



**ANNUAL
REPORT**
TO CONGRESS
2022



OFFICE OF THE DIRECTOR LETTER

It is my pleasure to deliver the Office of Financial Research 2022 Annual Report to Congress.

I began leading the Office of Financial Research (OFR) in February 2022, charged with temporarily performing the duties of the Director. I am incredibly proud of the efforts of our team this year to advance the vital work of meeting the needs and priorities of the Financial Stability Oversight Council (Council).

The last few years have been historically tumultuous, marked by a global pandemic, a slowdown in economic growth, substantial volatility in the investment markets, and increased political tensions abroad. Despite the challenging environment of the past year, the OFR never wavered in executing its critical mission. Our staff demonstrated leadership in the international financial data standards space, built and maintained sophisticated technology systems to facilitate research, and contributed to multiagency groups focused on addressing critical risks to financial stability. We made significant strides in closing financial-data and visibility gaps and informing policymakers via a wide range of monitoring tools and published research.

As noted in this year's report, the information we cover describes our research and analysis as of September 30, the end of the fiscal year (FY) 2022. In an ever-changing environment, however, we recognize that much has continued to evolve since that time. The OFR has and will continue to monitor and analyze risks to financial stability, remaining agile to identify and examine emerging threats as they arise now and in the coming years.

This year, our report found that throughout FY 2022, financial stability risk was elevated. Several factors contributed to this assessment: the financial and economic stress of Russia's war against Ukraine, the Federal Reserve's tightening of monetary policy to reduce elevated inflation, lingering supply disruptions as economies continued grappling with the COVID-19 pandemic, and economic uncertainty based on the slowing of global growth.

Throughout 2022, the OFR proactively attended to the needs and priorities of the Council and its member agencies. Within this report, you will find details of our work, but I'd like to highlight a few examples at the outset—namely, the innovation of an OFR-hosted Data and Analytics Hub and our progress toward closing a critical data gap in the repurchase agreement (repo) market.

OFR-hosted Data and Analytics Hub

As a frontier risk, climate-related financial risk—though difficult to model and forecast within the financial system—presents an increasing threat to financial stability. Being able to assess it accurately is vital to mitigating its effects.

To address this Council priority head-on, the OFR partnered with colleagues at the Federal Reserve in early 2022 to pilot a collaboration space equipped with certain climate data, as well as high-powered computing and analytical tools that give researchers the capacity to integrate their financial data to produce high-quality research on climate-related financial risk.

Although climate-related data served as a test case for this prototype technology environment, the OFR is moving swiftly to build on its success with a greatly expanded scope. Once fully operational, the new Data and Analytics Hub will support comprehensive financial stability research by providing a platform to integrate and analyze a broad spectrum of financial and other relevant data that addresses risks beyond those that are climate related. Looking ahead, we hope to expand this collaboration space for use by other Council member agencies and provide these users with a range of data and analytical services that are responsive to their needs.

Non-centrally Cleared Bilateral Repo Pilot and Collection

Recent stress in Treasury markets and spillover into short-term funding markets have captured the attention of many in the financial services world. For years, regulators have called for greater insight and transparency into the repo market, which is the largest short-term wholesale funding market in the United States. The OFR answered that call and began to close this data gap in 2019 by establishing a daily data collection of centrally cleared repo transactions. We subsequently turned our attention to the non-centrally cleared bilateral repo, and in 2022, we made substantial progress in providing regulators with visibility into this market segment. Over the course of several months, the OFR conducted an outreach-

and-collection pilot with nine financial institutions voluntarily submitting transaction-level data. The pilot allowed us to provide the Council with preliminary insights into the non-centrally cleared bilateral repo market segment while laying the groundwork for a permanent collection. As this report goes to press, we have published a Notice of Proposed Rulemaking to establish an ongoing daily collection. Such a collection will significantly improve the Council's ability to oversee the nation's financial stability.

Like many organizations worldwide, the OFR began its physical return to the office in 2022 amid our new hybrid environment. Despite the challenges posed by the COVID-19 pandemic and the new normal it created, our staff remains responsive, committed, and highly productive. The flexibility created by OFR's new hybrid environment has enhanced the engagement and productivity of our dedicated staff and has improved our ability to retain and attract talent from across the nation. This is especially important as we continue to maintain and further develop expertise related to emerging risks and other priorities of the Council.

A team of dedicated and skilled public servants performs the work of the OFR. They understand well the importance of their financial stability mission and their work's impact on every American. This great responsibility motivates our staff every day. As a career executive civil servant, it has been both an honor and a privilege for me to lead the OFR and its diverse, talented, and committed team of professionals. For however long my service is needed to continue performing the duties of the Director, I remain committed to leading, supporting, and working alongside the team. Together, we will continue to meet the OFR's mission of promoting financial stability by delivering high-quality financial data, standards, and analysis for the Council, Congress, and the American public.



James D. Martin

Deputy Director of Operations

Performing the Duties of the Director

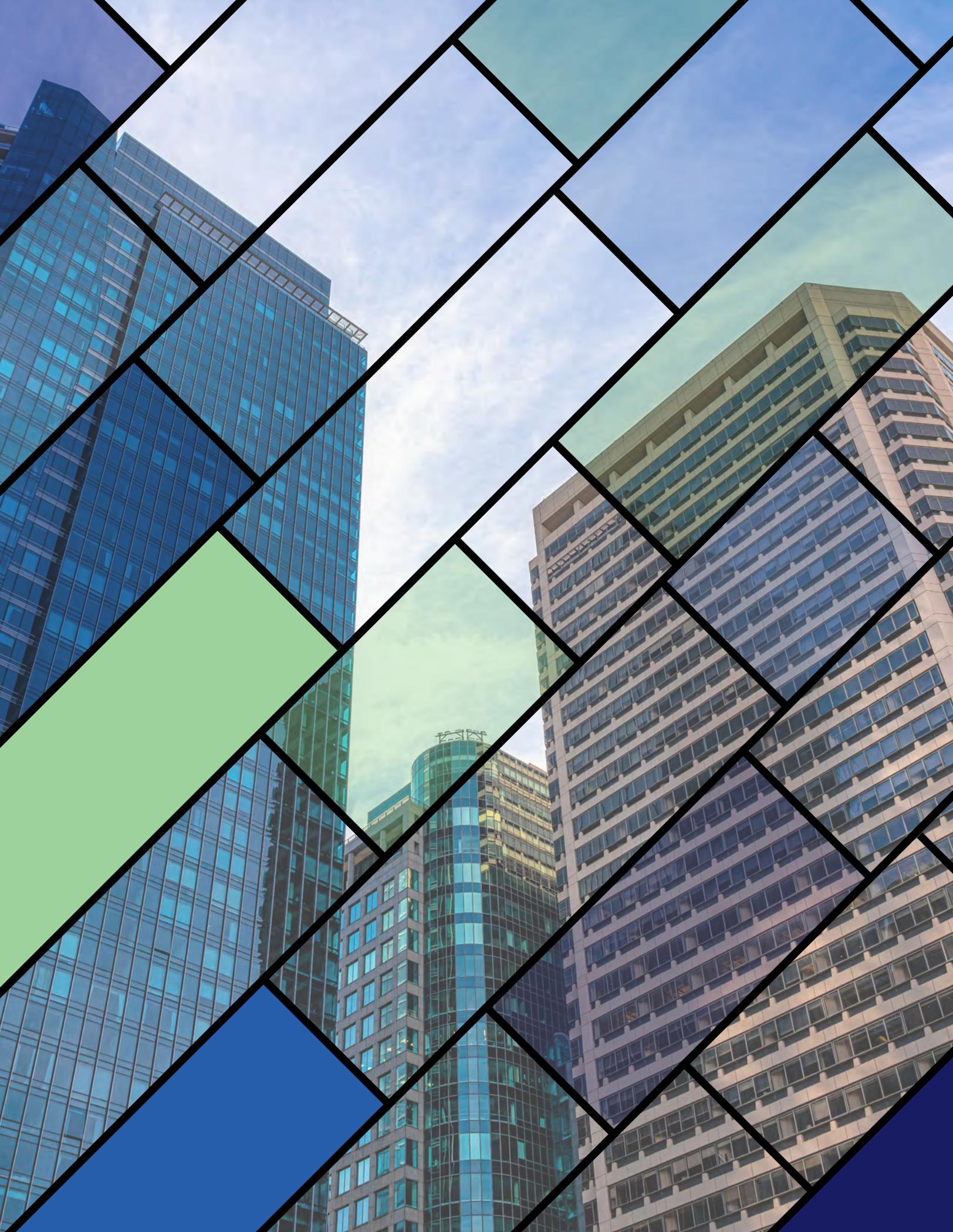
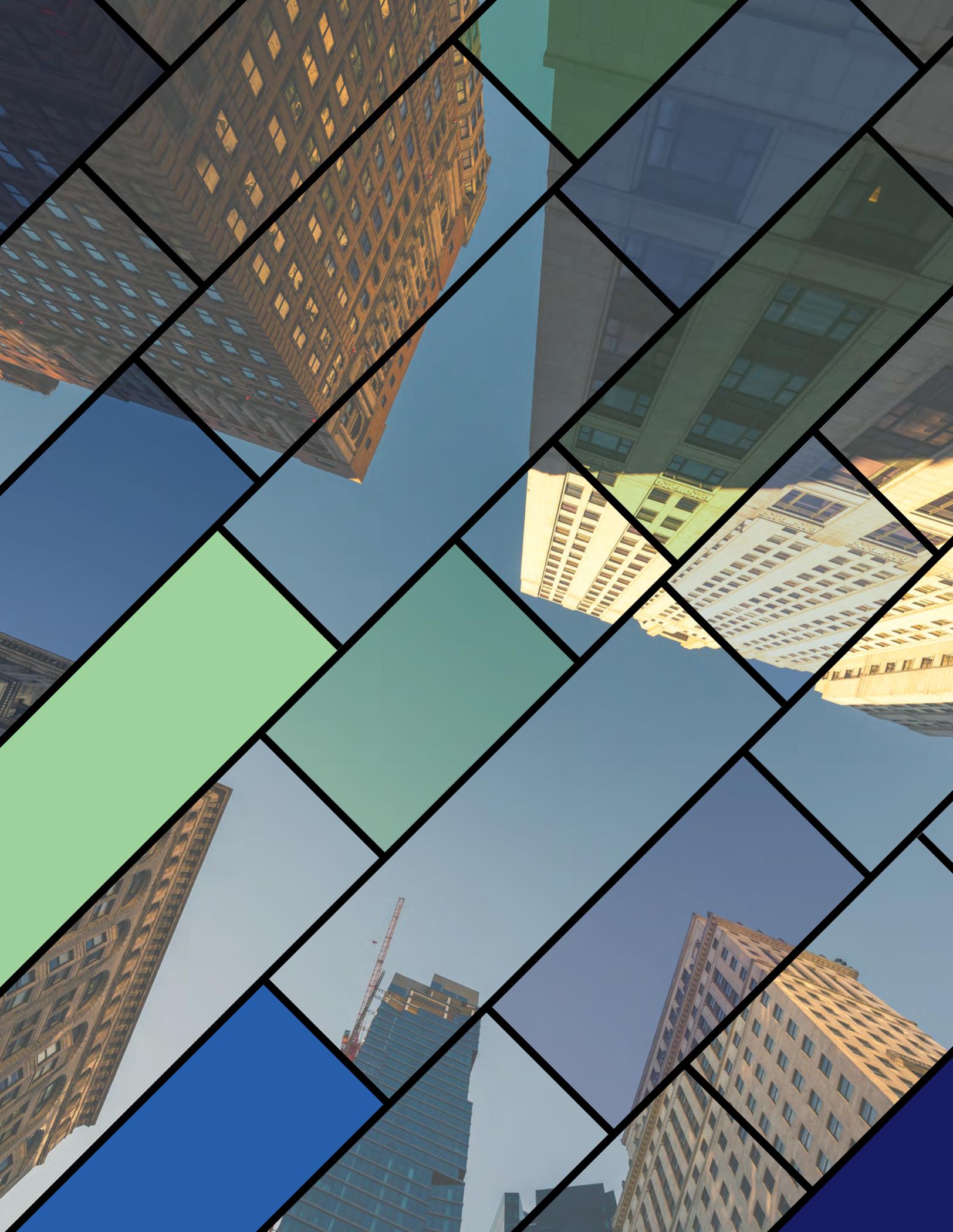


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EXECUTIVE SUMMARY

The 2022 OFR Annual Report reviews financial market developments, describes potential emerging threats to U.S. financial stability, and assesses global economies, financial markets and liquidity, financial institutions, digital assets, cybersecurity risks, climate change risks, and the performance of the Office.

Overall risks to U.S. financial stability are elevated and have increased since last year's report. This report discusses the Office's assessment of risks associated with the U.S. financial system and identifies areas causing stress, such as the following:

1. Weaker economic growth and monetary tightening.
2. Elevated volatility in the Treasury and short-term funding markets.
3. Surges in commodity pricing and hedge fund leveraging and interconnectedness.
4. Crypto asset volatility and the depegging of the third-largest stablecoin.
5. Increased state-sponsored cyberattacks and resulting changes in the cyber insurance market.
6. Climate-related financial risks.

February 2022 marked the beginning of major events that would stress the financial system. Contributing factors to the financial and economic stress included Russia's war against Ukraine, the Federal Reserve's tightening monetary policy to reduce inflation, lingering supply disruptions as economies worked past the COVID-19 pandemic, and economic uncertainty based on the slowing of global growth.

Strong consumer demand, labor supply shortages, and supply disruptions in commodities markets were among the major triggers of global inflation. With rising interest rates, certain sectors are more susceptible to credit risks. The total reported market capitalization of all crypto assets has fallen by more than 70% from its peak of \$3 trillion in November 2021. The increased frequency of cyberattacks and the growing costs to guard against them continue to pose risks. Finally, climate change introduced vulnerabilities to the financial system, yet assessing the risk is complicated by the threat's medium- to long-term nature.

Macroeconomy

The U.S. labor markets remain tight, although real wages have fallen, and the participation rate remains below its pre-pandemic level due to shifting economic dynamics post-pandemic. The job market's strength supports households but raises concerns about continued inflationary pressures.

Overall, macroeconomic risks to U.S. financial stability have increased since 2021. High inflation and a slowdown in growth posed risks to household balance sheets, residential and commercial real estate, and other parts of the financial system. In addition, the rising interest rate environment affected sovereign debt risk and segments of the corporate debt market. Consumer price inflation began rising in the spring of 2021. It continued to rise through the start of 2022, climbing to high levels not seen in several decades and remaining well above the Federal Reserve's target of 2% per annum. Several factors drove higher prices, including strong aggregate demand, a post-pandemic reopening of the economy, and a material shift from services to goods.

Supply chain distortions have been larger and more persistent than markets anticipated, putting upward pressure on prices. New waves of COVID-19 infections continue to disrupt overseas supply chains (particularly in China) and the domestic services sector. As a result, domestic and global energy prices increased significantly throughout the year, affecting domestic producers and importers. The high price of energy was a key contributor to the recent record inflation, with energy as one of the fastest-rising components of several price measures. In addition, Russia's war against Ukraine significantly disrupted European energy markets, driving up costs in the global market.

At the same time, the post-pandemic recovery in the U.S. labor market has been remarkable, and indicators show that the labor market remains tight. The unemployment rate is currently near a 50-year low. On the other hand, Russia's war against Ukraine impacted global growth and trade. The war decreased expectations of global macroeconomic growth. The World Bank reduced its global growth forecast for 2022 to 2.9% (from 4.1%) and forecasted a contraction of 4.1% in Europe and Central Asia.

High inflation led to considerably tighter conditions in financial markets globally. Interest rates broadly increased. The Federal Reserve began hiking the federal funds' target rate in March 2022 after maintaining a target rate of 0% - 0.25% since March 2020. As of September 2022, the target range of federal funds stood between 3.0% - 3.25% and is expected to increase. The Federal Reserve also began reversing its quantitative easing policy and is now engaging in quantitative tightening. Central banks around the world implemented similar measures. In June, the European Central Bank (ECB) announced that it raised its key policy rate for the first time in over 11 years. The ECB raised interest rates from -0.50% in July to 1.5% in October, with further increases planned. Despite inflation rising to reach the Bank of Japan's target of 2% for the first time in years, the bank intends to maintain rates at just below zero with no expected rate increases.

The global economy is experiencing high inflation driven by strong demand following the COVID-19 pandemic and disruptions in the supply of energy and other commodities:

- U.S. economic growth has slowed as financial conditions have tightened, partly due to interest rate hikes and quantitative tightening. The U.S. labor market remains strong, but the labor force participation rate and the employment-to-population ratio are below pre-pandemic levels.
- Higher inflation in the post-pandemic global economy and a dramatic rise in commodity prices following Russia's war against Ukraine have hampered global growth prospects. European economies are particularly vulnerable to rising energy costs that affect labor productivity and consumption. As a result, many European economies entered into a recession in 2022.
- Central banks are raising interest rates to fight inflation but must balance this against the risk of overtightening. European central banks are facing the prospect of stagflation as the U.S. dollar continues to strengthen and the war in Ukraine drags on. Moreover, increasing yields in peripheral eurozone countries have given rise to fragmentation concerns and a potential return of the European debt crisis of the 2010s.
- In emerging markets, food and energy prices remain high, hampering economic growth and raising social tensions. In addition, increasingly tight financial conditions may push some debt burdens to unsustainable levels.

Credit Risk from Tighter Financial Conditions

Corporate leverage remains elevated, but it has declined from the peak. Credit risk premiums, the difference in yield between a corporate bond and a Treasury bond of the same maturity, increased sharply in 2022 and are above historical medians. As the U.S. economy transitions from an era of unprecedented quantitative easing and zero interest rates to one with quantitative tightening and higher rates, the outlook for the corporate credit cycle is more uncertain. As a result, corporate sector vulnerabilities could amplify stress in the economy and financial markets.

The 2007-09 financial crisis illuminated financial-stability channels related to the household sector and how systemic shocks to the financial system can originate from household balance sheet issues. The net worth of U.S. households declined to \$143.8 trillion in Q2 2022 from its peak of \$149.8 trillion in 2021, based on the Federal Reserve's Financial Accounts data. Adjusting for inflation and expressed in real terms, household net worth remains slightly higher today compared to pre-pandemic levels, or \$123.8 trillion compared to \$116.4 trillion in Q4 2019. Household debt increased over the past year to levels not seen since 2007. The year-over-year aggregate growth in household debt is 7.0% in September 2022, or \$15.6 trillion.

A depressed commercial real estate (CRE) market can cause and has caused past financial stability issues, such as during the 1990-91 recession, when depository failures were primarily

due to CRE lending-related losses. However, we have seen limited CRE market stress in recent years as the CRE market has performed well with strong occupancy rates, rising rents, and property values. However, offices in dense central business districts such as New York and San Francisco had physical office occupancy rates well below their pre-pandemic usage, due to the work-from-home (WFH) phenomenon.

Tighter financial conditions expose credit risk vulnerabilities:

- Nonfinancial firms with floating-rate debt or near-term maturities face larger financing burdens. This headwind is amplified by weaker fundamental trends.
- The CRE market's performance is softening after exceptional performance in recent years. Unlike previous market downturns, credit losses on CRE loans are not expected to pose a significant risk to financial stability. The longer-run performance of the office sector is unclear, especially in dense central business districts where WFH appears to be a permanent development.
- Household leverage remains at historically low levels because low interest rates and COVID-19 pandemic-related support programs aided households in decreasing debt obligations. Household financial conditions have deteriorated for some, due to inflationary pressures. Delinquency rates have increased more rapidly for renters compared to homeowners among the most vulnerable households.
- Rapidly rising mortgage rates dampened home price appreciation, though the risks to the economy are lower than they were in the period leading up to the 2007-09 financial crisis.

Financial Markets and Liquidity

Short-term funding markets support core functions of the financial system, providing liquidity to borrowers and allowing corporations, financial firms, and other investors to meet immediate and near-term cash needs. Funding markets are relatively stable, but market liquidity remains fragile. In addition, market volatility and the impact of Federal Reserve interest rate increases are magnified in short-term markets.

In Treasury markets, the persistent specialness in certain securities may have resulted from the repositioning around Federal Reserve tightening combined with one-sided positioning and limited supply. As tightening continues, there is a possibility that liquidity challenges may persist if high levels of uncertainty remain about the future path of policy. In the market for short-term Treasury securities, substantial increases in investors' cash balances have led to demand outpacing the supply of new Treasury bills.

While market risk, or volatility in asset prices, is not the same as financial-stability risk, market risk may interact with and reinforce other vulnerabilities where the combination amplifies financial-stability risk. For example, negative nominal and real yields distorted asset prices and encouraged borrowers to maintain high leverage levels. The normalization of yields reduces these effects and provides a more robust set of investment opportunities for fixed-income investors, reducing incentives to reach for yield.

The overall health of the municipal market was strong after municipalities received support during the onset of the COVID-19 pandemic. In addition, states entered the monetary-tightening cycle in a strong position due to the 2021 economic expansion, which increased tax receipts and saw a decline in fuel and energy costs. Infrastructure spending continued to be a significant issue because municipal issuers invested in repairing or replacing failing bridges, dams, utilities, and other projects. Since the 1960s, the proportion of U.S. infrastructure spending to GDP has declined by 47%. This lack of expenditures has placed municipalities and states at risk of catastrophic infrastructure failures. The economic impact of infrastructure failures is significant and can impact communities for decades through higher taxes, reduced productivity, and higher costs.

Fixed income and equity investors experienced large losses from a sharp increase in risk-free rates and may face more declines if market sentiment deteriorates:

- Treasury market volatility is elevated, and liquidity remains tight amid monetary policy uncertainty. More generally, bond market stress measures are showing levels comparable to March 2020 and the early days of the 2007-09 financial crisis.
- Short-term funding market conditions have tightened as investors become more risk averse amid economic and monetary policy uncertainty. Structural vulnerabilities remain in some segments of the short-term funding market, such as money market funds and other cash management vehicles.
- Asset prices have fallen sharply, but many valuation metrics are either elevated or near historical averages. Further price declines are possible if economic conditions weaken materially or if another shock emerges.
- State and local governments emerged from the COVID-19 pandemic with strong balance sheets but face increasing cost pressures from energy and wage inflation, which siphon resources from needed infrastructure spending.

Financial Institutions

After enjoying a relatively benign economic and financial climate in 2021, buoyed by strong profitability and limited credit losses, U.S. banks entered a period of heightened uncertainty. Higher inflation and interest rates, a greater risk of recession, and enhanced global risks due to Russia's war against Ukraine lowered the sector's outlook. Nevertheless, despite headwinds, in aggregate, the U.S. banking sector remained well capitalized and maintained risk-based capital ratios well above regulatory minimums.

While the insurance industry was not immune to the stresses of 2022, it is unlikely to meaningfully affect the U.S. financial system's near-term stability. Yet, there remain important issues impacting the insurance industry, including the following:

1. Changes in insurers' investment policies as interest rates rise and fall.
2. Rising claim costs due to inflation.

3. Increased life sector involvement by private equity–affiliated insurers.
4. The increasing stress on the ability of the private insurance industry to cover large and growing risks.

Since the market downturn in March 2020, hedge fund leverage and asset class exposures have grown significantly, although these increases have moderated in the past year. Hedge funds engaged in various trading strategies to maximize risk-adjusted returns. While many hedge funds sought to mitigate the sensitivity of their performance to adverse market movements, certain fund classes were not able to mitigate with the rise of inflation.

In February and March 2022, the surge in commodity prices following Russia’s war against Ukraine forced several commodity-focused central counterparty (CCP) clearinghouses to raise initial margins on various commodity contracts. The increases were most significant in Europe, where margins nearly doubled compared to the prior year’s average. In the U.S., the initial margin increase at commodity CCPs was 20%-30%. The sudden increase in volatility would have led to even larger increases were it not for the residual effects of market volatility in early 2020, which led CCPs to maintain high resource levels in the U.S. due to the lengthy lookback period of their risk models. Although increased margin demands have put a temporary strain on the liquidity of some members, the resulting elevated levels of posted collateral can aid in easing concerns about potential CCP defaults going forward.

Financial institutions face uncertainty and unique challenges due to higher interest rates and inflation, slower economic growth, and geopolitical risks:

- In aggregate, the U.S. banking sector remains well capitalized and has maintained risk-based capital ratios well above regulatory minimums.
- Insurers have increased the risk profile in their investment portfolios in response to low interest rates in recent years, thereby making them more exposed to investment losses during an economic downturn. Inflation continues to negatively affect property and casualty insurers as claim costs rise, especially for homeowners and automobile insurance.
- Bond fund flows are sensitive to interest rate increases. Significant outflows may strain fixed-income markets. During historical periods of rising interest rates, the size of bond funds was much smaller, and dealer capacity to intermediate was much greater.
- The hedge fund industry has experienced negative returns but has been able to outpace broad market indices during this high inflationary period in 2022. The industry’s asset exposures and leverage moderated in 2022 after rebounding from the 2020 downturn. Despite declines in aggregate industry leverage, some funds are highly leveraged and may pose a threat to financial stability.
- The surge in commodity prices in March and September 2022 triggered large increases in initial margins at some CCPs. Several commodity-centric CCPs faced significant stress, although no CCP member defaulted. The size and concentration of member positions in commodity markets have raised questions about the transparency of exposures across CCPs, making it difficult to set effective margins.

Digital Assets

Risks in the digital-assets markets were highlighted when several crypto asset lenders suspended customer withdrawals following the decline in crypto asset prices in June 2022. Central banks can issue central bank digital currencies (CBDCs), which are digital liabilities of the central bank. As discussed in the 2021 OFR Annual Report, CBDCs should be immune to the run risk of stablecoins but may increase flight-to-safety concerns. U.S. regulators are currently exploring CBDCs. The Federal Reserve issued a CBDC consultation paper in January 2022 and is continuing its independent research into and experimentation with CBDCs. Globally, around 90% of central banks now report studying or working on developing a CBDC. Four central banks issued CBDCs (the Bahamas, the Eastern Caribbean Currency Union, Jamaica, and Nigeria), and over 30 CBDCs are in development or pilot phases.

Digital assets experienced a volatile 2022, with the total market capitalization falling from over \$2.2 trillion in January 2022 to under \$1 trillion in August 2022. Losses to date appear largely contained within the digital-asset sector, although the risk of contagion looms.

- Many prominent crypto asset trading and lending platforms suspended customer withdrawals. Some also filed for bankruptcy.
- The third largest stablecoin at the time depegged in May 2022. During that month, the \$18.5 billion loss in value highlighted risks associated with stablecoins and spillover risks in the digital-assets space.

Cybersecurity Risk

Russia's war against Ukraine heightened the prospect of state-sponsored cyberattacks and the importance of vigilance and planning in technology infrastructure. Prior events—such as the 2012 coordinated denial-of-service cyberattack, where several major U.S. financial institutions suffered simultaneous outages—were believed to be in response to the U.S.-imposed economic sanctions on Iran. Furthermore, beyond attacks directly targeting U.S. financial services institutions, there were concerns of unintended spillovers from cyberattacks stemming from state-sponsored actions, as demonstrated by the NotPetya malware incident in 2017. This alleged Russian attack infected software used by Ukrainian organizations and then spread to companies worldwide, leading to billions of dollars in U.S. corporate losses.

Organizations are continually working to mitigate the consequences of attacks in response to these various actors' threats to the financial system. Otherwise, there is the potential that a successful attack will cause significant harm not only to the organization but to the financial systems in which they operate. Three mechanisms can be used to prepare for potential cyber incidents:

1. Mechanism 1 - *technology security, resiliency, and recovery*. This consists of preventing attacks by minimizing vulnerabilities that adversaries could exploit, such as active cyber defense, cybersecurity hygiene, and insider threat management.
2. Mechanism 2 - *coordination and information sharing*. Cybersecurity discussions tend to focus on reducing risk for the individual through means such as multifactor authentication and zero-trust architecture, coordination, and communication across firms and government agencies, such as the Cybersecurity and Infrastructure Security Agency (CISA), the Office of Cybersecurity and Critical Infrastructure Protection (OCCIP), and the Financial Services Information Sharing and Analysis Center (FS-ISAC).
3. Mechanism 3 - *cyber insurance*. This can offer vital financial support and recovery assistance to an entity suffering from a cyberattack. Increased numbers of written policies and premiums per policy have driven rapid growth in this sector. As a result, annual policy premiums grew at a double-digit rate or (in some cases) a triple-digit rate, depending upon the risk-and-loss profile of the insured.

The increasing frequency of cyberattacks and the growing cost to guard against them pose risks to the financial system:

- Russia's war against Ukraine has substantially increased the perceived risk of state-sponsored cyberattacks in the U.S. financial services sector, although the majority of attacks have been focused on theft. The cyber posture of the sector has responded through increased information sharing and focused readiness exercises.
- Firms can implement cyber-defense mechanisms that reduce financial stability risk. These include undertaking internal/individual security measures, such as the application of the zero-trust framework; information sharing and coordination among firms and the government; and cyber insurance.
- As the cyber insurance market matures and adapts to new threats, substantial changes are emerging:
 - The number of policies written continues to grow as the need for cyber risk insurance becomes increasingly evident and cyber risk coverages are excluded from general insurance policies.
 - Obtaining cyber insurance has become more challenging because insurers have tightened their underwriting standards and insurance premiums for cyber policies have risen substantially.

Climate-related Financial Risk

Climate-related financial risk is the risk of financial losses due to rising global temperatures and accompanying environmental shifts, such as rising sea levels and more severe weather events. Climate-related financial risk poses physical and transition risks to the financial system. *Physical risks* describe the potential destruction or damage of physical assets, the impact on economic activity, and other losses from extreme weather events. *Transition risk*,

created by technological advances, policy changes, and preferences shifts, can be more challenging to quantify economically. Governments face financial risks related to climate change. An increase in climate-related events is likely to cause firms and households to increasingly rely on the insurance and banking sectors. At the same time, local municipalities and state governments are likely to rely on the federal government for financial support. Some households and businesses might be left without insurance as private insurers may become increasingly unwilling or unable to insure against climate-related physical risks. Climate-related damages in the U.S. have grown to about \$133 billion per year, with the federal government often stepping in with emergency relief and acting as an insurer of last resort.

Climate change impacts numerous aspects of the financial markets, often in unanticipated ways. In addition to transition risks, a myriad of physical risks can affect the financial markets. Climate risks are being priced into financial assets, but the extent varies depending upon the market, and not all risks are priced for the market. For example, the potential risk of mispricing lies in the mortgage industry. Lenders may be indirectly encouraged to underwrite mortgages without accounting for flood risks and then pass these loans to government sponsored mortgage companies (GSMC) to securitize into mortgage pools. This may indirectly encourage households to locate or, after disaster strikes, rebuild in areas prone to risks such as flood, hurricane, and wildfire. Recent evidence suggests this hasn't been the case, but it could be a source of future risk.

Climate-related financial risk has introduced vulnerabilities into the financial system, although assessing the risk to financial stability is complicated by the medium- to long-term nature of the threat.

- Physical and transition risks have already affected the broader economy.
 - Assessing and forecasting these risks to financial stability can be challenging.
 - Emerging areas of research highlight how interactions and networks in financial markets might amplify these risks.
- The costs of climate change related to damages and mitigation may be transferred to third parties.
 - Firms and households affected by climate disasters are increasingly relying on the insurance and banking sectors to finance repairs and fund mitigation efforts.
 - State and local governments are likely to rely on federal support for recovery efforts, disaster relief, and insurance programs.
- Climate-related risks could affect financial institutions and GSMCs through securitization, especially in flood-prone areas.
- To facilitate the dissemination of data, the OFR, in collaboration with the Federal Reserve, piloted an OFR-hosted Climate Data and Analytics Hub that provided staff from the Federal Reserve Board and Federal Reserve Bank of New York access to public climate and financial data, high-performance computing tools, and analytical and visualization software.

The OFR's Performance

FY 2022 was a significant year for the OFR, highlighted by the launch of two major pilot programs: the Non-centrally Cleared Bilateral Repo Pilot Project and the Climate Data and Analytics Hub pilot.

While the OFR's centrally cleared repo collection has been an asset in allowing regulators greater visibility into this market, non-centrally cleared bilateral repo has remained largely opaque and regarded as a potentially significant liability for regulators. This led to the creation of a pilot data collection project in which nine firms volunteered to participate. The project shed light on several market practices, including the composition of collateral, the identity of counterparties, and the terms of repo agreements. Notably, it was determined that most non-centrally cleared bilateral repos are collateralized by U.S. Treasuries, despite the eligibility of much of the collateral for bilateral central clearing. The OFR has initiated the rulemaking process to establish a permanent data collection, and the pilot data collection and subsequent analysis are expected to lead to a proposed rule governing these repo transactions.

The OFR's Climate Data and Analytics Hub pilot was intended to allow regulators to assess climate risks to financial stability. The project met the Federal Reserve's request for reliable climate data and tools, and it allows the OFR to potentially provide additional capabilities or enhanced services to the Council and its member agencies. Pilot participants included researchers, analysts, and support staff of the OFR; the Federal Reserve; and the Federal Reserve Bank of New York. After the conclusion of the pilot, a review will be conducted to document lessons learned, assess scalability, and document future requirements.

Regulatory Oversight Committee (ROC)

The OFR assumed the role of ROC Secretariat, a key role in the organization, and is providing administrative services to the global body of authorities for multiple International Organization for Standardization (ISO) standards and data. The ROC is composed of more than 50 countries and is responsible for overseeing the governance of multiple globally used financial data standards, including the Legal Entity Identifier (LEI), the Unique Product Identifier (UPI), the Unique Transaction Identifier (UTI), and Critical Data Elements (CDE) for over-the-counter derivatives transaction reporting.

Data Center

The enhancement of the Financial Instrument Reference Database (FIRD) was a notable achievement. It included the addition of new data elements of the Financial Information eXchange (FIX) Protocol, and it brought in ideas for future functionality from the X9 Industry Forum for Financial Terms Harmonization, which analyzes and maps the terms and definitions across multiple industry standards. The Office also made significant gains toward fulfilling

its mission to promote financial stability by delivering high-quality financial data standards, including improving the quality and utility of financial data in a way that facilitates data aggregation, integration, sharing, access, interoperability, and exchange.

Research and Analysis Center

Throughout the year, the OFR published numerous working papers on timely topics of high importance to financial regulators, including hedge funds, central bank digital currencies, and Treasury market stress. Other noteworthy content included financial stability monitors, research and evaluation of financial stability policies, and briefings for the FSOC and other stakeholders. In addition, the Office assisted the Defense Advanced Research Projects Agency (DARPA) EcoSystemic program to address disruptions to distributed financial ledgers.

Integrated Planning

Significant progress was achieved this year on the OFR's *Workforce Plan 2020–2024* by addressing gaps related to staff retention, workforce development, training, and recruitment. Of particular note were the development of an OFR-wide competency model and the completion of a competency assessment for all staff and leaders. In addition, the OFR expanded its team by 14%, enabling the closure of key gaps in subject matter expertise. The OFR filled multiple critical leadership positions, including Associate Director of Financial Institutions and a supervisory information technology specialist. In addition, the Office added considerable expertise and bench strength to its research, analysis, information technology, operations, and public affairs teams.

Technology

The Office implemented new layers of security focused on infrastructure and data. This included the creation of a new security operations facility that enabled significant advances toward a zero-trust architecture, in line with the federal mandate that all agencies should be compliant with zero trust by 2024. The OFR also completed the four-year migration from Treasury-hosted services, hardware, and equipment to a 100% cloud-based environment. Finally, the Office initiated hybrid workplace flexibilities, including telework and remote work, following temporary workplace provisions that began during the COVID-19 pandemic.





THE OFFICE OF FINANCIAL RESEARCH

The Office of Financial Research (OFR or the Office) was established by the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) and is charged with the following purposes and duties:

Support the Financial Stability Oversight Council (Council)'s purposes which include:

- identifying risks to the financial stability of the United States (U.S.) that could arise from the material financial distress or failure, or ongoing activities, of large, interconnected bank holding companies or nonbank financial companies, or that could arise outside the financial services marketplace;
- promoting market discipline by eliminating expectations on the part of shareholders, creditors, and counterparties of such companies that the U.S. government will shield them from losses in the event of failure; and
- responding to emerging threats to the stability of the U.S. financial system.

OFR's duties in support of the Council include:

- collecting data and providing such data to the Council and member agencies;
- standardizing the types and formats of data reported and collected;
- performing applied research and essential long-term research;
- developing tools for risk measurement and monitoring;
- performing related services;
- making the results of the activities of the office available to financial regulatory agencies; and
- assisting member agencies in determining the types and formats of data authorized by the Dodd-Frank Act to be collected by member agencies.

Statutory Requirements for the Annual Report

Section 154(d) of the Dodd-Frank Act requires the OFR to submit a report to Congress.

Subparagraph (1) requires that no later than 120 days after the end of the fiscal year, the Office will submit a report to Congress.

