The adoption of shared tools and strengthened coordination are among the major areas of work aimed at bolstering the resilience of the overall system

Every entity in the financial system has its own risk management organisation and is therefore the first link in the chain of resilience against a major operational shock affecting the financial sector. Accordingly, it is vital that the prevention, response and post-incident recovery arrangements set up by financial institutions continue to be strengthened and adjusted. However, because of major operational and financial interdependencies between participants, as well as the significant interconnectedness of financial centres, a cyber incident, even if targeted, can quickly become a threat to the stability of the overall financial system, making the case for steps to strengthen collective prevention and response capabilities.

An initial way to respond to systemic cyber risk is to work at European and international level to promote the adoption of shared measurement, prevention and crisis management tools. First and foremost, there is a growing need for financial entities and supervisors alike to adopt shared tools to refine their assessment and

⁹³ Principles for operational resilience; Principles for the sound management of operational risk.

measurement of IT-related threats and incidents. The completion of initiatives aimed for example at ensuring that serious incidents are systematically notified to the authorities (DORA) or at harmonising incident taxonomies will help to address some of the challenges in quantifying cyber risk. A proposed common categorisation of IT incidents, prepared by the ACPR and other G7 authorities, was published in April 2021. Work is continuing on this topic within the Financial Stability Board (FSB). The adoption of these tools will make it possible to refine the risk assessments of individual entities and promote better comparability. The FSB is also working on a revision of the 2018 Cyber Lexicon⁹⁴ in order to encourage the use of shared terms and enable more effective identification of best practices in cyber incident reporting.⁹⁵

To better quantify the risks to the financial sector, progress also needs to be made in identifying the main sources of cyber risk at the level of the financial system and in analysing their potential impact on financial stability. Accordingly, working groups under the authority of the G7's Cyber Expert Group (CEG) have come up with an initial analysis of operational interdependencies between financial participants. In the same vein, the ESRB is proposing to identify systemically important financial and operational nodes, including third party providers, to increase the understanding of existing vulnerabilities and contagion channels in the financial system.⁹⁶

In terms of crisis management, the FSB has published best practices for responding to cyber incidents.⁹⁷ The G7's CEG is also looking at tools to respond to cyber crises, third party risk and ransomware. More broadly, the ESRB is stressing the need to strengthen recognition of cyber risk in macroprudential tools, through discussions on the acceptable level of operational disruption, the conduct of systemic cyber resilience scenario stress tests, and the development of crisis management tools designed specifically to deal with systemic cyber risk.⁹⁸

Besides these tools, effective coordination between private participants and with financial authorities is conducive to building relations of trust within the financial system, which are needed for information-sharing in normal times and during major crises. Effective coordination requires first and foremost the establishment of communities of trust, safe and reliable communication channels and well defined processes between entities to ensure strong responsiveness in the event of a crisis. In France, banks, market infrastructures, financial authorities and government departments talk to each other within the organised and secure framework of the Marketwide Robustness Group, which was set up in 2005 and for which the Banque de France provides the secretariat. Its purpose is to facilitate information-sharing and operational coordination in the event of a major operational shock with a potentially systemic impact. During a crisis, the group uses information gathered from members to prepare a full assessment of the situation on the Paris markets, identifies potential collective measures, facilitates dialogue between private participants, government departments and authorities, and prepares for the post-crisis period.

The Banque de France and the ACPR are also establishing bilateral cooperation ties in the area of cybersecurity with foreign financial authorities. For example, a Memorandum of Understanding (MoU) was signed with the Monetary Authority of Singapore (MAS) in 2019 to increase the cyber resilience of the two financial ecosystems by sharing information on the cyber threats and cyber incidents observed in each jurisdiction. In Europe, discussions within the Cyber Information and Intelligence Sharing Initiative (CIISI-EU), which is under the authority of the Euro Cyber Resilience Board for pan-European Financial Infrastructures (ECRB), are enabling public sector participants and market infrastructures to share strategic and operational cyber information within a trusted body and to improve collective understanding about the cyber threat landscape.

To improve the preparedness of financial authorities in the event of a systemic cyber crisis, in January 2022, the ESRB issued a recommendation calling for a pan-European Systemic Cyber Incident Coordination Framework (EU-SCICF) to be set up.⁹⁹ This recommendation seeks to improve information-sharing and crisis communication among European Union financial authorities and with other authorities internationally in order to promote

⁹⁴ The lexicon defines 50 or so resilience and cybersecurity terms.

⁹⁵ "Cyber Incident Reporting: Existing Approaches and Next Steps for Broader Convergence", October 2021.

⁹⁶ "Mitigating systemic cyber risk", January 2022.

⁹⁷ "Effective Practices for Cyber Incident Response and Recovery", October 2020.

⁹⁸ ESRB, "Mitigating systemic cyber risk", op. cit.

⁹⁹ Recommendation of the European Systemic Risk Board of 2 December 2021 on a pan-European systemic cyber incident coordination framework for relevant authorities, 27 January 2022.

consistent and swift collective responses. The EU-SCICF would round out existing cyber incident response systems by factoring in the systemic aspects arising from cyber risk.

Crisis simulation exercises involving financial institutions and public authorities are also vital to improving the individual and collective management of cyber crises and mitigating the impact of a potential systemic incident.

Accordingly, to strengthen its crisis management framework, the Marketwide Robustness Group conducts marketwide exercises every year, during which members practice managing incidents and ensuring continuity of the most critical services. These exercises end with a feedback phase during which areas for improving the crisis management system are identified. At European level, the Eurosystem has already organised two exercises, Titus in 2015 and Unitas in 2018, that simulated a cyber crisis affecting the TARGET2 payment system and the TARGET2-Securities (T2S) securities settlement platform. These exercises involved the main stakeholders and users of these platforms. French authorities are also taking part in similar crisis exercises organised by the G7, such as the Cross-Border Coordination Exercise (CBCE) led by the Banque de France during France's Presidency of the G7 in 2019, which was used to validate the G7 Cyber Incident Response Protocol (G7 CIRP)¹⁰⁰ for the 23 financial authorities of the G7. The protocol can be activated 24/7 in the event of an international cyber crisis.

¹⁰⁰ Among other things, the G7 CIRP defines a list of contacts and provides reporting templates to gather incident information, in order to bolster the response and communication capabilities of G7 financial authorities in the event of a cyber incident affecting one or more jurisdictions.

3. Risks on commodity markets

Russia's invasion of Ukraine exacerbated tensions in the commodity markets, which are acting as the primary channel for the financial and economic disruption caused by the war, with differentiated effects for different categories of commodities:

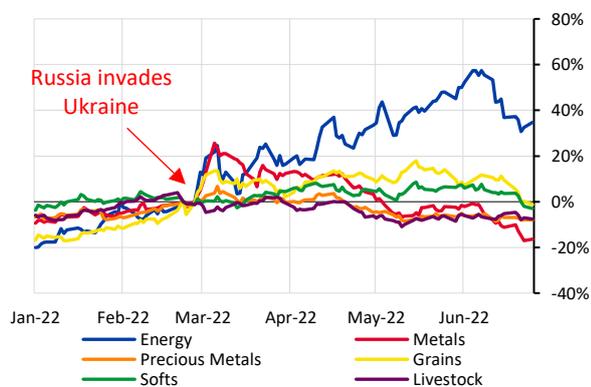
- Energy products experienced a spike in prices and volatility in late February/early March (volatility was far more pronounced than on non-energy commodity markets) which led to (i) a higher pressure on consumer prices and (ii) liquidity stress on energy derivatives markets and a deterioration in the financial positions of some energy firms. Supply uncertainties in Europe could cause these pressures to re-emerge, particularly going into next winter;
- The most problematic effects agricultural products concern the food security of emerging economies that rely most heavily on Russian and Ukrainian commodities, including grains and oilseeds;
- Industrial metals companies are being hardest hit through supply chain disruptions and higher input prices.

This chapter begins by describing the macroeconomic mechanisms underpinning the surge in prices for each commodity type. It then discusses the key role played by derivatives on commodity markets in ensuring the transportation, storage and delivery of commodities, and reviews the exposure of the French financial system to the energy firms (producers and traders) that use these derivatives. The chapter concludes by looking at the financial stability issues that were thrown into relief by the liquidity stress observed in March 2022 and considers regulatory work areas aimed at guarding against new shocks in the future.