Subparagraph (2) requires each report to assess the state of the U.S. financial system, including:

- (a) an analysis of any threats to the financial stability of the U.S.,
- (b) the status of the efforts of the Office in meeting the mission, and
- (c) key findings from the research and analysis of the financial system by the Office.

With this report, the OFR presents its assessment of the state of the U.S. financial system. All data cited in this report is as of September 30, 2022, unless otherwise noted. This report also reflects the OFR's duty to inform policymakers, regulators, market participants, and the American public about its work to monitor, investigate, and report on changes in systemwide financial stability risk levels and patterns. In addition, the OFR's efforts support sound risk management for the entire financial system.

Throughout the report, some organizations will only be referenced by abbreviations, such as the following:

Department of the Treasury (Treasury)

Financial Stability Oversight Council (Council)

Board of Governors of the Federal Reserve System (Federal Reserve)

Office of the Comptroller of the Currency (OCC)

Federal Deposit Insurance Corporation (FDIC)

Commodity Futures Trading Commission (CFTC)

National Credit Union Administration (NCUA)



PART ONE

RISKS TO U.S. FINANCIAL STABILITY

Economic Indicators

Macroeconomy

The central economic themes of 2022 have been high inflation, a slowdown in growth, and a robust labor market. In addition, supply chain constraints, high energy prices, and extraordinary fiscal and monetary support in response to the coronavirus (COVID-19 pandemic) led to a four-decade high in consumer price inflation. This prompted the Federal Reserve to raise interest rates substantially and begin a quantitative tightening program.

This economic environment and other factors, such as Russia's war against Ukraine and continuing global COVID-19 pandemic lockdowns, created significant economic headwinds and raised fears of a possible recession. As a result, Real Gross Domestic Product (RGDP) growth for the first two quarters of 2022 was negative, while advance estimates for the third quarter were positive, signaling that the robust recovery of 2021 has downshifted.

U.S. labor markets remain tight, although real wages have fallen, and the participation rate remains below its pre-pandemic level due to shifting economic dynamics post-pandemic. The job market's strength continues to support households but raises concerns about continued inflationary pressures.

Overall, macroeconomic risks to U.S. financial stability have increased since 2021. High inflation and a slowdown in growth will pose risks to household balance sheets (see **Household and Consumer Credit section**), residential and

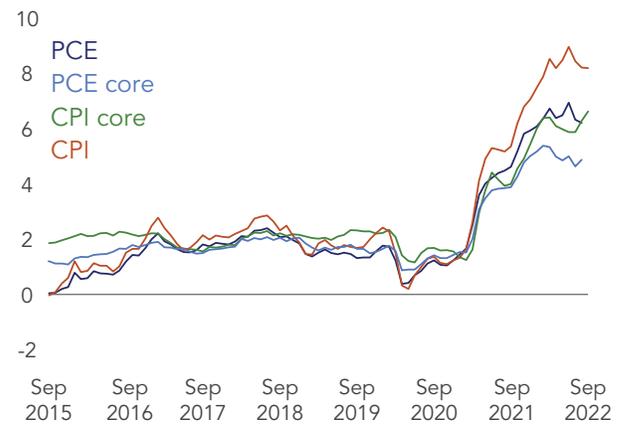
commercial real estate (see **Residential and Commercial Real Estate sections**), and other parts of the financial system. In addition, the rising interest rate environment will affect sovereign debt risk and segments of the corporate debt markets (see **Corporate Debt section**).

Inflation

Measures of consumer price inflation began to rise in the spring of 2021 and continued to rise through the start of 2022, climbing to high levels not seen in several decades and remaining well above the Federal Reserve’s target of 2% per annum. In July 2022, the consumer price index (CPI) increased 8.5% year-over-year after reaching 9.1% in June. Increases remained above 8% through the summer and early fall. The personal consumption expenditure core price index (PCE Core), which excludes food and energy, has hovered at around a seasonally adjusted 5% throughout 2022 (see **Figure 1**).¹ Durable goods inflation, which was significantly below services price inflation over the last decade, has risen above it since 2021.

Several factors have been driving prices higher, including strong aggregate demand, a post-pandemic reopening of the economy, and a material shift from services to goods. In addition, demand increased as the U.S. introduced an unprecedented fiscal and monetary policy response to the COVID-19 pandemic. For example, the American Rescue Plan Act authorized \$1.9 trillion in federal government spending in 2021, in addition to the \$2.2 trillion in spending authorized by the Coronavirus Aid, Relief, and Economic Security (CARES) Act the

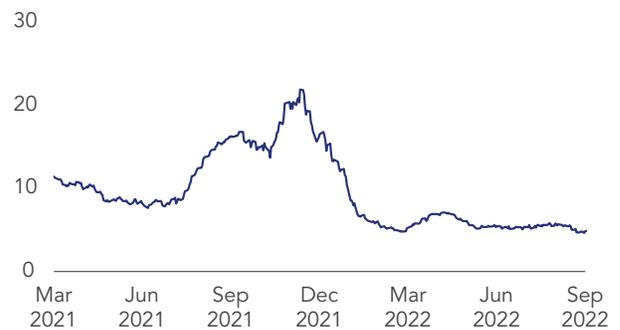
Figure 1. Inflation Measures (percent change)



Note: Chain-type price index, percent change from a year ago, monthly, seasonally adjusted.

Sources: FRED, Office of Financial Research

Figure 2. Port of Long Beach Vessels Average Days at Anchor & Berth (days)



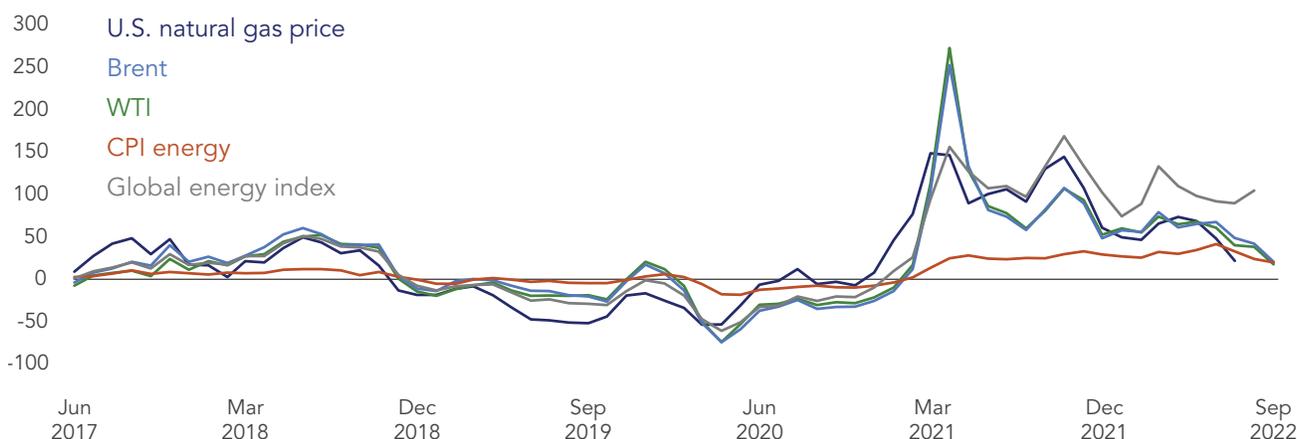
Note: Data are 20-period moving average of daily average for business days.

Sources: Bloomberg Finance L.P., Office of Financial Research

previous year. According to one estimate, these sizable fiscal support measures can explain about three percentage points of the recent rise in inflation.²

Furthermore, supply chain distortions from the COVID-19 pandemic persist both at home and abroad and have been larger and longer than anticipated, putting upward pressure on prices. Waves of COVID-19 pandemic infections

Figure 3. Domestic and Global Energy Prices (percent change)



Note: Percent change from a year ago, monthly, not seasonally adjusted.

Sources: FRED, Office of Financial Research

and subsequent lockdowns continue to disrupt supply chains abroad, particularly in China,³ and the services sector domestically. Several disruptions along the supply chain, coupled with strong demand, have resulted in significant increases in the time it takes for goods to reach consumers (see **Figure 2**). In addition, producer prices for freight costs have been increasing significantly since 2021 due to high demand, port congestion, gas prices, and pandemic-related supply chain stresses. Some of these costs will have been passed on to consumers, putting further price pressures on consumer goods. Forecasters point to these combined stresses to supply and demand as forces driving prices upward.⁴

The high price of energy has been one of the key contributors to the recent record inflation, as energy has been one of the fastest-rising components of several price measures. Domestic and global energy prices increased significantly throughout FY 2022, affecting domestic producers and importers. In addition, Russia's war against

Ukraine significantly disrupted European energy markets. Domestic prices have not been spared fallout from the war, as price increases hit consumers at the gas pump in the middle of 2022. As of July 2022, the CPI: Energy Services in U.S. City Average had increased by 32.9% from a year ago but began to come down as the year progressed (see **Figure 3**).

Inflation also continues to run high globally. Inflation reached as high as 10.7% in the European Union (EU) and 10.4% in the United Kingdom. Inflation was more moderate in the large Asian economies, such as China (+2.1%) and Japan (+2.5%); however, both countries saw relative increases over 2022. Inflation was generally higher in the U.S. than in Europe over the previous 2020-21. On the other hand, the effects of Russia's war against Ukraine have since accelerated inflation in Europe, matching the level of inflation in Europe with that of the U.S. (see **Figure 4**).

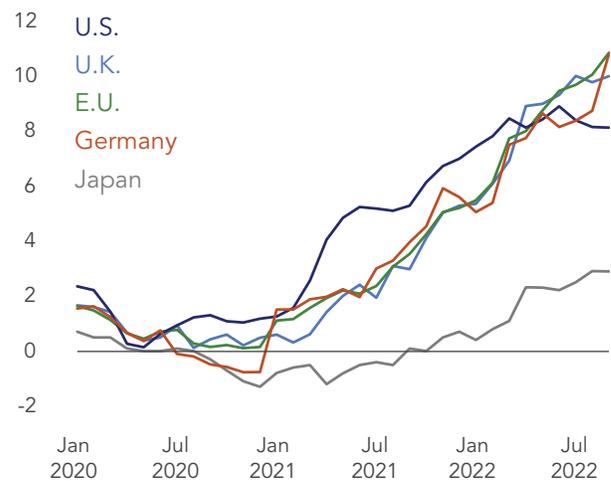
As measured by the Federal Reserve Bank of Philadelphia's Aruoba Term Structure

of Inflation Expectations (see **Figure 5**), long-run inflation expectations (i.e., over the next 10-15 years) were generally between 2% and 2.5% through 2021 but seem to be settling at around 2.5% as of 2022. This slight increase could put more upward pressure on prices. In addition, short-run inflation expectations, which tend to be much more volatile, are also reacting to current inflation by inching higher. Short-run survey expectations indicate that forecasters believe inflation peaked in Q2 2022 and will decrease from 3% to 5% by August 2023.⁵ Long-run inflation expectations that deviate from target and react strongly to short-run price volatility, commonly called *unanchored expectations*, would create significant uncertainty about the future economy's direction and policy. Unanchored expectations could create volatility in financial markets, amplify various macroeconomic risks, and prove more costly to reduce if they become entrenched.

Interest Rate Environment

High inflation led to considerably tighter conditions in financial markets domestically and globally. Interest rates broadly increased. The Federal Reserve began hiking the federal funds' target rate in March 2022 after maintaining a target rate of 0% to 0.25% since March 2020. As of September 2022, the target range of federal funds stands between 3.0% and 3.25% and is expected to increase more throughout the rest of the year. Federal funds' futures indicate that financial markets expect the Federal Reserve to reach a terminal policy rate between 4.5% and 5% by the middle of 2023. The difference in yield between the

Figure 4. Global Inflation (percent)



Note: Percent change from a year ago.

Sources: Refinitiv Datastream, Office of Financial Research

Figure 5. Aruoba Term Structure of Inflation Expectations (percent, months ahead)



Note: Term structure of average annualized expected CPI Inflation.

Sources: Federal Reserve Bank of Philadelphia, Office of Financial Research

10-year Treasury and the 2-year tightened throughout 2022 and began fluctuating below zero from July onwards, indicating that bond markets became pessimistic about the economic outlook.

The Federal Reserve also began reversing its quantitative easing policy enacted during the COVID-19 pandemic and is now engaging in quantitative tightening. As of September 2022, it is decreasing assets from its balance sheet at a pace of \$60 billion per month of Treasuries and \$35 billion per month of mortgage-backed securities (MBS) (see **Box Topic Federal Reserve Balance – Quantitative Easing and Tightening**).

Central banks around the world have implemented similar measures. In June, the European Central Bank (ECB) announced that it would raise its key policy rate for the first time in over 11 years. The ECB raised interest rates from -0.50% in July to 0.75% in September. It also ended its bond-buying stimulus program in July. Meanwhile, the Bank of England raised rates to 1.75% in September 2022, its eighth consecutive rise since late 2021. Despite inflation rising to reach the Bank of Japan's target of 2% for the first time in years, the bank maintained rates at just below zero with no rate increases in 2022. In addition, the Bank of Japan's balance sheet is expected to shrink due to a significant portion of its securities inventory reaching maturity. As a result, 2022 broadly featured a higher interest rate environment for all economies.

FEDERAL RESERVE BALANCE SHEET– QUANTITATIVE EASING AND TIGHTENING

The Federal Reserve quickly identified the COVID-19 pandemic as a serious threat to its employment and price stability goals and responded promptly and aggressively. With the federal funds target rate already cut to near zero by mid-March 2020, the Federal Open Markets Committee (FOMC) announced an aggressive asset purchase program to further support households' and businesses' credit flow.

On March 15, 2020, the Federal Reserve initially committed to purchasing an additional \$500 billion in Treasuries and \$200 billion in MBS over the following months.⁶ However, they ended up purchasing at an even more aggressive rate than initially planned, and the assets on their balance sheet increased by over \$2 trillion in the three months between March and June 2020 (see **Figure 6**). This rate of balance sheet increase was far beyond anything previously observed in the three quantitative easing cycles following the 2007-09 financial crisis. Moreover, between June 2020 and November 2021, the Federal Reserve continued adding to its balance sheet at a consistent pace. It purchased \$80 billion in Treasuries and \$40 billion in MBS per month, in addition to reinvesting any principal payments received.

By November 2021, the Federal Reserve slowed its rate of purchases after weighing

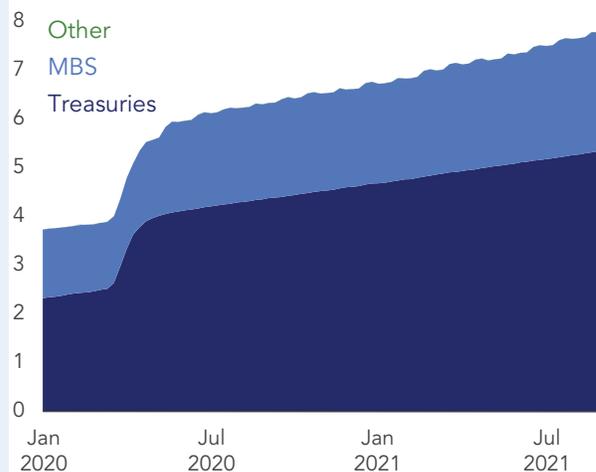
growing inflation concerns and judging that significant progress had been made toward the FOMC’s goals of price stability and maximum employment.⁷ Throughout the first half of 2022, the Federal Reserve continued to slow down its rate of asset purchases while beginning to raise the federal funds rate. The Federal Reserve signaled starting in March 2022 that they would cease the asset purchase program and began reducing balance sheet holdings starting in June 2022.

As of June 2022, the Federal Reserve’s balance sheet sat at \$8.9 trillion, with \$8.5 trillion in securities. This represents around 35% of GDP. At the end of the previous round of large-scale asset purchases by the Federal Reserve in November 2014, the balance sheet peaked at \$4.5 trillion, representing 24% of GDP at the time.⁸ On May 4, 2022, the Federal Reserve finalized plans to reduce securities held on its balance sheet beginning on June 1, 2022.⁹

Figure 7 shows the distribution of Treasuries and MBS held on the Federal Reserve’s balance sheet by maturity. The majority of Treasuries have a maturity of at least one year, while the majority of MBS have a maturity of at least 10 years. Given the maturity distribution of MBS holdings and the current environment of rising mortgage rates, it is unlikely that the MBS prepayment amount will hit the cap in the next couple of years, as highlighted in independent studies by the Federal Reserve Bank of New York¹⁰ and the Federal Reserve Bank of Richmond.¹¹

The Federal Reserve has not publicly stated a specific long-run goal for the size of its balance sheet, only noting that current levels are elevated.¹² As a result,

Figure 6. Assets Held Outright on Federal Reserve Balance Sheet (\$ trillions)



Sources: Federal Reserve Bank of St. Louis, Office of Financial Research

Figure 7. Federal Reserve Balance Sheet Holdings by Type and Maturity (\$ billions)



Note: Data as of June 1, 2022.

Sources: Federal Reserve Bank of St. Louis, Office of Financial Research

uncertainty remains as the Federal Reserve navigates current economic conditions at the beginning of this tightening period. Because market conditions are more unsettled than they were at the beginning of the previous tightening period in October 2017, there are several

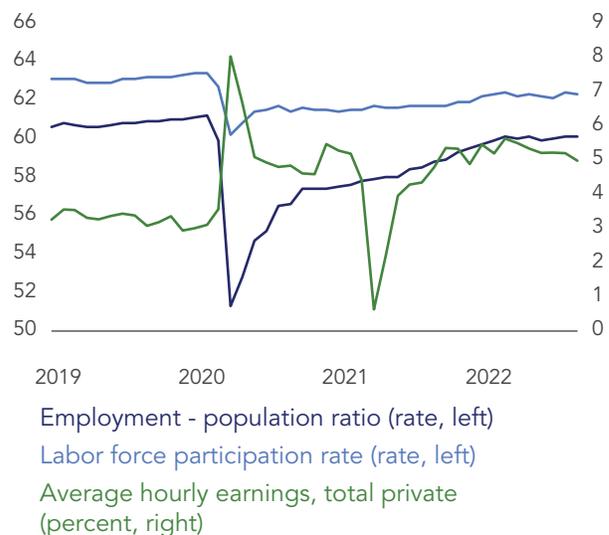
dimensions of risk. First, Treasury market volatility is higher while Treasury market liquidity is lower. Second, interest rate uncertainty is greatly elevated. Finally, some investor types are already holding treasuries and MBS on their balance sheet near historic highs, limiting their ability to absorb these securities onto their balance sheet.¹³ While the FOMC has expressed that they will lean on lessons learned from 2017 to 2019, they will need to address additional headwinds to facilitate as smooth a tapering as possible.

Domestic Growth and Unemployment

The post-pandemic recovery in the labor market has been remarkable, and indicators show that the labor market remains tight. The unemployment rate is currently near a 50-year low. Employment has risen by 419,000+ jobs per month on average through the first three quarters.¹⁴ Average hourly earnings growth was elevated throughout 2022, with wages rising by 5% in nominal terms on average compared to 2021 (see **Figure 8**). However, wage growth remains negative in real terms.

The robust improvement in labor market conditions has been widespread across all major demographic groups, with a strong recovery in employment-to-population ratios in every ethnic, educational attainment, income, and age group.

Figure 8. Labor Market Metrics (rate, percent)



Note: Average hourly earnings is percent change from a year ago. All series monthly, seasonally adjusted.

Sources: FRED, Office of Financial Research

As a result, forecasters are expecting unemployment rates to stay near 3.7% but have begun revising their forecasts for 2023 to around 4.2%, indicating a belief that monetary policy tightening coupled with the pullback of fiscal support will affect labor markets. Nonetheless, even though total employment has recovered, labor force participation remains well below its pre-pandemic levels. Wage growth also failed to keep up with inflation, meaning real wages fell. Indeed, low participation is likely why the job market remains so tight even as growth has turned negative and real wages have fallen.

GDP growth was strong coming into January 2022 but began to sputter in the first half of 2022 and recovered in the third quarter. Slowing growth may lead to increased defaults and loan underperformance, potentially creating losses for lenders (see **Nonfinancial Corporate Credit** section). Real GDP surged to a 6.9% annual rate in the fourth quarter of 2021 but declined with a -1.6% annual rate in the first three months of 2022 and -0.9% in the second quarter. Fluctuations in net exports and inventory investment, normally volatile expenditures, were the main drivers of the decline. Other activity measures, such as employment and industrial production, indicate continued growth during the first three months of 2022. However, growth survey expectations¹⁵ were more muted for 2022, with professional forecasters revising their estimates down to 1.5% to 2% for 2022 and 0.5% to 1.5% for 2023. Forecasters are continually assessing the impact of high inflation and subsequent tightening of monetary policy by the Federal Reserve.

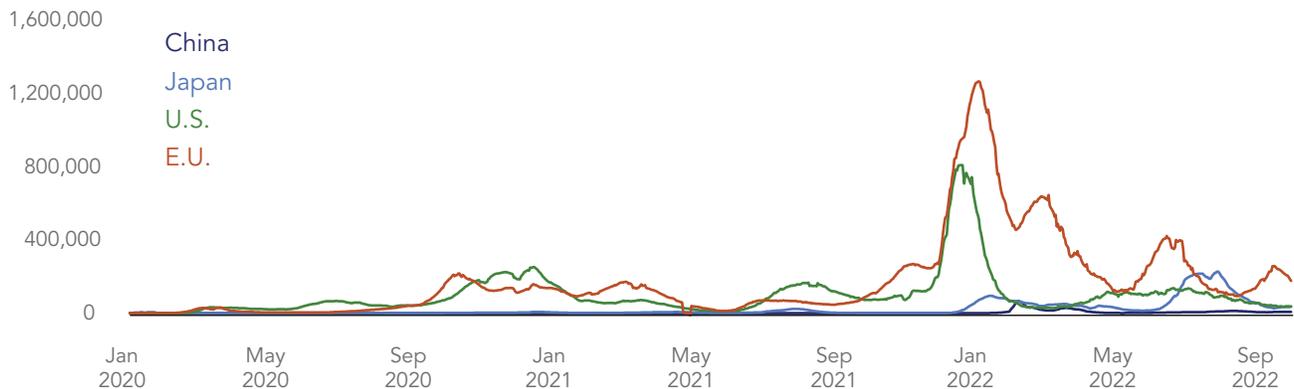
Real consumer spending, supported by high levels of household wealth, continued to inch higher during the first quarter of 2022 but stalled. While supply chains remain severely constrained, a partial unwinding of some of these bottlenecks and the lifting of COVID-19 pandemic restrictions enabled households to normalize their spending patterns, and the demand for goods is leveling off while demand for services recovers. However, higher prices and the absence of robust fiscal support at levels seen in 2021 caused real consumer spending in 2022 to slow down from its previously rapid pace.¹⁶ The effects of a slowdown in growth remain a primary concern, particularly for lower-income households.

The COVID-19 Pandemic and Economic Recovery

The COVID-19 pandemic has continued to contribute to inflation and hinder growth, especially early in the year. In terms of the number of daily confirmed cases, the COVID-19 pandemic reached its peak in several countries in early 2022, following the increased spread of the Delta and Omicron variants of SARS-CoV-2 in mid-to-late 2021. For example, in Q1 2022, daily confirmed cases peaked in the U.S. at over 800,000 per day and reached a peak of over 1.2 million per day in the EU. In addition, China reported new cases peaked in March, reaching over 25,000 per day (see **Figure 9**).¹⁷

Although the total number of reported cases in some countries remained relatively small, the effects of these COVID-19 pandemic surges were large. Even after considering potential differences in measurement and reporting, the

Figure 9. Seven-Day Moving Average of Daily Confirmed New COVID-19 Cases (number of cases)



Note: Daily confirmed cases are calculated on a seven-day rolling average.

Sources: COVID-19 Data Repository by the Center for Systems Science and Engineering (C.S.S.E.) at Johns Hopkins University, Office of Financial Research

Figure 10. Google Mobility Trends (indices)



Note: Shows change in number of visitors (or time spent) in categories compared to a pre-pandemic baseline. Indices are smoothed to rolling 7-day average.

Sources: Our World in Data, Office of Financial Research

macroeconomic effects in countries such as China differ due to differences in the stringency of government responses. While the government responses to the COVID-19 pandemic were less stringent in the U.S., Japan, and EU during this time, the Chinese response remained a strict “zero-COVID” policy. In April 2022, driven by the Omicron variant, China experienced its largest outbreak since early 2020. China continued to uphold its zero-COVID

policy, although a reduction was made to quarantine periods. Notably, the city of Shanghai was placed on a strict citywide lockdown. The result of tight lockdowns in China during this period was additional pressure on supply chains and inflation, even while the rest of the world was reopening.

In the U.S., high-frequency activity indicators supported normalizing the U.S. economy as COVID-19 pandemic

restrictions eased. Google Mobility Trends (see **Figure 10**) suggests several developments. First, time spent at home (measured by “residential”) and visitors at groceries and pharmacies are back to near pre-pandemic levels. Despite most COVID-19 pandemic restrictions being lifted across the country, the index for total visitors in workplaces and transit stations has been between 15% and 30% lower through 2022 than during the baseline period for this metric (January 3 to February 6, 2020). This could signal a permanent shift by employers to work-from-home (WFH) policies due to the COVID-19 pandemic (see **Commercial Real Estate** section).

Apart from permanent structural changes brought about by the shift to remote work across several industries, these metrics are expected to continue to go back to normal as the year progresses, barring any significant COVID-19 pandemic variants worsening the public health situation.

Global Growth and Russia’s War Against Ukraine

In conjunction with the effects of the COVID-19 pandemic, Russia’s war against Ukraine has impacted global growth and trade. The war has decreased expectations of global macroeconomic growth. The World Bank reduced its global growth forecast for 2022 to 2.9% from 4.1% and forecasted a contraction of 4.1% in Europe and Central Asia. In addition, the war disrupted commodities trading and exacerbated inflation in the U.S. and globally, particularly through its effects on the supply of oil, natural gas, and other commodities.

One significant macroeconomic vulnerability arising from Russia’s war against Ukraine is the effect of Russia’s decision to cut off natural gas flows to Europe. Since September 2022, Russia has partially or entirely cut off gas to many European countries, including Germany, France, and Italy. The economic effects of this decision are expected to be significant due to Europe’s high reliance on this energy source, particularly during the winter (see **Box Topic Commodities Market**).

If the war becomes protracted with no decisive outcome, or if it potentially spreads, then widening geopolitical turmoil could further destabilize the global economy and lead to a polarization of trade, investments, and financial intermediation. Weak growth coupled with high inflation is likely to continue well into 2023 and possibly longer. It remains to be seen whether governments and financial institutions will be able to withstand this negative outlook.

COMMODITIES MARKETS

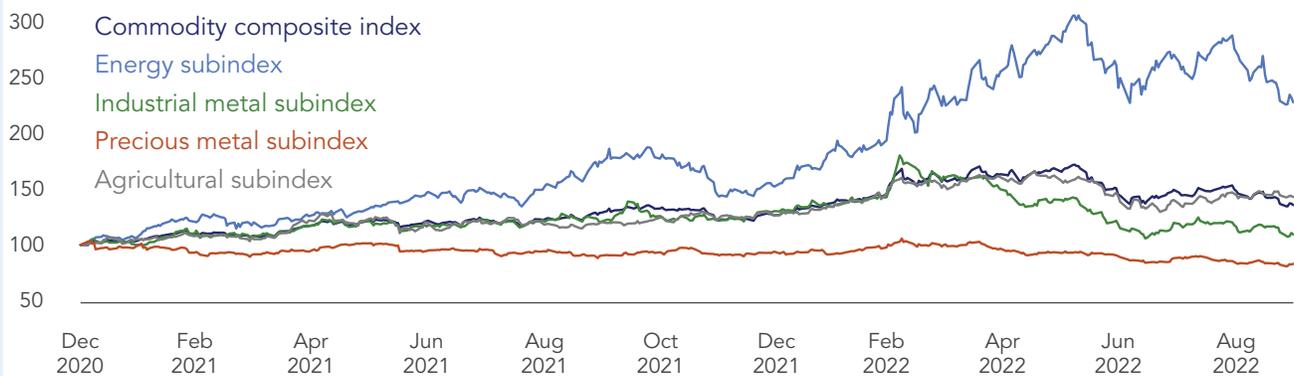
Over the past few years, two events have raised the financial stability risks emanating from commodities markets and their transmission channel: (1) the COVID-19 pandemic and corresponding quarantines, followed by the rapid reopening of the economy and supply shortages across various markets; and (2) Russia's war against Ukraine in 2022, which created further constraints on productivity via dislocations across various commodities markets.

The most direct of these transmission channels is the price instability experienced in the commodities markets. Price instability, over time, leads to periods of under- and over- capital investment, employment, and utilization. Additionally, higher energy prices are passed down to consumers, which impacts spending and economic growth.¹⁸ Generally, volatility in commodities markets is correlated with global recessions¹⁹ and uncertainty for producers and consumers.²⁰

A related concern is the dependence upon foreign commodities, including energy, rare-earth metals, and agricultural products. Volatility in commodity prices has resulted from shipping, production, payments, and delivery interruptions to consumers and manufacturers (see **Figure 11**). Russia's war against Ukraine has particularly exacerbated the price stability of such commodities.

Price volatility across commodities has also translated into several financial market risks. First, market liquidity decreased in many markets, in part due to restrictions on trader funding availability. This resulted in a reduction in traders' ability to make markets.²¹ Second, while many larger firms hedge commodities exposure via futures and swaps, some operationally complex markets may require costs/expertise that can exceed the reach of smaller firms. In these cases, small- to medium-sized firms can be more exposed to price swings due to the unpredictability of future cash flows. The result can lead to higher borrowing costs, increased defaults, and lower

Figure 11. Commodity Price Indices



Note: Data is indexed to 12/31/2020=100.

Sources: Bloomberg Finance L.P., Office of Financial Research

equity values when firms are exposed to such cash flow uncertainty.²² Third, the potential failure of trading firms during the period of highly elevated volatility brought with it additional stresses on central counterparties (CCPs) and the underlying markets. This was highlighted by the London Metals Exchange (LME) decision to close the nickel market and reverse trades (see **Central Counterparty section**).

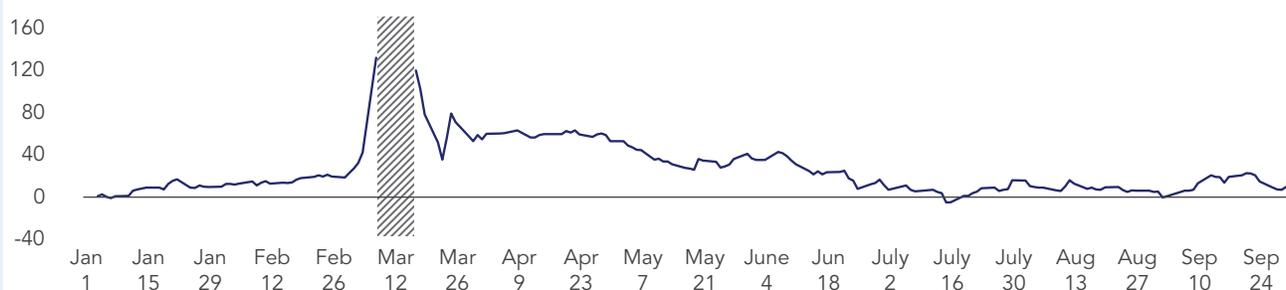
Nickel contracts surged nearly three and a half times on March 7, 2022, two weeks after the beginning of Russia’s war against Ukraine (see **Figure 12**). The meteoric price increase resulted from a large short position held by a nickel producer. The short positions and corresponding market volatility resulted in a disorderly market, and on March 8, the LME closed the nickel market for a week and “tore-up” some of the trades.

The reopening of world economies following the COVID-19 pandemic, in conjunction with the Russian war against Ukraine, resulted in substantial volatility in other commodities markets, which raised systemic concerns. Among the most noticeable commodity price increase was

the 286%²³ increase in crude oil, which, along with the low utilization of refiners, led to significantly higher national gasoline prices. Natural gas prices were close behind as they climbed 217% in the first 18 months of the COVID-19 pandemic, partly due to the increase in China’s demand for natural gas.²⁴ Between October 2021 and June 2022, natural gas saw an additional 52% increase. One recent study estimated that, for every dollar increase in the price of oil, goods consumption is reduced by a dollar.²⁵ Natural gas has a similar impact because 91% of natural gas consumption in the U.S. is delivered to consumers²⁶ through higher electricity prices and, indirectly, higher costs of goods sold and food prices. Lastly, the Russian war against Ukraine has led to increases in the price of critical agricultural supplies, such as fertilizer and wheat.

Commodities markets, including the underlying prices and volatility, directly impact manufacturers, suppliers, and consumers. In addition, banks that make markets in commodities and clearing firms that provide clearing services for commodity firms are impacted indirectly through market and counterparty risks,

Figure 12. Nickel Price Pre and Post LME Nickel Price Disruption (percent change in price)



Note: Nickel performance, base Jan. 2, 2022. Shaded area represents a halt in trading of nickel from March 8 to March 15 and no prices are available. Prices are prices at which trades were executed but excludes torn-up trades (where the exchange reversed the trade).

Sources: Bloomberg Finance L.P., Office of Financial Research

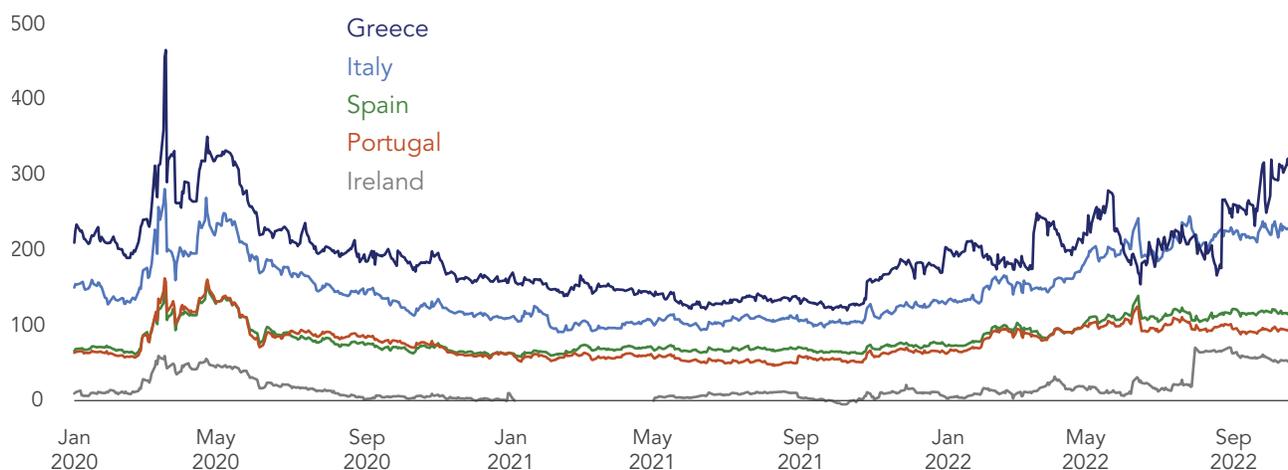
with potential implications for the broader financial system. For example, a large counterparty failure could spill over into other markets and create a domino effect in financial markets and real economies. In addition, the inability to source raw materials for goods production, energy, and food could have dire impacts on financial stability through increased inflation and supply chain uncertainty.

Sovereign Debt

The COVID-19 pandemic crippled many economies in 2020, forcing world governments to borrow unprecedented amounts and bringing total global debt to over \$300 trillion, or 350% of Debt/GDP equivalent and a 97% government Debt/GDP. As 40% of sovereign debt is short term in nature, the rising rates will detrimentally affect the fiscal positions of many sovereign issuers. Moreover, growth forecasts continue to dim, increasing the risks of default for speculative sovereign issuers.

The sovereign debt yields across the eurozone have diverged over the last year. As a result, borrowing costs of fiscally weaker eurozone countries have risen relative to stronger ones. This is commonly called *fragmentation risk* and threatens another European debt crisis reminiscent of the 2010s. High inflation, coupled with lower growth forecasts, poses a unique challenge within the eurozone as the European Central Bank (ECB) must balance fighting inflation with the risk of increasing fragmentation of financial markets. At the start of the COVID-19 pandemic, the dispersion of yields on sovereign debt across the eurozone increased. For example, the yield spread on 10-year Italian bonds over 10-year German bunds reached as high as 250 basis points (bps) early in 2020 (see **Figure 13**). This spread fell to nearly 100 bps by 2021 but has slowly increased. The figure also shows spreads on the yields of 10-year Greek, Irish, Italian, Portuguese, and Spanish (GIIPS) bonds and 10-year German bunds.

Figure 13. 10-year Bond Yield Spread Over German Bunds (basis points)



Sources: Refinitiv Datastream, Office of Financial Research

The key concern is that raising interest rates, as the ECB is doing to fight inflation, will increase the costs that peripheral eurozone countries face as they raise or roll over debt. Steep increases in interest rates risk putting too much stress on fiscally strained eurozone economies, such as Greece (189% debt-to-GDP) and Italy (153% debt-to-GDP). For context, at a 100% debt-to-GDP ratio, raising the interest rate by 1% adds 1% of GDP to the annual interest costs of debt in the long term. If the ECB wished to fight inflation by raising nominal rates high enough to make the real rate positive, for example, then the increased annual cost of servicing debt would be large for countries with high levels of sovereign debt. Sharp increases in real interest rates would present themselves as a large fiscal shock for these countries. Given this, especially in conjunction with lower expected growth rates, such a tightening could trigger a flight to safety in the eurozone, likely resulting in a sell-off of peripheral eurozone issuers. So, the ECB must potentially balance addressing eurozone-

wide inflation risks with member-specific debt service risks.

One concern is the risk of triggering what is commonly called a *doom loop*, which is the following sequence of events:

1. Banks typically hold a large amount of domestic sovereign debt, making them vulnerable to sovereign default risk.
2. Given an economy's reliance on bank lending, any shock to the banking system is likely to put pressure on the government to bail out the troubled banks (e.g., via moral suasion).
3. To the extent that bailouts are debt-financed, a bailout will tend to increase the risk premia on sovereign debt and put further pressure on troubled banks.

A dramatic illustration of this can be seen in the case of the Irish Bank Bailout of 2008, as it's estimated that just one of the banks that was bailed out cost the government 25 billion euros, or 11.26% of Ireland's GDP, which, in turn, later had a role in the subsequent downgrades of Irish debt.²⁷ Although the existing

European resolution framework, which includes the 2014 Bank Recovery and Resolution Directive (BRRD), should reduce the likelihood of such a bailout, there is concern over its adequacy.²⁸

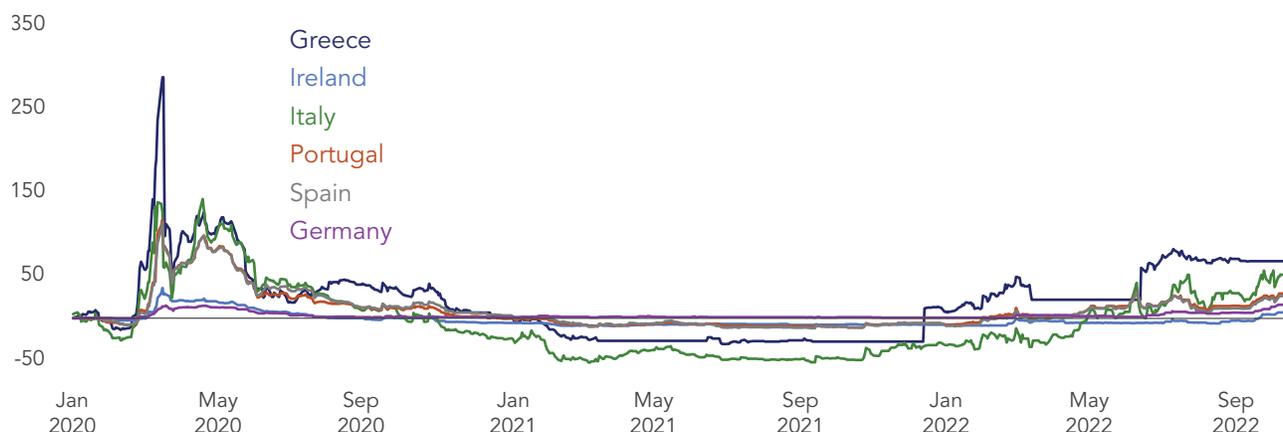
Changes in credit default swap spreads can measure increases in sovereign debt default risk. For a select number of eurozone countries, **Figure 14** plots the cumulative change in five-year credit default swap spreads on each country's sovereign debt since the beginning of 2020. Although these rates generally fell below their pre-pandemic levels in mid-2021, they began rising in late 2021 with the expectation of persistent higher inflation and lower growth.

As this fragmentation risk poses an obstacle to its ability to implement monetary policy effectively, the ECB held an emergency meeting in June 2022 and announced that it was developing a new policy instrument to combat eurozone fragmentation. On July 21, 2022, the ECB announced its Transmission Protection

Instrument (TPI). The TPI enables the Eurosystem, members of the ECB whose currency is the euro, to "make secondary market purchases of securities issued in jurisdictions experiencing a deterioration in financing conditions not warranted by country-specific fundamentals."²⁹

The risk of a European debt crisis threatens financial stability in the U.S. through several channels. The direct effect works through the exposure of U.S. banks and other financial companies to the EU countries. Currently, large bank holding companies and commercial banks have over \$600 billion of exposure to the EU via direct cross-border, foreign-office, and gross-derivative claims. The indirect effects arise from the fact that such a crisis will likely cause a recession in the EU. A European recession affects the U.S. through its impact on trade, the performance of U.S. firms' investments in Europe, and the effects of a general decrease in business and consumer confidence. These indirect effects would likely be large, given that U.S. exports to

Figure 14. Cumulative Change in 5-year Credit Default Swap Spreads on Sovereign Debt (basis points)



Note: Senior CR14 5-year USD CDS, mid spread. Cumulative difference since Jan 1, 2020.

Sources: Refinitiv Datastream, Office of Financial Research

the EU exceed \$270 billion, foreign direct investment of the U.S. in the EU exceeds \$2.5 trillion, and EU investment in the U.S. exceeds \$2 trillion.

By contrast, the financial stability implications of a Russian default are small. In April, Russia was forced into a selective default following its nonpayment of certain U.S. dollar-denominated Eurobonds in rubles. In June, Russia defaulted on its foreign debt. While direct exposure to Russian debt is small, the U.S. has a consolidated exposure of \$8.9 billion to Russia; there remains a notable amount of indirect exposure. Generally, contagion risk arising from global exposures to sovereign debt represents another potential vulnerability. However, global bank exposures to Russia are mostly low in this case (see **Figure 15**).

Overall, global debt levels remain highly elevated, with total global debt topping \$300 trillion by year-end 2021 and the average government debt/GDP ratio standing at 97%.³⁰ Moreover, recent stress tests by major ratings agencies showed that 10% of the sovereign high-yield market faces the prospect of default in severe stress scenarios. Moreover, roughly 45% of sovereign debt by issuance is

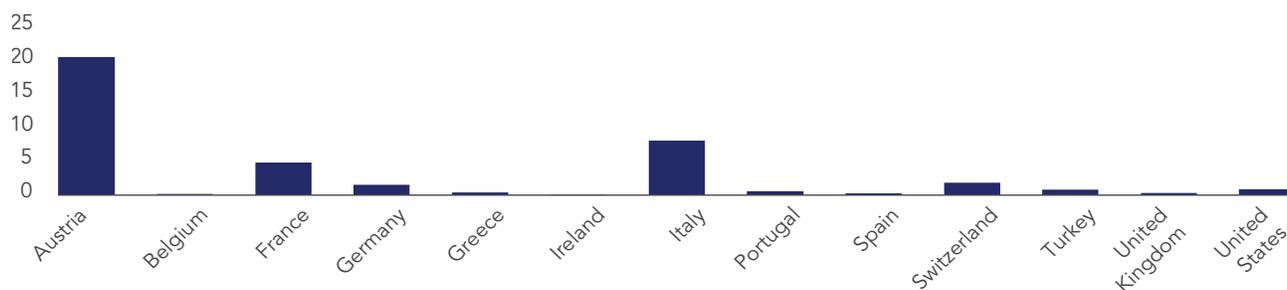
now rated below investment grade. As a result, cross-border exposures through this channel are likely to have a larger bearing on U.S. financial stability moving forward.

Nonfinancial Corporate Credit

Vulnerabilities within the corporate sector threaten financial stability when leverage is extremely high and risk premiums are at extreme lows. While neither is the case today, rising interest rates, profit margin pressures, and economic uncertainty pose risks to the credit cycle. Corporate leverage is elevated but has declined from the peak. Credit risk premiums, the difference in yield between a corporate bond and a Treasury bond of the same maturity, have increased sharply year-to-date and are above historical medians and well above the extreme lows of early 2022 and 2021.

In 2021, the twin vulnerabilities of high leverage and compressed risk premiums were mitigated by a strong earnings recovery, extraordinary government support, and a stable inflation outlook. However, in 2022, the environment has changed dramatically. Fiscal and monetary

Figure 15. Bank Exposures to Russia for Select Countries (percent)



Note: Total claims on an immediate counterparty basis as a fraction of total equity, as of the end of December 2021.

Sources: Bank for International Settlements, Office of Financial Research

policies are constrictive, earnings growth has slowed materially, and inflation has risen to a 40-year high (see **Box Topic: The Great Inflation**).

As the U.S. economy transitions from an era of unprecedented quantitative easing and near-zero interest rates to one of quantitative tightening and higher rates, the outlook for the corporate credit cycle is more uncertain for the following reasons.

First, borrowing costs have increased. If financial conditions tighten too much, credit spreads could widen materially, collateral values could decline, and defaults could rise. In particular, tighter borrowing conditions are problematic for leveraged loan borrowers. The increase in interest rates to date means that these borrowers now face higher interest costs, as most loan contracts have interest rates that reset monthly or quarterly to benchmark rates like the London Interbank Offered Rate (LIBOR) or Secured Overnight Financing Rate (SOFR). Higher borrowing costs reduce the ability to service debt, particularly for highly levered borrowers or those with low profitability. Interest coverage is the ratio of a company's earnings to its interest expense. The ratio declines as the denominator (interest expense) increases, all else being equal. Companies with persistently low-interest coverage ratios, commonly called *zombie companies* (more on this topic later), are adversely impacted in a higher-rate environment. More zombie companies mean that the speculative-grade universe is less resilient to shocks.

Second, slower economic growth is an intended consequence of monetary tightening. As economic growth slows, so does corporate profitability. Profit

margins remain elevated but have declined from the 2021 peak. In the first half of 2022, companies largely maintained high margins by offsetting higher input costs with a combination of price increases and operating efficiencies. However, high inflation and weaker demand limit companies' ability to increase prices. This, in turn, pressures profit margins and earnings. As a result, it becomes more challenging for leveraged companies to further reduce their debt ratios via earnings growth. (Debt ratios will increase in a recessionary scenario.) Elevated debt levels will likely amplify default rates during the next cyclical downturn.

Third, the extraordinary business-friendly policies enacted during the COVID-19 pandemic have ended.³¹ These policies resulted in far fewer corporate defaults in 2020 and 2021 than would have otherwise occurred. Thus, it's more likely that, in the next downturn, unconstrained market forces will result in higher default rates compared to the last downturn.

However, the credit cycle would likely remain intact if the Federal Reserve could engineer a soft landing.³² Such a scenario would enable weaker corporate borrowers to continue to access funding and roll over maturing debt. In addition, more creditworthy corporate borrowers could continue to reduce leverage via earnings growth. Historically, soft landings are few—more often, recessions coincide with rate-hiking cycles. For example, there have been multiple Federal Reserve tightening cycles since World War II, but only three (1965, 1984, and 1994) were soft landings. Consistent with a soft landing, analysts expect corporate defaults to rise but remain moderate in 2023.

Corporate Zombie Risk

In the decade preceding the COVID-19 pandemic, low interest rates and loose borrowing conditions enabled many companies with weak competitive positions and balance sheets to access abundant financing. Such companies consistently struggle to generate sufficient profits to cover interest costs. Despite financial challenges, these companies continue to survive by taking on more debt to avoid insolvency, hence the label *zombie firms*. Loose lending conditions after the 2007-09 financial crisis coincided with an increase in the number of zombie firms (see **Figure 16**). This subsequently increased to a record high during the COVID-19 pandemic recession because extraordinary fiscal and monetary policies enabled many such firms to remain in business.

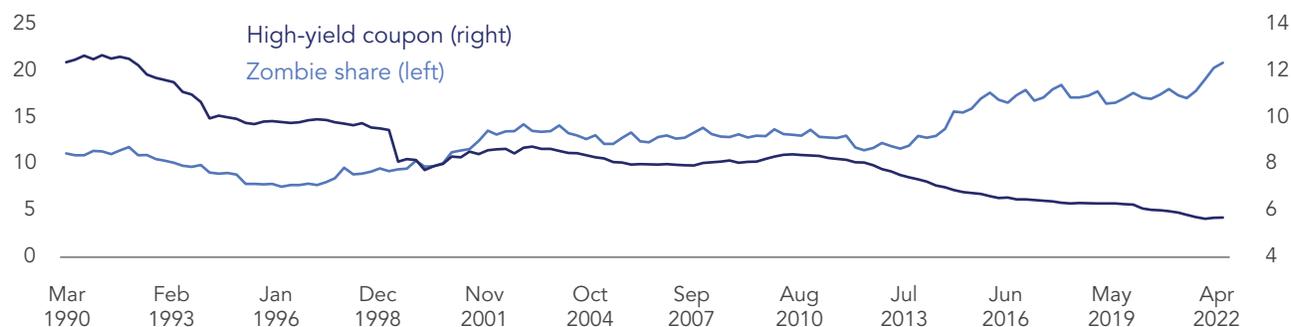
Zombie companies have real-world implications. Academic research has found that industries with a higher share of corporate zombies exhibit excess capacity, lower prices, and lower productivity.³³ This may lead to weaker investments by healthy firms competing with these

firms. As a result, industries with a higher concentration of zombie companies are less resilient and more vulnerable to external shocks. This, in turn, amplifies financial stability risks; if economic conditions deteriorate or interest rates rise materially, zombie companies may suddenly file for bankruptcy, with effects that cascade throughout the broader economy.³⁴

In this report, we define zombie companies as those with interest coverage ratios below one for three consecutive years, a sufficiently long period to minimize capturing companies facing temporary profit setbacks. In other words, zombie companies perpetually struggle to generate sufficient earnings to cover interest costs—it goes unsaid that they cannot cover principal payments without rolling over debt.

An increasing share of the non-investment-grade universe meets this definition. In 1990, zombie companies represented only 11% of non-investment-grade, nonfinancial issuers. This share increased modestly during and after the 2007-09 financial crisis and remained steady at approximately

Figure 16. Share of Nonfinancial Zombie Companies (percent)



Note: Data as of Q2 2022. Percent represents the share (based on issuer count) of U.S. nonfinancial companies, excluding utilities, with low interest coverage (< 1) for three consecutive years. Sample reflects high-yield and unrated firms.

Sources: Compustat, Bloomberg Finance L.P., ICE Data Services, Office of Financial Research

13% until mid-2014. The initial increase that began that year was due to defaults by energy and commodities companies. Since then, the share has increased across all sectors. In aggregate, zombie companies now represent 21% of non-investment-grade, nonfinancial issuers—a record high.

This trend overlapped a period of unprecedented declines in borrowing costs. The weighted average coupon for high-yield bonds declined 50%, falling from over 12% in 1990 to under 6% in 2021. It's noteworthy that the share of zombie companies increased so much during a period when borrowing costs fell materially.

An important caveat to **Figure 16** is that many of today's zombie companies are relatively small. Therefore, if defaults increase, the resulting losses imposed on creditors will likely be more manageable. Thus, the financial stability implications may be more limited compared to a world with numerous large corporate zombies. Additionally, many of these companies are more likely to be funded by private equity and private debt firms than by banks. Thus, an increase in zombie company defaults is less likely to adversely impact institutions like banks that rely on government-backed deposit insurance. However, if interest rates continue to rise and credit conditions tighten materially, then there is a potential for many more companies, large and small, to fall into the zombie universe. Such a scenario would impose larger losses on creditors and congest bankruptcy courts.

THE GREAT INFLATION

The Great Inflation was one of the most consequential periods in U.S. history, marked by damaging economic and financial consequences from sustained high inflation. While the recent rise in inflation has conjured up memories of the Great Inflation, which lasted from the mid-1960s through the early 1980s, today's economy and financial markets are very different, and this time isn't destined to be a repeat. Here, we examine the similarities and differences between now and then.

Background

As in the current environment, inflation was remarkably stable in the years before the Great Inflation. From 1958 through 1964, wholesale prices were virtually unchanged, and the consumer price index (CPI) rose at an annual rate of just over 1%. In the second half of the 1960s, fiscal policy was highly expansionary, and monetary policy remained accommodative to support large federal spending programs (e.g., the Vietnam war and Great Society programs such as the War on Poverty, Medicare and Medicaid, and the Housing and Urban Development Act). This was followed by a series of supply shocks (e.g., energy and food) in the 1970s and an unanchoring of inflation expectations. As a result, the consumer price index (CPI) increased from approximately 1% in 1964 to a peak level of 15% in March 1980 (see **Figure 17**). This resulted in significant uncertainty and instability in the real economy and financial markets—the U.S. experienced four recessions (1970, 1975, 1980, and 1982). Several large corporations failed, New York

Figure 17. Inflation (percent)



Note: Data as of August 2022. Shaded areas indicate U.S. recessions. Percent is year-over-year change in the consumer price index.

Sources: Haver Analytics, Office of Financial Research

City lost access to credit markets, and the global monetary system of Bretton Woods collapsed.³⁵

The Great Inflation is unique for both its volatility and duration. Inflation averaged 9% annually over the decade ending in November 1982, the end of the fourth recession of the era. This was the highest multiyear inflation rate in modern U.S. history.³⁶

How did the Great Inflation end? In 1979, the Federal Reserve, under new leadership, announced a change in strategy. The Federal Open Markets Committee (FOMC) would target money supply growth, letting the federal funds rate adjust freely. This radical policy change had dramatic consequences for monetary policy as short-term interest rates subsequently increased to 22% in late 1980. This unprecedented tightening of financial conditions ultimately broke the back of inflation. By the mid-1980s, spot

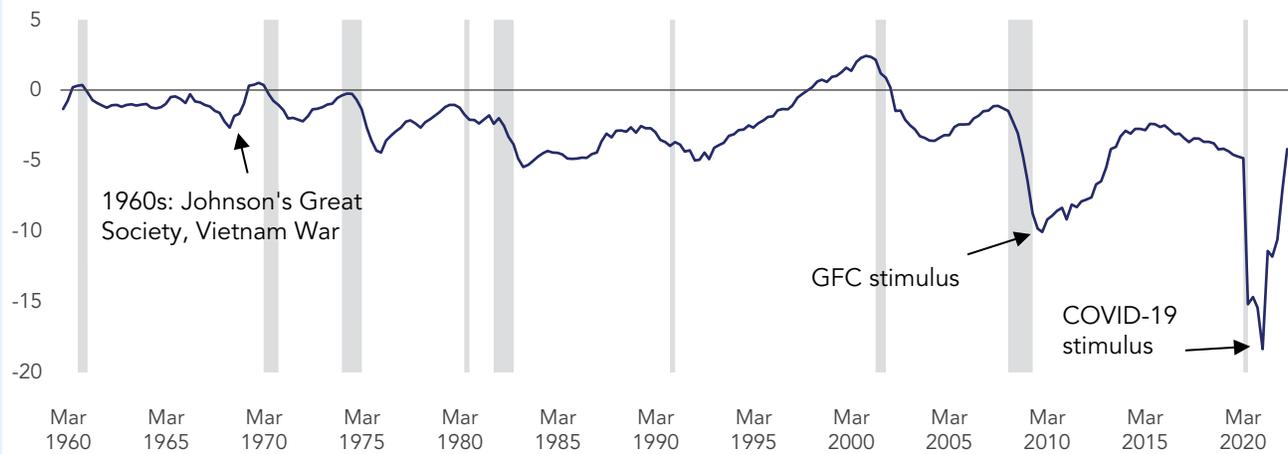
inflation and inflation expectations had declined sharply.

Similarities

Expansionary fiscal policies. While the Great Inflation spanned multiple presidential administrations, a common thread was expansionary fiscal policy. The mid-1960s included a large tax cut, legislation related to the Great Society programs, and military spending for the Vietnam War. Top economic priorities included expanding economic opportunities and employment.

The current federal budget deficit significantly surpasses deficits seen back then (see **Figure 18**). In 2020, the U.S. economy was severely impacted by the COVID-19 pandemic. The federal government responded with extraordinary policies to stimulate employment and stabilize financial markets that, in turn,

Figure 18. Federal Budget Deficit (percent)



Note: Data as of June 2022. Shaded areas indicate U.S. recessions. Budget deficit (trailing twelve months) is a percent of annualized nominal GDP.

Sources: Haver Analytics, Office of Financial Research

led to a surge in the budget deficit because policymakers prioritized reducing unemployment and explicitly favored higher inflation. Similar to the 1970s, stimulating employment was a key priority in 2020—runaway inflation seemed improbable.

Supply shocks. While policymakers were attuned to the late 1960s initial inflation increase, they believed it was within their control. It wasn't until the 1970s that three major supply shocks emerged: two related to international oil supply shocks in 1973 and 1979 and the third in 1973-74, when low agricultural yields led to a surge in world food prices. At the time, policymakers viewed these shocks as transitory. However, as consumers and businesses came to expect high future prices, higher inflation expectations became embedded in wage- and price-setting behavior. This is commonly called a *wage-price spiral*.

Supply shocks also play a key role in the current inflationary environment. In 2020, the production of goods slowed dramatically due to business lockdowns and workers' hesitancy and inability to go to work during the COVID-19 pandemic. Meanwhile, government stimulus enabled households to continue to spend money, particularly on goods, during the lockdown. As a result, the supply of goods could not keep up with demand. This supply-demand imbalance worsened due to numerous supply chain bottlenecks when the economy reopened. A second supply shock emerged in February 2022 with Russia's war against Ukraine. Global prices surged because both countries are key agriculture and energy commodities suppliers.³⁷

Accommodative monetary policy. Due to strong government and private sector demand, overall inflation rose throughout the late 1960s. While the Federal Reserve showed concern about inflation and tightened monetary policy, its actions were

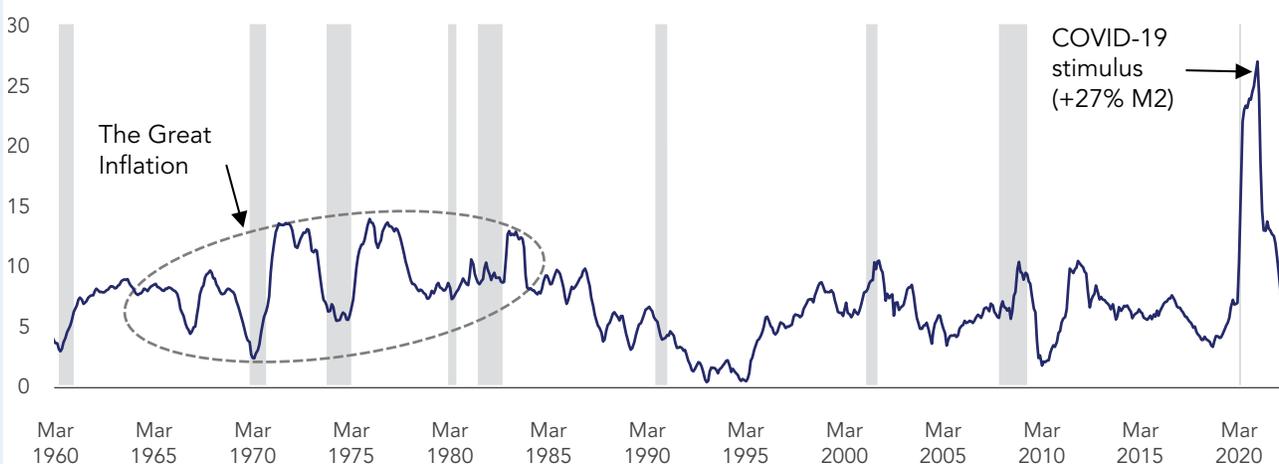
insufficient to constrain the rise in prices. In 1970, with the U.S. in a recession, the Federal Reserve pursued expansionary monetary policies to stimulate a recovery. And throughout the 1970s, the Federal Reserve accommodated large and rising imbalances generated by fiscal policies leading to a large expansion of the money supply.

Accommodative monetary policy during the Great Inflation partly reflected misperceptions about how economic forces affected inflation. In the 1960s, prominent economists generally believed expansionary monetary policy could propel the economy toward full employment without runaway inflation. What happened instead was that inflation and unemployment rose together. This combination, commonly called *stagflation*, was puzzling to policymakers at the time. The tipping point came in 1971, when U.S. gold reserves declined rapidly due to foreign central banks remitting dollars for gold. As a result, the Nixon

administration suspended the dollar's convertibility into gold or other reserve assets, to stop the reserves' decline. This broke the link between the convertibility of the U.S. dollar into a fixed amount of gold.³⁸ In other words, the U.S. monetary system experienced a monumental shift to fiat money from paper money backed by claims on gold.³⁹ This also profoundly affected the global monetary system because most other major currencies were valued based on fixed exchange rates with the dollar.

For very different reasons, monetary policy was highly accommodative in 2021. Fiscal and monetary stimulus to combat the COVID-19 pandemic led to a surge in the money supply (see **Figure 19**). This increase coincided with a rise in inflation. The Federal Reserve, and many others, believed inflation was "transitory" and would remain at a low and controllable level for the foreseeable future. This view was reflected in a policy change to the Average Inflation Targeting (AIT)

Figure 19. Money Supply Growth (percent)



Note: Data as of August 2022. Shaded areas indicate U.S. recessions. Money supply is M2 (cash, checking and savings accounts, and money market funds). Series is year-over-year change.

Sources: Haver Analytics, Office of Financial Research

Framework.⁴⁰ The near-term effect of this change was that, in early 2021, monetary policy remained accommodative even as inflation increased. By May 2021, inflation (CPI) reached 5%, well above the historical 2% target; after that, inflation surged, reaching 9.1% in June 2022.

Differences

Policymakers have the resolve and support to mitigate inflation. A key difference between the Great Inflation and now is that policymakers today are laser-focused on reducing inflation. For example, Federal Reserve Chair Powell stated in May 2022, “We will go until we feel like we are at a place where we can say, yes, financial conditions are at an appropriate place. We can see inflation coming down. We will go to that point, and there will not be any hesitation about that.”⁴¹ This is very different from the Federal Reserve’s priorities (e.g., low unemployment) in the 1970s.

During that time, the Federal Reserve under Chairman Arthur Burns lacked the support of the presidential administration to combat inflation. In 2022, the White House declared tackling inflation as a “top economic priority,”⁴² pledging its support for the Federal Reserve’s actions. In summary, policymakers have learned from the mistakes of the 1970s—they better understand the roles of inflation expectations and central bank actions.

Energy is a smaller share of the U.S. economy; the U.S. is less reliant on foreign supplies. Today, the U.S. economy is less energy intensive and more energy independent than in the 1970s. In 2021,

the ratio of energy input costs to GDP (i.e., the amount of energy consumption needed to produce a dollar of GDP) was only 37% of its 1970 level. This decline occurred due to more energy-efficient cars, machinery, and homes and a shift to alternative energy sources. At the same time, domestic energy production has increased dramatically since the 1970s, enabling the U.S. to achieve energy independence. As a result of these factors, the surge in global energy prices from the Russian war against Ukraine has impacted the U.S. less today compared to the 1970s oil supply shocks.

Wages are less procyclical with inflation than in the past. Today, labor negotiating power in the U.S. is lower versus the 1970s. Back then, a much larger share of the labor force was unionized.⁴³ As inflation expectations increased, workers demanded higher wages from employers. As wages increased, this prompted employers to raise output prices, which fed back into worker demands for higher wages—a circular feedback loop or wage-price spiral. In the 1970s, wage rates were impacted by cost-of-living adjustments (COLA). These *escalator clauses*, which tended to lock in inflation, were embedded in many union-negotiated employment agreements. Today, wage-price spirals are less likely due to the weaker influence of labor unions and fewer institutional arrangements such as COLA escalator clauses.

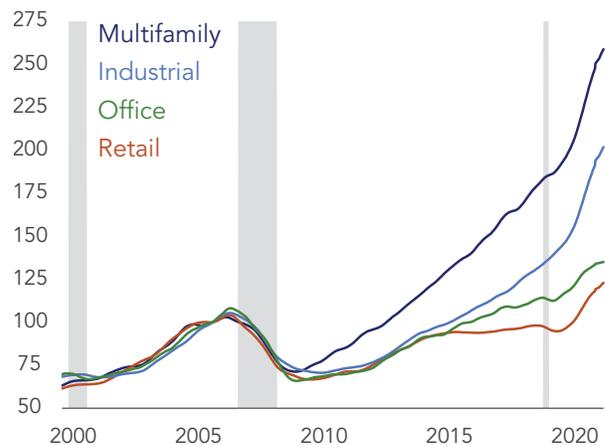
Commercial Real Estate

A depressed commercial real estate (CRE) market can cause and has caused financial stability issues, such as during the 1990-91 recession, when depository failures were primarily due to CRE lending-related losses.⁴⁴ In addition, CRE loan defaults result in credit losses for CRE lenders such as banks and insurers. If CRE credit losses are widespread, they can cause severe financial distress and institutional failures. This is particularly true with smaller banks, which are often heavily focused on CRE lending.⁴⁵

Occupancy Rates and Demand Trends

We have seen limited CRE market stress in recent years as the CRE market has performed well, with strong occupancy rates, rising rents, and property values. The CRE market has performed exceptionally well over the last few years, measured by changes in property values (see **Figure 20**). Exceptions to this strong performance are retail malls, older office buildings, and hotels heavily dependent upon business travel, all of which underperformed. These weak sectors are experiencing depressed occupancy levels in which occupancy determines an asset's long-run health. An asset subject to low occupancy will eventually become subject to declining rental income and property value. This limits the likelihood and extent of investors receiving scheduled interest and principal payments. Risks related to occupancy rates are present across CRE sectors, so this factor features prominently in financial stability considerations.

Figure 20. Commercial Real Estate Price Trends by Sector (units)

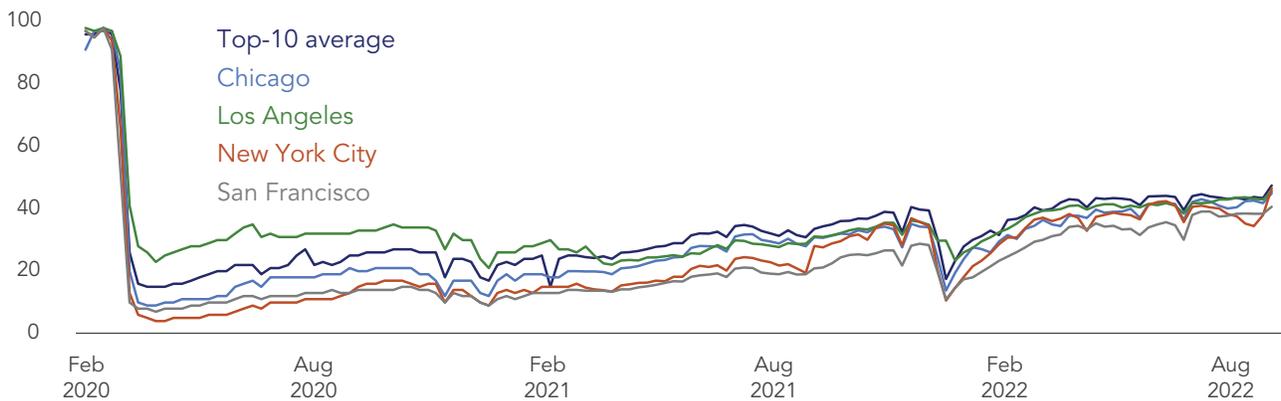


Note: Data as of July 31, 2022. Shaded areas are U.S. recessions.

Sources: MSCI Real Capital Analytics, Office of Financial Research

Offices, especially those in dense central business districts such as New York and San Francisco, had physical occupancy rates remaining well below their pre-pandemic usage due to the work-from-home (WFH) phenomenon (see **Figure 21**). WFH is much less pronounced in less-dense cities and smaller metro areas, where office workers typically drive to work instead of using public transportation. Due to the WFH trend, office vacancy rates have risen modestly to 18.4% as of August 2022 and are expected to continue rising over the next few years (see **Figure 22**). The current impact of office usage has been muted by the multiyear leases typical for office space. If the WFH trend continues for an extended period, it may eventually have a more meaningful impact on vacancy rates and market values of older and less well-positioned office buildings in areas such as San Francisco, Chicago, and midtown Manhattan.

Figure 21. Office Return-to-Work Barometer (percent)



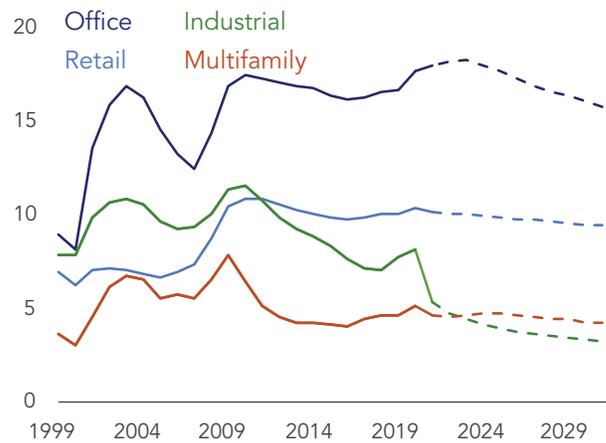
Note: Relative to Pre-COVID Baseline.

Sources: Haver Analytics, Office of Financial Research

Due to historically high occupancy levels and rising demand, industrial space continued performing exceptionally well. Internet commerce resulted in a huge need for well-located warehouse space. In addition, there is a demand for additional safe storage space to act as a buffer for unreliable supply chains. As a result, heavy demand is driving considerable industrial space development, but this new space is unlikely to fully satisfy growing demand.

Multifamily properties also performed very well in recent years, with very high occupancy levels. Consumers' overall financial position remains solid, given low unemployment rates and demographics leading to growing housing demand. Also benefiting the multifamily market are elevated housing prices reducing homeownership rates, increasing numbers of individuals seeking their own homes, and challenging conditions for building new housing units, thereby limiting supply growth. As a result, multifamily rents and property values have grown at exceptional rates in recent years. Slowdowns have begun in both metrics in many markets,

Figure 22. Vacancy Rates by Property-Type (percent)



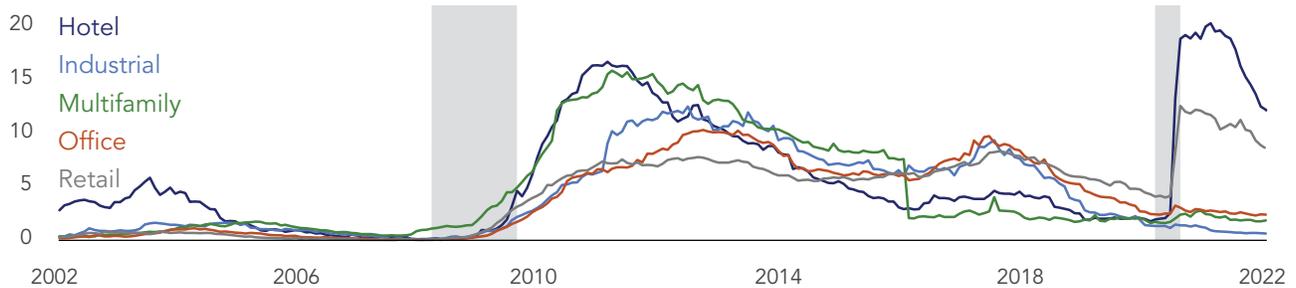
Note: Data through December 2021 is actual; dashed are base case projections.

Sources: Moody's Analytics REIS, Office of Financial Research

but the multifamily market is expected to continue performing favorably overall.

The performance of retail space slowly improved during the COVID-19 pandemic period and is expected to continue improving modestly into the future. Retail store closings declined substantially because most weaker store chains had already suspended or reduced operations.

Figure 23. Commercial Mortgage-backed Securities 60+ Day Delinquency Rate (percent)



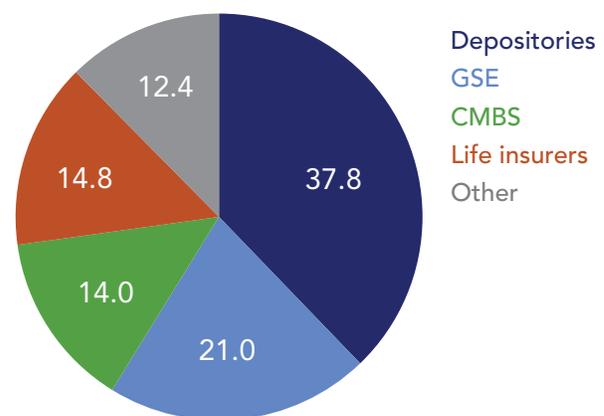
Note: Moody's conduit DQT defines delinquent loans as loans that are 60 or more days in payment arrears; performing matured; nonperforming matured; foreclosure in progress; or real-estate owned (REO). Conduit loans only. Shaded areas indicate recession.