3.1 The Ukrainian crisis has exacerbated pre-existing market pressures

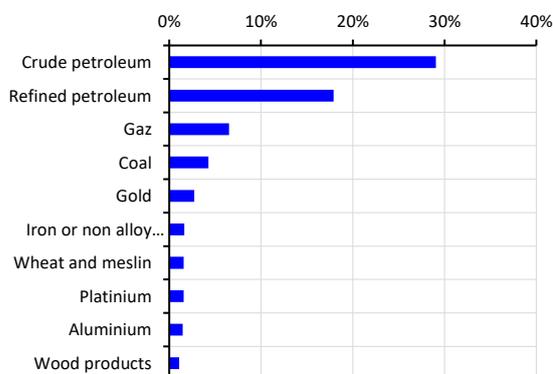
Russia's invasion of Ukraine has had a powerful impact on commodity prices (cf. Chart 3.1). Both countries are major exporters of numerous commodities: in 2019, Russia's total exports were concentrated on fossil fuel products (hydrocarbons), metal products (steel, platinum, aluminium) and grains (wheat) (cf. Chart 3.2). The crisis has come at a time when markets were already under severe strain owing to the post-Covid-19 surge in demand and numerous supply constraints. The economic impacts of the price shocks and the channels through which they are transmitted vary depending on the specific features of physical markets, the share of Russian and Ukrainian imports in different countries, and the level of product substitutability.

Chart 3.1: Commodity performances by sector, before and after the Russia/Ukraine crisis
x: month / y: %



Source: Bloomberg.

Chart 3.2: Main products exported by Russia in 2019, HS4 nomenclature
x: product share (%) / y: EUR billion



Source(s): Banque de France and CEPII BACI data.

Slower production and the segmentation of some energy markets herald long-lasting stress

Although natural gas and oil are both fossil fuels and are often substitutable, their markets differ in numerous respects. The gas and oil markets are both dominated globally by a handful of producers. The United States, whose output has soared since the shale gas revolution in 2013-2014, and Russia together accounted for close to 41% of the world's production of natural gas and 29% of oil production in 2020. Russia alone exports around 12% of the world's oil production. In response to the invasion of Ukraine, several countries said that they were either phasing out or planning to phase out Russian imports. The expected decrease in demand due to higher prices will probably be curbed by the weak price elasticity of demand for oil products. Output by the main oil-producing countries edged up by just 1% in the first quarter of 2022 and continued to sit around 3% below pre-pandemic levels.¹⁰¹ These factors are compounded by low investment across the production chain in recent years, a trend that was exacerbated by the Covid-19 pandemic. There is therefore a risk that demand could outstrip the supply of oil products, keeping prices high for a prolonged period.

Unlike the oil market, the gas market is somewhat fragmented. This is symptomatic of a particular feature of the natural gas market: namely, natural gas is a more difficult hydrocarbon to transport than oil, which explains why a larger proportion is consumed locally. Transporting natural gas requires major infrastructure, such as pipelines (62% of exports worldwide)¹⁰² or liquefied natural gas (LNG) import and export terminals (38% of exports).¹⁰³ Owing to these transportation challenges, the gas market has tended to become segmented into regional markets (mainly European, American and Asian). The imperfect interconnectedness of these markets leads to some price volatility, as a function of asymmetric shocks affecting different regions. However, the rise of LNG over recent years has helped to globalise the LNG market, which is heavily dominated by exports to Asian countries (cf. Chart 3.3, 74% of imports in 2020), chiefly from Australia and Qatar. That being said, LNG's ability to balance regional markets, particularly in Europe and France, remains limited for several reasons, including the fact that the destinations of LNG carriers are set in advance, and low recent investment in LNG terminals.

The coal market has also come under strain since the outbreak of the war as, to be ready should the supply of Russian gas be cut off, some European countries, and especially emerging countries, are turning to coal, whose price has skyrocketed. Higher prices reflect not just firmer demand, but also the logistical challenges involved in transporting coal. Even though European countries have cut their coal consumption in recent years, coal remains an energy source that can be quickly mobilised to make up for a shortage of electricity or gas.

Accordingly, in the absence of an alternative supply solution and a significant increase in production capacities, energy markets are set to remain under pressure for some time. According to World Bank April 2022 forecasts, Brent prices are expected to average USD 100 a barrel over the year before gradually easing to around USD 90 in 2023. European natural gas prices are also expected to double in 2022, US natural gas prices will increase to a lesser extent, while coal prices are expected to almost double by the year's end.¹⁰⁴

¹⁰¹ IEA, "Oil Market Report", April 2022.

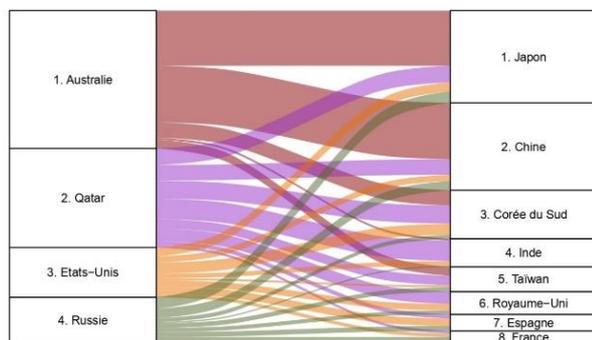
¹⁰² IEA, "Natural Gas Information", 2021.

¹⁰³ LNG terminals in particular require major long-term investments: OIES estimates for example that an LNG export terminal takes ten years to build on average, from design to production.

¹⁰⁴ World Bank, "Commodity Markets Outlook", April 2022

Chart 3.3: LNG exports and imports by country (2020, in millions of metric tonnes)

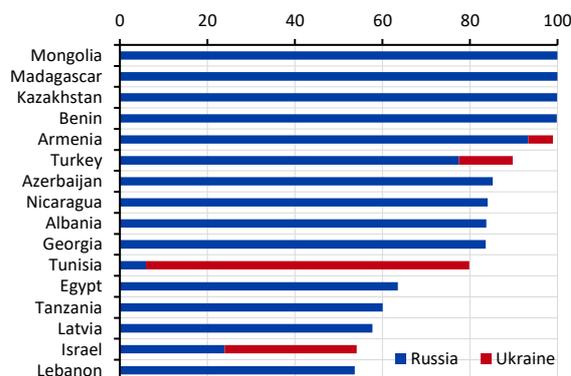
Sankey diagram



Source: IIGNL Annual Report 2021. Banque de France calculations.
 Note: The width of the bands is proportionate to imports/exports.

Chart 3.4: Russia's and Ukraine's shares of wheat imports

x: country / y: %



Source(s): Banque de France and CEPII BACI data (2019).

Box 3.1: Electricity pricing mechanisms

To understand the link between gas and electricity prices, it is necessary to look at how the wholesale electricity price is set at European level. By enabling cross-border commercial trading to take place, electrical interconnectors make it possible for a pan-European wholesale market to exist. This market fosters competition on domestic markets and exploits the fit between demand and production sites. It operates according to a merit order, whereby power-generating units are used based on their ascending marginal cost. For each time slot, the first units to be called on to provide power are those whose production has a zero marginal cost, namely renewables (wind, solar), followed by nuclear, whose marginal costs are low, and finally thermal power plants, which are more flexible but whose production costs are high (coal, fuel oil, gas). The spot price of electricity is thus set by the marginal cost of the last facility called on to provide power, with units generating at a lower cost earning a profit. Because thermal power plants have to be used during consumption peaks (especially since nuclear production is decreasing), the wholesale electricity spot price is therefore determined by the cost of producing electricity using gas.

In France, unlike in other European countries, there is no clear link between the wholesale and retail prices of electricity. This reflects the heavily regulated nature of the French market, which is in turn connected with the country's large-scale nuclear-based electricity production. The 2010 NOME Act introduced a scheme offering regulated access to existing nuclear power (ARENH). The aim was to ensure that consumers benefit from the presence of France's nuclear power plants (by allowing them to share in the "nuclear rent" generated these facilities, i.e. when the spot price exceeds the cost of producing electricity using nuclear energy), and to introduce competition to the retail market. The ARENH scheme allows suppliers other than EDF to access the cost of generating electricity using nuclear energy. Accordingly, a large share of the supply of alternative electricity suppliers is provided at a fixed cost that does not depend on the wholesale market price, which is largely linked to the gas price.

Once electricity suppliers have received an allotment of ARENH power, they go to the wholesale market to source the rest of the energy for distribution to customers. At the same time, to ensure that regulated sales tariffs do not hinder competition, the cost of electricity in these tariffs must be close to that borne by other suppliers (who do not have as much nuclear energy as EDF). This is achieved through a capping mechanism. In February 2022, regulated electricity sales tariffs ought to have increased automatically by 44.5% (excl. VAT) for residential consumers. However, the government took two measures to put up a price shield that capped the VAT-inclusive increase in regulated sales tariffs at 4% in February:

- the domestic tax on final electricity consumption was cut;

- the volume of electricity sold by EDF under the ARENH scheme to alternative suppliers was exceptionally raised by 20 TWh.

The spot price of electricity is strongly correlated with the production cost of gas power plants, which is in turn determined by the wholesale price of gas, as well as by the prices of the CO₂ emissions allowances that these facilities must have. Using the production cost of a gas power plant, the recent increase in the wholesale spot price of electricity can be broadly broken down into the share attributable to the gas price and that attributable to the carbon price. This shows that in 2021 in France, over 90% of the increase in the wholesale price of electricity was attributable to the price of gas, while the increase in the carbon price accounted for less than 10%.