Sources: Moody's Investors Service, Office of Financial Research

The rate of new store openings now exceeds closings due to formerly online-only retailers opening physical locations. The retail delinquency rate of commercial mortgage-backed securities (CMBS) was 7.6% for September 2022, with regional malls more than double that at 16.2% (see **Figure 23**). Many of these loans are in varying stages of forbearance.

Lodging has always been a volatile CRE sector. Currently, occupancy levels vary greatly by property type. Properties in dense central business districts and those dependent upon conventions remain challenged with low occupancy rates and high operating costs. In contrast, properties at resort locations benefit from strong occupancy and room rates. Extended-stay properties are also doing well. As a result, we expect a continuing ongoing performance bifurcation in the lodging sector; in particular, business-oriented hotels must identify alternative uses to substitute for reduced business travel.

Figure 24. CRE Debt Outstanding by Lender (percent)



Note: Data as of Q2 2022.

Sources: Mortgage Bankers Association, Office of Financial Research

Risk Exposures

Banks and other depository institutions hold 38% of outstanding CRE debt (see **Figure 24**). These loans accounted for 18.2% of the commercial banking industry's total loan portfolio as of June 30, 2022. Smaller banks with \$100 billion or less in assets have higher concentrations in CRE loans—including higher-risk segments, such as lodging and construction and development lending—and thus have

heightened exposure to CRE credit risk. However, in this credit cycle, the increase in nonperforming CRE loans held by U.S. banks was modest, with only 0.7% of CRE mortgage loans nonperforming as of June 30, 2022.

Life insurers held 15% of total outstanding CRE loans as of June 30, 2022, but insurers are less exposed to credit risk than other CRE lenders. They require low loan-to-value and high debt service coverage ratios, making their loans relatively low risk. Insurers are expected to benefit from their relatively conservative lending practices in any coming CRE market downturn. Insurers own a wide range of debt backed by CRE, with CMBS debt being the largest portion. Insurers also hold substantial amounts of multifamily and office property-backed loans. Insurers are only modestly exposed to retail and hotel properties because they have always perceived these sectors as riskier. Life insurers' 60+ day CRE delinquency rate was only 0.04% as of June 30, 2022.⁴⁶

CRE lenders that assume credit risk, typically private debt investment funds and subordinate CMBS tranche investors, will likely absorb substantial credit losses if defaults materialize. These lenders represent a smaller share of the overall market, although the exact percentage is unknown. CMBS investments at the highest risk of principal losses are those backed primarily by higher-risk properties, such as lodging and shopping malls. Alternative lenders expanded their CRE lending market share during this period because they are more willing to assume credit risks than regulated financial institutions. These yield-driven debt investors will likely face the largest losses

in any coming CRE market downturn, but this should not give rise to financial stability concerns.

With interest rates rising and the economy slowing down, we expect to see increasing pressure on the CRE market, causing some loan performance degradation at CRE lenders. Capitalization rates will rise in tandem with interest rates, and the values of some properties will decline. However, given the large increase in property values that occurred in recent years, this is unlikely to result in substantial lender credit losses, except for the weakest properties. Consequently, financial stability risks arising from the CRE market are expected to be limited. Only the most aggressive lenders and the most highly leveraged or poorly performing properties will become problems for their lenders. Default rates and loss costs will rise for banks and other lenders, but they should remain well below levels that cause financial stability concerns.

Household and Consumer Credit

The 2007-09 financial crisis illuminated financial stability channels related to the household sector and how systemic shocks to the financial system can originate from household balance sheet issues. The past year brought new issues following the extraordinary strain on household finances that was introduced by the COVID-19 pandemic. Household wealth has eroded since the beginning of 2022, following its staggering growth since the start of the COVID-19 pandemic in 2020. The net worth of U.S. households declined to \$143.8 trillion in

Q2 2022 from its peak of \$149.8 trillion in 2021, based on the Federal Reserve's Financial Accounts data. Adjusting for inflation and expressed in real terms, household net worth remains slightly higher today compared to pre-pandemic levels, or \$123.8 trillion compared to \$116.4 trillion in Q4 2019. Coincident with these shocks, pandemic-related relief programs and other government transfer payments began to wind down in 2021. These developments may have magnified potential vulnerabilities in some households because many depended on these programs and payments to bolster their liquidity.

Despite these issues, household leverage remains below pre-pandemic levels and resides in a historically low range. The ratio of aggregate household debt service payments to aggregate disposable income is 9.58% as of Q2 2022 and has been rising in recent quarters, though it remained below the 9.93% mark in Q4 2019. The increasing trend can be explained to some extent by households exiting mortgage forbearance programs over the past year and relatively high debt growth due to high demand. Across households, high-income, prime households generally have higher debt-servicing obligations relative to salaries and wages than other households, based on credit bureau data. One explanation for these patterns is credit availability, and households with lower income and credit scores have had greater difficulty in obtaining credit, increasing financial leverage.

Meanwhile, household debt increased over the past year to levels not seen since 2007. The year-over-year aggregate growth in household debt is 7% in September 2022,

or \$15.6 trillion. Most growth comes from mortgages, bank cards, and auto loans. The growth has primarily come from prime households, with credit scores of at least 660. Since Q4 2019, nonprime household debt balances have declined by \$190 billion, while prime household debt balances have increased by \$2.46 trillion. Overall, the share of aggregate household debt held by nonprime households has declined from 22.1% in Q4 2019 to 17.5% in September 2022.

The relatively rapid growth in household debt since the beginning of 2022 coincided with higher levels of household spending and inflation. Household income has not kept pace with higher spending and has declined. Personal consumption expenditures have grown year-over-year by 9.2% in Q2 2022, while disposable personal income growth has been flat. In real terms, disposable personal income has decreased by 6.1%. Survey data suggests that these trends will likely continue through 2023. According to the Survey of Consumer Expectations, one-year ahead, expected spending growth increased to 9 percentage points in Q2 2022, while expected earnings growth has remained at 3 percentage points. The one-year ahead expected inflation rate is 6.6 percentage points in the same period.

Despite these pressures, household delinquency rates across major loan categories remain below pre-pandemic levels and in a historically low range. Noncurrent rates increased slightly from their lows in 2021, while 90-day delinquency rates remained flat. Unsurprisingly, homeowners account for the majority of household debt, or 88.7%, as of Q2 2022. Homeowners account for

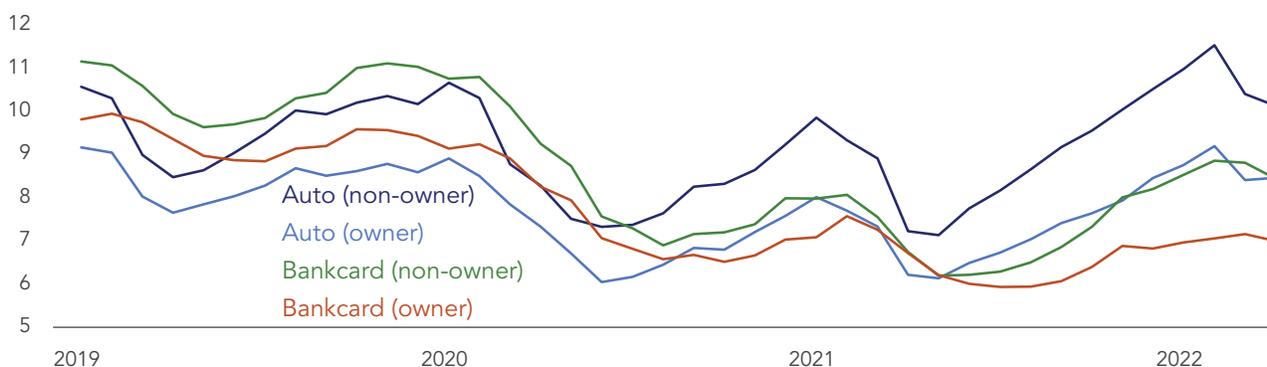
59.3% of total household debt of loans not collateralized by real estate. Strong loan performance could be attributable to homeowners' relatively stronger financial-liquidity positions. Heightened liquidity and rapid price appreciation in the housing markets over the past year may have enabled households to access liquidity.

These households may also be less susceptible to inflationary pressures. Many homeowners have obtained mortgages at historically low fixed rates in recent years. In addition to potentially eroding asset valuations, inflation can devalue these liabilities and decrease financial leverage. In contrast, the average rental expenditures for primary residences increased by 5.2 percentage points year-over-year, the largest increase since 1987. Low-income households with lower credit scores are more likely to be affected by inflationary shocks. Delinquency rates for nonhomeowner households reverted more quickly to pre-pandemic levels than for owner households (see **Figure 25**). In contrast, there is little evidence of

reversion to pre-pandemic levels in higher-income households or households with stronger credit.

Due to deferred payments, student loan forbearance provided many households with additional liquidity. For most forms of government-backed student debt, borrowers were automatically enrolled in forbearance programs and were not required to make payments. As a result, nearly one-tenth of aggregate household debt is attributable to student debt, and the share is much larger for low-income households (42.4%) compared to high-income households (4.2%), based on credit bureau data. While low-income households account for only 9% of aggregate debt, there are concerns about the potential impacts on these households once these programs are ultimately phased out. These concerns are reinforced to some extent by the low fraction of households voluntarily making payments on deferred accounts. The fraction of households with deferred student loan debt making voluntary payments is smaller for low-income (1.4%) compared to high-

Figure 25. Delinquency Rates for Bankcard and Auto Accounts by Homeownership (percent)



Note: Owners are defined as households with a mortgage or home equity loan at at point up to the measurement date, and are otherwise classified as non-owners. Non-current rates are weighted by outstanding balances.

Sources: Equifax Information Services LLC, Office of Financial Research

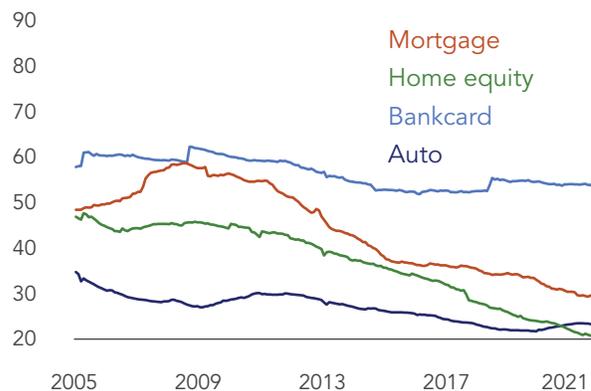
income (6.1%) households. However, even if pandemic-related programs are retired, a large fraction of these households may still be eligible for hardship forbearance. Moreover, the estimated payments only account for 0.9% of monthly income for low-income and 0.3% for high-income households.

Lastly, interest rate policy normalization may affect financial stability through its impact on household demand. These effects may be limited due to the relatively small share of debt to households with weaker credit than in prior economic downturns. A higher-rate environment may perhaps be more consequential through its impact on the market structure of credit institutions with household exposures. Higher interest rates and recessionary concerns diminish expected profitability due to weaker consumer demand and may spur industry consolidation. Since 2010, concentration has diminished significantly across most loan categories (see **Figure 26**), due partly to increased supervisory oversight of larger credit institutions and enhanced regulations that discourage high concentration levels. As a result, consolidation among nonbank lenders and servicers is expected to occur at a greater rate than consolidation among banks. While this alone does not imply greater vulnerabilities to the financial system, consolidation may contribute to a buildup of risk concentrations. These and related issues merit monitoring in the intermediate term.

Residential Real Estate

Overly optimistic housing prices and lax mortgage underwriting standards played pivotal roles in leading the

Figure 26. Loan Market Concentration by Product (percent)



Note: Concentration ratios are defined as the market share of the top five lenders for each product category.

Sources: Equifax Information Services LLC, Office of Financial Research

housing markets to threaten financial stability before the 2007-09 financial crisis. However, double-digit price appreciation since year-end 2020 has raised concerns that home prices may once again be overheated. U.S. home prices appreciated over 11% from the previous 12 months, according to the S&P Case Schiller National Price Index, as of September 2022.

However, the housing market's resilience may be attributed to factors such as lack of supply, high increases in rental payments, and widespread WFH and hybrid work arrangements. Price appreciation is outpacing wage increases and lessening affordability for home buyers, particularly low-income and first-time purchasers. Despite continued demand, home sales continue to decline, given the tight supply.

First-lien residential mortgage originations totaled a record \$4.4 trillion for 2021 (see **Figure 27**). Approximately 58% of this activity was due to homeowners refinancing existing loans. However,

with originations comprised primarily of refinancings with rising interest rates, refinancing activity has dropped. In addition, mortgage application volume declined due to rising mortgage rates, as reflected by a more than 3.5 percentage point increase in the average 30-year fixed mortgage rate from 2021 levels. Application volumes have since dropped to their lowest levels since 1997.

However, household mortgage debt is not the risk to financial stability that it was during the 2007-09 financial crisis. First, the household sector is much less leveraged now than before the crisis. Second, the new mortgage originations favor Fannie Mae and Freddie Mac’s conventional loan programs; the mortgages written in these programs have tighter underwriting standards than the mortgages originating from the crisis.

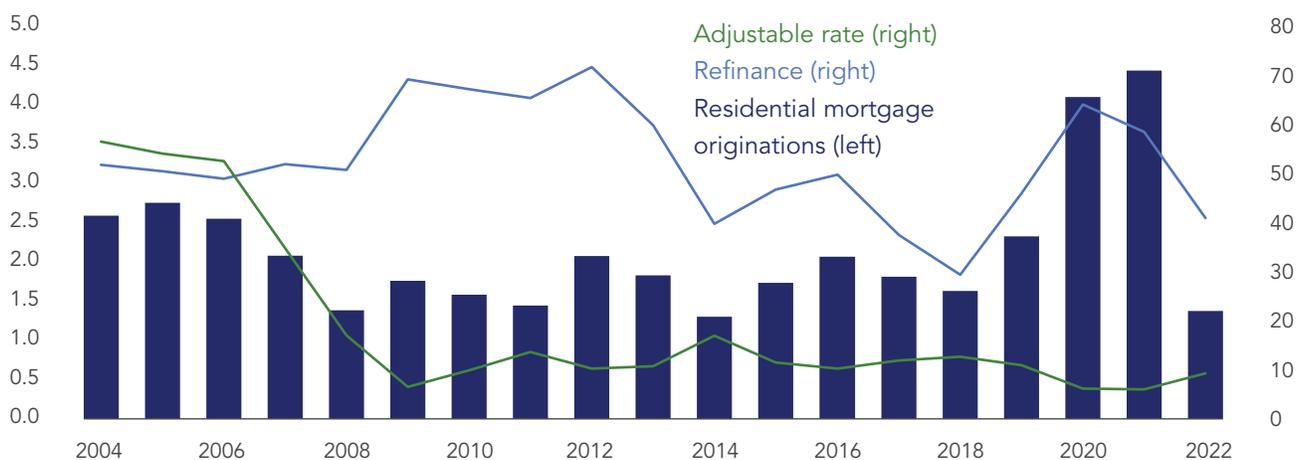
Additionally, the high percentage of fixed-rate loans indicates that few borrowers are likely to experience payment shocks associated with interest rate resets on adjustable-rate mortgages. These

payment shocks were common before the crisis. The quarterly Mortgage Bankers Association’s National Delinquency Survey⁴⁷ reported that the delinquency rate on one- to four-unit residential properties dropped 143 basis points (bps) from a year ago to 3.45% in Q3 2022, the lowest level since the survey started in 1979.

Record housing prices resulted in higher monthly payments for new homeowners with mortgage debt during this period. Therefore, a correction in home prices to historic levels, depending on its speed and severity, could pose three risks to U.S. financial stability:

1. Falling home prices may erode household wealth and dent consumer confidence and spending.
2. Reduced loan-to-value may generate defaults, distressed sales, and loan losses.
3. A simultaneous severe housing market downturn with tightening monetary policy could lead to a recession.

Figure 27. Residential Mortgage Lending Originations (\$ trillions, percent)



Note: Originations represent first-lien mortgages only. 2022 data reflect year-to-date values through June 30, 2022.

Sources: Inside Mortgage Finance, Office of Financial Research

Financial Markets and Liquidity

Short-term Funding

Short-term funding markets support core functions of the financial system, providing liquidity to borrowers and allowing corporations, financial firms, and other investors to meet immediate and near-term cash needs. Consequently, disruptions in funding markets can present serious financial stability risks since they jeopardize institutions' ability to roll over their existing short-term funding obligations and meet pending expenditures.⁴⁸

Funding markets are relatively stable, but market liquidity remains fragile. Market volatility and the impact of Federal Reserve interest rate increases are magnified in short-term markets. First, a protracted period of low interest rates and the Federal Reserve's quantitative easing facilitated risk taking. Second, investors may have taken market liquidity and low price volatility for granted and underestimated the speed and pace of interest rate increases. Third, the market remains vulnerable to liquidity and maturity transformation mismatches for banks and nonbanks. Fourth, there is heightened uncertainty related to the Federal Reserve's monetary policy and its impact on growth, inflation, market sentiment, and market liquidity.

As of March 2022, the Federal Reserve began raising its policy interest rate to tighten the money supply and reduce inflation. The central bank increased the target range for the federal funds rate by 300 bps between March and September and communicated plans for further

rate hikes.⁴⁹ Accordingly, the effective federal funds rate (EFFR) increased by the same amount. Additionally, in June, the Federal Reserve began reducing the size of its balance sheet through quantitative tightening by allowing maturing securities to run off the balance sheet rather than be reinvested. For the following reasons, the Federal Reserve's planned balance sheet reduction could be more disruptive than in the past:

1. The planned reduction will be larger than in the prior quantitative tightening cycle in 2017.
2. Financial markets are strained, as reflected in lower valuations and elevated volatility.
3. The Federal Reserve has not yet completed its adjustments to the policy rate.
4. Inflation remains well above the central bank's target.⁵⁰

As the Federal Reserve commenced tightening financial conditions, policy rate increases have passed through relatively smoothly into funding markets, with most overnight funding rates following the rise in the EFFR. For example, overnight Treasury repurchase agreement (repo) rates have maintained consistent spreads relative to the federal funds rate target amid policy tightening.

Before the 2007-09 financial crisis, the Federal Reserve primarily controlled the policy rate in the interbank market by adjusting the supply of reserves in the banking system.⁵¹ Since the crisis, U.S. monetary policy has been implemented in an environment with ample reserves, reducing the interbank market's

importance for banks' funding. Now, the Federal Reserve instead pays interest on reserve balances (IORB) to influence banks' overnight rates. Additionally, to broaden support for the floor of overnight rates, the Federal Reserve uses the Overnight Reverse Repo Facility (ON RRP) to support a floor on short-term rates by providing an alternative investment for nonbank financial institutions such as money market funds (MMFs) and government-sponsored enterprises (GSEs).^{52 53} In the ON RRP operation, the Federal Reserve borrows cash overnight at a specified rate from counterparties, secured by collateral from the central bank's Treasury securities portfolio.

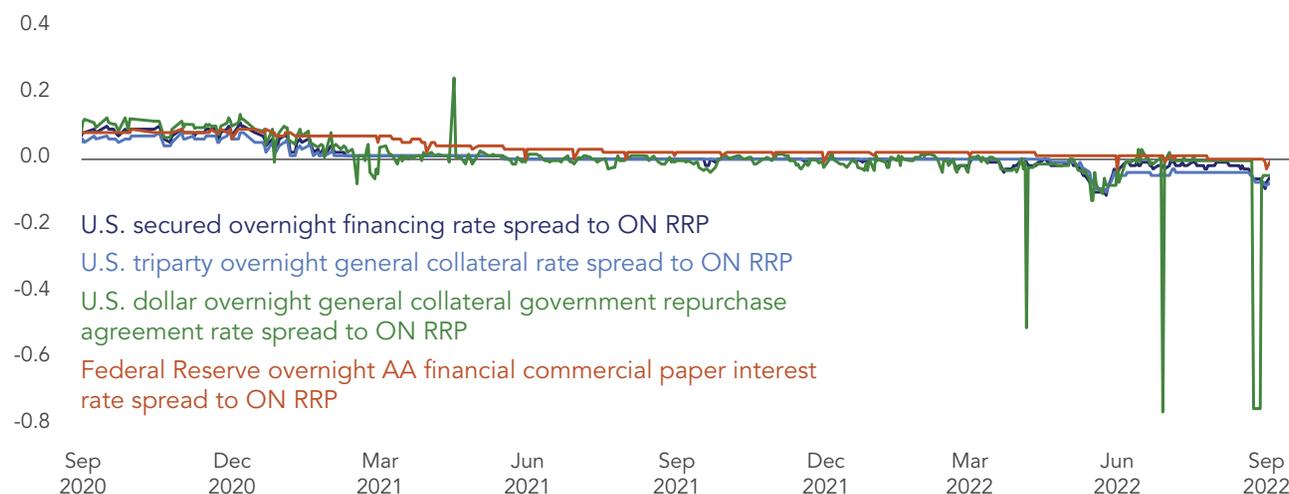
The ON RRP level is very high at \$2.4 trillion as of September 30, 2022, an increase of \$846.4 billion since the start of 2022.⁵⁴ For comparison, during 2020 and the pre-pandemic period, its peak daily usage was \$400 billion. Bank reserves dropped 30.1% to \$3.0 trillion (as of September 28, 2022) since December 2021,

when they reached a high of around \$4.3 trillion, but are still regarded as ample.⁵⁵

Traditionally, ON RRP usage tends to spike around month- and quarter-end reporting dates when some banks shrink their balance sheets, limiting overnight investment options for cash-rich money market participants. Additionally, GSEs' investment in the ON RRP tends to follow intra-month calendar effects.⁵⁶ However, Treasury collateral scarcity and elevated demand for overnight investments pushed rates on private sector overnight repurchase agreements below the ON RRP award rate (see **Figure 28**). As a result, eligible money market participants invested substantially in the ON RRP, with prime and government MMFs accounting for up to 92% of the total lending to the ON RRP.⁵⁷

Broadly speaking, MMFs comprise a substantial source of short-term funding, given their need to invest large cash balances and to hold mostly short-term investments.⁵⁸ The OFR Money Market

Figure 28. Select Overnight Funding Rate Spreads Over the Federal Reserve Reverse Repurchase Agreement Program Rate (ON RRP) (percent)



Sources: Federal Reserve Bank of New York, Bloomberg Finance L.P., Office of Financial Research

Fund Monitor shows that total U.S. MMFs' assets under management have hovered around \$5 trillion since the early days of the COVID-19 pandemic in 2020.⁵⁹ In anticipation of interest rate increases in 2022, MMFs sharply reduced their portfolio holdings' weighted average maturities (WAMs) (see **Figure 29**). MMFs are incentivized to shorten their portfolio WAMs because rate hikes lead to mark-to-market losses on existing security holdings. Shortening the WAM allows MMF managers to reduce losses and increase holdings of newly issued securities with higher yields.

Treasury Markets

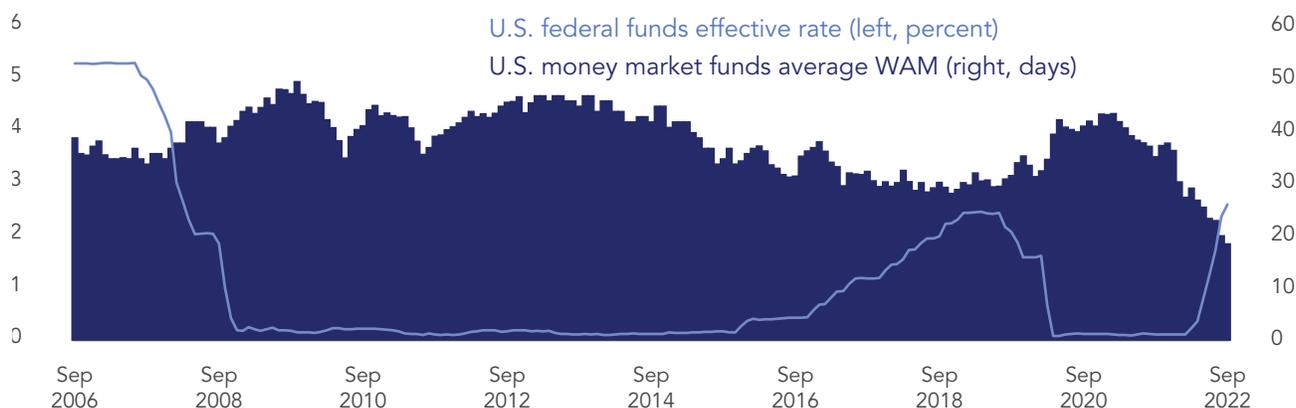
The Treasury market is the deepest and most liquid market in the world and a central component of the U.S. and global financial systems. It includes markets for outright purchases and sales of securities or cash transactions, repos, and futures on Treasury securities.⁶⁰ A notable theme in Treasury markets is persistent specialness in certain securities, which may result from the repositioning around Federal Reserve tightening combined with one-

sided positioning and limited supply. As tightening continues, there is a possibility that liquidity challenges may persist if high levels of uncertainty remain about the future path of policy.

In the market for short-term Treasury securities, substantial increases in investors' cash balances led to demand outpacing the supply of new Treasury bills. The supply of bills decreased from peak pandemic levels when they were issued to meet fiscal borrowing needs. This imbalance between supply and demand for Treasuries led to difficulties in sourcing specific Treasuries. It also played a role in the increased investment in the ON RRP, as MMFs and other counterparties seek a source for higher yields. As shown in **Figure 30**, MMFs' holdings of Treasury securities have declined since 2021 as fund managers have increasingly turned to the ON RRP.

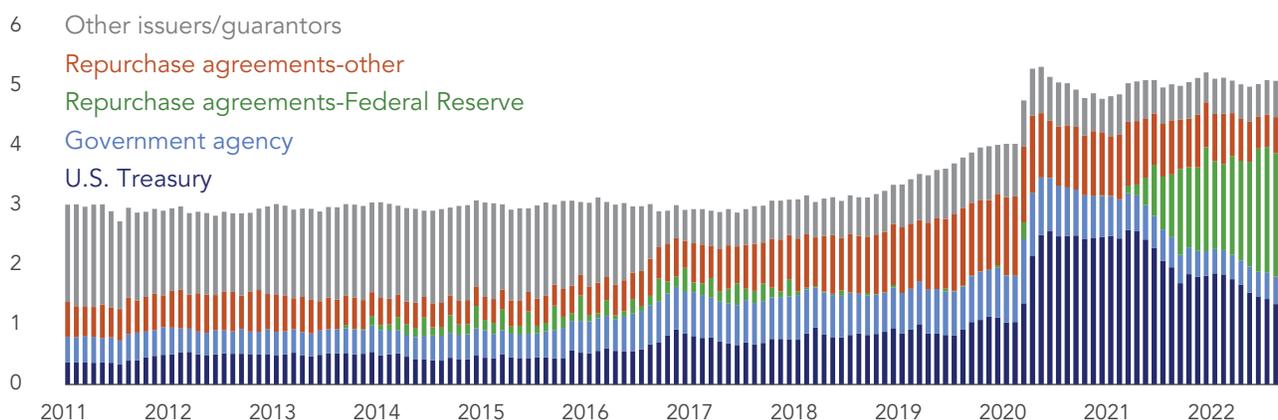
Looking at broader Treasury market conditions beyond Treasury Bills, average bid-ask spreads for off-the-run 5-year and 10-year securities remain stable relative to past conditions. In contrast, bid-ask

Figure 29. U.S. Federal Funds Effective Rate and Money Market Fund WAM (percent, days)



Sources: Federal Reserve Bank of New York, Bloomberg Finance L.P., Crane Data LLC, Office of Financial Research

Figure 30. U.S. Money Market Fund Assets by Select Holding Types (\$ trillions)



Sources: Securities & Exchange Commission Form N-MFP, Office of Financial Research

spreads for off-the-run 2-year Treasuries have been slightly elevated (see **Figure 31**). However, volatility increased, especially at the short end of the Treasury yield curve. For example, in September 2022, the ICE Bank of America Merrill Lynch Option Volatility Estimate, or MOVE Index, a gauge of Treasury bond price volatility, measured 161.⁶¹ This high level has not been seen since the peak of 164 on March 9, 2020 (see **Figure 32**).

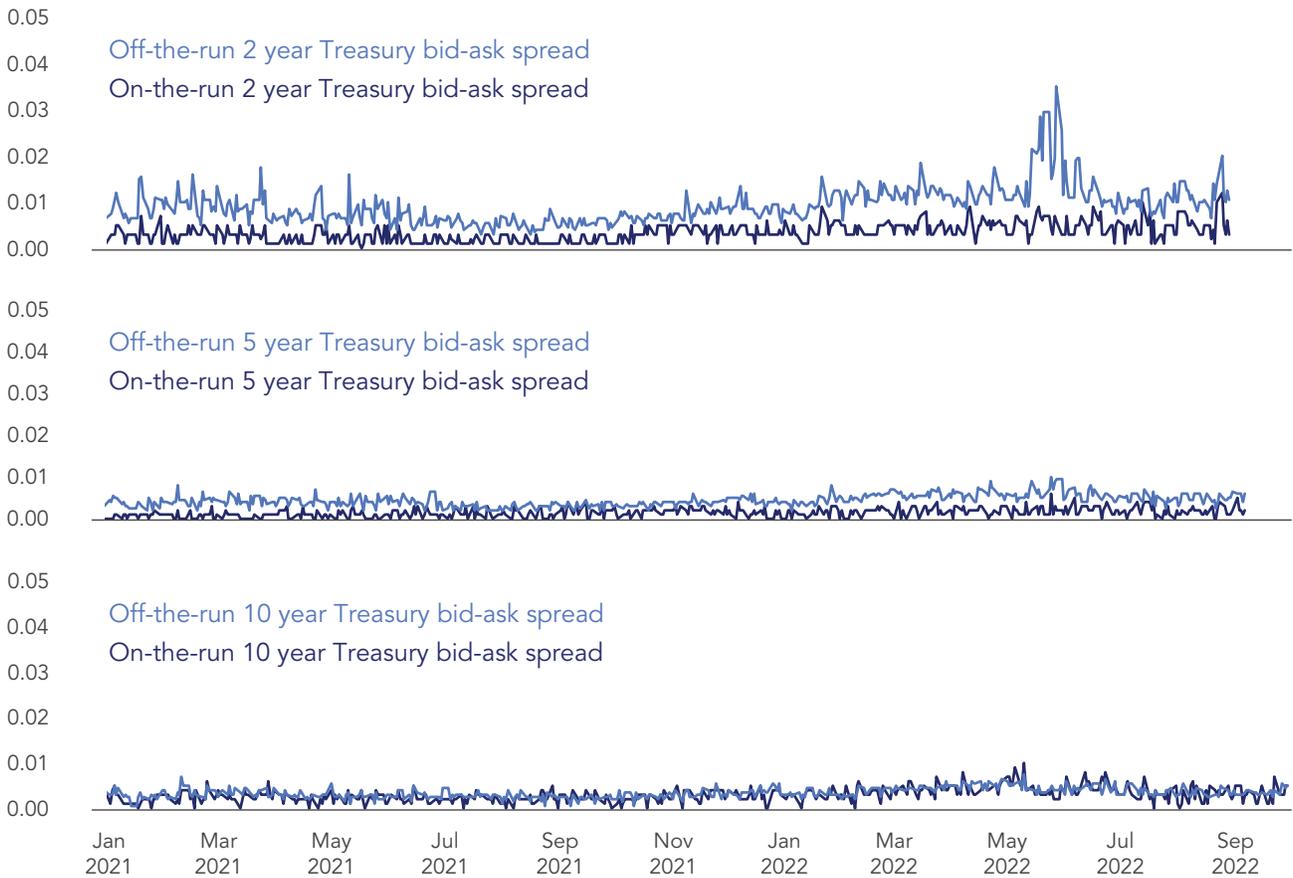
Increased volatility and yields may stem from uncertainty around the pace of the Federal Reserve tightening, geopolitical risks, and bottlenecks in market functioning, as was the case in March 2020. Consistent with the Federal Reserve tightening, yields have increased across the yield curve, leading to an inversion between short-term and long-term yields.

The increased volatility has contributed to the difficulty in sourcing specific Treasuries, especially in shorter-term maturities such as the 2-year Treasury Notes. In recent months, repo rates in the centrally cleared bilateral segment of the market (Fixed Income Clearing Corporation's (FICC)

Delivery-versus-Payment (DVP) Repo Service) have been low relative to the federal funds rate target. As OFR research shows, this downward pressure may be partly driven by specials activity, reflecting significant specific-security demand.⁶² As an indication of the difficulty in sourcing certain Treasuries, overnight DVP repo rates averaged 20 bps between March 16 and April 1, while the Secured Overnight Financing Rate (SOFR) was slightly below the ON RRP offering rate of 30 bps.⁶³ Dealers' willingness to lend below the ON RRP rate, which should provide a floor for funding rates, suggests that some dealers had difficulty sourcing certain securities.

The rise in specials activity is also reflected in the pattern of Treasury failures to deliver, as measured by FICC, a subsidiary of the Depository Trust & Clearing Corporation (DTCC). FICC data show that Treasury fails have been elevated since February 2022, with a spike on March 31 to \$80 billion. However, these levels are still well below the maximum of \$141 billion over March 2020 and well below historical levels.⁶⁴ Moreover, failure to deliver Treasuries can have a domino effect on other market

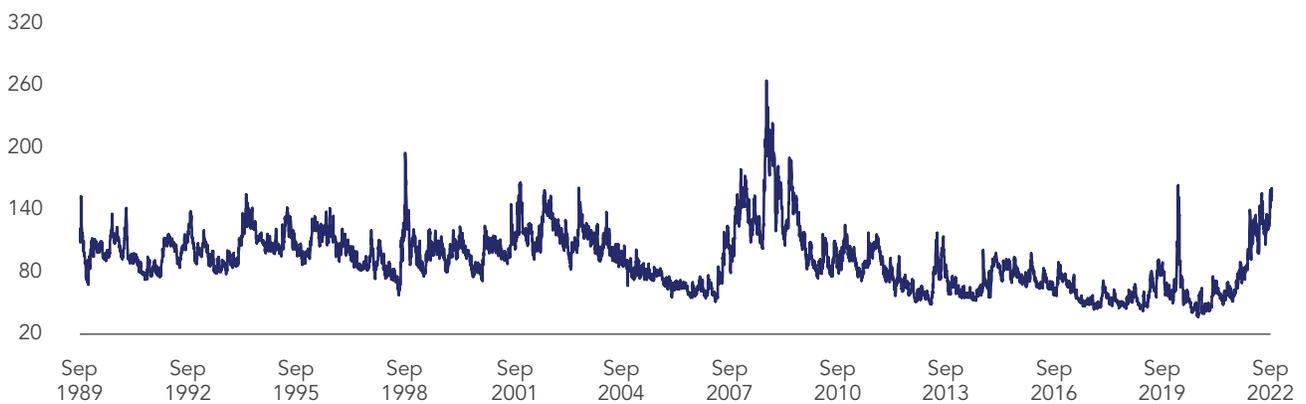
Figure 31. Bid-Ask Spreads for On- and Off-the-run Treasury Securities (basis points)



Note: Off-the-run Treasury security bid-ask spread is an average bid-ask spread of the most recently auction off-the-run security and the second most recently auction off-the-run security of a given maturity.

Sources: Bloomberg Finance L.P., Office of Financial Research

Figure 32. The MOVE Index (points)



Note: The MOVE (ICE BofAML U.S. Bond Market Option Volatility Estimate) Index measures the markets expectation of implied volatility of the U.S. bond market using 1-month U.S. Treasury options weighted for 2, 5, 10 and 30 year contracts.

Sources: Intercontinental Exchange Inc., Bloomberg Finance L.P., Office of Financial Research

participants, who may be engaged in secured transactions that require Treasuries as collateral.

In sum, as indicated by rising specialness, this difficulty in sourcing securities may reflect deeper constraints in the structure of Treasury markets and shorter-term factors such as investors' responses to Federal Reserve policy tightening. As tightening continues, Treasury market liquidity will remain a primary concern to monitor. In the short run, Federal Reserve policy tools like the Standing Repo Facility (SRF) and the ON RRP can help control repo rates by setting both a floor (via the ON RRP) and a ceiling (via the SRF) on repo rates with a variety of counterparties. However, over the medium term, as reserves begin to decrease and Treasuries currently held by the Federal Reserve are allowed to mature without replacement, it remains to be seen if these policy tools will provide sufficiently broad control over the floor and ceiling of target policy rate ranges. Additionally, easy access to SRF does not necessarily solve the problems of costs incurred through dealers' balance sheet exposure to Treasuries or the potential stigma associated with borrowing from the facility, which is similar to the stigma that disincentives banks from discount window borrowing.