The reliance of some emerging countries on imports of Russian and Ukrainian agricultural commodities points to a major food crisis

The prices of some food products have also hit unprecedented levels. Wheat prices have jumped by over 60% between the 1st of January and the 7th of March because of the turmoil unleashed by Russia's invasion of Ukraine, as the two countries account for around one-third of global wheat exports. The disruption caused by the crisis to Ukrainian wheat exports has already affected a number of importing countries, particularly in the Middle East and North Africa, such as Egypt and Lebanon. Several countries have responded by introducing or announcing measures to reduce or ban wheat exports, before returning to an increase of nearly 30% between the 1st of January and the 21st of June. India, the world's largest wheat producer after China, which had filled the gap created on the markets by the downturn in Ukrainian and Russian production, suffered a drought episode and announced that it was halting wheat exports, barring a handful of exceptions, to focus on meeting its own needs and those of neighbouring countries.

There is therefore a major risk of a global food crisis that could severely affect developing and emerging countries owing to their dependence on Russian and Ukrainian grains (cf. Chart 3.4). Tunisia, for example, relies on Russia and Ukraine for 80% of its wheat imports, of which 74% are from Ukraine. Logistical difficulties linked to the war could prevent deliveries or affect production. There is thus a risk that the war in Ukraine could spill over into a food crisis that might come with political instability in the most exposed countries. The Covid-19 crisis, recurring droughts and the spike in prices are a threat to the food security of some countries, but also to their stability.¹⁰⁵ To address this issue, in early May 2022, major agricultural powers, including the European Union, the United States, Canada and Australia, committed to overcome the shocks caused by Russia's invasion of Ukraine and ensure the food security of the most vulnerable people.

Industry supply chains remain strained owing to shortages of some metals

The post-Covid-19 economic recovery had already propelled demand for some industrial metals to elevated levels. Russia exports many metals, including steel, aluminium, nickel and palladium, that are critical to the supply chains of numerous industries. Carmakers, for example, have been particularly affected, and are forecasting price increases of between 15% and 25% owing to higher prices for key materials such as aluminium, copper and steel. Commodity price disruptions are also hitting materials used in the aerospace industry. Aircraft, engine and component manufacturers are especially exposed to Russia, which is the third-largest producer of titanium. Higher oil and metal (nickel) prices also have direct consequences for the petrochemical (polymers) and building industries (cf. cross-cutting analysis, Section 1.3 on French companies).

Supply chain fragilities in the industries using these products are compounded by substitutability issues, with challenges in identifying the extent to which alternative suppliers can be used and the associated timelines. The substitutability question forms part of the economic policy debate on relocating activities. In a recent blog post,¹⁰⁶ the International Monetary Fund called for countries to diversify supply sources rather

¹⁰⁵ In 2021, 8,000 protests were held in Africa about higher consumer prices (AFD).

¹⁰⁶ "Global Trade Needs More Supply Diversity, Not Less", *IMF Blog*.

than repatriate production. Significant and potentially long-lasting pressures are therefore likely to be ahead for commodities markets. Market participants who move physical products around the world are especially exposed owing to the risks inherent in this activity, the significant financing required and their heavy use of derivatives.

3.2 Derivative products play an essential role in orderly commodities markets

Derivatives are used for hedging purposes, intermediation and to take directional positions on prices

Commodity market participants are subject to specific constraints, including the need to store, transport, deliver and maintain the quality of goods. Derivatives are a vital tool because they allow participants to hedge the risks arising from these physical constraints, and especially the risk of price changes. Without these financial instruments, the ability of firms to finance and undertake the extraction, processing and transportation of commodities in large quantities on a stable and secure basis would be severely curtailed.

Derivatives are traded on financial markets that can be separated into two categories: organised and over-the-counter (OTC). On organised derivatives markets, trading is centralised on an exchange and a central counterparty (CCP) is present. On OTC derivatives markets, trading happens on a decentralised, bilateral basis. The distinction is an important one because it has consequences for the risk level and transparency of trades: on organised markets, the CCP has the job of securing trades against counterparty risk; to do that, it collects margins in the shape of financial flows that are exchanged at the start of the contract and whenever the value of the assets is reassessed – cf. below. Furthermore, contracts on organised markets, such as futures, are extensively standardised, which strengthens the liquidity on these markets. In contrast, OTC markets do not offer the same level of security but provide greater flexibility in contract specifications (amount, type of underlying, amount of collateral and frequency with which it is exchanged, delivery terms and more); however, these products are nevertheless subject to minimum margin requirements, under certain conditions¹⁰⁷ and some contracts traded on these markets are centrally cleared on a voluntary basis (cf. below).

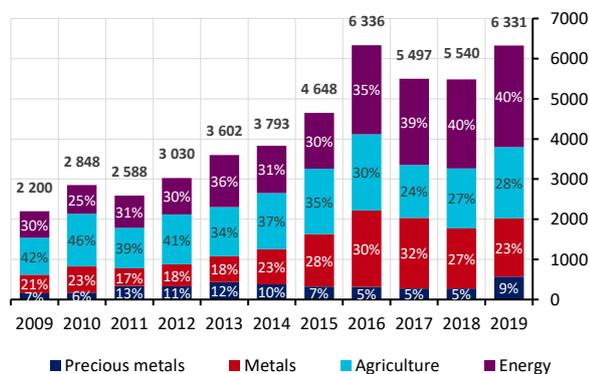
Commodity derivatives are traditionally used by participants to pursue three objectives: i) to hedge risk, ii) for intermediation purposes and iii) to speculate on own account or for a customer. These objectives, and hence market positioning, vary depending on participants' business activities. Broadly, non-financial firms, such as producers, processors and distributors, use derivatives to hedge against future price falls (producers, traders) or increases (consumers, traders). Accordingly, they account for a large share of commodity derivatives markets as compared with other types of derivatives (cf. Chart 3.6). Derivatives enable them to protect themselves by selling (buying) some or all of their production (consumption) in advance. Commercial banks, and French banks in particular, more typically act as financial intermediaries and market makers, enabling non-financial firms to hedge their risks and allowing funds to take directional positions. Acting on behalf of client investors, investment fund managers use commodity derivatives to take positions on prices and diversify portfolios, treating them as a separate asset class like shares and bonds. The diverse community of participants on the commodity derivatives market has fuelled steady growth in the volume of commodity derivatives¹⁰⁸ traded on global stock exchanges (cf. Chart 3.5).

¹⁰⁷ BCBS CPMI IOSCO margin requirements for non-centrally cleared derivatives.

¹⁰⁸ FIA monthly statistics

Chart 3.5: Annual trading volume of centrally cleared commodity derivatives on global exchanges by type of underlying (2009 – 2019)

x: year / y: % share

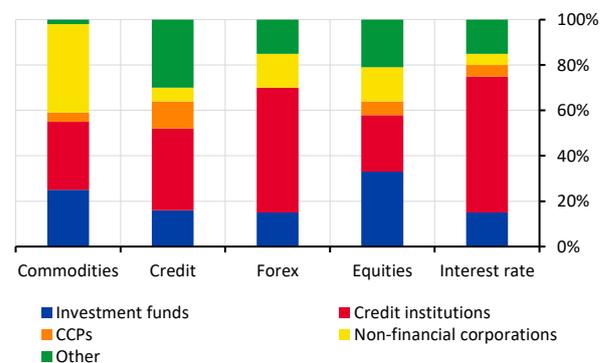


Sources: FIA.

Notes: Data to end-2019.

Chart 3.6: Breakdown of counterparty sectors for different classes of derivatives; non-financial firms account for 50% of commodity derivatives:

x: asset class / y: % share



Source: ESMA.

Margins are used to secure trades against counterparty risk

CCPs play a critical role in managing the counterparty risk of centrally cleared derivatives, mitigating the risk of financial loss in the event of a counterparty default and the resulting systemic risk. CCPs occupy a central role in transactions, positioning themselves between buyers and sellers and ensuring that trades are secure by means of margin exchanges. Two types of margins are exchanged. Initial margin covers the maximum financial loss that a counterparty is likely to suffer in one or two days for products traded on organized markets and in five days for OTC products. This loss is estimated when the contract is signed and may be adjusted based on market conditions. Variation margin is deposited or received daily, or even intraday if required by price movements, as a function of changes in the derivative's market value, i.e. as a function of the price volatility of the derivative's underlying assets. On the whole, margins are not exchanged directly between end customers and the CCP: members of the CCP, known as clearing members, which are usually commercial banks, collect and deposit margins on behalf of their customers.

OTC markets are primarily run by brokers as electronic platforms. Parties execute trades on OTC markets bilaterally. Products traded OTC can be separated into products that are centrally cleared by a CCP, i.e. products that are standardised by currency, interest rate or maturity, and non-centrally cleared, non-standardised products. The obligation to clear centrally, which was phased in from 21 June 2016 and then revised in 2019, applies to all counterparties whose aggregate month-end average positions in commodity derivatives exceeded EUR 3 billion for the previous 12 months.¹⁰⁹ CCP margin requirements apply to these centrally cleared products, while in the case of non-centrally cleared products, initial margin must be exchanged only by companies that have a notional amount of non-centrally cleared OTC derivatives exceeding an average of EUR 50 billion over the months of March, April and May of the previous year¹¹⁰ (this threshold will be lowered to EUR 8 billion on 1 September 2022). It has been mandatory to exchange variation margin for all derivatives since 1 March 2017.¹¹¹

Margin exchanges thus can be the source of strong interconnections between multiple participants, creating risks that shocks could be amplified. Margin exchanges occur not only (i) between CCPs and clearing members, and (ii) between clearing members and their customers, but may also take place (iii) bilaterally (without going through CCPs). Since non-financial firms, such as energy producers, energy-consuming factories or businesses, and commodity traders, may act as counterparties for each other, they may be mutually subject to margin calls following a material change in the value of a contract or resulting from a change in a

[Public statement by ESMA on EMIR Refit](#)

¹¹⁰ [EUR-Lex - 32016R2251 - EN - EUR-Lex \(europa.eu\)](#)

¹¹¹ [EMIR | AMF \(amf-france.org\)](#)

counterparty's risk profile, determined as a function of expected future cash flows, the commercial relationship or the type of underlying (cf. Section 3.3 on liquidity risks and financial stability issues).

Box 3.2: Problems on the London nickel market

On 8 March 2022, the London Metal Exchange (LME) suspended trading on the nickel market for six days owing to soaring prices. Prices took off following the invasion of Ukraine by Russia, which is the world's third-largest producer of nickel, and after Russia's subsequent decision to ban commodity exports in response to European and US sanctions.

Nickel producers generally hedge against price falls by taking short futures positions on the derivatives market. This was the approach taken by Tsingshan Holding Group, one of the world's largest nickel producers, whose short positions totalled 150,000 tonnes, 30,000 tonnes of which were on the LME, or equivalent to about 2% of open interest. In a short-squeeze, Tsingshan tried to cover its short positions by buying back nickel at very high prices, which further increased the price and accelerated its losses. The company reportedly had similar positions on OTC markets with a number of banks of which the LME was not aware, otherwise the margin requirements would have been higher.

Fearful that Tsingshan might not be able to meet its margin calls, which were rising sharply, and worried that spillover might lead to payment defaults by other clearing members, the LME suspended trading and deferred physical delivery of maturing contracts. Trading resumed on 16 March under daily price change limits, which were hit and widened several times.

To contain market volatility, the LME also imposed daily price change limits on other base metals and on 24 March prohibited the submission of orders outside the daily limit.

By cancelling some trades, the LME not only wiped out the losses but also the profits made by those holding long positions. Such an intervention is extremely rare on organised markets and was widely criticised by market participants, who pointed to the potential conflict of interest and the threat to the principle of free and fair market access, particularly since not all trades were cancelled. UK regulators responded swiftly and announced that independent investigations would be held to review the exchange's practices, with a particular focus on governance issues.¹¹²



The episode highlighted the role of circuit breakers, raised the question of their application to certain commodity markets in Europe and served as a reminder that the financial equilibrium of CCPs is ultimately dependant on the strength of clearing members. It is vital for members to stay resilient during periods of extreme volatility, in order to ensure that trades are duly cleared and maintain financial stability.

¹¹² "Joint statement from UK Financial Regulation Authorities on London Metal Exchange and LME Clear", Bank of England.

Commodity markets are heavily concentrated with a handful of major commodity traders, which use the services of financial institutions

Besides being exposed to energy producers (cf. cross-cutting analysis, Section 1.2.1), French banks are also exposed to the commodity market through the financing that they provide to commodity trading firms (cf. Box 3.3). These firms are highly leveraged, with a narrow capital base relative to their turnover or total assets. Their business (transportation or delivery, for example) exposes them to risks, which they manage through financial instruments: futures to protect against the risk of price changes, letters of credit and bank guarantees for counterparty risk, specialised insurance policies to cover logistical risk, and cash or lines of credit to deal with liquidity risk (meeting margin calls on futures in the event of high volatility). Financing for these trading firms may be provided through debt security issues, bank loans, or financial commitments or guarantees: in terms of delivery of the goods, the bank first ensures that the trader is properly hedged price-wise on the delivery portion at a broker, i.e. between the production and delivery locations and over the delivery period; contracts are typically 30-45 days for oil and several months for metals and agricultural commodities to take account of storage time at the port of origin (before the ship/container is full).

In the final quarter of 2021, French banks had exposures of close to EUR 150 billion to energy sector firms, of which EUR 43 billion to firms trading in various types of commodities, EUR 53 billion to companies providing gas and electricity distribution services and EUR 52 billion to fossil fuel-producing firms (cf. Chart 3.7). These exposures make up 5.75% of the risk-weighted assets of the main French banks, taken together. For each of these sectors, the breakdown for the three types of financing is as follows: debt securities account for around 40% of exposures, ii) financial guarantees also account for about 40% and iii) firm loan commitments (other than derivatives) make up between 20% and 35% of direct exposures. Derivatives, reported on the basis of netting sets,¹¹³ account for a fairly small share of the direct exposures of French banks to traders, and between 10% and 14% of exposures to energy producers and distributors (cf. Chart 3.7). Bank exposures to commodity traders are concentrated with energy traders, which account for 75% of exposures, rather than with food or metal traders (cf. Chart 3.8). The war in Ukraine caused a sudden drop in the prices of bonds issued by most large trading companies as well as increased volatility (cf. Chart 3.9), reflecting investor fears about how sanctions against Russia might affect the credit quality of these firms. A fall of this kind in the value of securities issued by commodity trading firms does not materially impact the banks (400 million euros of shares, i.e. 0.04% of the securities held by French banks) and non-banks (700 million euros of shares, i.e. 0.03% of the securities held by insurers and 1 billion euros of shares, i.e. 0.06% of the securities held by French funds).

Chart 3.7: Initial direct exposures of French banks to energy sector firms

x: sector / y: % of RWA of French banks

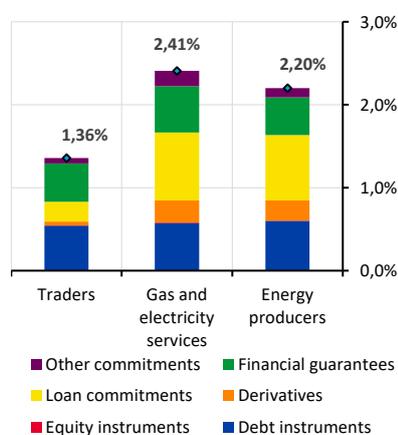


Chart 3.8: Initial direct exposures of French banks to commodity trading firms, by sector and type of financing

x: sector / y: EUR billion

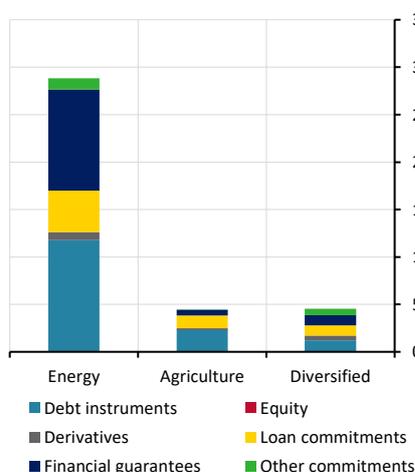
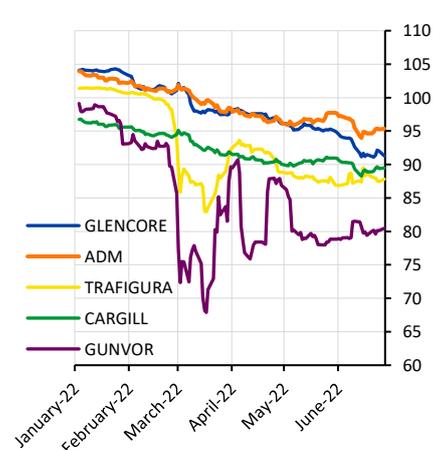


Chart 3.9: Prices of 2026 bonds issued by five commodity trading firms

x: month / y: price



¹¹³ A netting set is a group of transactions between two counterparties that are subject to a bilateral agreement and whose exposures may be netted to obtain a single amount. See paragraph 50.15 of [CRESO](#) (BIS).

Source: ACPR.

Source: ACPR.

Source: Bloomberg.