Fixed Income

Fixed income markets help governments (i.e., federal, state, and local), nonprofits, and companies borrow money to fund economic growth. They enable borrowers to access a broad spectrum of investors in their debt, and they diversify the provision of credit in the economy, making it more competitive and resilient. U.S. fixed-

income markets include several segments. The U.S. Treasury market (see preceding section) is the world's largest, deepest, and most liquid government securities market. As a result, it plays a critical role in global finance as a risk-free benchmark from which many other financial instruments are priced. Other segments, listed in order of market size, include mortgage-backed securities, corporates, municipals, asset-backed securities, agency securities, and money markets.⁶⁵

Bond prices fell sharply in 2022 due to rising interest rates and inflation. Bond investors suffered heavy losses due to the sharp increase in risk-free rates as a result of monetary tightening by the Federal Reserve. As a result, the ICE Bank of America U.S. Corporate & Government Index, a broad-market index of corporate and government bonds, has fallen 15% through September 2022, the largest year-to-date decline on record.⁶⁶ A major driver was elevated bond duration, a measure of bonds' price sensitivity to interest rate changes, at the end of 2021. High duration meant that heading into 2022, bond prices were particularly vulnerable to any increase in risk-free rates.

This sell-off was followed by a yield curve inversion in July, with the 2-year Treasury yield rising above the 10-year. Additionally, concerns over slowing economic growth resulted in wider credit spreads and tighter financial conditions. As a result, credit spreads for U.S. high-yield corporate bonds rose to almost 600 bps in early July 2022, nearly double the 300 bps of late December 2021. While this increase is consistent with a weaker growth outlook, spreads remain well below levels seen in advance of historical recessions.

During prior recessions, high-yield spreads have, on average, exceeded 1,000 bps.

Price declines alone are not sufficient to pose a threat to financial stability. However, large price declines can transmit stress to market participants and result in adverse feedback loops. For example, price declines may prompt investors to sell, resulting in further price declines and more selling, adversely impacting market liquidity and price discovery. Moreover, investor leverage amplifies this adverse feedback loop. Historically, large asset price declines are potentially problematic for financial stability when accompanied by fire sales from leveraged investors.⁶⁷

Rising yields also have positive effects. The global rise in risk-free rates has sharply reduced the amount of negative (nominal) yielding debt. As a result, in September 2022, the market value of negative-yielding debt was \$1.7 trillion globally, down from almost \$18 trillion at its peak in December 2020. As a share of outstanding debt (market value), negative-yielding debt represented under 5%, down from 30% in August 2019. Negative nominal and real yields distort asset prices and encourage borrowers to maintain high leverage levels. The recent normalization of yields reduces these effects and provides a more robust set of investment opportunities for fixed-income investors, reducing incentives to reach for yield. It also facilitates more effective capital allocation as weaker borrowers with unsustainable business models lose access to cheap capital.

Another effect of higher interest rates is the dampening effect on nonfinancial corporate bond issuance. U.S. investment-grade and high-yield bond issuance year-

to-date declined by over 25% and over 75%, respectively. Meanwhile, leveraged loan issuance fell over 40%. In fact, issuance across all three of these markets is below comparable year-to-date levels pre-pandemic (2019). While these declines appear large, they are relative to very high issuance levels in 2021.

Finally, while the future path of interest rates is an important factor affecting bond prices, foreigners will also play a key role. Foreign investors are the largest holders of U.S. corporate bonds, at approximately 30% of total holdings (they represent a much smaller portion of the U.S. leveraged loan market). These investors, including foreign central banks, are also substantial holders of Treasury bonds. According to Treasury and Capital Markets data, net foreign purchases of U.S. corporate and Treasury bonds are positive year-to-date. Any decline in foreign demand not offset by higher domestic demand would contribute to liquidity risks and higher borrowing costs.

Equities

The equity market is the largest U.S. capital market, at approximately \$52 trillion in publicly traded U.S. corporate stock outstanding as of year-end 2021.⁶⁸ A healthy U.S. equity market is an important component of well-functioning capital markets and overall economic growth. A well-functioning equity market can provide basic services, such as capital allocation, price discovery, and liquidity provision, in the face of shocks. Key participants in equity markets include issuers and investors. Equity issuers include U.S. companies that raise equity capital for various reasons. Companies need capital

to finance their operations, fund mergers and acquisitions, and invest in capital projects for future growth. Investors include individuals and institutions. Equity markets are an important means for individuals to build wealth. According to the Federal Reserve, approximately 53% of U.S. households own equities, directly or indirectly. Institutional investors, such as mutual funds, pension funds, and hedge funds, are also large participants in the equity market. These entities often invest on behalf of U.S. households.

The Standard and Poor's 500 Index (S&P 500), a stock market index tracking the performance of 500 large companies listed on exchanges in the U.S., entered a bear market in June 2022. Market watchers categorize declines of 10% or more as "corrections," with declines of 20% or more labeled "bear markets." The latter are generally longer in duration, less frequent, and often coincide with recessions. To put the recent market decline into context, since 1929, there have been 28 corrections and 14 bear markets (on average, there is a bear market

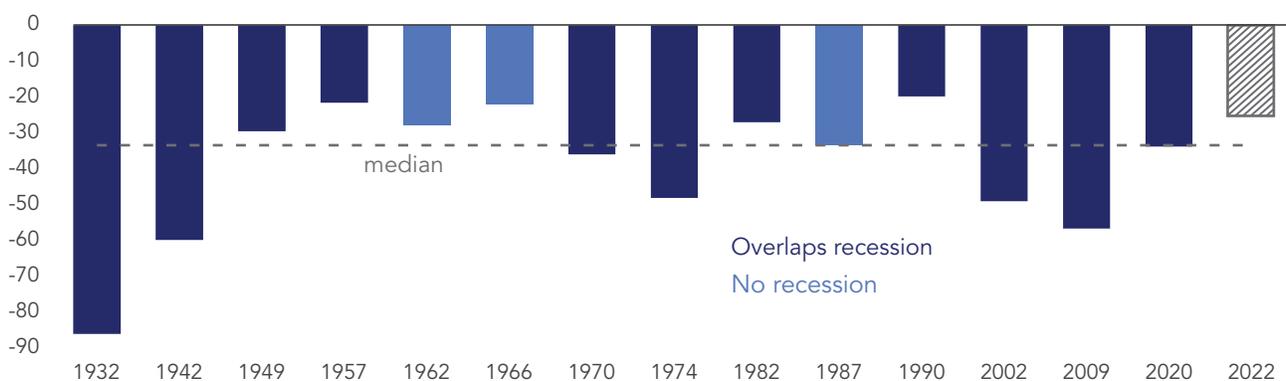
every 6 to 7 years) with an average bear market duration of 19 months. In addition, recessions were associated with 11 of these 14 bear episodes, with 1961, 1966, and 1987 being the exceptions.

As of September 2022, the S&P 500 had fallen 25% from its peak. Historically, the median market decline is 27% for periods associated with recessions, while the overall median decline, including all bear markets, is 34% (see **Figure 33**).

Asset price volatility is inherent in capital markets. While market risk, or volatility in asset prices, is not the same as financial stability risk, market risk may interact with and reinforce other vulnerabilities where the combination amplifies financial stability risk. Research shows that systemic crises tend to be preceded by bubbles in one asset class or another. Brunnermeier and Schnabel (2014) noted that the financing of bubbles is much more relevant than the type of asset bubble.

Margin debt outstanding has declined sharply, in line with the decline in the equity market. Margin debt peaked at

Figure 33. Price Declines During Bear Markets (percent)



Note: Percent declines are measured from peak to trough of S&P 500 index. X-axis is last year of bear market. 2022 reflects values through September 30, 2022.

Sources: Bloomberg Finance L.P., Office of Financial Research

\$936 billion in October 2021 and has fallen 27% to \$688 billion as of August 2022. In addition, it is below prior peaks as a share of overall market capitalization. However, other forms of leverage, primarily derivatives, are not captured in publicly reported margin debt. Sophisticated investors use derivatives to achieve larger exposures than could otherwise be possible. Leveraged investors, which include hedge funds and family offices, could be a source of fire sales risk.

Financial stability vulnerabilities that stem from market risk are more salient when valuations and sentiment are both at extremes—neither of which is the case today. Asset valuations are less elevated, and market sentiment is significantly more cautious compared to 2021. Despite the sharp decline in stock prices, many valuation metrics remain elevated compared to history (see **Figures 34** and **35**).

Valuations are vulnerable to further declines. First, market sentiment could worsen. Consumer and CEO confidence surveys point to weak sentiment, but this could deteriorate further (i.e., sentiment indices remain above all-time lows). Second, the era of loose monetary policy has come to an end. Policy rate hikes and quantitative tightening mean that the path of least resistance for risk-free rates is higher. This, in turn, adversely impacts asset valuations, particularly for long-duration securities like growth stocks. Third, geopolitical risks remain high. Trade and geopolitical tensions with China, Russia’s war against Ukraine, and the effects of the global COVID-19 pandemic (e.g., lockdowns, labor shortages, and supply chain bottlenecks)

Figure 34. U.S. Stock Valuations for the Median Stock in S&P 500

Metric	Q2 2022	Historical Percentile (percent)
Price-to-sales	2.6	96
Trailing P/E	19.8	83
Price-to-book	2.9	78
EV-to-EBITDA	12.9	95
EV-to-sales	3.4	95
EV-to-FCF	23.3	91
FCF yield (FCF/P)	4.2%	51

Note: Percentiles are based on historical data since 1976 for all metrics except EV/FCF and FCF yield, which are since 1984.

Sources: Compustat, Office of Financial Research

Figure 35. U.S. Stock Valuations Based on Aggregates

Metric	Level	Historical Percentile (percent)
CAPE ratio	28.3	92
Market cap to profits	15.2	82
Buffett Indicator	148%	93
S&P 500 trailing P/E	17.6	54
S&P 500 forward P/E	15.6	49
S&P 500 price-to-book	3.6	81

Note: Percentiles are based on historical data since 1881, 1970, 1970, 1954, 1990, and 1990, respectively. CAPE, P/E and P/B use S&P 500 index. Market cap to profits ratio uses Wilshire 5000 market cap and BEA profits. Buffett Indicator uses Wilshire 5000 market cap.

Sources: Bloomberg Finance L.P., Haver Analytics, Robert Shiller, Wilshire Associates, BEA, Office of Financial Research

raise uncertainties about economic growth. Finally, earnings growth is slowing as profit margins come under pressure. At first, companies passed higher input costs to consumers through higher prices. However, companies are reaching a limit concerning price hikes

as consumers become stretched. In fact, many companies have warned of weaker profit margins in the second half of 2022. Despite these headwinds, the consensus S&P 500 earnings estimate for 2023 has yet to reflect an earnings downturn. If recessionary pressures build, then the consensus estimate will prove too optimistic. During historical recessions, the median decline in S&P 500 earnings has been approximately 18%.

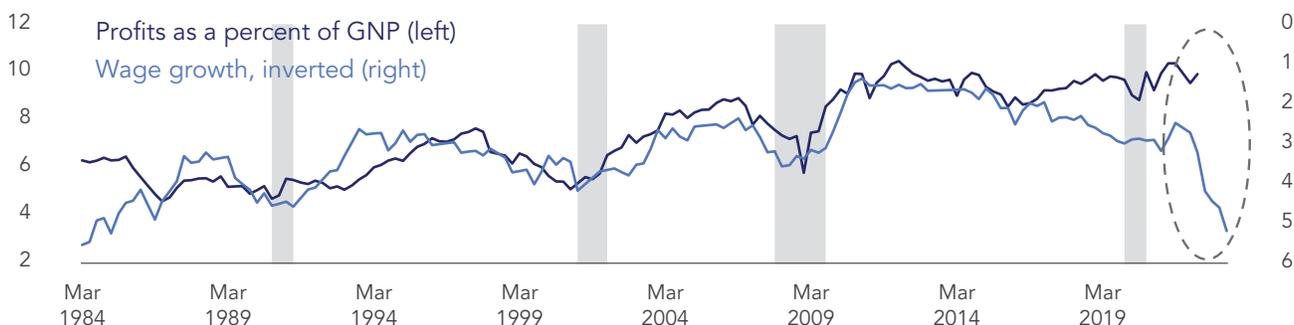
The threat to margins is salient. Higher input costs, including raw materials, transportation, storage, and wages, are widespread. Importantly, wage growth at mid-year 2022 exceeded 5%; historically, profit margins were much lower when wage growth was as high (see **Figure 36**). Structural changes—such as the Tax Cuts and Jobs Act (2017) and the secular shift in the mix of companies favoring less capital-intensive, higher-technology, and higher-margin services—explain today’s higher margins compared to prior decades. But other secular headwinds, such as deglobalization and reglobalization, could result in a significant hit to margins. The deterioration in U.S.-

China trade relations, the global COVID-19 pandemic, and Russia’s war against Ukraine have prompted companies to reevaluate trade and manufacturing dependencies. Greater onshoring or near-shoring of manufacturing will result in higher costs and margin pressures. In addition, if inflation persists, worker demands for higher compensation could become more problematic for companies.

State and Local Governments

The \$4 trillion⁶⁹ municipal bond market comprises a diverse set of issuers, including states, cities, towns, hospitals, schools, toll roads, and other projects. The market has a significant role in that debt issuances support long-term projects and serve the local communities by funding normal operations such as education, policing, and utilities. Additionally, these debt obligations are held by various investors, such as bond funds, banks, pension funds, and individuals. A systemic disruption in this market could create an inability for issuers to access the market at

Figure 36. Corporate Profit Margin v. Wage Growth (percent)



Note: Data as of June 2022. Shaded areas represent U.S. recessions. Corporate profits are after-tax and include inventory valuation and capital consumption adjustments. GNP is gross national product. Wage growth (four quarter lead) is year-over-year change in Employment Cost Index.

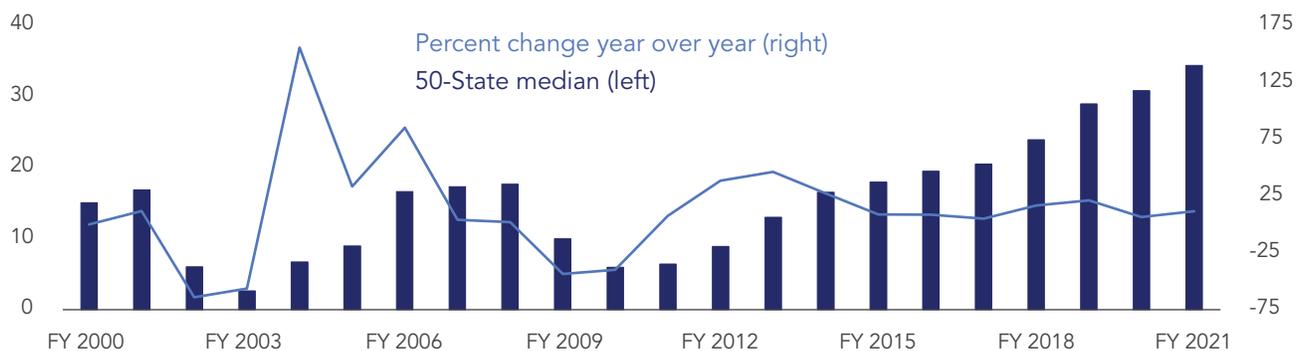
Sources: Haver Analytics, Office of Financial Research

favorable rates, resulting in higher taxes, higher borrowing costs, reduced project investments, and reduced community support.

The overall health of the municipal market is strong because municipalities received support during the onset of the COVID-19 pandemic. In addition, states entered the monetary tightening cycle in a strong position due to the 2021 economic expansion, which increased tax receipts and saw a decline in fuel and energy costs.⁷⁰ As a result of the savings and increased income, the aggregate state fund balances grew 95% from FY 2020⁷¹.

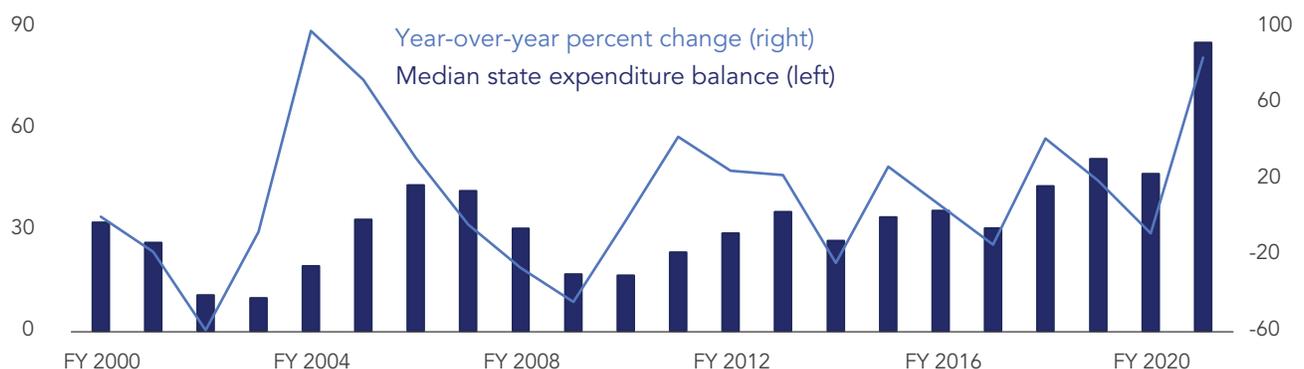
While the increase is a strong indicator of states' health, there are additional measures to gauge fiscal health. One such measure compares rainy day funds⁷² to the state's daily general fund expenditures (see **Figure 37**). In FY 2021, the average \$34 million increase in rainy day funds represented a healthy 12% growth over FY 2020. The increase in savings also increased the average number of days when these funds could cover general expenses to 34 from 31. Another such measure often employed calculates the days general fund expenditures are held in the general fund account (see **Figure 38**). The average FY 2021 increase of \$85.1 million was 84% higher than the

Figure 37. State Median Days of Rainy Day Funds (days, percent)



Sources: National Association of State Budget Officers, Pew Charitable Trusts, Office of Financial Research

Figure 38. Median State Days of Fund Expenditures (\$ millions, percent)



Sources: National Association of State Budget Officers, Pew Charitable Trusts, Office of Financial Research

prior fiscal year's \$46 million increase. The trend seems to continue for FY 2022 as state collections exceeded expectations in 49 states; state tax collections were up 22% in the first half of calendar year 2022, compared to the first half of 2021.⁷³

States can use the increase in balances during economic slowdowns. Overall, state and local governments are entering the credit-tightening cycle in a strong position. Should the economy contract or slow, resulting in declining revenues, state and local governments can employ levers to balance budgets. For example, general-obligation municipal issuers can increase taxes, curtail projects, and reduce government employment to balance budgets.

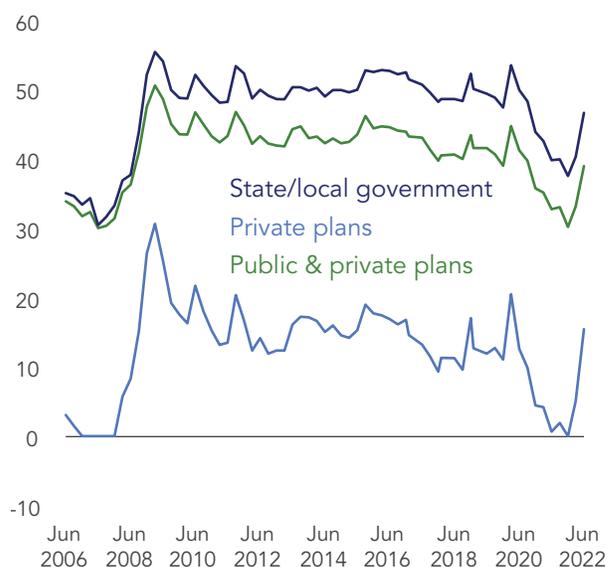
Pension funding remains the largest long-term concern for most states, even ahead of outstanding debt. This is, in part, because changing pension benefits is more complicated. Many pension benefits are enshrined in state law and practices, making it difficult for plan sponsors to reduce future benefits and liabilities. Long-term, states and municipalities with large and underfunded pension obligations create a risk for investors. A large failure could amplify perceived risks and raise borrowing costs for some issuers who might be perceived as similarly situated.

In the U.S., there are about 6,000 public pension plans with a combined asset value of over \$4.5 trillion. These investment assets are the retirement benefits of nearly 26 million retired and active workers or plan participants.⁷⁴ Pension plan sponsors, both public and private, must balance plan contributions to ensure adequate funding for future payments while meeting other

budgetary obligations. As a result, state and local governments may increase or decrease pension plan contributions to manage finances.

Despite pension plans benefiting from the strong 2021 economic environment, public pension plans remain underfunded compared to their private counterparts. Between FY 2019 and FY 2021, state pension underfunding declined by over \$250 billion to below \$1 trillion.⁷⁵ In addition, data from the Federal Reserve allows for comparing funding levels between private and public pension funds.⁷⁶ Private pension funds were underfunded at 15%, while state and local government plans, in the aggregate, were deeply underfunded at 46% as of June 30, 2022 (see **Figure 39**).

Figure 39. Pension Underfunding (percent)



Note: Data as of June 30, 2022. Public and private category includes federal pension plans.

Sources: Board of Governors of the Federal Reserve, Office of Financial Research

While the average funding level of state pension plans has improved over the last two years, the dispersion between states is more diverse and, thus, concerning. Comparing state personal income to pension underfunding can measure a state's ability to levy taxes to support the pension debt. As of 2019, only South Dakota and Wisconsin had pension plan savings greater than the value owed. Eight states had pension liabilities to personal income that exceeded 10% and seven that exceeded 15%.⁷⁷ Moreover, the recent reversal of the financial markets in 2022 is likely to have retraced market gains pension funds made in 2021. Pension funding, while long-term, continues to be an overhang and concern for municipal investors and the financial market.

Beyond the wall of pension risks, municipalities face issues that are, due to a lack of data, more difficult to quantify. Examples of such risks include cybersecurity, infrastructure spending, and climate-related financial risk. Infrastructure spending continues to be a significant issue because municipal issuers need to invest in repairing or replacing failing bridges, dams, utilities, and other projects. Since the 1960s, the proportion of U.S. infrastructure spending to GDP has declined by 47%.⁷⁸ This lack of spending has placed municipalities and states at risk should catastrophic infrastructure failures continue.⁷⁹ The economic impact of infrastructure failures is significant and can impact communities for decades through higher taxes, reduced productivity, and higher costs.

Despite these concerns, the demand for municipal issues remained relatively strong due to their federal tax-free status. This

helped drive tighter spreads between U.S. Treasury and municipal securities, despite a minor increase in defaults to 0.38% (up from 0.35%), excluding Puerto Rico.⁸⁰ Within the municipal market, however, the source of revenues for bond repayment continues to play a critical function in determining defaults. General-obligation issuers have a broader taxing authority to repay their debt, while bonds backed by revenues from schools, industrial parks, healthcare facilities, and others are considered higher risk. At the end of July, according to Municipal Market Analytics, these riskier sectors had a default rate of 1.33%, compared to that of 0.07% for general obligation bonds. Headwinds for the municipal market are similar to those facing other fixed-income sectors; they include interest rate increases, wage pressures, record inflation, and slowing revenue.

Financial Institutions

Banks

After enjoying a relatively benign economic and financial climate in 2021, buoyed by strong profitability and limited credit losses, U.S. banks have entered a period of heightened uncertainty. Higher inflation and interest rates, a greater risk of recession, and enhanced global risks due to Russia's war against Ukraine lowered the sector's outlook. Nevertheless, despite headwinds, the U.S. banking sector remains well capitalized and maintains risk-based capital ratios well above regulatory minimums.

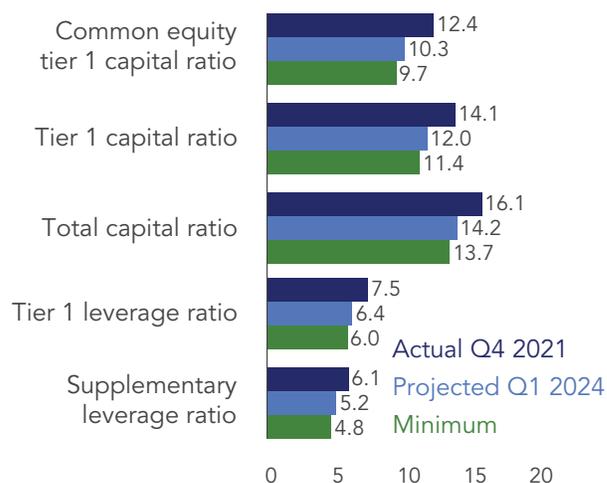
Banking Sector’s Health and Performance

The Federal Reserve’s 2022 stress tests, performed on the largest U.S. and foreign bank holding companies and savings and loan holding companies, showed that the banks have sufficient capital to absorb more than \$612 billion in losses and continue lending to households and businesses under stressful conditions. In addition, the 2022 stress test modeled a severe global recession and heightened stress in commercial real estate and corporate debt markets using a severely adverse supervisory scenario.

In the results of the 2022 stress tests, post-stress common equity tier 1 (CET1) risk-based capital ratios remained well above the required minimum levels (see **Figure 40**). As a result of the stress tests, several global systemically important banks (G-SIBs) are subject to increased capital buffers and G-SIB surcharges beginning in Q4 2022. These firms already have sufficient capital to meet these increased capital levels.

Under the severely adverse scenario of the capital stress tests, \$463 billion of the \$612 billion of estimated losses were attributable to loans (see **Figure 41**), with an average loan loss rate of 6.4%. As a result, projected consumer loan losses represented a smaller share, 41%, of total losses, as opposed to commercial loan losses, which constituted 59%. Within the loan portfolios, the largest amount of losses are commercial and industrial loans and credit cards, each representing 26% of total loan losses. This reflects credit losses of firms and households in an adverse economy, presaging a reduction

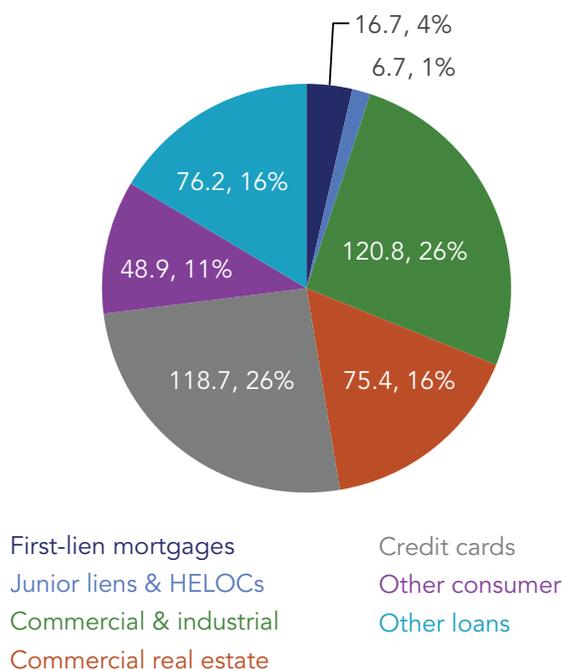
Figure 40. Bank Capital Ratios, Severely Adverse Scenario (percent)



Note: Projected Q1 2022 to Q1 2024.

Sources: Federal Reserve, Office of Financial Research

Figure 41. Bank Loan Losses, Severely Adverse Scenario (\$ billions)



Note: Projected Q1 2022 to Q1 2024.

Sources: Federal Reserve, Office of Financial Research

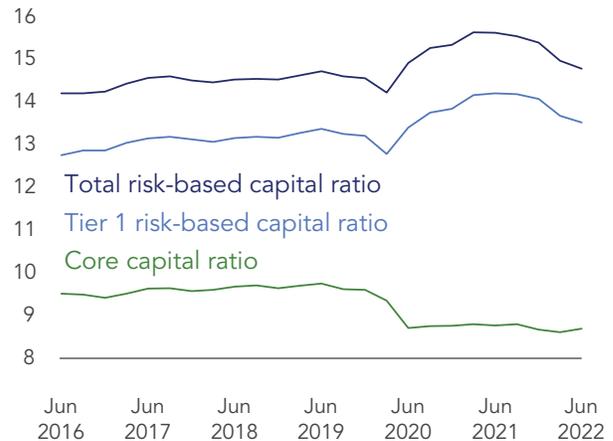
in the growth rate of future investment or consumer spending.

Although the risk-based capital ratios of FDIC-insured banks and savings and loans (depositories) have remained well above pre-pandemic averages, they have generally declined since the end of 2021. Several factors have driven them lower, including higher risk-weighted assets from balance sheet growth, implementation of the standardized approach for counterparty credit risk assessments, and equity buyback programs.

Though depository institutions' capital ratios have softened since the beginning of 2021 (see **Figure 42**), bank net interest income rose for the fifth consecutive quarter through Q2 2022. As a result, the average annualized Q2 2022 net interest margin for depositories with greater than \$1 billion in assets increased by 26 basis points (bps) to 2.77% during Q2 2022 (see **Figure 43**). This increase in net interest income reflects earnings from loan growth during the recent rising interest rate environment.

Despite the increase in net interest income in Q2 2022, including a slight growth in noninterest income, bank net income fell by \$6.0 billion, or 8.5%, to \$64.4 billion in Q2 2022 from Q2 2021 (see **Figure 44**). The reversal in net income growth was driven by the decrease in provisions for future credit losses and noninterest expense growth. During the quarter, provisions for credit losses increased from negative \$10.8 billion to positive \$11.1 billion, largely driven by banks with assets greater than \$10 billion. In addition, Q2 2022 noninterest expenses rose \$8.7 billion, or 6.96%, year-over-year, led by higher marketing, consulting, and salary

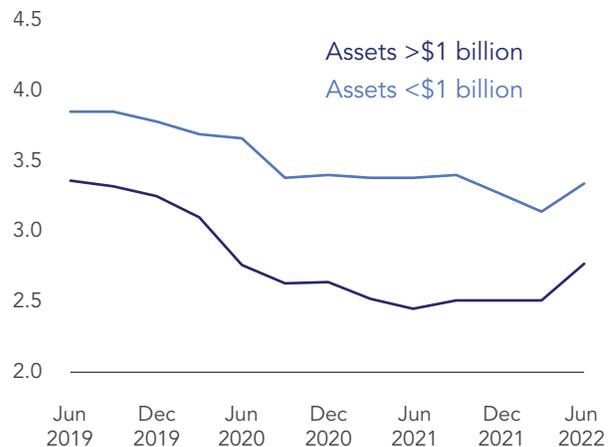
Figure 42. Depository Capital Ratios (percent)



Note: <https://www.fdic.gov/analysis/quarterly-banking-profile/graph-book/2022jun/QREGCAP.html>

Sources: Federal Deposit Insurance Corporation, Office of Financial Research

Figure 43. Depository Quarterly Net Interest Margin (percent)



Note: <https://www.fdic.gov/analysis/quarterly-banking-profile/graph-book/2022jun/QNIQB2.html>

Sources: Federal Deposit Insurance Corporation, Office of Financial Research

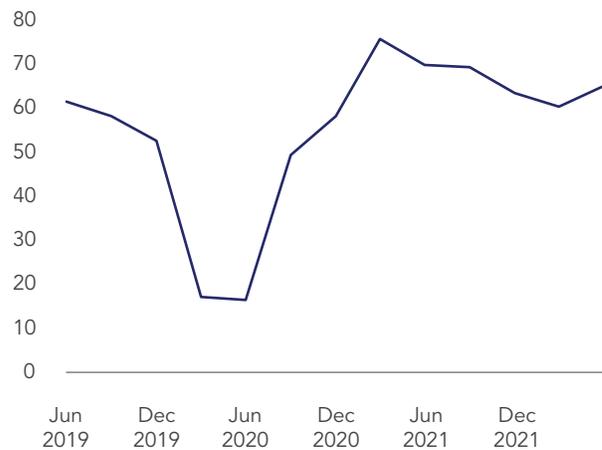
and benefit expenses. As a result, the decline in net income reduced the return on average assets ratio to 1.08%, down 16 bps from one year ago and up 8 bps from the previous quarter (see **Figure 45**).

The lack of bank failures and the low number of problem institutions illustrate the current health of the banking sector. No FDIC-insured depository has failed since October 2020 (see **Figure 46**). The number of banks on the FDIC’s “Problem Bank List,” a confidential list for institutions with a Capital, Assets, Management, Earnings, and Liquidity rating of 4 or 5, remained unchanged from Q1 2022 at 40, the lowest level since data collection began in 1984. In addition, the total assets of problem banks declined by \$2.7 billion to \$170.4 billion (see **Figure 47**) during Q2 2022. These strong figures, together with the results of the 2022 Federal Reserve stress tests, reflect a benign lending environment, the substantial buildup of capital since the 2007-09 recession, and successful regulation and supervision of banks to restrain excess exuberance of these institutions in relatively good times. However, future headwinds include inflation, recession, emerging competition, and the ongoing Russian war against Ukraine, which may stress the financial strength of these institutions.

Evolving Market Conditions and Risks

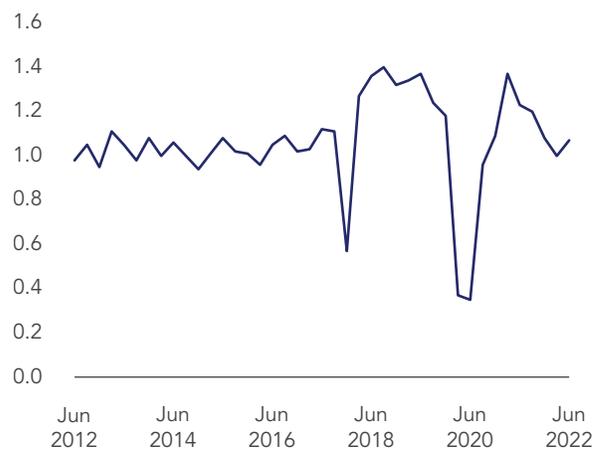
If the recent increase in inflation were to prove persistent, meaning if it were to continue over an 18- to 24-month period, this would likely be positive for bank profits overall. As a result of higher inflation, nominal gross domestic product growth would be stronger, driving up bank credit and revenues at a more rapid pace than implied by the consensus inflation outlook. However, these impacts would not necessarily be equally distributed; small

Figure 44. Depository Net Operating Income (\$ billions)



Sources: Federal Deposit Insurance Corporation, Office of Financial Research

Figure 45. Depository Return on Assets (percent)

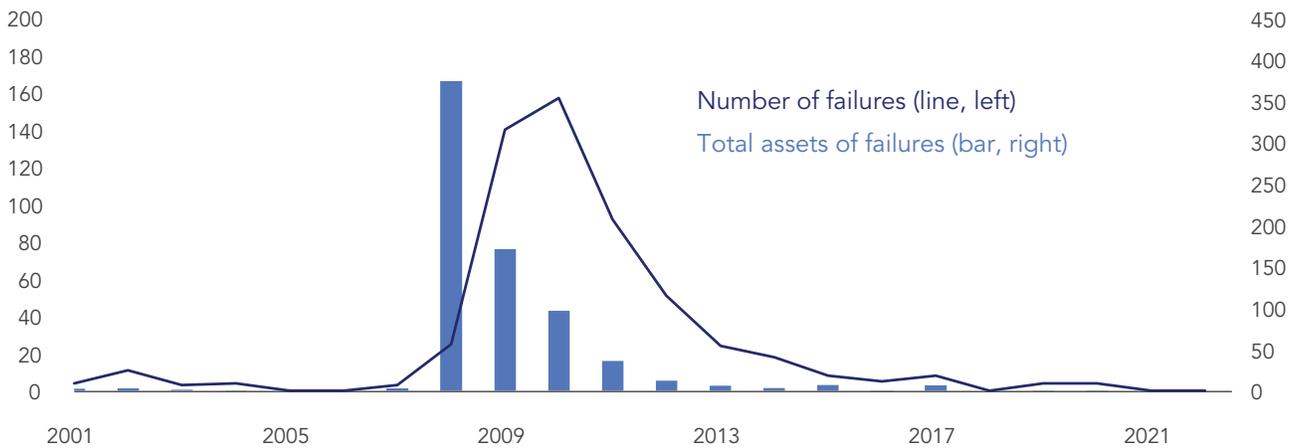


Sources: Federal Deposit Insurance Corporation, Office of Financial Research

banks are more sensitive to term structure shocks than larger financial institutions.