3.3 Liquidity risks, financial stability issues and future areas of regulatory work

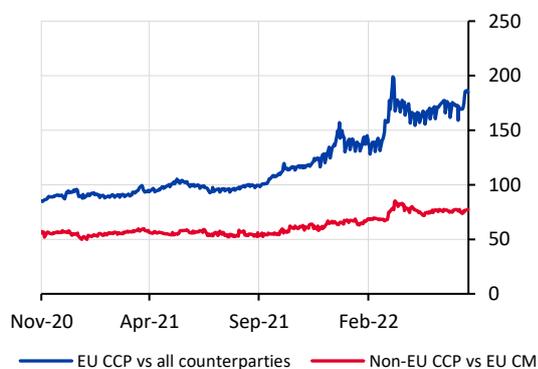
During times of high volatility, margin calls can fuel liquidity stress, which is what happened in March 2022

Margin calls are a safety mechanism needed to ensure orderly derivatives markets, but they can also act as a transmission channel for liquidity risk. A company selling an energy commodity or a processed commodity, such as refined oil or electricity, and that wants to protect itself against a potential fall in prices could, for example, take a short futures position, locking in a selling price at a future time and gaining protection against loss of value for its production. Liquidity mismatches may arise between the value of the underlying products and the value of the hedging contracts. For although the two positions offset each other economically, the cash flows do not balance each other out, because an increase in prices on physical markets implies a decrease in the market value of the short position and therefore creates a liquidity need for the company to cover margin calls on the short derivative position. Conversely, the counterparty with the corresponding long position, which thus acquired the contract at a lower price than the current price, benefits from the variation margin calls.

Extreme volatility in commodity prices since February has severely impacted the energy sector and especially electricity and natural gas. Owing to CCP margin models, this volatility caused initial margins to almost double (cf. Charts 3.10 and 3.11), rising from EUR 142 billion to EUR 267 billion between the end of 2020 and the peak on 10 March 2022. Initial margins for some natural gas contracts reached up to 80% of the notional value of the contract (cf. Chart 3.13). In practice, this means that to sell EUR 100 of natural gas at a future date, a producer would have to deposit around EUR 80 as a guarantee (initial margin) with the CCP for the entire duration of the contract.¹¹⁴

Chart 3.10: Initial margin requirements on centrally cleared markets (all derivatives)

x: month / y: EUR billion

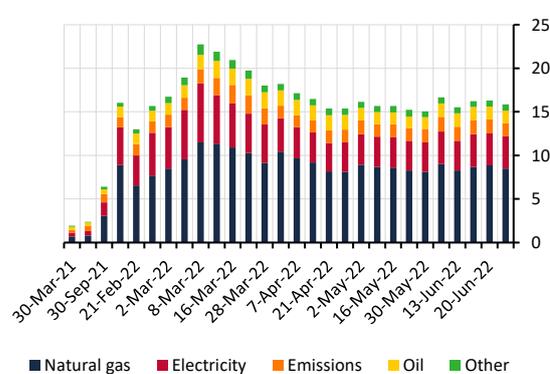


Source: EMIR data provided by ESRB.

Notes: CCP = Central counterparty, CM = Clearing member.

Chart 3.11: Initial margin requirements on centrally cleared markets for energy producers that are customers of French clearing members

x: time / y: EUR billion



Sources: EMIR data, DTCC France.

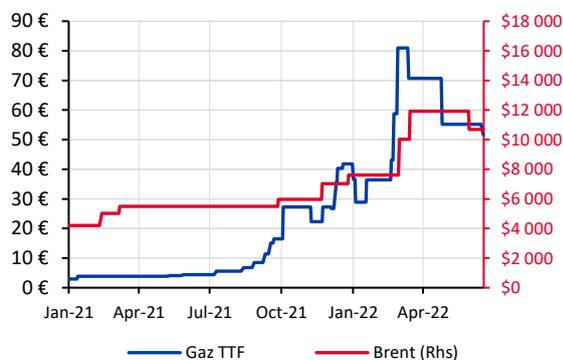
European data on derivatives trades¹¹⁵ taken from EMIR reports show that the increase in initial margin deposited by selected European energy producers with French institutions peaked initially at end-December 2021. This was followed by a second wave of increases driven by the Ukrainian crisis that culminated on 8 and 9 March 2022

¹¹⁴ A contract's margin requirement depends, among other things, on when the contract matures. The closer the maturity, the higher the initial margin requirement tends to be.

(Chart 1.8). Margin requirements have eased since then, with levels converging with those recorded in December 2021.

Chart 3.12: Initial margin requirements on TTF Gas and Brent (ICE)

x: month / y: left: EUR/MWh, right: USD per contract

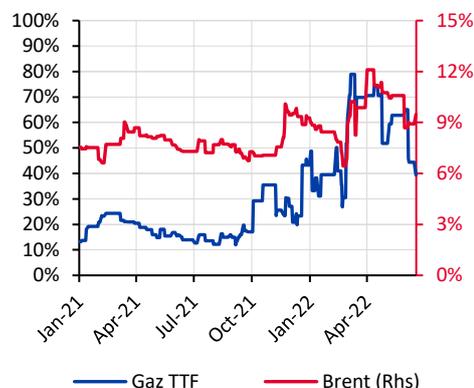


Source: ICE.

Note: The chart shows initial margin requirements for front-month contracts.

Chart 3.13: Initial margin requirement as a % of contract notional value

x: month / y: right and left: as a % of contract value



Sources: Bloomberg, ICE.

Note: The chart shows initial margin requirements for front-month contracts.

Because of their major presence in European derivatives and their function as a clearing member / intermediary between customers and CCPs, French banks play a key role in managing these liquidity pressures: they demonstrated their capacity to absorb the shock in March 2022. In normal times and during periods of stress, when the CCP increases margin requirements, banks themselves are not impacted directly, as they pass these requirements on to customers. The CCP issues a margin call to the clearing member, which then forwards it to its customer, potentially including an additional margin requirement – a practice known as over-margining¹¹⁶ – to protect itself against the inability of customers to meet margin calls and the risk of having to put up its own capital. The additional margin is calibrated according to i) the customer's business (additional margin required especially for speculative funds and, to a lesser extent, corporate clients), ii) the counterparty's credit quality, iii) risk appetite (strategies), iv) exposure level and v) types of underlyings handled. When volatility was extremely high in March 2022, French banks granted lines of credit to energy firms to finance their margin calls and prevent them finding themselves in a situation of liquidity risk and hence of solvency risk.

The ability of energy firms to meet margin calls in a context of high price volatility depends on the strength of their cash positions, but also on their ability to draw on bank credit lines, or, if they have critical mass, to issue market debt. It is important to underline that liquidity stress will be more or less acute depending on how firms are positioned in derivatives. In the case of firms that have hedged their positions, for example by being long natural gas and short electricity, variation margins linked to daily changes in market prices (cf. Box on gas and electricity prices) offset each other at least partially. Conversely, margin calls add significant liquidity constraints for participants with a long or short directional positions. Hydroelectric (or nuclear) power producers may, for example, hold directional positions because they need to hedge only electricity generation (not water purchase). Periods of high volatility generate cash difficulties for smaller firms (reduced ability to draw on bank credit lines, too small to issue debt on the markets). These issues can morph quickly into solvency risk for these firms (threatening their survival) or even trigger a series of failures through a domino effect within the energy sector. Specifically, if one energy firm defaults, other firms might potentially follow suit if they have positions in that firm. Above all, in each case, demand that is not met by the defaulting party needs to be absorbed by the market, contributing to an increase in prices (physical and derivatives markets), which in turn generates additional costs or new margin calls that further amplify liquidity pressures.

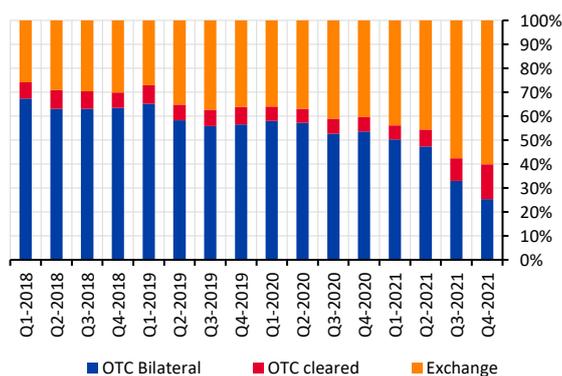
¹¹⁶ Over-margining is a practice used by banks, whereby they ask their customers to provide margins higher than those required by CCPs. It is used to reduce counterparty risk.

In addition, the liquidity constraints associated with margin calls for hedges might prompt companies to pursue more complex derivative strategies. To hedge against new price spikes for commodities, companies could purchase commodity options with higher strike prices, i.e. the price at which the option can be exercised, in order to generate cash inflows through margin calls in the opposite direction that offset margin calls on short positions. These options are unlikely to be exercised unless there is a sudden trend reversal. For example, although a portion of the growth of out-of-the-money oil options (where the strike price is higher (lower) than the current price in the case of an call (put) option) may reflect market opinions about the future path of prices, some may also be attributable to companies that are looking to minimise the liquidity constraints associated with other derivative positions.