However, inflation could hurt bank profitability along two dimensions. First, noninterest expenses such as salaries and other operations costs could grow more quickly than revenues. During the 1960s and 1970s, escalating inflation pushed up

Figure 46. Number and Total Assets of Depository Failures (\$ billions)

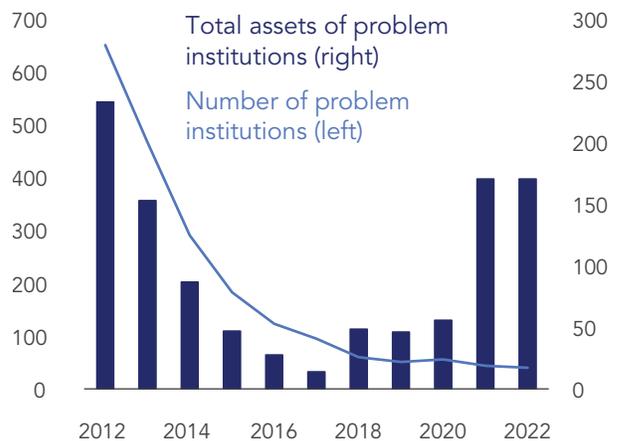


Sources: Federal Deposit Insurance Corporation, Office of Financial Research

noninterest bank costs relative to revenue, cutting into profits. However, at that time, banking business models were more labor-intensive, labor unionization rates were higher than today, and globalization was not sufficiently entrenched to restrain wages. Second, higher prices could erode the value of real wages and savings, reducing household purchasing power and consumption.

In the case of a financial downturn, whether driven by inflation or other factors, bank consumer and business lending product growth and the credit quality of debt would decline. Moreover, should a recession linger, a feedback loop could occur as loan losses incentivized banks to tighten lending requirements and restrict credit. This could exacerbate a recession, forcing banks to reduce credit further. Although a prolonged recession could negatively affect bank profitability and reported capitalization, banks are better positioned today to withstand an economic downturn than in prior recessions, as reflected in the 2022 Federal Reserve stress test results.

Figure 47. Number and Total Assets of Problem Banks (\$ billions)



Sources: Federal Deposit Insurance Corporation, Office of Financial Research

The growth of fintech firms, standalone, and subsidiaries of other financials like brokers and specialty lenders signal emerging competition for traditional lenders. Many new entrants into the financial services markets offer their products online, reducing the need for and costs of a brick-and-mortar operation and allowing fintech firms to pay higher rates on deposits. The pandemic further accelerated the fintech industry's growth

as customers shifted away from brick-and-mortar operations and toward digital channels. In addition, these firms may not be subject to many types of financial services regulation with which incumbent financial service providers must comply.

Finally, despite the uncertainty regarding the duration and outcomes of the ongoing Russian war against Ukraine, future vulnerabilities of the banking sector appear to be limited. Before the war, most U.S. banks maintained relatively small footprints in Russia, and their outstanding loans to Russian borrowers were small. That said, the war impacted banks indirectly by virtue of volatility and disruptions in multiple economic sectors. For instance, although there is ongoing volatility of commodity prices and there has been a marked increase in larger banks' exposures to active counterparties in these markets, banks appear to have managed risks effectively thus far. There is also the risk to emerging sovereign borrowers, who now have to pay much higher prices to commodity producers, thus stressing their fiscal positions. Several other indirect channels could also present certain banks with risks, including:

- heightened volatility in asset markets;
- disruptions in payment, clearing, and settlement systems due to sanctions; and
- interconnections with large European banks, which could be adversely affected by the effect of the Russian war against Ukraine on the European economy.

Insurance

While the insurance industry has not been immune to the stresses of 2022, it is unlikely to meaningfully affect the U.S. financial system's near-term stability. Yet, there remain important issues impacting the insurance industry, including:

- changes in insurers' investment policies as interest rates rise and fall,
- rising claim costs due to inflation,
- increased life sector involvement by private equity-affiliated insurers, and
- the increasing stress on the ability of the private insurance industry to cover large and growing risks.

Since the 2007-09 financial crisis, insurers' financial performance has been negatively affected by historically low interest rates. Low rates reduced insurers' profitability by depressing their investment income. Insurers responded by assuming credit, liquidity, and other risk-on investing through less liquid and sometimes more complex securities, such as collateralized loan obligations (CLOs).⁸¹ Bond holdings remain the largest share of life insurers' investments, but this share declined while those of mortgage loans and alternative investments increased (see **Figure 48**). Insurers also increased their borrowings from the Federal Home Loan Banks (FHLBs), increasing the two sectors' interconnectedness. In many cases, these FHLB advances are reinvested in other higher-yielding assets in a spread arbitrage.

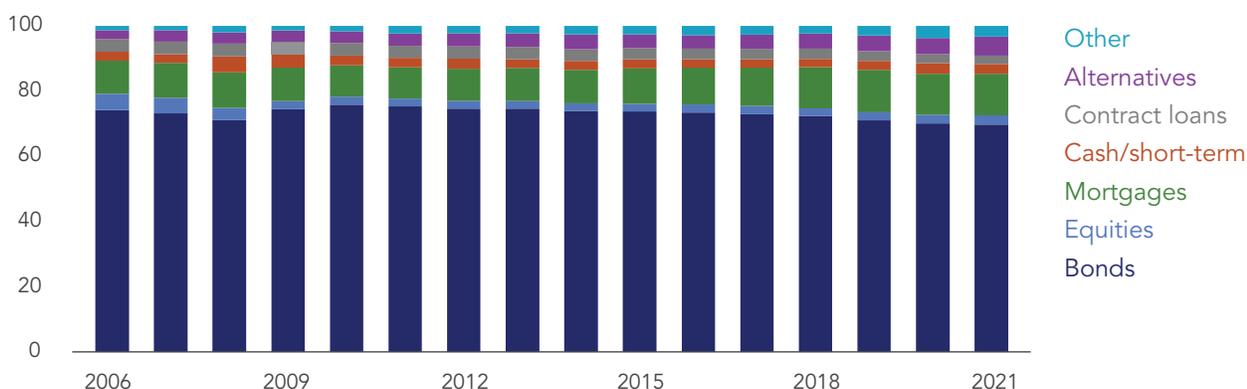
For many property and casualty (P&C) insurers, much of this investment income benefit has been offset by rapidly rising

inflation-driven claim costs, especially in property-focused lines such as automobile and homeowners' insurance. These changes include economic inflation and social inflation. Unexpectedly rapid increases in labor and material costs resulted in repair or replacement costs for damaged property exceeding expected claim costs. That has begun to impact insurers' earnings, leading to large premium rate increases and more conservative underwriting. To date, this has been limited to an earnings event for the impacted insurers and has not called into question their solvency. Moreover,

today's U.S. P&C industry has over \$1 trillion in capital, so it has ample capacity to pay these claims and those that might arise from a major natural catastrophe.⁸² In comparison, the largest natural catastrophe inflation-adjusted insured loss ever incurred by the U.S. P&C sector was \$136 billion for all of 2005, which was predominantly a result of Hurricane Katrina.

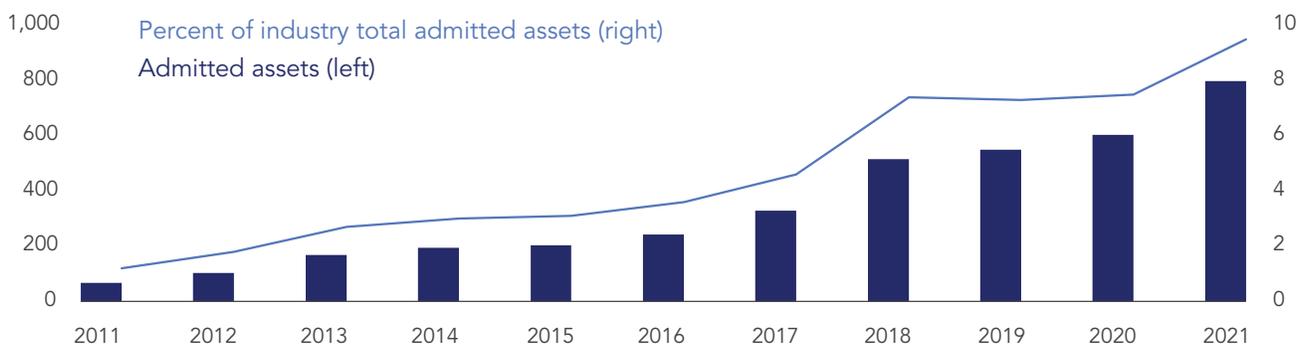
Private equity (PE)-affiliated insurers rapidly grew their presence in the life sector, reaching almost 10% of industry assets (see **Figure 49**). PE firms participate in the life insurance industry

Figure 48. Life Insurers' Investment Portfolios (percent)



Sources: S&P Global Market Intelligence, Office of Financial Research

Figure 49. Private Equity-Affiliated Life Insurers' Admitted Assets (\$ billions, percent)



Note: Data as of May 16, 2022.

Sources: A. M. Best, Office of Financial Research

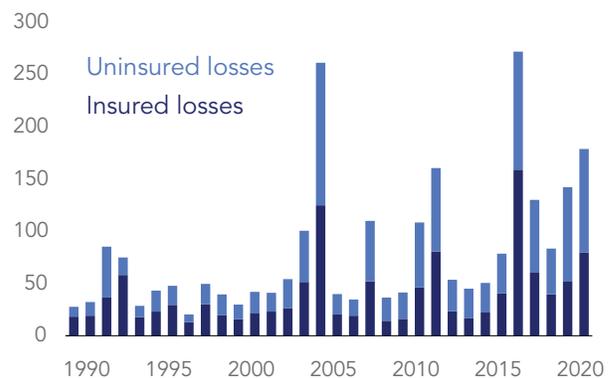
to obtain liabilities, such as annuities backed by insurance reserves. The PE-affiliated insurers then invest these funds in less traditional but higher-yielding assets.⁸³ This business growth occurred through multiple channels, including the acquisition of insurers, assuming existing business through reinsurance, and writing new business. Much of this business is eventually reinsured offshore, typically to Bermuda-based reinsurers. In addition, insurers owned by PE firms have been actively developing new investment approaches designed to improve portfolio returns, with PE-affiliated life insurers having a 74-bps yield advantage over the total life insurance industry at year-end 2021.^{84 85}

In 2022, the private insurance industry found it increasingly challenging to cover some of the largest and most important risks presenting catastrophic risk exposures. This has left those risks uninsured or substantially backed by other risk management mechanisms. U.S. local and federal governments have often become primary insurers of such risks, including terrorism, flood, and earthquake. Other risks, such as the Florida hurricanes and California wildfires, are increasingly uninsurable by the private insurance sector. In addition, the insurance sector is unable to cover future pandemic-related risks, leaving a large coverage gap in markets such as business interruption insurance.

Florida homeowners' risk, which includes wind damage coverage, is a good example of a trend to increasingly rely on governmental support to obtain insurance against the most challenging risks. The state of Florida is currently involved in underwriting homeowners' risks through

three different channels as the private sector continues to reduce its exposure. This lack of coverage availability for the most severe weather and climate risks is increasingly problematic because the frequency and severity of losses continue to grow (see **Figure 50**). This has been especially difficult in Florida. According to Moody's, "the combination of significant Hurricane Ian losses, poor historical operating results, deteriorating capitalization, and higher reinsurance costs may contribute to additional insolvencies among Florida-only insurers over the coming year."⁸⁶ Through September 2022, six Florida homeowners' insurers became insolvent.⁸⁷ In effect, the State of Florida is now the insurer of much of Florida's hurricane risk.⁸⁸ This coverage gap may eventually have wider ramifications because the lack of affordable, widely available property insurance may eventually negatively impact the value of Florida residential real estate and buyers' ability to finance purchases with loans

Figure 50. Incurred Losses from U.S. Weather and Climate Disaster Events (\$ billions)



Note: Losses in constant 2022 dollars. Disasters include tropical cyclones, severe thunderstorms, flooding, wildfires, drought, and winter weather.

Sources: Aon, Office of Financial Research

guaranteed by Fannie Mae and Freddie Mac (the Enterprises). Florida has even taken the extraordinary action of effectively guaranteeing a troubled local insurer to keep its property coverage eligible under the Enterprises' mortgage guidelines.⁸⁹

Asset Management

Open-end mutual funds (including exchange-traded and money market funds) supply substantial investment capital to the U.S. financial system. Many funds share maturity and liquidity transformation characteristics of banks in that they offer daily liquidity to fund investors while holding assets that can take longer to sell in an orderly way. However, unlike banks, these funds generally do not have access to lender-of-last-resort facilities.⁹⁰ Given that open-end funds lack this guaranteed backstop and many have a structural liquidity mismatch, these funds may be vulnerable to runs in a period of heavy redemptions that reduce credit supply and amplify stress.

Although these funds did not cause the acute financial market stress of March 2020, this period highlighted the potential for funds to amplify liquidity and valuation pressures in the financial system through their structural vulnerabilities. Elevated redemptions from open-end funds show the potential for these vehicles to create risks to financial stability. In addition, many open-end funds experienced a broad decline in portfolio values and assets under management during the first nine months of 2022, driven by uncertainty regarding geopolitical conflict, inflation, and the impact of monetary policy responses on financial markets.

Monetary policy is regarded as a driver of financial cycles, and U.S. bank balance sheets are historically viewed as the main provider of credit and transmitter of financial conditions. However, banks' share of U.S. financial sector assets declined over the past decade (see **Figure 51**). Instead, the Federal Reserve Financial Accounts data show capital financing increasingly shifted to the nonbank channel, particularly the open-end fund channel.⁹¹

The mutual fund sector has grown enormously over the past three decades. In 1994, the mutual fund sector accounted for 10% of the \$21.8 trillion in financial-sector assets, but in Q1 2022, the sector accounted for 25% of the nearly \$132 trillion in assets. Moreover, as the industry's overall size grew, the fraction of less-liquid holdings also grew.^{92 93} Thus, shocks that result in elevated investor redemptions can have broader financial and economic implications, due to the large size and intrinsic link to financial markets of money market, open-end, and exchange-traded bond funds.

Money Market Funds

Money market funds (MMFs) are generally perceived to offer the preservation of capital and liquidity in normal market environments. They are viewed as an alternative to bank deposits and used as a cash management tool by investors. However, MMFs shares are not cash equivalents to the extent that they invest in certain securities that cannot be easily liquidated at par in all markets. They also do not carry the same protections as cash equivalents. Some assets held by MMFs have limited secondary market liquidity and are often held to

Figure 51. Financial Intermediation (\$ billions, percent)

	1994 (\$ billions)	2008 (\$ billions)	2021 (\$ billions)	Percent of Total Financial Sector Assets 2008	Percent of Total Financial Sector Assets 2021	CAGR: 2008-2021 (percent)	CAGR: 1994-2021 (percent)
Total Financial Sector Assets	21,762	69,758	135,249			5	7
Monetary Authority	452	2,271	8,911	3	7	11	12
Depository Institutions	5,143	14,424	25,628	21	19	5	6
Insurance Companies¹	2,532	6,415	12,963	9	10	6	6
Open-end Mutual and Exchange-traded Funds²	2,156	10,152	34,605	15	26	10	11
Money Market Mutual Funds	611	3,832	5,205	5	4	2	8
Bond Funds³	529	1,570	5,625	2	4	10	9
Exchange-traded Bond Funds⁴		57	1,227	0	1	27	
Closed-end Funds	118	184	310	0	0	4	4
Private and Public Pension Funds	5,981	13,479	27,615	19	20	6	6
Defined Contribution Funds	3,101	7,793	18,742	11	14	7	7
Government-sponsored Enterprises (GSE)⁵	782	3,363	8,304	5	6	7	9
Agency- and GSE-backed Mortgage Pools	1,472	4,961	2,502	7	2	-5	2
Asset-backed Securities Issuers	536	4,227	1,361	6	1	-8	4
Other Financial Institutions⁶	3,125	14,508	14,411	21	11	0	6
Rest of the World	2,829	13,947	47,518	20	35	10	11

Note:

1 Includes separate account assets.

2 Open-end investment companies; excludes funding vehicles for variable annuities, which are included in the life insurance sector.

3 Bond Funds exclude hybrid and other funds with debt security holdings. It also excludes other funds that hold debt securities.

4 Excludes other funds with debt security holdings.

5 Includes Federal Home Loan Banks.

6 Includes asset-backed securities issuers, real estate investment trust companies, securities brokers and dealers, holding companies, funding subsidiaries, and custodial accounts for reinvested collateral of securities lending operations.

Sources: Federal Reserve Financial Accounts of the United States, Investment Company Institute, Haver Analytics, Office of Financial Research

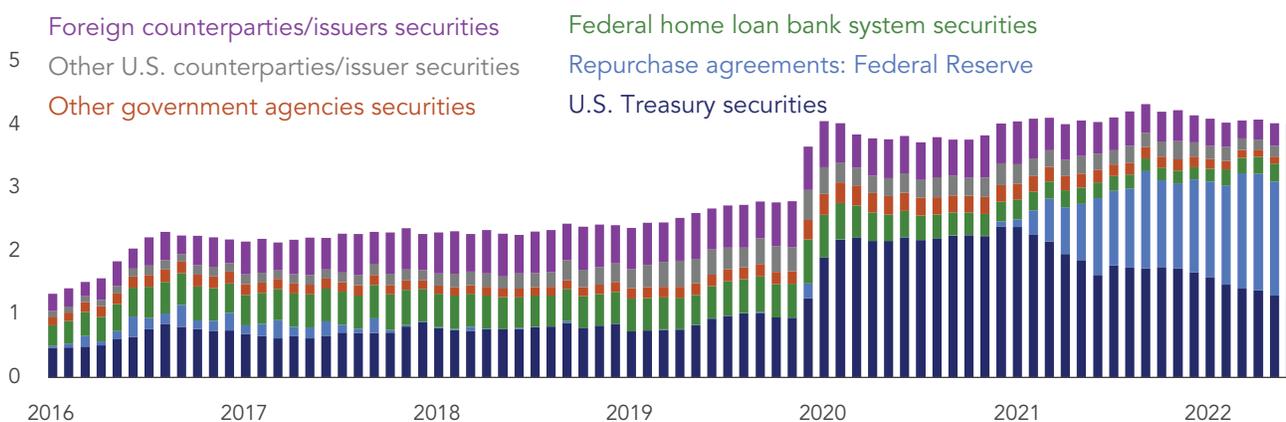
maturity. The limited liquidity of many money market instruments creates a first-mover advantage that generates run risk whenever investors believe conditions are deteriorating, which can exacerbate moves in asset prices.

Banks, particularly foreign-owned banks (FOBs), are large funding recipients of prime and government funds. On average, 60% of credit provided by prime funds and 20% provided by government funds was to FOBs since 2016 (see **Figures 52a** and **52b**). This creates cross-border

vulnerabilities, where shocks in both directions can quickly transmit stress across jurisdictions. A related vulnerability is that government MMFs often enter into repurchase agreements with non-U.S. counterparties and purchase Federal Home Loan Bank System debt, exposing MMFs to cross-border and counterparty risks.⁹⁴

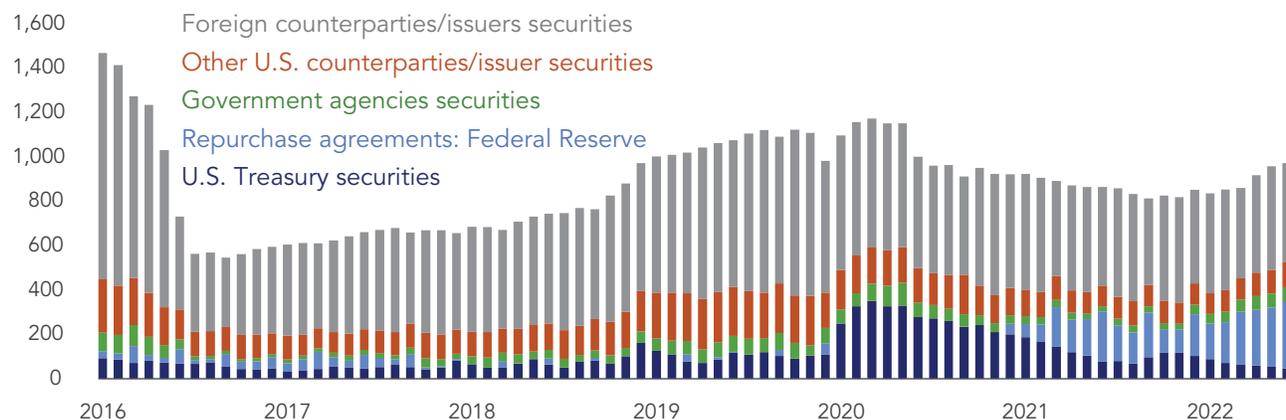
In December 2021, the SEC proposed amendments to certain rules that govern money market funds under the Investment Company Act of 1940 (Release No. IC-

Figure 52a. U.S. Government Money Market Fund Assets by Select Holding Types (\$ trillions)



Sources: Securities & Exchange Commission Form N-MFP, Office of Financial Research

Figure 52b. U.S. Prime Money Market Fund Assets by Holding Types (\$ billions)



Sources: Securities & Exchange Commission Form N-MFP, Office of Financial Research

34441).⁹⁵ The proposed amendments are intended to improve money market fund resilience and transparency while preserving the core attributes of money market funds.⁹⁶ If adopted as-is, the proposed amendments would:

1. Remove the ability of MMFs to impose liquidity fees and redemption gates when they fall below certain liquidity levels;⁹⁷
2. Require swing pricing specifically for institutional prime and tax-exempt MMFs when the funds experience net redemptions, so that redeeming investors bear the liquidity consequences;⁹⁸ and
3. Increase the minimum liquidity requirements applicable to money market funds to provide a more substantial buffer for rapid redemptions.

While the proposed rules bolster liquidity and shift the liquidity costs of redemptions to redeeming investors, the proposals may not discourage outflows in the tail scenarios that prompted the proposed rules. First, though increasing the liquidity requirements would better position funds to meet redemptions, the lessons from March 2020 may underestimate future risk without similar interventions from the Federal Reserve and the U.S. Treasury. Second, swing pricing may not avert run risk if investors preemptively redeem to benefit from disposing of their shares at the initial net asset value (NAV). This is because that NAV does not reflect the costs of the managers having to potentially sell additional assets at discounted prices to meet additional redemptions. Similar to the fears of

redemption rates, MMFs investors may be concerned about absorbing the costs of a fund manager's sudden forced sales. They may preemptively decide to try and sell first—in the process, creating a feedback loop. Third, certain types of MMFs, such as government funds and select retail funds, are exempt from some proposed requirements. However, these types of funds are still susceptible to interest rate, duration, and credit risks and, in turn, to run risk.⁹⁹ Fourth, many underlying money market instruments held by MMFs have limited secondary market liquidity, which may amplify stress if fund managers are forced to sell these instruments instead of holding them to maturity. And lastly, as noted in the 2020 OFR Annual Report, sponsor support is commonly used to prevent runs, but there is no certainty about the availability or magnitude of sponsor support in future stress periods. This lack of certainty may generate incentives for fund investors to run.¹⁰⁰

In addition, the 2021 OFR Annual Report noted that other cash alternative funds also experienced heavy outflows, contributing to the stress in the funding markets in March 2020.¹⁰¹ This included dollar-denominated offshore MMFs, bank-managed short-term investment funds (STIFs), local-government investment pools (LGIPs), private liquidity funds, and ultra-short corporate bond mutual funds. These funds serve a similar purpose as MMFs but are subject to varying degrees of regulatory oversight and portfolio transparency. Arguably, investors in these products are inclined to run when markets are under severe stress.

Open-End Mutual Funds

Open-end bond mutual funds share some similar inherent structural vulnerabilities as money market funds because they offer daily redemptions to fund investors while holding relatively less-liquid debt securities that may be challenging to sell in stress periods. In general, the limited liquidity of bond fund holdings is a product of broader liquidity concerns in U.S. bond markets, because most U.S. debt securities are traded over-the-counter, are transacted less frequently (except for U.S. Treasuries), and rely on dealer intermediation. These liquidity concerns explain both the appeal and the risks of bond funds, namely, that bond funds offer a more liquid alternative that is only possible because these funds engage in liquidity transformation.

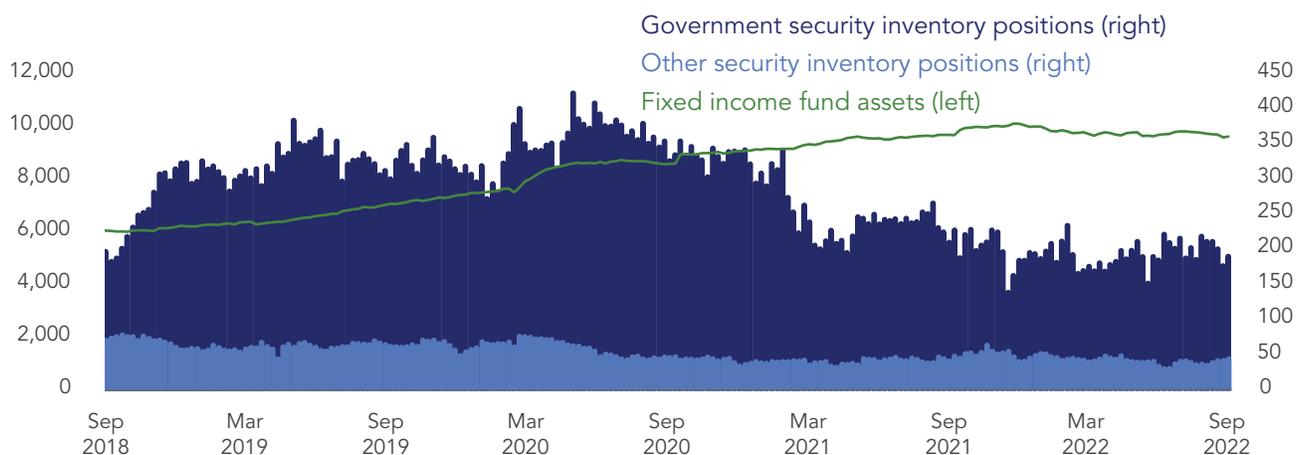
This liquidity mismatch can incentivize investors to redeem ahead of others (rendering these funds vulnerable to panic-based runs) in the face of a negative shock, such as a sharp, unexpected

change in interest rates or a large credit or geopolitical development.¹⁰² In addition, this liquidity mismatch can be exacerbated by dealers' shrinking securities inventories, particularly in over-the-counter fixed-income securities, relative to the growth in open-end fund assets (see **Figure 53**).

Bond funds, including bond exchange-traded funds (ETFs), supply more than \$6 trillion in financing to U.S. financial sector assets, more than four times their level in 2008 (see **Figure 51**). In comparison, depository institutions supply \$26 trillion in financing, less than double their level in 2008. Moreover, primary dealers' securities inventories declined during this period. The reduction in dealers' inventories and their market making implies that market liquidity could be scarcer in periods of stress.¹⁰³

In addition to liquidity and credit concerns, bond fund flows are sensitive to movements in interest rates. When interest rates are higher, prices of existing

Figure 53. U.S. Primary Broker-Dealer Security Inventory Positions and Bond Fund Assets (\$ billions)



Note: Fixed-income fund assets exclude funds that only report assets monthly or quarterly. Bond Fund assets include money market fund assets.

Sources: Morningstar Direct, Bloomberg Finance L.P., Office of Financial Research

bonds decline to compensate for the lower interest rates investors earn on them compared to new debt issuance. As shown in **Figure 54**, flows generally are high during bond market expansion when interest rates are falling and the spread between 2- and 10-year Treasury rates is rising. Conversely, bond fund flows are typically low when interest rates are rising and the spread between 2- and 10-year Treasury rates is declining.

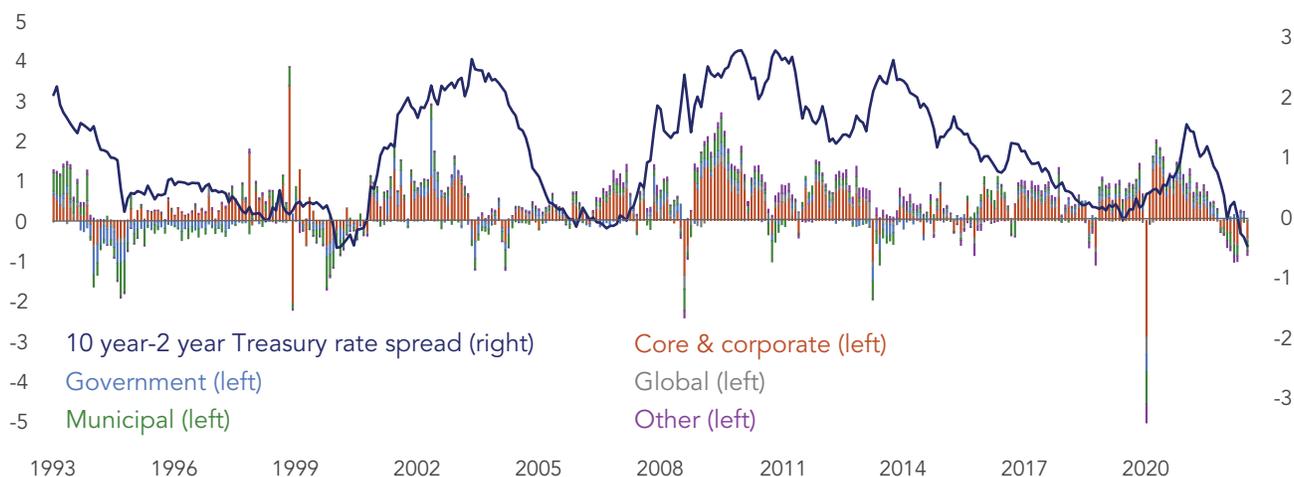
The Federal Reserve is raising interest rates to tamp down inflation and normalizing its balance sheet by withdrawing liquidity from the financial system. The previous two quantitative-tightening cycles occurred in a steady, predictable fashion, and balance sheet normalization was mostly a drawn-out process.

However, Russia’s war against Ukraine, which began in February 2022, aggravated bond fund investors’ concerns about their investments, such as rising inflationary pressures, uncertainty about the Federal Reserve’s future actions, and the resulting

impacts on asset values and fund returns. Aggregate U.S. direct exposure to Eastern Europe is small and mostly held in emerging-market funds and a few bond funds, according to Morningstar Direct data. However, the full extent of the broader, indirect economic impact on rising inflationary pressures could pose stability risks if investors redeem holdings in fear of further interest rate hikes and bond price declines. Consequently, elevated redemption rates could amplify the risk of widespread price volatility in the bond markets.

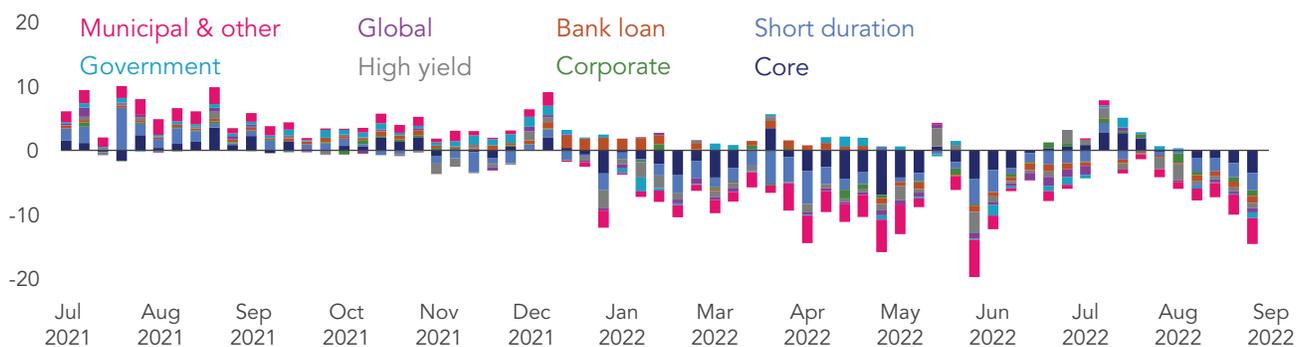
Year-to-date, bond funds (including traditional open-end bond mutual funds and bond ETFs) have recorded aggregate net outflows of \$271 billion total, or about 4.1% of total assets (see **Figures 55a** and **55b**). This level of aggregate outflows relative to the beginning-of-year total assets appears in line with that observed in previous periods of sharp policy rate hikes (see **Figure 54**) but below that observed in the March 2020 stress period. Despite the sizable fund outflows year-to-date,

Figure 54. Bond Fund Asset Weighted Monthly Flow Rate and the 10-2 Year Treasury Rate Spread (percent)



Sources: Morningstar Direct, Bloomberg Finance L.P., Office of Financial Research

Figure 55a. Weekly Open-end Bond Fund Flows by Investment Category (\$ billions)



Note: Excludes funds (roughly \$1.9 trillion or 37% of industry assets) that only report monthly or quarterly.

Sources: Morningstar Direct, Office of Financial Research

Figure 55b. Weekly Exchange-traded Bond Fund Flows by Investment Category (\$ billions)



Sources: Morningstar Direct, Office of Financial Research

available data suggests the outflows have been orderly, and any outflow pressures have not escalated into liquidity stress.

It is not uncommon for ETFs that hold less-liquid or illiquid assets, including some bond ETFs, to trade at a discount or premium to the portfolio's NAV. However, unlike traditional open-end bond mutual funds, most bond ETFs depend on large financial intermediaries, called *authorized participants* (APs), to arbitrage any discounts or premiums. While APs are granted special privileges with the fund sponsor, APs have no legal obligation to exercise these privileges.

In normal market conditions, the arbitrage mechanism (also referred to as the primary market creation and redemption mechanism) tends to minimize discrepancies between an ETF's price and its NAV, due to APs' ability to capture arbitrage profits. However, discounts or premiums can be pronounced during periods of elevated stress.¹⁰⁴

Year-to-date through September 2022, U.S.-domiciled bond ETFs saw \$123 billion in net inflows, a stark contrast with the pattern of outflows observed in traditional open-end bond mutual funds.¹⁰⁵ Bond ETF investors are usually drawn to the

intraday liquidity typically offered by these vehicles.¹⁰⁶ However, given that APs can step away from the market, intraday liquidity can dry up in periods of distress. Research shows that ETF share prices deviated from their net asset values, and the resulting discounts were not arbitrated away by the APs in early March 2020. The discounts to net asset values and investor redemptions persisted until the Federal Reserve intervened on March 23, 2020. The central bank's announcement that it would support corporate bond and ETF markets helped to stabilize the significant dislocation between ETF share prices relative to the underlying net asset values. This also tempered heavy bond fund investor redemptions.¹⁰⁷ OFR research shows that the Federal Reserve's subsequent purchase of corporate bonds in May 2020 supported APs' balance sheets, even after the March announcement. This suggests that APs' balance sheet capacity improvements can have positive spillover effects on bonds beyond those directly targeted by policy intervention.¹⁰⁸

While there is no visible evidence that U.S. open-end bond funds outflow pressures have escalated into liquidity stress, market fragility has risen. Liquidity is also discontinuous, can change quickly, and is often one-sided in periods of stress. Moreover, prior periods of rising interest rates occurred when bond funds had a much smaller presence in debt markets and when dealer inventories—a core indicator of their capacity to intermediate in the fixed income market—were much greater. Open-end fixed-income funds accounted for more than 17% of U.S. debt securities at the end of 2021, compared to 12% in 1993, and the portion of corporate

debt held by mutual funds has also been growing steadily; in 2021, open-end and exchange-traded funds owned roughly 23% of outstanding balances, up from 9% in 2008 and 7% in 1993.¹⁰⁹ This combination of increased bond market size, increased debt holdings by open-end mutual funds, and dealers who may be less inclined to commit capital to market making in periods of market uncertainty imply that a future market downturn or surprise could prompt larger fire sales and greater financial fragility.

Hedge Funds

Hedge funds engage in various trading strategies to maximize risk-adjusted returns for their investors. Due to the leverage and interconnectedness of many of their strategies, along with the limited regulation of the industry, hedge funds are a potential source of risk to financial stability. Since the market downturn in March 2020, hedge fund leverage and asset class exposures have grown significantly, although these increases have moderated in the past year. While many hedge funds seek to mitigate the sensitivity of their performance to adverse market movements, certain fund classes cannot when they arise from inflation (i.e., equity-focused funds).

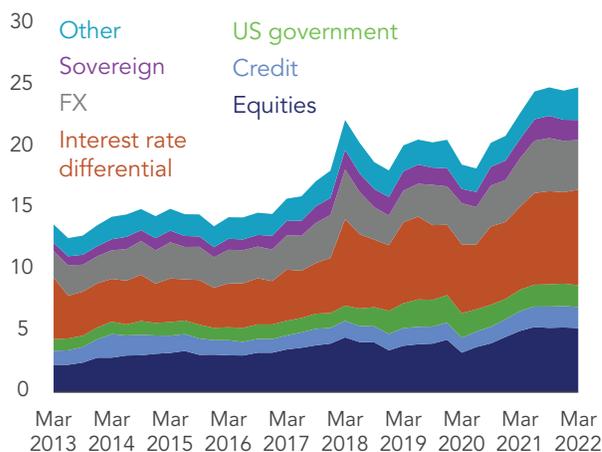
One gauge for hedge fund risk appetite is the industry's total gross notional exposures (GNE). GNE captures the absolute value of long and short positions in respective asset classes, including derivatives. Following the industry's adverse performance in March 2020, hedge fund exposures to risky asset classes have continually risen until mid-2021. Subsequent to the rise, the growth

rate of exposures has leveled off, as shown in **Figure 56**. While some of these effects might be due to movements in market valuations, the leveling off has mostly occurred in the equity, U.S. debt, foreign exchange, and sovereign debt categories. As seen in the figure, equity exposures were down 1.50% from their peak in June 2021. Meanwhile, foreign exchange and sovereign exposures are down 5.3% and 5.7%, respectively.

As hedge funds reduced their exposures to certain asset classes from late 2021 to early 2022, performance also cooled off across several fund strategies. According to size-weighted performance data from Hedge Fund Research, the overall hedge fund industry declined 4.0% from June 2021 through August 2022. While macro funds yielded 8.4% in returns over the same period, they are very much an outlier. Funds with equity-focused strategies saw the largest losses, declining 10.2%, and other risk-sensitive fund classes, such as event-driven funds, also fared poorly. In addition, several issues continue to plague markets (e.g., inflation pressures, increasing interest rates, recession concerns), and market commentators worry that institutional selloffs might lead to further deterioration.

Leverage in the hedge fund industry poses a risk to financial stability through potential fire sale risks and counterparty spillovers in the event of a crisis. As leverage use varies by strategy type and larger funds pose greater systemic importance, it is essential to account for both of these characteristics appropriately. **Figure 57** displays average leverage by strategy type, where larger-sized funds are given greater weight within a strategy, and the value

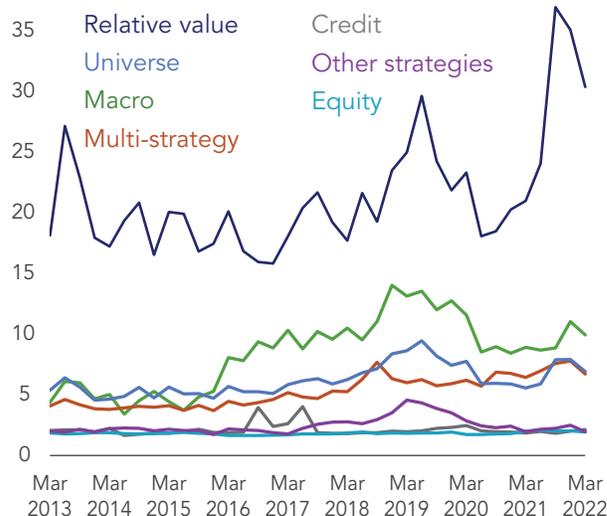
Figure 56. Gross Notional Exposure (\$ trillions)



Note: Data as of Q1 2022. Exposures represent the value of long plus the absolute value of short notional exposures as reported on Form PF Questions 26 and 30 (excluding repo positions).

Sources: SEC Form PF, Office of Financial Research

Figure 57. Leverage by Strategy (ratio)



Note: Data as of Q1 2022. Leverage is defined by the ratio of gross to net assets, as reported in Questions 8 and 9. A weighted average of leverage, by gross assets, is reported for each strategy.

Sources: SEC Form PF, Office of Financial Research

of gross assets over net assets measures leverage. Overall, hedge fund leverage saw a spike in the last half of 2021 but has since declined from 7.9 to 6.9. The largest reductions were found in relative-value funds, which cut balance sheet leverage from 37.0 to 30.4, and macro funds, which reduced from 11.0 to 9.9. Leverage is generally concentrated in a small number of funds, so large declines in overall borrowing can primarily result from the activity of a small set of hedge funds.

As part of their explicit investment strategy, hedge fund managers often seek to ensure that their investors are hedged against broad macroeconomic risks. In the present environment, however, inflation poses a significant risk to fund valuations. As inflation rises, nominal discount rates can increase due to monetary policy or risk premia effects, potentially causing asset valuations to drop and borrowing costs to rise. Moreover, inflation can affect valuations through growth. As a result, asset classes held by hedge funds and sensitive to growth concerns (e.g., equities or credit) might falter in a heightened-inflation scenario.

Historically, broad market returns (e.g., S&P 500) have been negatively correlated with inflation. For example, a regression of broad market returns on quarterly changes in inflation over the last 32 years suggests that market returns decline a quarter of a percent, on average, following a 1% increase in quarterly inflation. After 2010, these negative sensitivities only picked up in magnitude.

Based on returns data from Hedge Fund Research, one can also conclude that hedge fund performance is correlated

with inflation at a lower rate. The lower magnitude is partially reflective of the industry's hedging capacity. As different fund types execute different trading strategies, funds can vary in their degree of inflation sensitivity. For example, macro and relative-value funds display a low absolute sensitivity to inflation. Meanwhile, equity and event-driven funds are much more exposed. Understanding this heterogeneity is important when considering potential financial stability concerns in response to adverse inflation news.

Central Counterparties

Central counterparties (CCPs) clear a wide variety of financial instruments, including derivatives, equities, and futures, on behalf of members and their clients. Since the 2007-09 financial crisis and subsequent regulatory reforms, firms have become increasingly incentivized to use CCPs instead of bilateral contracts, making them key actors in the global financial system. CCPs can reduce contagion by shortening intermediation chains and providing greater scope for the netting of counterparties' positions. They also create greater transparency and incentivize the standardization of contracts. However, a potential disadvantage of central clearing is that risk is concentrated in a few critical counterparties whose default could have a major impact on the financial system.

In February and March 2022, the surge in commodity prices following Russia's war against Ukraine forced several commodity-focused CCPs to raise initial margins on a variety of commodity contracts. The increases were greatest in Europe, where margins nearly doubled compared to

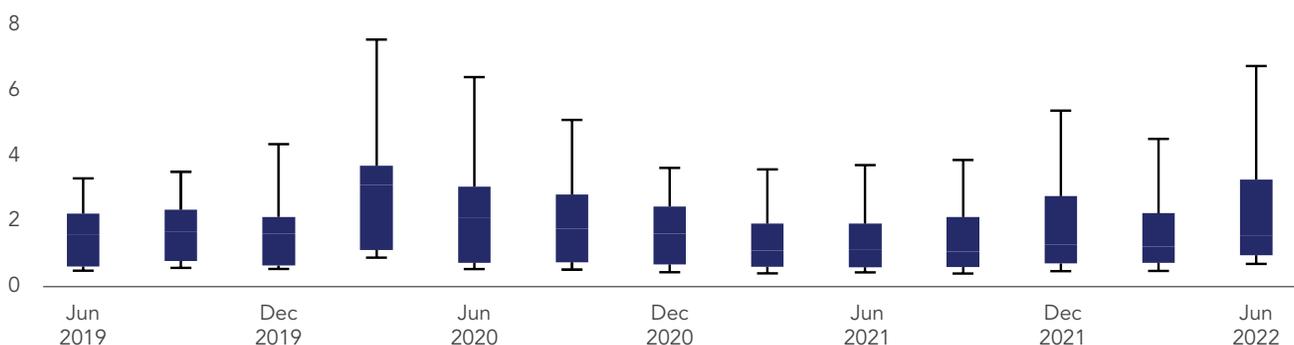
the prior year’s average. In the U.S., by contrast, initial margin increases at commodity CCPs were on the order of 20%-30%. The sudden increase in volatility might have led to even larger increases, were it not for the residual effects of market volatility in early 2020, which led CCPs to maintain high resource levels in the U.S. due to the lengthy lookback period of their risk models.

Although increased margin demands may have put a temporary strain on the liquidity of some members, the resulting elevated levels of posted collateral can aid in easing concerns about potential CCP defaults going forward. Evidence for this claim comes from the Federal Reserve’s Comprehensive Capital Analysis and Review data collection, which contains quarterly estimates of the probability of default as provided by the members of each CCP. **Figure 58** shows the range of default estimates for all commodity CCPs (i.e., foreign and domestic) over the past 13 quarters. Over the past year, the median estimated risk of default remained steady at about 1%. This compares with a median estimate of about 3% in Q2 2020, when the COVID-19 pandemic severely stressed markets.

Demands by CCPs for increased initial margins can impact liquidity in the financial system. Some of these impacts are temporary, as initial margin payments make their way back into the financial system through CCP investments in overnight repo agreements and sovereign debt purchases.¹¹⁰ However, a longer-term drain on liquidity can occur if CCPs shift the margin into central bank deposits. Just such a shift occurred in recent quarters for some major CCPs. This trend can be seen in the resources held by CME Clearing over the past several years (see **Figure 59**). From September 2019 to March 2022, the amount of cash held in CME Clearing’s central bank accounts increased fivefold, from under \$25 billion to over \$150 billion.

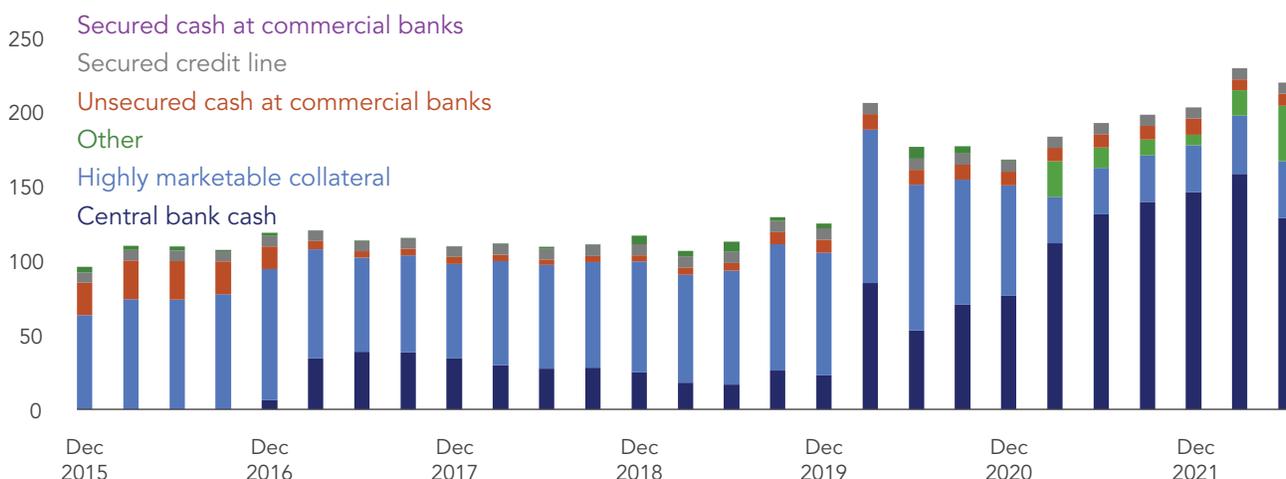
Moreover, the proportion of liquid resources held at the central bank grew from under 20% to over 70%. This amounts to a large shift away from U.S. Treasuries and repo markets. While these actions help to fortify the ability of the CME to fulfill payments, if this trend is mirrored at other CCPs, it could effectively reduce the total amount of liquidity in the financial system because the cash is not being redeployed.

Figure 58. Global Commodity CCP Default Risk Estimates (percent)



Sources: Federal Reserve-Y14-Schedule L, Office of Financial Research

Figure 59. CME Clearing’s Liquid Resources (\$ billions)



Sources: Clarus CCPView, Office of Financial Research

Despite the sudden increase in margins in February and March 2022, there were no reported defaults by CCP members or their clients and very few serious disruptions. One exception was the London Metal Exchange’s (LME) nickel market closure for a week, due to the prospect of restrictions on Russian metal exports. On March 7 and 8, the price nearly tripled, from an opening price of \$29,770 per metric ton on March 7 to a high of \$101,365 per metric ton on March 8, an order of magnitude higher than the prior two-day price moves. This made the existing margin charges of \$2,000 per metric ton insufficient to cover the CCP if there were a default. As prices surged, the exchange decided to close the market and cancel some trades rather than risk default by several of its members and their clients. This incident is similar to the near collapse of the NASDAQ OMX electricity market in 2018. In that case, a single member accumulated a massive derivatives position that their initial margin could not cover when prices moved against them. In the latter case, the market remained open, but the member’s

positions were closed out, and the other members were forced to contribute more to the guarantee fund to ensure that the shortfall could be covered.

The LME’s nickel market closure highlights areas where commodity CCPs may be subject to heightened risk factors. First, price volatility in commodities is often significantly higher than in other product classes and requires correspondingly large initial margins to protect against potential default. Second, the diversity of hedging instruments used by commodities trading firms is relatively wide, with positions potentially held across multiple CCPs and in uncleared instruments with multiple intermediaries. This fragmentation in exposures can make it difficult, at times, to fully understand market and counterparty risks during periods of stress. With this opacity, it can be difficult for commodity CCPs and their regulators to fully assess the size and concentration of member and client positions and set margins accordingly. When margin calibrations do not fully represent the full spectrum of

correlated risks held by a participant, this could potentially lead to financial instability because unexpected liquidity demands could lead to rapid price shifts.

Digital Assets

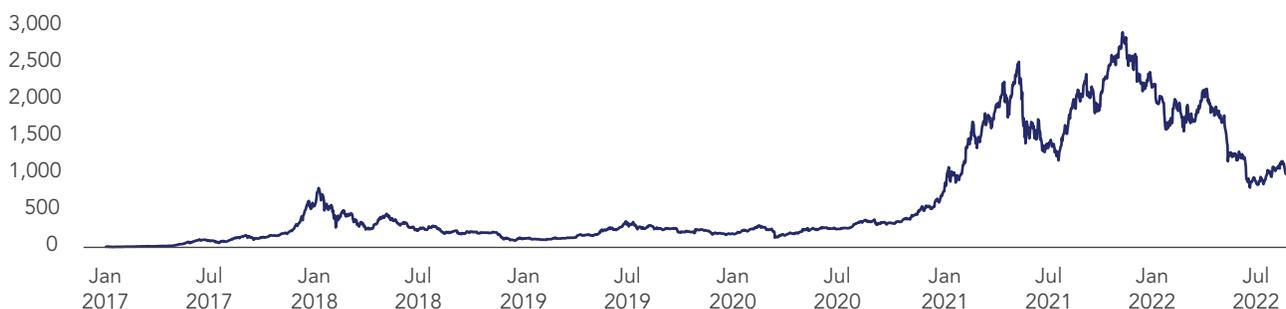
The first decentralized digital asset, Bitcoin, was introduced in 2008. Since then, digital assets—which include crypto assets and central bank digital currencies (CBDCs)—have grown substantially in total reported market capitalization and the sheer number and diversity of instruments. This growth has led to increased interest from both institutions and retail investors. The size and concentration of the digital-assets space makes it a potential financial stability risk, particularly if it continues to grow and if interconnectedness with the broader financial system increases. Adverse shocks to crypto asset companies in the first half of 2022 raised concerns about contagion risk associated with concentration among prominent digital asset players. The scope of spillovers into the traditional financial system remains an open question, although there is growing evidence of and concern about the level of interconnectedness between the two ecosystems. One

example of a salient financial stability risk that can stem from the digital-assets space is a run on *stablecoins*, a digital currency that is pegged to a stable reserve asset, which can potentially destabilize money markets.¹¹¹ Central bank digital currencies may also increase the risk of flight-to-safety episodes.

Crypto Assets

Crypto assets are private sector digital assets that depend on cryptography and whose prices are intended to either fluctuate freely (e.g., Bitcoin or Ether) or maintain a stable value relative to another asset (i.e., stablecoins). Overall, the market prices of crypto assets, especially non-stablecoin crypto assets, continue to be highly volatile, experiencing periods of rapid increase and sharp downturns. At their peak in November 2021, the total reported market capitalization of all crypto assets had increased by over 500% year-over-year to nearly \$3 trillion. By June 2022, however, the total reported market capitalization had fallen more than 70% from its peak (see **Figure 60**). In addition, this period saw several sharp downturns, including a decline of more than 25% over three days in January 2022. Further analysis suggests that reported market

Figure 60. Total Crypto Asset Market Capitalization (\$ billions)



Sources: Coinmarketcap.com, Office of Financial Research

capitalizations may overestimate the actual available supply of crypto assets. For example, there is evidence that 20% of the theoretical supply of bitcoin has been irretrievably lost.¹¹²

This price volatility observed over the year may reflect various factors, including uncertainty about the viability and pace of adoption of blockchain and distributed-ledger technologies, concerns over the regulatory treatment of digital assets across jurisdictions, and risks associated with manipulation, hacks, runs, rug pulls, and other kinds of fraud. In addition, the increased popularity of crypto asset derivatives and lending platforms has enabled higher degrees of leverage in the market, exposing market participants to margin calls and forced selling in response to price declines. Finally, crypto assets are generally not backed and do not represent a claim on any future cash flow, making their prices particularly susceptible to changes in sentiment.

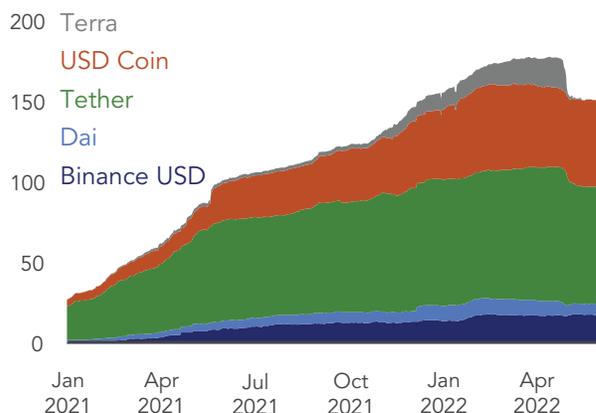
Ether (the native crypto asset on the Ethereum blockchain) and Bitcoin have the largest market share of crypto assets, but close to 20,000 others have been developed. While most of these assets have little or no value, more than 100 crypto assets had a reported market capitalization above \$1 billion each at the market's peak in November 2021.¹¹³ Despite the significant growth in their total market cap, crypto assets remain a small part of the overall financial system. The total reported market capitalization of all crypto assets represents less than 1% of the size of the global financial system.¹¹⁴

Stablecoins

Stablecoins are crypto assets that aim to maintain a constant value relative to an existing currency or asset, often the U.S. dollar. Stablecoins play at least two key roles within the digital-asset ecosystem. First, they serve as a blockchain-native means of payment and a short-term store of value. This role facilitates trading, as evidenced by the fact that the most common activity on centralized crypto assets platforms is trading a stablecoin for another digital asset.¹¹⁵ In addition, stablecoins are increasingly used in borrowing and lending arrangements; for example, stablecoins are used as collateral to support highly leveraged strategies. After experiencing rapid growth in 2021, the reported market capitalization of stablecoins as a group leveled off in the first months of 2022 (see **Figure 61**).

As discussed in the 2021 OFR Annual Report,¹¹⁶ stablecoin arrangements may be vulnerable to run dynamics. If some stablecoin holders fear a stablecoin will

Figure 61. Market Capitalization of Top 5 Stablecoins (\$ billions)



Note: Top 5 stablecoins calculated by market cap as of January 2022.

Sources: Coinmarketcap.com, Office of Financial Research

lose value, their efforts to trade or redeem the stablecoin may drive down its price. When other holders see the stablecoin's value fall below its target, they may also rush to redeem the token. Whether a stablecoin arrangement can survive such a loss of confidence depends partly on the mechanisms through which it maintains a stable value.

Stablecoins are divided into two broad groups in this dimension: (1) asset-based and (2) algorithm-based. An asset-based stablecoin arrangement purports to hold either crypto or traditional assets greater or equal in value to the outstanding stablecoins. If demand for the stablecoin decreases, the arrangement can sell these assets and use the proceeds to redeem or buy back unwanted quantities. Algorithm-based stablecoin arrangements, in contrast, may hold assets worth much less than the face value of the stablecoins outstanding and may hold zero assets. These arrangements rely instead on algorithms that aim to reduce the supply of stablecoins when demand decreases.

Asset-based stablecoins have been more durable than algorithm-based stablecoins to date, and currently, the largest stablecoin arrangements are all asset-based. Nevertheless, these arrangements may also be susceptible to runs. Even if the value of the assets that back the stablecoin exceeds the face value of the outstanding stablecoins, those assets may not be fully liquid, especially during periods of market stress. If a stablecoin issuer is forced to sell assets in stressed market conditions in response to falling demand for the coin, the value of its assets could quickly fall below the level needed to fully back the outstanding stablecoins.

In this way, asset-based stablecoins could experience runs similar to those experienced by some money market mutual funds in September 2008 and again in March 2020.¹¹⁷ The susceptibility of an asset-based stablecoin to such a run critically depends on the composition of its assets and how liquid those assets are in stressed market conditions. It is difficult to judge the fragility of many popular stablecoin arrangements because there is insufficient transparency around the assets backing them, and the redemption rights of stablecoin holders are not guaranteed or clearly disclosed.

Events to date suggest algorithm-based stablecoins may be fragile and prone to collapse.¹¹⁸ Several algorithmic stablecoins failed over the past two years, leading to substantial losses for stablecoin holders.¹¹⁹ The largest of these failures was TerraUSD, which had a reported market capitalization of \$18 billion before its collapse in May 2022 (see **Box Topic: The Collapse of TerraUSD and Luna**). It remains to be seen whether, in light of these events, algorithm-based stablecoins will be a significant part of the digital-asset landscape in the future.

Central Bank Digital Currencies

Central banks can issue *central bank digital currencies* (CBDCs), which are digital liabilities of the central bank. As discussed in the 2021 OFR Annual Report,¹²⁰ CBDCs should be immune to the run risk faced by stablecoins but may increase flight-to-safety concerns. For example, bank depositors and other short-term investors could rush into CBDCs during periods of market stress. Other factors may

mitigate this risk, however. For example, introducing a CBDC may help regulators monitor financial conditions in real time.¹²¹

In the U.S., regulators are exploring CBDCs. For example, the Federal Reserve issued a CBDC consultation paper in January 2022 and is continuing its independent research into and experimentation with CBDC.¹²² Subsequently, the President's Executive Order on Ensuring Responsible Development of Digital Assets in March 2022 directed the Treasury and other agencies to further analyze the potential implications of a U.S. CBDC, including its impact on financial stability. Globally, around 90% of central banks now report studying or working on the development of a CBDC.¹²³ Among these, four (the Bahamas, the Eastern Caribbean Currency Union, Jamaica, and Nigeria) have issued CBDCs, and over 30 CBDCs are in development or pilot phases.¹²⁴

Crypto Asset Trading and Lending Platforms

A large number of crypto asset platforms facilitate trades in crypto assets. These platforms offer a broad range of services beyond trading and lending, including custody, clearing, and settlement of trades. They also provide access to margin and derivatives trading, and many crypto asset platforms permit much higher leverage than traditional financial exchanges.¹²⁵ Unfortunately, many crypto platforms also operate in noncompliance with existing U.S. laws and regulations and claim to operate outside these laws and regulations. This exposes clients to many additional risks, including operational risks, potentially illegal activities on the part of

the platform, and problematic terms of service.¹²⁶

Crypto asset lending platforms form another crucial component of the digital-assets ecosystem. These arrangements promise returns to customers who deposit their crypto assets with the lending platform, which lends the assets to market makers or market participants looking to hedge, speculate, or build a leveraged position.

In some ways, the activities of crypto asset lenders may mirror those of banks and other intermediaries in the traditional financial sector. However, in practice, crypto asset lenders currently operate with little to no regulatory oversight, and backstops that exist in traditional banking—such as deposit insurance or a lender of last resort—are absent in the crypto lending market. As a result, crypto asset lenders are more vulnerable to changes in asset prices and investor sentiment.

These risks were highlighted when several crypto asset lenders suspended customer withdrawals following the decline in crypto asset prices in June 2022. The largest of these lenders, Celsius Network, offered clients the ability to withdraw on demand. Meanwhile, Celsius invested in assets subject to market and liquidity risk. When withdrawals accelerated, Celsius suspended withdrawals.¹²⁷ Celsius later sought Chapter 11 bankruptcy protection, indicating that it lacks sufficient liquid assets to cover its obligations to its depositors, among other creditors.¹²⁸ This episode resembled the bank runs common in the U.S. before the adoption of federal deposit insurance in 1934.

Decentralized Finance

Decentralized finance (DeFi) refers to arrangements that aim to provide financial products or services without relying on a traditional financial intermediary.¹²⁹

Instead, these products and services are automated to some degree using smart contracts, a type of computer code stored on a blockchain that self-executes when certain conditions are met. There are some concerns that DeFi has not been fully decentralized, as a core group of developers and promoters in practice control many DeFi protocols. DeFi protocols can perform some of the same services as centralized crypto asset intermediaries, including exchange, collateralized lending, and asset management. DeFi activity increased rapidly throughout 2021.

According to DefiLlama, a tool used to aggregate decentralized finance data, the total value of digital assets locked in decentralized protocols grew from \$20 billion in December 2020 to a peak of over \$250 billion a year later.¹³⁰ However, this value fell to \$72 billion by June 2022, driven down by the general decrease in crypto asset prices, the failure of a large stablecoin, and problems experienced by crypto asset lenders who were active DeFi participants.

DeFi protocols primarily facilitate speculative and arbitrage trading in crypto assets today. The pseudonymous nature of decentralized finance requires that digital assets collateralize or overcollateralize most loans. Despite the highly volatile nature of crypto assets, DeFi lending protocols generally allow much higher leverage than is possible in traditional financial arrangements.¹³¹ These protocols

allow liquidators—who can be automated trading bots or market participants—to repay the loan for users whose collateral-to-loan ratio drops below a prespecified cutoff, then collect a reward. Depending on the protocol, these liquidators may utilize certain smart contracts to trigger a sale of assets posted as collateral. The combination of high leverage and automatic liquidation of collateral in response to price declines serves to amplify the volatility of crypto asset prices and is another potential source of spillover risk. This may also amplify concentrations of power in the space, as some platforms have affiliates who run large liquidators and dominate liquidations.

Monitoring Risks in Digital Assets

Digital assets and decentralized finance generally remain a small part of the overall financial system, with limited linkages to other financial markets and the real economy. For these reasons, the current risks to financial stability from these new financial arrangements remain modest. However, if decentralized finance continues to grow in size and scope, and if it continues to lack the guardrails that exist for traditional finance, it could become a future threat to financial stability. Moreover, past periods of rapid growth suggest that, under the right conditions, this shift could happen quickly. Therefore, developments in decentralized finance should continue to be monitored to identify emerging risks. However, significant data gaps currently hinder such monitoring.

There are several channels through which digital assets could become threats to financial stability. First, if

traditional financial market participants and institutions accumulate significant exposure to digital assets, future price declines or disruptions in the digital-asset market could have spillover effects on traditional financial markets and the real economy. Reports indicate that a majority of the world's largest banks have already invested in companies operating in the digital-asset or blockchain-related space to some degree.¹³² However, this information is primarily based on press releases from the banks or companies involved. Regulatory data on the exposures of traditional institutions to crypto assets are currently scarce, making it difficult to monitor the interconnectedness of crypto assets and traditional financial markets. Some indirect evidence of this interconnectedness can be gleaned from return correlations. For example, the 30-day rolling correlation between the returns on Bitcoin and the S&P 500 has increased noticeably since the beginning of 2021 (see **Figure 62**).

Second, decentralized finance could create financial stability risks through its direct integration with the real economy. Currently, most activity in decentralized finance supports trading and speculation in digital assets. Non-crypto assets, including commercial paper, purportedly back some stablecoins as an exception. Especially if stablecoins continue to grow, rapid withdrawals from such stablecoins could potentially disrupt commercial-paper markets, creating losses for traditional financial institutions holding similar assets and disrupting financing for commercial-paper issuers. This risk could increase further if traditional borrowers obtain funding through stablecoins or crypto asset lenders. Regulatory data on the assets held by such lenders would be an essential input to monitoring this risk.¹³³

Third, digital assets could become a threat to financial stability if they were to be widely adopted as a means of payment. While volatile crypto assets are unlikely to become a means of payment, stablecoins are expressly

Figure 62. 30-Day Rolling Correlation Between S&P 500 Index Returns and Bitcoin Returns



Sources: Maystreet, cryptodatadownload.com, Office of Financial Research

designed to serve this role for blockchain-based transactions. Proponents claim that blockchain technology may be adopted for various commercial uses over time, such as tracking and verifying components in global supply chains.¹³⁴ A blockchain-native means of payment, such as a worldwide stablecoin, may bring substantial efficiencies to such processes. If participants adopted a stablecoin, disruption or failure could have immediate economic consequences. The President's Working Group on Financial Markets recommended that Congress act promptly to enact legislation to ensure that payment stablecoins and payment stablecoin arrangements are subject to a federal prudential framework on a consistent and comprehensive basis.¹³⁵

Because the technologies and processes associated with distributed ledgers and digital assets are relatively new, they may be especially vulnerable to operational and cyber risks. For example, since the much-publicized hacking of the crypto assets trading platform Mt. Gox in 2014, dozens of further hacks of platforms have been reported.¹³⁶ In addition, malicious actors may exploit bugs in smart contracts to divert funds. While such risks exist for traditional institutions as well (see **Cybersecurity Risk section**), the heightened risk in decentralized finance merits additional monitoring, particularly because crypto asset platforms currently do not have regulatory backstops in place.

Significant data gaps currently hinder monitoring each of the risks described above. The arrangements in decentralized finance—both centralized and decentralized—tend to mirror activities in the traditional financial sector. Over time,

regulators developed ways of monitoring risk in the traditional sector using a wide range of regulatory data. The effective monitoring of risks associated with digital assets and decentralized finance will require similar regulatory data sources for these new activities.

THE COLLAPSE OF TERRAUSD AND LUNA

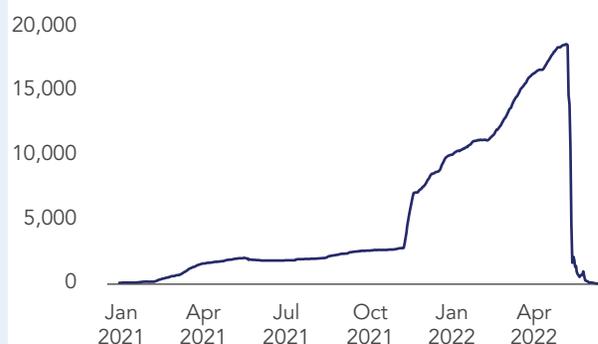
In May 2022, the third-largest stablecoin at the time, TerraUSD, depegged when its price fell below its peg of \$1. This box discusses the details of the algorithmic stablecoin's depegging, including drivers and the role of crypto asset returns. The event prompted financial stability concerns about contagion with other digital assets.

Like other algorithmic stablecoins, TerraUSD used smart contracts to control the supply and maintain its price stability. If the price of TerraUSD fell, the algorithm decreased the supply of TerraUSD. This worked by TerraUSD trading in tandem with Luna, its sister cryptocurrency, where one dollar of TerraUSD could be created by burning (removing from circulation) one dollar of Luna or vice versa. Thus, TerraUSD's peg was maintained using an arbitrage relationship. Additionally, TerraUSD's peg purportedly was supported using any available reserves held by the Luna Foundation Guard.

Ultimately, the market mechanism for pricing TerraUSD and Luna relied on demand for TerraUSD and Luna. Demand for Luna was generated either by charging transaction fees for exchanging TerraUSD and Luna and paying the fees to Luna holders or through TerraUSD's use in lending markets. Stablecoins were used as margin collateral to take on leveraged positions in crypto asset markets. Stablecoin holders could earn interest by lending stablecoins to investors who wished to take on leverage. For example, TerraUSD earned a 19.5% lending rate on the Anchor lending protocol.¹³⁷

In May 2022, TerraUSD broke its peg. As a result, TerraUSD's reported market capitalization plummeted from a high of \$18.7 billion to \$220 million by the end of the month (see **Figure 63**). Throughout April, TerraUSD's price was stable at around \$1, and Luna's price fluctuated between \$77 and \$116. Then, starting on May 7, the price of both assets dropped dramatically in a death spiral. TerraUSD ended the month at \$0.02 and Luna at \$0 (see **Figure 64**).

Figure 63. Market Capitalization of TerraUSD (\$ millions)



Sources: Coinmarketcap.com, Office of Financial Research

Figure 64. Terra Price (USD) and Luna Price (USD)



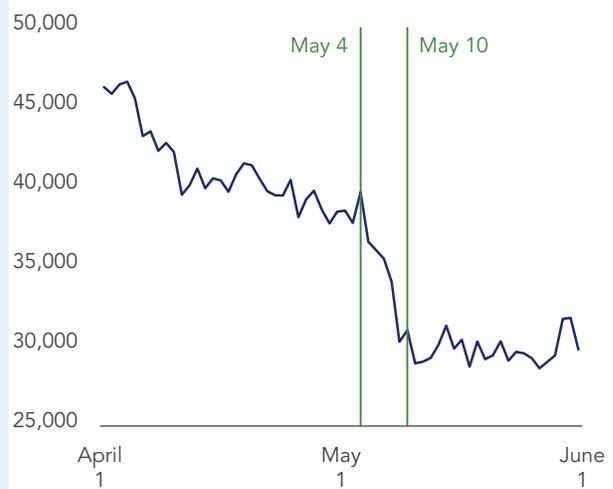
Sources: Coinmarketcap.com, Office of Financial Research

A loss of confidence in TerraUSD and Luna's systems prompted steep price declines. Many holders of TerraUSD wished to sell TerraUSD in exchange for Luna, decreasing the price of Luna. At a certain point, Luna's price was too low, and traders were unwilling to conduct the arbitrage to maintain the peg.¹³⁸ In the weeks after TerraUSD's depeg, reports by Nansen¹³⁹ and Jump Crypto Assets¹⁴⁰ highlighted three critical drivers of the depeg and subsequent crash. First, liquidity conditions deteriorated. Second, a large lending protocol (Anchor) that offered a return for lending out stablecoins had substantial outflows. Finally, there was a large crypto asset sell-off.

These reports point to the role of large investors in TerraUSD's depeg. Large investors provoked liquidity problems due to their significant withdrawals of TerraUSD supply from liquidity pools, and large investors also were a major source of outflows from the Anchor lending protocol. Depressed prices of Bitcoin added to the unfavorable conditions. Earlier in 2022, the Luna Foundation Guard purchased Bitcoin to defend the peg in bad times. When the liquidity crunch arrived in May, the lower price of Bitcoin meant the backing was less valuable, and TerraUSD depleted its Bitcoin reserves, purportedly trying to defend the peg. Moreover, selling Bitcoin reserves to defend the peg had a price impact, pushing the Bitcoin price down further (see **Figure 65**).¹⁴¹

TerraUSD's depeg highlighted the possibility of contagion across the stablecoin market, mainly because Tether, the largest stablecoin, faced a drop in reported market capitalization and a spike in its lending rate. One key driver of

Figure 65. Bitcoin Price (USD)



Sources: Coinmarketcap.com, Office of Financial Research

contagion was Bitcoin's price, which was important for many stablecoins and their lending rates. Recent research showed that higher expected returns on Bitcoin lead to higher lending rates on Tether. Also, changes in stablecoins' volumes were correlated, and drops in stablecoin volume were more correlated in times of market stress when Bitcoin's price fell.¹⁴² Lastly, the demand for leverage, collateralized by stablecoins, reflected market sentiment.

May 2022 market events also highlighted unique properties of TerraUSD, or perhaps properties of algorithmic stablecoins generally, driving TerraUSD's depeg. For example, algorithmic stablecoins, especially those with no underlying collateral or reserves, were particularly vulnerable to collapses in value. Collateralized stablecoins may also face runs, but collateral can limit losses.

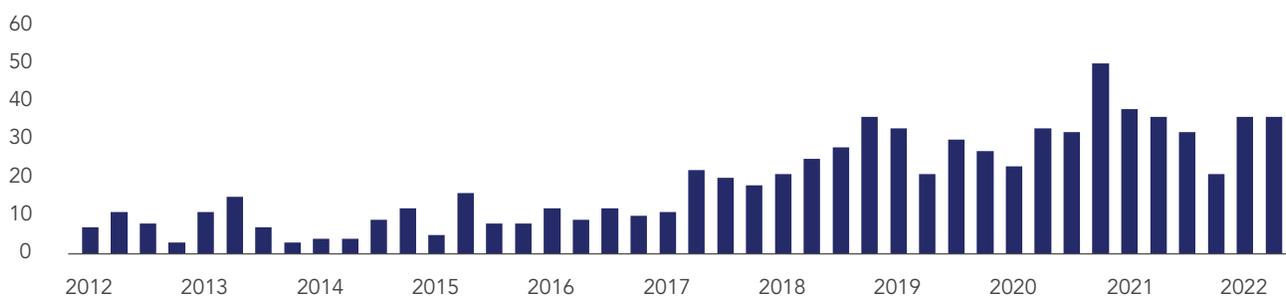
Cybersecurity Risk

Cyberattacks with substantive financial impacts continue to concern the global economy, including the financial services sector. Despite the rise in cyber incidents (see **Figures 66** and **67**), there has yet to be a cyber event that manifested into a threat to U.S. financial stability, whereby a disruption to financial services caused severe impairment to parts of the financial system and led to serious negative consequences for the real economy.¹⁴³ Most known events focused on single organizations and had limited spillover consequences to the financial system.