Finally, the significant increase in margins on organised markets could prompt some market participants to shift to OTC markets, increasing counterparty risk and lessening the transparency of market transactions. Since initial margin requirements are subject to threshold effects, some participants whose outstanding financial instruments are below these thresholds may develop strategies aimed at avoiding organised markets, notwithstanding the benefits that such markets offer in terms of counterparty risk management. This kind of strategy increases counterparty risk. Conversely, other participants, concerned by the increase in counterparty risk, might be prompted to transfer some of their trades from OTC markets to cleared markets, a trend that has been in evidence on the European natural gas market since mid-2021, for example (cf. Chart 3.14).

Chart 3.14: Exchange shares of main European natural gas hubs

x: Date / y: % share



Sources: European Commission, Trayport Euro Commodities Market Dynamics Report.

Notes: This chart includes the following hubs: TTF, NBP, THE, PEG, PSV, PVB, Zeebrugge Beach, VTP.

These pressures are fuelling regulatory discussions

The difficulties encountered by energy firms in March 2022 recalled the liquidity crisis of March 2020, when margin calls linked to equity, interest rate and commodity derivatives exploded. This disruptive episode (cf. chapter on disruptions to non-bank financing, *Assessment of Risks to the French Financial System*, December 2020) led to the creation of working groups and then a public consultation by BCBS CPMI IOSCO.¹¹⁷ The consultative report said that during the Covid-19 crisis, insufficient transparency in margining practices on centrally cleared markets was noted, with differences observed across CCPs and jurisdictions; clearing members and customers called, among other things, for more precise tools to anticipate margin changes.

Box 3.3: Characteristics of the commodity traders market and the existing regulatory framework

Commodity traders play a pivotal role on commodity markets (agricultural, energy, metals and ores). They organise the global logistics chain, especially transportation and processing, act as the link between producers and consumers, and hedge their risks through transactions on financial markets.

¹¹⁷ BCBS CPMI IOSCO Oct. 2021 Review of margining practices.

The war in Ukraine has sent financial commodity markets into turmoil. The substantial increase in margin calls in response to severe price volatility caused liquidity stress for traders and potentially for other financial participants that are interconnected with them, such as banks and investment funds.

These liquidity pressures have prompted discussions internationally (FSB)¹¹⁸ and within Europe (ESRB)¹¹⁹ on the adequacy of the scope of supervision for commodity trading activities and the related derivatives markets, given their potentially systemic importance and the moral hazard that could potentially be associated with them.

The commodity trading market has two main characteristics that could create risks for the financial system during times of severe stress:

- First, it is an oligopolistic market, with a handful of firms¹²⁰ that generate substantial income accounting for most of the trading. Accordingly, problems at one of these firms could cause disruption across all supply chains;
- Second, these non-financial corporations are closely interconnected to financial firms through their massive use of derivatives to hedge against price and currency risks and through the large loans provided to them, chiefly by banks, to finance the goods being transported.

Following the Great Financial Crisis, a global consensus was reached to improve the regulation of financial commodity markets. France, in particular (G20 Presidency), spearheaded these efforts. In this regard, the [Commodity Principles](#) published in 2011 by the International Organization of Securities Commissions (IOSCO) represented a key step forward for financial stability. Among other things, the principles recommended introducing position limits, consistent with US reforms that began in 2010 under the Dodd-Frank Act.

In the EU, EMIR¹²¹ and MiFID II¹²² were part of the same movement, MiFID II imposes position limits (recently reduced to apply only to "significant" or "critical" contracts as well as to derivatives on agricultural commodities) as well as a disclosure obligation on the volumes traded. However, these provisions may turn out to be partially ineffective as they do not apply to non-financial firms acting for hedging purposes, which is the case for a substantial portion of the derivatives transactions conducted by commodity dealers. Accordingly, more extensive work still needs to be done on the regulation of these participants. To be effective, these efforts must be the subject of international cooperation, given the global nature of the business of commodity trading firms. In addition, EMIR specifies activity thresholds above which an entity must apply the clearing obligation. This concerns some interest rate and credit derivatives, but no commodity products are subject to this obligation. Thus, a non-financial company exceeding the threshold for commodity products would be subject to the obligation to exchange bilateral margins on its positions, all products combined¹²³.

Six potential areas for further regulatory work were proposed in the intermediate report published in late October 2021. Increasing transparency in centrally cleared markets and encouraging the use of margin calls is the first area. Enhancing the liquidity preparedness of market participants, for example through increased transparency in the non-bank financial intermediation sector and by clearing members with regard to clients, is the second area. The report's authors also underlined the need to clearly identify gaps in regulatory reporting. To limit prolonged liquidity retention, the framework for collecting and distributing variation margin in centrally cleared and non-centrally cleared markets could be streamlined. With regard to the procyclicality of initial margins on centrally cleared markets, an assessment of models used by CCPs and clearing members should be undertaken. On centrally cleared markets, the responsiveness of initial margin models during periods of stress should be examined.

The BCBS and IOSCO extended by one year the final two implementation phases of the international agreements in order to enable orderly and progressive implementation of bilateral margin exchanges at international level against the backdrop of the Covid-19 crisis. With this extension, from 1 September 2021 entities with an aggregate average notional amount of non-centrally cleared derivatives greater than €50 billion will be subject to initial

¹¹⁸ Financial Stability Board.

¹¹⁹ European Systemic Risk Board.

¹²⁰ They include Glencore, Trafigura, Vitol, ADM, Bunge, Cargill and Louis Dreyfus.

¹²¹ [European Market Infrastructure Regulation – EMIR](#)

¹²² [Markets in Financial Instruments Directive II \(MiFID II\)](#)

¹²³ EMIR requires a non-financial firm that exceeds a threshold to centrally clear the products subject to the clearing obligation for which the threshold is met. However, a financial company exceeding a threshold must centrally clear all transactions subject to the clearing obligation, regardless of whether they relate to the threshold exceeded.

margin exchange requirements, and on 1 September 2022, entities with an aggregate average notional amount of non-centrally cleared derivatives greater than €8 billion will be subject to the requirements.

In Europe, the ESRB has relaunched work intended to regulate margin procyclicality. In June 2020, an ad hoc ESRB group proposed recommendations for national competent authorities aimed at regulating the potentially procyclical practices of CCPs, clearing members and bilateral counterparties. Among other things, it was recommended that: i) CCPs provide advance notification to their supervisors and their supervisory college before introducing any material binding measure for collateral, such as an increase in haircuts; ii) CCPs have adequate liquidity resources to cope with the default of two entities providing critical services; iii) clearing members and bilateral counterparties should avoid cliff effects in their collateral policy in the event of a crisis. The ESRB plans to continue working on the procyclicality of margining and haircut practices in the new Expert Group on Clearing, notably with a view to supporting work by ESMA to harmonise CCP practices.

Following the outbreak of the war between Russia and Ukraine, ESMA also proposed acting urgently to raise the clearing threshold for commodity derivatives by EUR 1 billion, from EUR 3 billion to EUR 4 billion, in order to reduce margin requirements for non-financial participants. It was stressed that this change would be made on a temporary and contingent basis.

Methodological annex on the framework used to analyse risks and vulnerabilities

Introduction

Since 2021, the Banque de France has updated the framework used to analyse and assess vulnerabilities and risks. The purpose of this exercise was to enhance the Bank's crisis prevention capability and to have tools to manage crises as effectively as possible when they do arise. Several goals underpinned the work done in this regard:

- Adopt a more systematic approach encompassing all the characteristics of the financial system, that is, identify the vulnerabilities associated with systemically important financial participants, but also interactions between them;
- Do a better job of anticipating and preventing financial crises by identifying vulnerabilities at an early stage;
- Promote corrective measures to safeguard financial stability and ensure continuity of the functions of the financial system, in support of the economy;
- Contribute to international efforts to maintain financial stability, while taking account of adjustments made by our partners to their own analytical frameworks.

The framework is based notably on i) a definition of the conceptual framework, and ii) creation of a mapping of vulnerabilities measured for different types of economic, financial and non-financial participants and on financial markets. In practice, this formal exercise entails identifying the existing qualitative and quantitative tools, clarifying the assessment of gross and net vulnerabilities and explaining the governance framework.

The conceptual framework used to analyse vulnerabilities requires three elements: (1) definition of the concepts, (2) explanation of how they are related, and (3) creation of a mapping of the vulnerabilities that form the scope of analysis.

Explanation of how key concepts are related and illustration

The analytical framework is based in particular on the relations between vulnerabilities, resilience and the risk to financial stability. Accordingly, it is necessary to distinguish the vulnerabilities of non-financial participants that could lead to a shock to the financial system, from vulnerabilities in the financial system that reflect imbalances affecting one or more financial participants and that could increase the probability of a shock and/or lead to system-wide disruptions. To respond to these vulnerabilities, financial participants can draw on factors of resilience, defined as the capacity of the financial system to absorb shocks and so prevent contagion effects, mitigating the impact of a shock. Vulnerabilities that are not adequately offset by resilience factors create a risk to financial stability, which could lead to a potential failure of the financial system in the event of a shock.

The notion of risk to financial stability is usually understood as exposure to a risk factor (product of the probability of an adverse event occurring and its adverse impact). The severity of the consequences of a risk occurring in turn depends on the intensity of the exposure and how the effects of a shock are controlled (function of vulnerabilities and resilience factors). In a financial stability context, risks result in particular from an imbalance between the vulnerabilities and resilience of the financial system, leading to an increased probability of a shock occurring or of a failure of the financial system in the event of a shock.

Box 4.1: Definition of concepts

Financial system: Set of financial intermediaries (banks, insurers and other non-bank financial institutions, such as asset managers and investment funds), financial markets and financial instruments as well as the infrastructures that support them.

Financial stability: State of the financial system in which the system is resilient to episodes of financial stress or real shocks.¹²⁴

Financial vulnerability: Property of the financial system that (1) characterises the accumulation of imbalances, (2) may increase the probability or impact of a shock, and (3) could lead to disruptions for the financial system when subject to a shock. The development of a complex and fragile system of financial intermediation and a market microstructure promoting elevated volatility may, for example, be financial vulnerabilities.

Gross and net vulnerabilities: Vulnerabilities are described as gross when they are assessed without recognising resilience factors. Net vulnerabilities recognise resilience factors. In practice, the two concepts are often hard to distinguish, since data integrate resilience factors.

Shock: An event that could lead to disruptions affecting some or all of the financial system or make the financial system partially or totally unable to perform its functions. Shocks can be economic or technical in nature. They can also be geopolitical or health events or even natural disasters. Such shocks can trigger vulnerabilities and cause financial system disruptions. Shocks are characterised by a probability of occurrence and an impact in the event that they occur. Some shocks are unpredictable, while others may be anticipated.

Contagion: Mechanism through which the materialisation of financial vulnerabilities following a shock may spread the disruptions caused by the shock. Contagion may be linked to direct interconnections between financial institutions or to indirect interdependencies, such as shared market exposures or similarities in positions or business models.

Amplification: Mechanism through which financial vulnerabilities can magnify the effect of a shock. Amplification may be linked to intrinsic weaknesses or second-round effects, i.e. a situation in which a vicious circle is set up between the economy and the financial sphere.

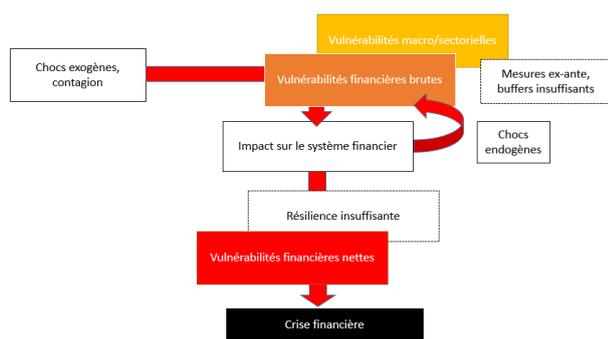
Resilience: Capacity of the financial system to absorb shocks and prevent contagion effects. Resilience includes an intrinsic component (intrinsic property of the financial system based on its structure and how it functions, for example) and a component based on regulation and measures adopted by public authorities, such as macroprudential tools or fiscal or monetary support.

Broadly, when a shock occurs, it exerts pressure on financial system vulnerabilities and may cause systemic effects if the system is insufficiently resilient (cf. Diagram 1).

To prevent financial crises, the authorities establish ex ante prudential and supervisory measures in order to make the financial system more resilient. When a particularly intense or long-lasting shock occurs, public authorities may take exceptional measures to stem the effects. Recognition of the financial system's resilience factors following action by public authorities leads to reduced net vulnerabilities (cf. Diagram 2).

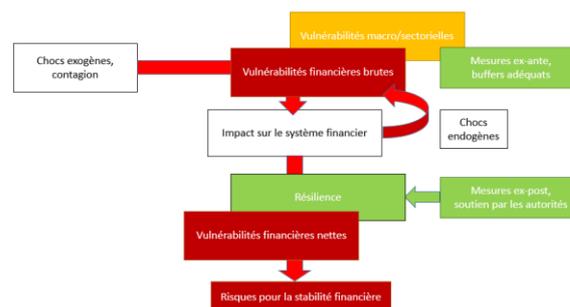
¹²⁴ Bennani, T. et al., *Politique macroprudentielle*, Pearson, 2017.

Diagram 1: Impact of a financial system shock



Source: Banque de France.

Diagram 2: Impact of a financial system shock, after measures by public authorities



Source: Banque de France.

Box 4.2: The shock unleashed by the Covid-19 pandemic

The pandemic was an exogenous event that prompted non-financial participants to adjust their consumption and lifestyle behaviours and required health-related measures to be imposed, including lockdowns and travel restrictions. These health measures had a direct effect on the financial system through the operational constraints that they created for financial institutions, and an indirect effect via macroeconomic uncertainties about the impact and duration of the reduction in production activity and changes to production and consumption habits.

These shocks put pressure on existing vulnerabilities (debt levels, asset valuation, bank profitability) and tested resilience (use of existing buffers), leading to increased risks to financial stability.

In response, authorities adopted a set of support measures that helped to boost the resilience of the financial system in the new environment created by the pandemic, thereby containing the risks to financial stability.

Mapping vulnerabilities

An analysis of vulnerabilities is used to identify existing or growing weaknesses affecting a portion of the financial system and to implement the necessary corrective measures. The exercise should cover all participants and activities that could cause a systemic failure. The assessment of vulnerabilities and the requisite analytical tools, are designed to identify vulnerabilities that could trigger inter-sector and cross-border contagion effects.

To map vulnerabilities it is necessary to consider several distinct blocks, namely financial participants (banks, insurers and the non-bank sector – including investment funds and CCPs), non-financial participants (non-financial corporations, households and the sovereign) and financial markets. For each block, vulnerabilities are grouped into categories, e.g. asset prices, asset quality, liquidity, etc., and assessed using indicators. Various kinds of indicators are used, including statistical indicators (price series, volumes, balance sheet ratios) of different sorts and with differing frequencies, and the results of models designed to simulate the effect of an event on some or all of the financial system and estimate the level of vulnerability. Each category of vulnerabilities comprises indicators identifying vulnerabilities of the same sort.

The quantitative signals generated by the mapping are compared against the qualitative assessment prepared by experts for each block in the matrix of vulnerabilities. At each stage of preparing the assessment, these experts, who work in a network, play a critical role in the ongoing evaluation of systemic risks, by i) determining the

indicators that form the matrix of vulnerabilities and reviewing them on an ongoing basis; and ii) comparing the emerging signals generated by the indicators and exercising expert judgement, where need be, to refine the assessment of vulnerabilities. Accordingly, the systematic assessment of vulnerabilities is based on two levels that ensure stable evaluations while also supporting flexibility: (1) a set of systematically and periodically assessed indicators, which make up the matrix of vulnerabilities, (2) expert judgement, which is used, in particular, to identify emerging vulnerabilities or to qualify existing vulnerabilities.

Vulnerability indicators

Extracting signals

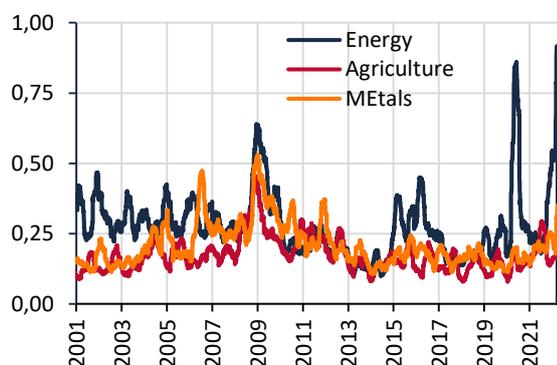
Each block comprises different categories of vulnerabilities, themselves measured using indicators from which signals are statistically extracted to assess gross vulnerabilities (cf. Chart 4.1). The indicators are updated quarterly for each assessment exercise, and their signals are extracted using a statistical method (cf. Chart 2). The signals are generated using a statistical z-score method and analysed on a statistical basis (percentiles). For a time series X , the z-score Z is defined as:

$$Z_t = \frac{X_t - \mu}{\sigma}$$

with μ the mean of X and σ its standard deviation. The z-score is calculated according to the same frequency as the original series (usually daily or monthly). The process is used to normalise different series and aggregate them easily by making them comparable: aggregation is performed quarterly, using a simple arithmetic mean. This makes it possible to smooth out very short-term shocks, while capturing pronounced trends.

Chart 4.1: 90-day annualised volatility, commodities

x: time / y: volatility

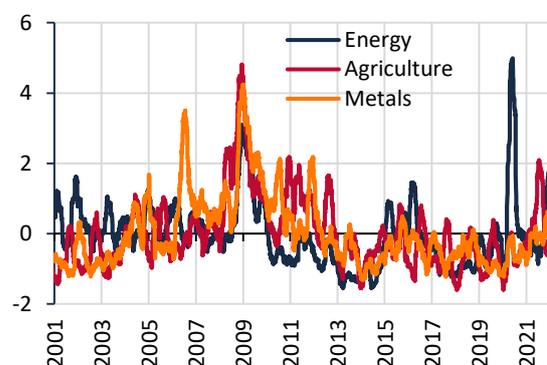


Scope: Volatility of commodity price indices (energy, agricultural and industrial metals), 90-day annualised

Sources: Bloomberg, Banque de France calculations.

Chart 4.2: Z-score for 90-day annualised volatility, commodities

x: time / y: z-score



Sources: Bloomberg, Banque de France calculations.

The signal (z-score) is assessed by comparing the position of a point in a series relative to all the points in a historical or cross-sectional series. The three series of z-scores for 90-day annualised volatility of commodities (cf. Chart 4.2) are aggregated into a single quarterly series (cf. Chart 4.3). The level of the signal is then assessed by comparing the position of the score relative to the historical series (based on series distribution percentiles, cf. Table 1). There are variants, notably in cases where data are examined on a cross-sectional basis,¹²⁵ i.e. at a given time, rather than as time series. In the case of a cross-sectional sample, the signal is produced by analysing the position of a point within the overall sample over a specific time period.¹²⁶

Table 4.1: Relationship between vulnerability level, percentile and colour

Vulnerability	Low	Moderate	High	Very high
Percentile	< 50	>= 50 and < 70	>= 70 and < 90	>= 90

¹²⁵ For example, some indicators, notably for banks, are assessed by comparing French banks with other European G-SIBs.

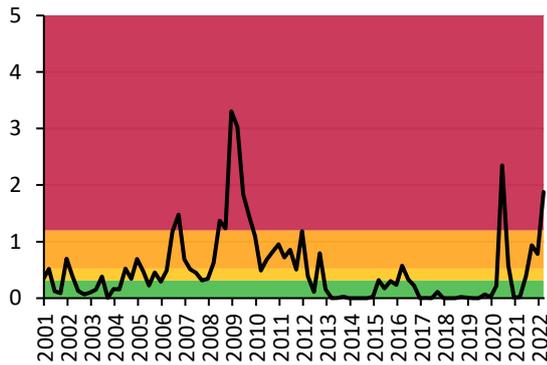
¹²⁶ Generally on a specific date.



Source: Banque de France.

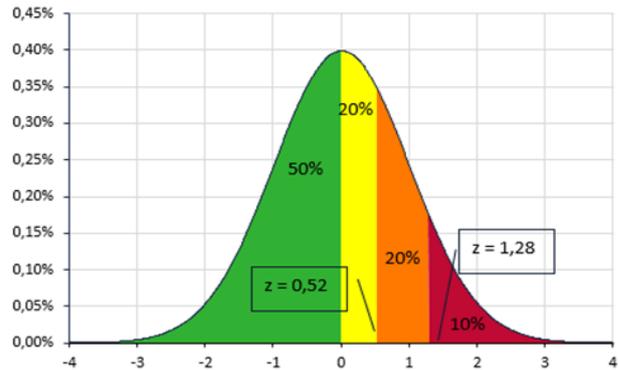
Thus, for each quarter in the series, a signal for the vulnerability contribution is estimated (cf. Chart 4.3). For Q1 2022, commodity volatility is above the 90th percentile and its contribution to the vulnerability category to which the indicator belongs will be extremely high. In the theoretical case where time series follow a Gaussian distribution,¹²⁷ the z-scores corresponding to each percentile are known, e.g. z-score of 1.28 for the 90th percentile (cf. Chart 4.4). In practice, the empirical distribution is used to establish thresholds for each indicator.

Chart 4.3: 90-day annualised volatility, commodities
x: time / y: z-score



Scope: Volatility of commodity price indices, 90-day annualised
Sources: Bloomberg, Banque de France calculations.

Chart 4.4: Probability density of a standard normal distribution around 0
x: z-score / y: density



Source: Banque de France calculations.

Aggregation of signals by vulnerability category, then by block in the matrix

Since several indicators are followed for each vulnerability category, the signals have to be aggregated. In practice, the signals from a category's indicators are aggregated by calculating the mean of the z-scores for these indicators, or by using a simple quadratic mean,¹²⁸ which entails slightly overweighting higher vulnerabilities. In the most typical case where vulnerability is asymmetric relative to the indicator value, negative values are considered to be zero (a negative z-score corresponding to weak or absent vulnerability). Where vulnerability is symmetric, i.e. present at both high and low values, the series is restated.

Box 4.3: Illustration of the aggregation of signals within a vulnerability category and block

To illustrate the methodology, let us take indicative values for the z-scores of a series of indicators in the “Asset prices” category: 1.09 | -0.85 | 0.66 | 1.48 | 0.69 | 0.35 | -2.53. The z-score for the “Asset prices” category will be equal to:

$$Asset\ prices = \sqrt{\frac{1.09^2 + 0^2 + 0.66^2 + 1.48^2 + 0.69^2 + 0.35^2 + 0^2}{7}} = 0.81$$

This calculation is replicated for all the quarters making up the “Asset prices” time series, and each value is positioned using the quantile method (cf. Table 4.1). This provides a backward-looking view of this category in the form of a heatmap (cf. Chart 4.5). The assessment at Q1 2022 shows elevated vulnerability because the value 0.81 is between the 70th (0.807) and the 90th (1.179) percentiles of the series. This vulnerability level stems essentially from the “CAPE, CAC40”, “Negative-yield securities” and “Commodity prices” indicators (cf. Chart 4.5).

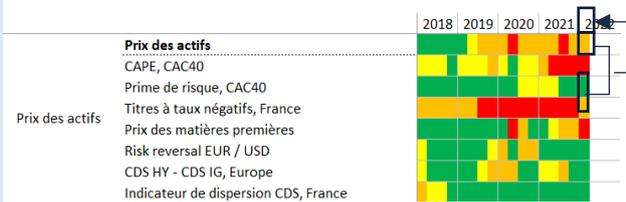
¹²⁷ Most vulnerability or market indicators do not usually follow a Gaussian distribution. In particular, some may have fatter tails.

¹²⁸ In the case of a quadratic mean, negative values are considered to be zero. A z-score of -2 signals a weak contribution to vulnerability, while squaring would produce the reverse effect. To avoid this, a floor of 0 is applied to the entire series.

The assessment of vulnerabilities for financial asset prices fell from severe vulnerability in Q3 2021 to high vulnerability in Q4 2021 and Q1 2022. The decrease was notably driven by the reduction in the signal

Chart 4.5: Aggregation of signals for the “Asset prices” category of the financial markets block

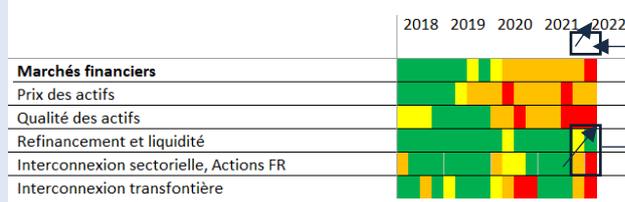
x: time / y: category and indicator



Source: Banque de France (matrix of vulnerabilities, financial markets block).

Chart 4.6: Aggregation of signals for the financial markets block

x: time / y: block and category

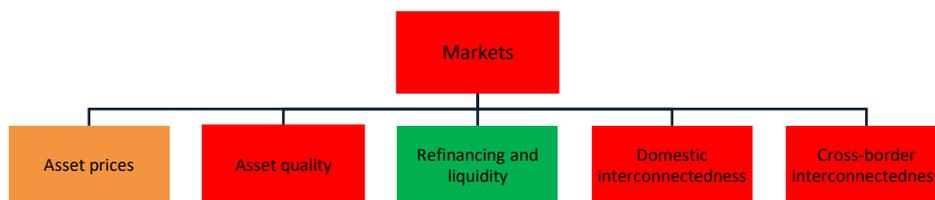


Source: Banque de France (matrix of vulnerabilities, financial markets block).

generated by the “Negative-yield securities” indicator, whose z-score fell from 2.08 to 0.66 over the period. Over the period, the score of the “Asset prices” category ranged from 1.184 (very high), to 1.296 (very high), 1.176 (high) and then 0.81 (high).

This process is applied to all of the blocks in the matrix. The vulnerability thresholds for the financial markets block between Q1 2000 and Q1 2022 were at the 50th, 70th and 90th percentiles (cf. Table 4.1). In Q3 2021, the vulnerability of financial markets was thus high overall (cf. Chart 4.6), with vulnerabilities identified for the “Asset prices” and “Asset quality” categories being offset by weak vulnerabilities in “Refinancing and liquidity”, “Sector interconnectedness” and “Cross-border interconnectedness”. Conversely, from Q4, the overall vulnerability of the financial markets block increased (cf. Chart 4.6) owing to a surge in vulnerability in several categories, notwithstanding a slight decrease in the “Asset prices” component.

Chart 4.1: Aggregation of signals for the financial markets block



Source: Matrix of vulnerabilities, financial markets block.

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