However, events such as SolarWinds in 2020 and Colonial Pipeline in 2021 highlight how single point of failure attacks can have systemic implications for downstream customers. While neither attack directly targeted the financial services sector, they highlight channels through which a cyberattack on a sector could manifest into a shock throughout the financial system.¹⁴⁴ These include:

- targeting financial market infrastructure or systemically important financial institutions;
- targeting certain information technology (IT) providers, which could create substitution risk and operational

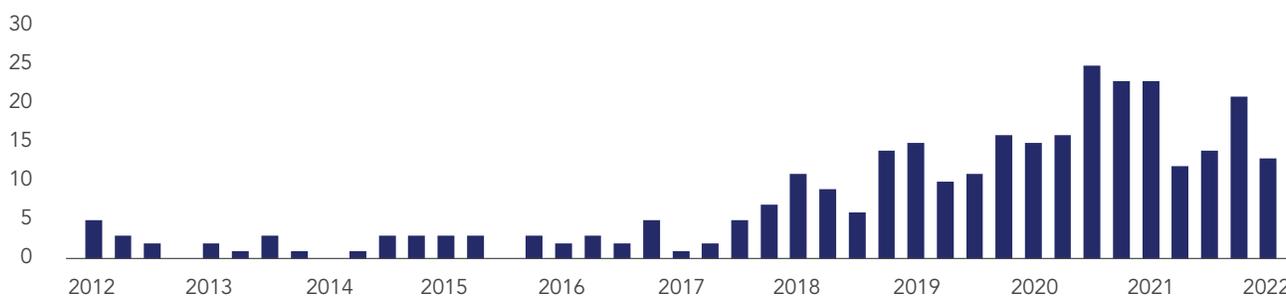
Figure 66. Number of Significant Cyberattacks



Note: Figure shows significant cyber incidents recorded by the Center for Strategic & International Studies. These are defined as an economic crime with a loss of more than \$1 million, or an attack on government agencies, defense firms, or technology companies.

Sources: Center for Strategic & International Studies, Office of Financial Research

Figure 67. Number of Financial Institution Cyberattacks



Note: Figure shows cyber incidents targeting financial institutions (including FinTechs) that are included in the Carnegie Endowment timeline. The timeline does not aim to capture every single incident, but to provide an insight into key trends.

Sources: Carnegie Endowment for International Peace, Office of Financial Research

challenges for a well-functioning financial system; and

- triggering a loss of confidence in financial systems that create spillovers in asset evaluations, market liquidity, and funding.

Russia’s war against Ukraine heightened the prospect of state-sponsored attacks and the importance of vigilance and planning in technology infrastructure. Prior events, such as the 2012 coordinated denial-of-service cyberattack, where several major U.S. financial institutions suffered simultaneous outages, were believed to be in response to the U.S.-imposed economic sanctions on Iran.¹⁴⁵ In addition, beyond attacks directly targeting U.S. financial services institutions, there are concerns of unintended spillovers from cyberattacks stemming from state-actor action, as demonstrated by the NotPetya malware incident in 2017.¹⁴⁶ This alleged Russian attack infected software used by Ukrainian organizations and then spread to companies worldwide, leading to billions of dollars in U.S. corporate losses.

Actors, Objectives, and Targets

While a significant number of cyberattacks are designed to cause adverse outcomes, their threats to financial stability tend to be unintentional and generally unanticipated. What cybersecurity actors are interested in impacting and how they measure success (i.e., what they are interested in stealing, disrupting, or observing) are vital to consider (see **Figure 68**). In some cases, there may be reason to believe destabilizing a financial system may be part of an attacker’s motivation.

The first and best-known class of cybersecurity actors is for-profit attackers, who evolved from employing basic malware through phishing emails targeting end users to sophisticated attacks against private and public organizations, causing millions of dollars of damage on an increasingly regular basis. The increasing payout of ransomware attacks makes this type of attacker one of the fastest-growing threats. Additionally, their provision of turnkey ransomware kits for direct purchase or service agreement contracts

Figure 68. Cybersecurity Actors and Their Motivations and Capabilities

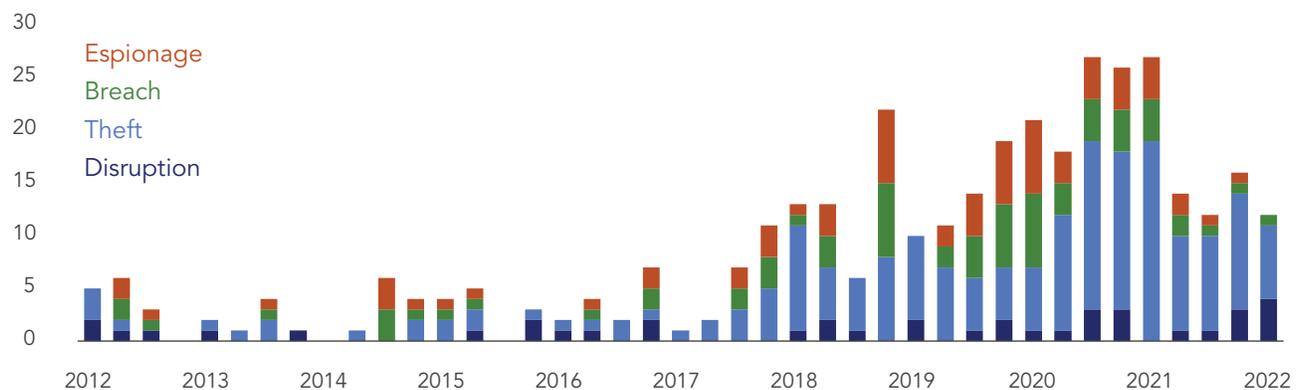
Category	For Profit / Ransomware	State Sponsored	Hackers and Hacktivists
Motives	Money	National service, defense, or offense against state adversaries, state salary, and commendations.	Curiosity, attention, revenge, social justice, or causes.
Capabilities	Moderate. Many attacks are simple but effective, though some groups write and deploy custom tools. Increasingly, these groups provide tools to others for payment.	Varies from low to very high. These are patient, persistent adversaries with the resources to try many vectors to compromise a target.	Typically low, such as using off-the-shelf tools, basic scripts, or web resources.

Sources: Nish, A., Saher Naumaan, and James Muir. “Enduring Cyber Threats and Emerging Challenges to the Financial Sector.” Working Paper no. 8, Washington, D.C.: November 2020. <https://carnegieendowment.org/2020/11/18/enduring-cyber-threats-and-emerging-challenges-to-financial-sector-pub-83239>

lowers the barrier to entry for many less-sophisticated attackers. As expected, a flood of new market entrants can be seen in the increasing prevalence of non-state actors whose objectives focus on theft and data breaches (see **Figures 69** and **70**). While aggressive in their actions, their motivations focus on extracting wealth from victims rather than damaging the targets' long-term operations.

The second class of cybersecurity actors is state-sponsored actors. This class of actors has varied objectives, some of which make them more of a severe threat to institutions or states, as they are typically well funded, organized, and tend to measure success beyond monetary gains. Despite the potential severity of the risks posed by these groups, their focus on the financial system has generally been on stealing funds through attacks on digital-

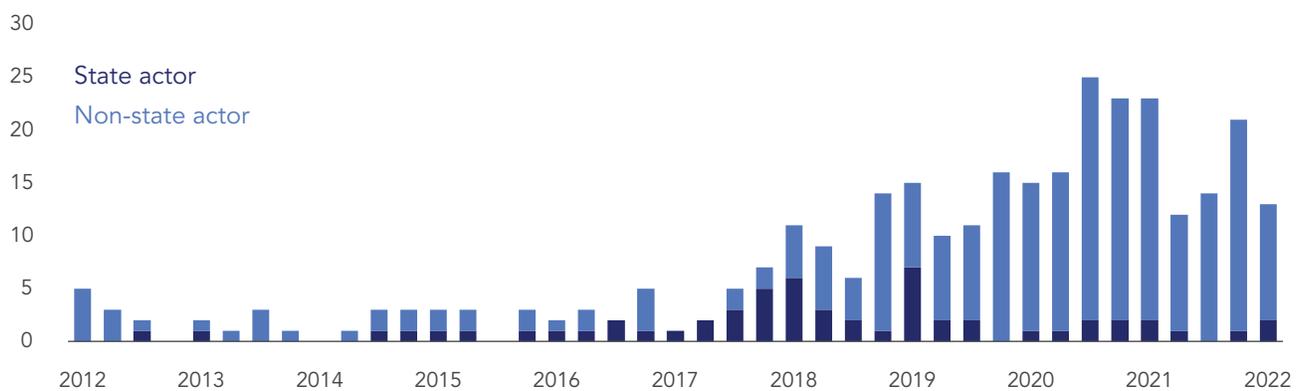
Figure 69. Number of Financial Institution Cyberattacks by Type



Note: Figure shows cyber incidents targeting financial institutions (including FinTechs) that are included in the Carnegie Endowment timeline. The timeline does not aim to capture every single incident, but to provide an insight into key trends. Several events are classified as multiple type or may not have been classified.

Sources: Carnegie Endowment for International Peace, Office of Financial Research

Figure 70. Number of Financial Institution Cyberattacks by Actor



Note: Figure shows cyber incidents targeting financial institutions (including FinTechs) that are included in the Carnegie Endowment timeline. The timeline does not aim to capture every single incident, but to provide an insight into key trends.

Sources: Carnegie Endowment for International Peace, Office of Financial Research

asset exchanges and other custodial organizations or stealing information through espionage. These organizations, however, have also implemented disruption attacks, as in the 2012 denial-of-service attack on U.S. financial institutions or the more recent attacks on major Ukrainian-based banks in advance of Russia's war against Ukraine. In addition, a growing concern has been a progression into attacks on deeper levels of financial infrastructure to create disruptions that will spill over into the financial system (see **Figure 69**). While the systemic risk is high, state-sponsored organizations tend to be measured in their actions, as they risk retaliatory consequences to their nations.

Finally, the third class of cybersecurity actors is hackers and hacktivists. They have motivations similar to state-sponsored actors. While typically smaller and less capable, their targets are likely to be wider ranging because the identity of the victim or the size of potential financial gain may be secondary to their primary motive. While the threats they pose to the financial system are seen as smaller due to the lesser significance of their targets, they make up most of the penetration attempts and cyberattacks.

In response to the threats that these various actors pose to the financial system, organizations should continually work to mitigate the consequences of attacks. Otherwise, there is the potential that a successful attack will cause significant harm not only to the organization but to the financial systems in which they operate.

The following sections introduce three mechanisms used to prepare for cybersecurity risks. Critical in this

endeavor is that the organization recognizes that cyberattacks will occur but that it can mitigate the consequences, whether or not an attack is successful.

Mechanism 1: Technological Security, Resiliency, and Recovery

Cybersecurity is concerned with preventing attacks by minimizing vulnerabilities that adversaries might exploit. Common elements of cybersecurity include the following:

1. Active cyber defense, such as detecting malicious code or network traffic and managing network connections, firewalls, and operations to mitigate threats.
2. DevSecOps (development, security, and operations), which is a paradigm for software development and IT system management that centers on agility and security over the entire IT lifecycle.
3. Cybersecurity hygiene and routine reviews of security systems practices, including software patching, device management, and authentication of user passwords.
4. Insider threat management through enhanced personnel vetting and training.

The current state of cybersecurity has been affected by a number of recent developments. First, remote work environments required during the COVID-19 pandemic accelerated the digitization of many business practices. Digitization breaks down traditional IT network boundaries and perimeter notions

of security, authentication, and resource management. Second, the introduction of zero trust—a strategic approach that secures an organization by eliminating implicit trust, requiring validation at every stage of digital interaction—has gained traction in the IT security community.

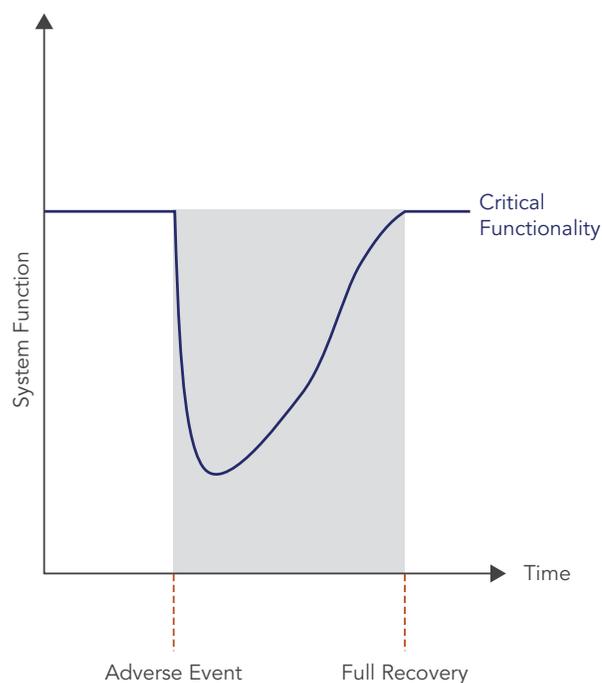
Because of these evolving paradigms and the prominence of digitizing financial services, many cybersecurity advocates believe organizations should undertake further structural changes regarding where they house cybersecurity risk, given its importance to business functions and performance. For most financial institutions, cybersecurity activities have their organizational homes under the IT function. Moreover, spending on cybersecurity in recent years has remained largely flat, with an average of roughly 11% of the IT budget.¹⁴⁷ As a result, cybersecurity experts have called for increasing the standing of cybersecurity within organizations by elevating this responsibility to the board or top-management level and increasing its budget.

Cyber resilience is “the ability of an organization to continue to carry out its mission by anticipating and adapting to cyber threats and other relevant changes in the environment and by withstanding, containing, and rapidly recovering from cyber incidents,”¹⁴⁸ as defined by the Financial Stability Board, an international body that monitors and makes recommendations about the global financial system. Central questions in the broader operational-resilience paradigm focus on the speed and completeness of system recovery from a disruption that causes loss of critical system functionality

(see **Figure 71**). Cyberattacks are considered disruptions in operational resilience, as are hardware or software failures.

The cyber resilience paradigm includes learning from the attack-recover sequence so that the system becomes better functioning or more absorbing of attacks over time. A capacity for adaptation is akin to the broad notion of *antifragility*, under which systems grow stronger from continued exposure to stress and disruption. One approach is *resilience by design*, in which endogenous technical and organizational mechanisms and responses to attacks are engineered based on modeling the loss of critical system functionality over time. Another approach is *resilience by intervention*, which is based on using pooled resources and transmission mechanisms to restore critical system functions.

Figure 71. Resilience Concept



Sources: Office of Financial Research.

In many cases, the most cost-effective cybersecurity solution is a centralized architecture, such as cloud-based security, computing, and data management. While benefiting from economies of scale and industry-leading security technologies and practices, these architectures introduce concentration risk in that a successful attack on such a provider would broadly impact firms in the sector.

Common platform risks associated with open-source protocols and industry standards can create a systematic risk to all users. For example, a long-standing vulnerability in Log4j, an open-source logging library commonly used by applications and services across the internet, posed a significant threat to banks and many other domains. However, given the widespread reliance on this library, it was unclear who in the open-source community, the government, or industry should bear responsibility for identifying and remedying the problem. Common vulnerabilities such as this naturally leads to the consideration of coordination, the subject of the next section.

Mechanism 2: Coordination and Information Sharing

While cybersecurity discussions tend to focus on reducing risk for the individual through means such as multifactor authentication and zero-trust architecture, coordination and communication across firms and government agencies serve to improve the global environment. To this end, organizations have been established to strengthen coordination, some focusing

on the financial services sector and others on cybersecurity more broadly. Those organizations most engaged in a well-functioning financial system are briefly described in **Figure 72**. Considering various coordination perspectives helps illuminate these organizations' roles in promoting cybersecurity.

The first perspective consideration is the timeframe of coordination. For example, longer-term coordination generally focuses on policy guidance and developing cyberattack scenarios meant to be holistically preventative. In contrast, short-term coordination focuses on near real-time responses such as incident information sharing and vulnerability assessment, typically targeted at specific threats and solution sharing.

A second perspective is who is best placed to coordinate a particular type of cybersecurity action within the financial sector. This varies in the U.S., based on the threat actors, their potential to create systemic risk, and what lines of communication may be the most effective.

A third perspective is reflected in Presidential Policy Directive (PPD) 41,¹⁴⁹ which outlines the principles governing the federal government's response to any cyber incident, and the 2016 National Cyber Incident Response Plan,¹⁵⁰ which provides guidance to enable a coordinated whole-of-nation approach to response activities during a cyber incident and defines the roles and responsibilities of the respondents. In 2021, CISA's JCDC, a public-private partnership, was created, leveraging expertise from within the government and across a broad array of private sector actors. Its goal is to

Figure 72. U.S. Organizations Focused on Financial Services Risk

Organization	Type	Est.	Description
Cybersecurity and Infrastructure Security Agency (CISA) [Department of Homeland Security]	Public	2018	CISA coordinates the federal response to cybersecurity and infrastructure incidents in 16 critical infrastructure sectors and across federal, state, local, and tribal governments. Financial services are one of the critical infrastructure sectors.
Office of Cybersecurity and Critical Infrastructure Protection (OCCIP) [Department of the Treasury]	Public	2001	OCCIP is the lead entity for the federal sector-specific response to cybersecurity and infrastructure incidents in financial services. OCCIP works with firms, trade groups, and government agencies to share information about physical and cyber threats.
Financial and Banking Information Infrastructure Committee (FBIIIC)	Public	2001	FBIIIC serves as the government coordinating council for the financial services sector. It serves as the intersection for financial regulators and cybersecurity and infrastructure policy.
Financial Services Sector Coordinating Council (FSSCC)	Private	2001	FSSCC coordinates with trade associations, financial utilities, and financial companies and works with the public sector on policy issues related to resilience and response to cybersecurity incidents, natural disasters, and terrorism.
Financial Services Information Sharing and Analysis Center (FS-ISAC)	Private	1999	FS-ISAC receives and communicates information about cyber incidents in near real-time, designs and implements training exercises, and organizes conferences among its members.
Analysis and Resilience Center (ARC)	Private	2016	The ARC coordinates efforts to strengthen the critical infrastructure that facilitates financial services and the energy sector.
Joint Cyber Defense Collaborative (JCDC)	Hybrid	2021	The JCDC brings together federal, state, local, and tribal governments, along with public, private, and international partners, to share information and strengthen cybersecurity.

create a proactive capacity to reduce risk before a cyber incident, complementing the incident response model of PPD 41. Insights gained by the JCDC are disseminated to the cybersecurity community through multiple channels, including FS-ISAC, which distributes the information in near-real time to its members in the financial services sector.

Most recently, CISA tasked the JCDC to develop a crisis plan in response to Russia’s war against Ukraine. The JCDC conducted a tabletop exercise of the plan in February 2022, and members used the plan to coordinate a response intended to reduce the harmful effects of possible Russian offensive actions. Beyond the realization of this plan, the communication network established by the JCDC enabled CISA to

share details about Russian attacks against Ukrainian institutions and added links to large financial institutions in cooperation with OCCIP.

Having the right level of transparency is fundamental to information sharing and preparation for a future crisis. In this spirit, several federal regulatory agencies now either require or have proposed requiring the firms they regulate to report cyber incidents within a specific timeframe. For example, in November 2021, the Federal Reserve Board, OCC, and FDIC approved a final rule requiring banking organizations to notify their federal regulator of a significant computer security incident as soon as possible and no later than 36 hours after discovery.¹⁵¹ Similarly, in February and July 2022, the SEC and NCUA

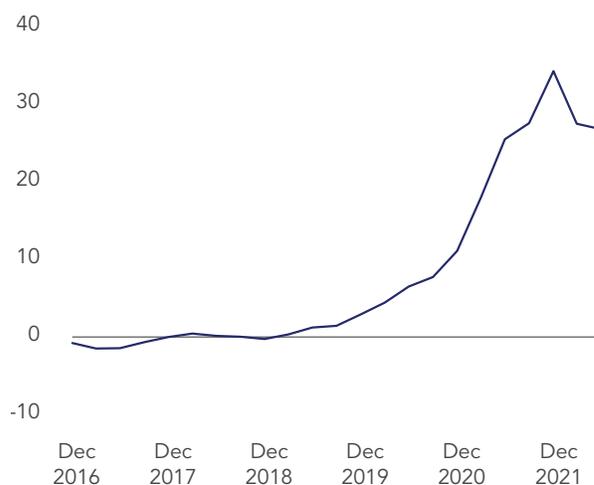
proposed rules on cyber incident reporting requirements.^{152 153} Moreover, in March 2022, the SEC proposed a rule requiring a public company to publicly disclose cyber incidents in a timely manner and to disclose annually the firm’s cybersecurity policies and whether board members have a cybersecurity background.¹⁵⁴

Mechanism 3: Cyber Insurance

The demand for cyber insurance continues to grow as exposure to cyber-related losses expands with increasing dependence on computer systems. At the same time, cyber insurance is becoming more expensive and harder to obtain. Insurers and regulators have made concerted efforts to eliminate “silent cyber” coverage from nonspecific cyber insurance policies, thus increasing the need and demand for specific, affirmative cyber coverage. Increasingly, cyber insurance is no longer generally included as part of an insurance policy package; instead, it is a separate coverage explicitly stated and priced.

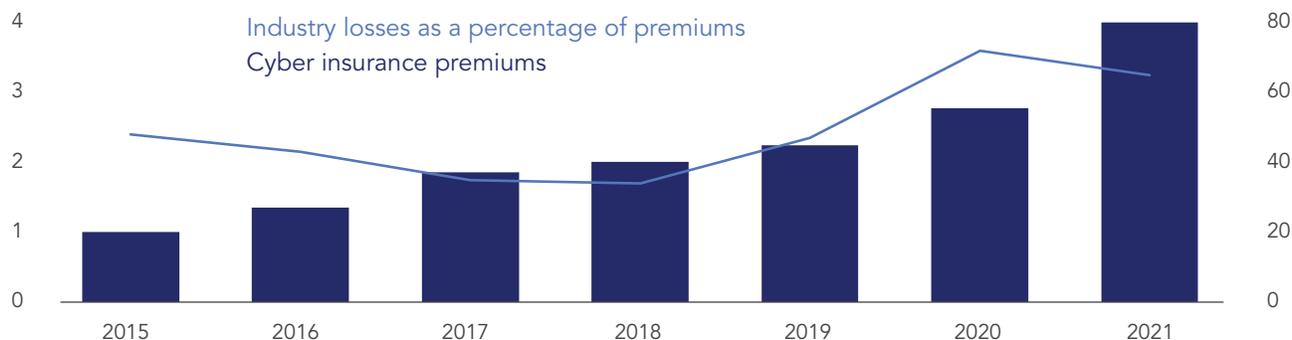
The rapid growth in this sector has been driven by increasing numbers of written policies and premiums per policy. Annual policy premiums are growing at a double-digit and, in some cases, triple-digit rate, depending upon the risk-and-loss profile of the insured (see **Figures 73** and **74**). Growth in the cyber insurance market is partially offset by insurers limiting their exposures through deductibles, coinsurance, sub-limits, and coverage caps.

Figure 73. Quarterly Cyber Insurance Premium Changes (percent)



Sources: Council of Insurance Agents and Brokers-Commercial Property/Casualty Market Index, Office of Financial Research

Figure 74. Insurers’ Cyber Insurance Results (\$ billions, percent)



Note: The loss ratio is based on the direct losses insurers incur, as well as their defense and cost containment expenses, divided by the premiums collected from clients. Loss ratio for standalone cyber only.

Sources: Fitch Ratings, Office of Financial Research.

Insurers manage assumed risk through a variety of methods that are continuously developing. As risks evolve and grow, insurers are becoming increasingly careful in managing the gross amount of their cyber risk exposure assumed and the details of this exposure. Reinsurance is a major risk management tool, with about half of all direct cyber insurance reinsured, but cyber reinsurance availability is limited.¹⁵⁵ Capital markets may eventually assist the growth of reinsurance coverage by developing specialized capital markets-funded products such as various insurance-linked securities (ILS).

Insurers risk an aggregation event whereby many claims are triggered simultaneously. There has been no occurrence of such a major aggregation event, but it is a well-placed major industry concern. Industry concentration through large, shared vendors such as cloud and widely shared software providers could result in widespread cyber events and large aggregate losses. Insurers attempt to manage their exposure to single risks, but this is challenging to implement, given complex cyber supply chains. For example, the failure of a major cyber service provider is of concern but is an associated risk that may be offset by careful management and enhanced levels of security and redundancy.

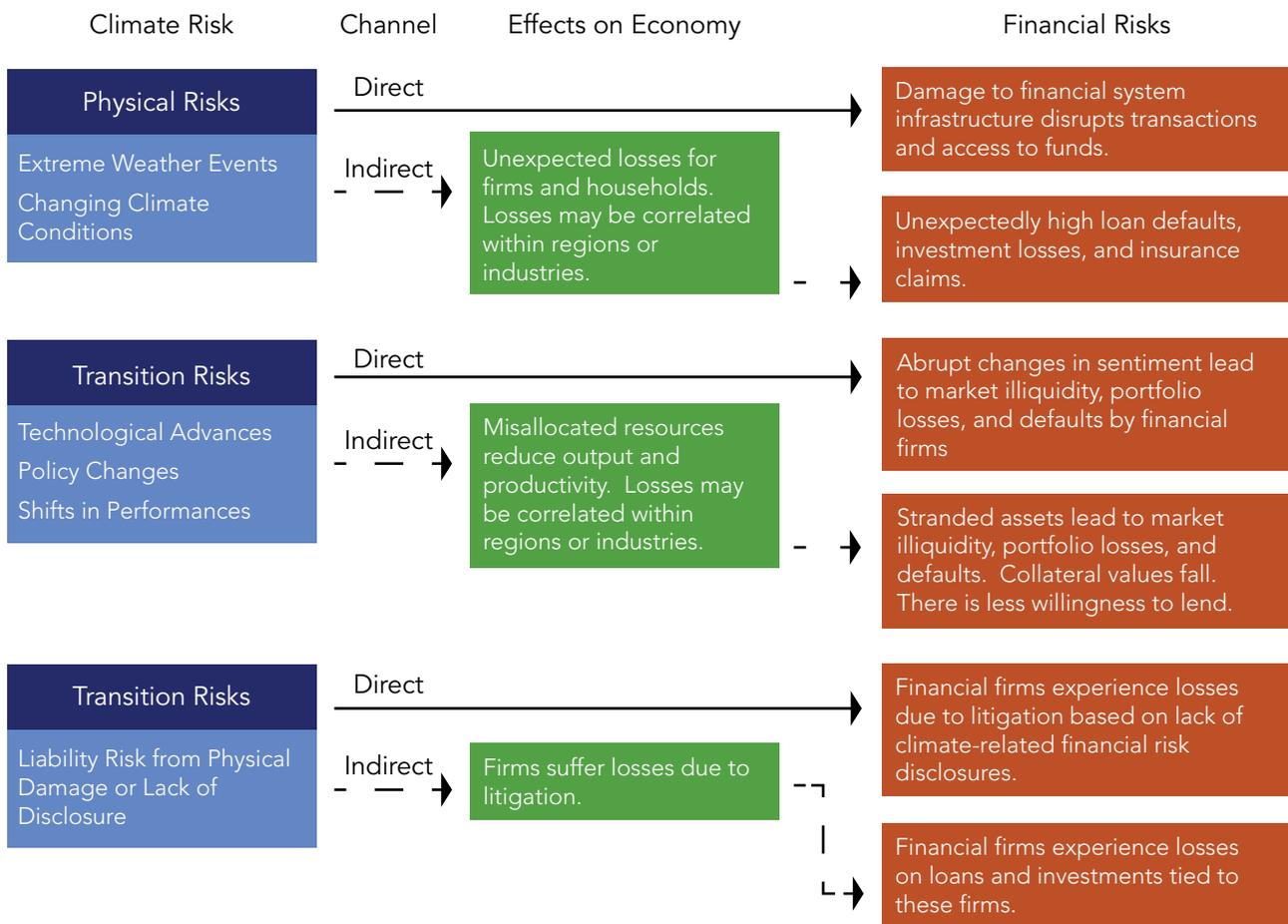
Finally, insurers are exposed to their own direct cyber risks. Their direct risk is enhanced as collection agents and evaluators of their client's cyber risk, and insurers are attractive targets of breach and espionage attacks due to the information maintained on their systems.

Climate-related Financial Risk

Climate-related financial risk is the risk of financial losses due to rising global temperatures and accompanying environmental shifts, such as rising sea levels and more severe weather events. Climate-related financial risks pose physical and transition risks to the safety and soundness of individual financial institutions and have broader financial stability implications for the financial system (see **Figure 75**).¹⁵⁶ Additional research is needed to better understand the intersection between climate-related financial risk and financial stability.

Physical risk is the potential for destruction of or damage to physical assets, the impact on economic activity, and other losses from extreme weather events. Climate-related financial risk is expected to lead to an increase in the severity and frequency of these physically destructive events, and degrading physical conditions are expected to result in costlier property damage and supply chain disruptions, ultimately negatively impacting the economy. Additionally, such events and conditions often negatively impact infrastructure such as bridges, water treatment plants, and power grids, and result in long-term damages.¹⁵⁷ For example, the 2021 Texas winter storm resulted in an estimated \$80 billion to \$130 billion in economic costs, while insured costs were estimated between \$10 billion to \$20 billion.¹⁵⁸ These events can also reduce future long-term local tax revenue and the affected area's standard of living.

Figure 75. Select Channels for Climate-related Financial Risks



Sources: Office of Financial Research

Transition risk, which is created by technological advances, changes in policy, and shifts in preferences, can be more difficult to quantify in economic terms. Some businesses face changing asset values, costs of doing business, or revenue levels as consumers and industries adapt to new regulations and disruptive technologies. Although poorly designed policies could exacerbate transition risk,¹⁵⁹ adopting new technologies and good policies can create substantial benefits and opportunities that provide some tradeoffs. For example, the transition to electric vehicles has been a job boon in

the electric vehicle industry and supporting industries. In 2021, the petroleum and coal industries lost 7% (around 39,000 jobs) of their combined workforce, while green electric vehicle jobs grew by just over 26% (around 22,000 jobs). These figures do not consider the growth of other green industries, such as the battery, solar, or smart electric grid industries, which also grew substantially in 2021.¹⁶⁰

A firm's transition risk is not limited to direct valuation but also includes the potential for liability risk that is associated with climate-related financial risk.¹⁶¹ This form of risk reflects potential litigation that

may take place between those impacted by climate events and institutions. These lawsuits can be between shareholders and firms, insurance companies and policyholders, or municipalities and bondholders. Liability risk also includes the lack of proper or adequate disclosure of climate-related risks, which could increase an entity's potential for facing climate-related litigation. Although lawsuits between governments and firms have been thus far limited;¹⁶² the impact on the private and public sectors could be substantial if firms fail to account for legal and regulatory changes; environmental, social, and governance (ESG) commitments; and actions. In addition, recent reports suggest that liability risk is becoming increasingly common.¹⁶³

Governments also face financial risks related to climate-related financial risk. An increase in climate-related events is also likely to cause firms and households to increasingly rely on the insurance and banking sectors, while local municipalities and state governments are likely to rely on the federal government for financial support. Some households and businesses might be left without insurance as private insurers may become increasingly unwilling or unable to insure physical risks. Climate-related damages in the U.S. have grown to about \$133 billion per year,¹⁶⁴ with the federal government often stepping in with emergency relief and acting as an insurer of last resort. The Office of Management and Budget (OMB) estimates the U.S. government can spend \$25 billion to \$125 billion per year on climate-related risks (e.g., disaster relief, flood insurance, crop insurance, health care expenditures, wildland fire suppression, and federal facility flood risk).¹⁶⁵ If events continue to

increase in frequency or inflation increases the costs dramatically, this could push costs back down to the local governments, communities, businesses, and households, which might not be as well equipped to bear the costs.

Financial Stability and Climate-related Financial Risk

Climate-related financial risks have begun to be priced into financial assets, but the extent varies depending upon the market,¹⁶⁶ and not all risks have been priced into the market. One example of potential risk mispricing lies in the mortgage industry. Lenders may be indirectly encouraged to underwrite mortgages without accounting for flood risks and then pass these loans to government-sponsored mortgage companies (GSMCs) to securitize into mortgage pools. This may indirectly encourage households to relocate to or, after disaster strikes, rebuild in areas prone to flood risk, hurricane storm surge, and wildfire. Recent evidence suggests this hasn't been the case but could be a source of potential risk.¹⁶⁷ For more information, see the box topics included in this section.

Understanding how the financial system may be exposed to physical, transition, and liability risks and how they might be amplified by interactions and networks in the financial markets is vital to understanding the link between climate-related financial risk and financial stability. Below are some examples:

1. Some research anticipates climate-related financial risk will lower gross

domestic product (GDP), but loss estimates vary widely.¹⁶⁸ In addition, the physical damage and transition changes could affect some regions and industries more than others.

2. Climate-related financial risk can affect credit risk because businesses, households, and counterparties could default at higher-than-anticipated rates due to physical and transition-related events. In addition, lenders with insufficient allowances for loss and capital could become insolvent if their exposures to such risks are too high.
3. Climate-related financial risk can also reduce the borrowers' ability to repay and service debts. Additionally, collateralized assets could decline in value or be stranded, thus impacting the lender recovery rates in the event of default.
4. Market risk is realized if a financial asset's value is impacted due to sudden climate events that were not previously expected. Climate risk also has the potential to change market liquidity, increase volatility, or alter the existing correlations between certain assets. In addition, stranded assets may impact firm valuations (e.g., carbon-intensive energy assets) from physical and transition risks.
5. Liquidity risk may occur if market conditions or investor sentiments change. Access to stable funding sources may become tenuous, which can cause counterparties to draw down deposits or credit lines.
6. Firms face potential operational, liability, and reputational risks associated with failing to account for

7. climate-related risks and appropriate disclosures.

Although this is an ongoing area of research, there is an increasing amount of empirical work and data surrounding these risks. One of the difficulties of modeling future climate-related financial risk and the corresponding economic impact is that the modeler's assumptions partially determine the results.¹⁶⁹ More research is needed to explore how climate-related financial risk and financial stress can be amplified and could result in greater aggregate impacts to the financial system.¹⁷⁰ If climate-related financial risk accelerates, the data will become more robust, but by this point, climate-related financial risk and its effects could potentially be irreversible.

Models linking climate-related financial risk and financial impacts continue to be built out, but these models and data are still in the early stages of development. For example, the United Nations' Intergovernmental Panel on Climate Change (IPCC) and other organizations, such as the Network for Greening the Financial System, developed several climate model pathways researchers can leverage to identify potential risks to local governments, households, and financial institutions.

While there has been less progress made in the quantification of climate-related events in financial sectors, research indicates there have been some impacts on real asset prices. For example, recent research found Hurricane Sandy, which hit New York and New Jersey hardest in 2012, caused a drop in coastal commercial property prices in Boston—even though Boston suffered no direct storm damage.¹⁷¹

Hurricane risk related to landfall and impact uncertainty has also been observed in the equity and options markets.¹⁷²

Studies of cap-and-trade programs and other climate policies have shown climate policy and transition risk lead to significant changes in affected high-emissions firms' corporate lending, including shorter loan maturities, lower access to term loans, and higher interest rates. On the other hand, some studies suggest banks will be resilient to climate risks, especially physical risks, as banks are agile in their ability to adjust credit exposure through loan renegotiation fairly quickly.¹⁷³

More research is required to understand how the climate effects can be amplified and result in greater aggregate impacts on the financial system.¹⁷⁴ Both physical and transition risks will have impacts on the federal budget, financial institutions, and markets. Individual households and a lack of preparedness could exacerbate financial impacts. Monitoring these risks will be crucial to maintaining financial stability, and climate-related financial risk modeling should include scenarios for disorderly transitions. Climate-related financial risk is increasingly important to consider in financial stability analysis.

CLIMATE-RELATED RISKS IN MORTGAGE SECURITIZATION

Climate-related financial risk impacts numerous aspects of the financial markets, often in unanticipated ways. In addition to transition risks, myriad facets of physical risks can impact the financial markets. One example of this channel is the risk financial institutions and government-sponsored mortgage companies (GSMCs) face through mortgage securitization—specifically, increasing risk in areas prone to flooding. **Figure 76** illustrates how physical climate risk drivers can potentially affect housing and financial-market volatility.¹⁷⁵

Although household exposure to climate risk is significant, mortgage originators can “originate and distribute” their exposure to mortgages in disaster-prone areas. As occurred in the early 2000s, the separation of loan origination and securitization led to loan underwriting standards and practices that did not adequately price the underlying risks and the creation of securities backed by these assets that did not accurately reflect the risks of default for the pooled loans. Currently, when a mortgage originator underwrites the loan, it then sells the loan to an investor that bundles it with other loans. The investor then sells the security into the secondary mortgage markets, with the underlying assets being the pool of loans.

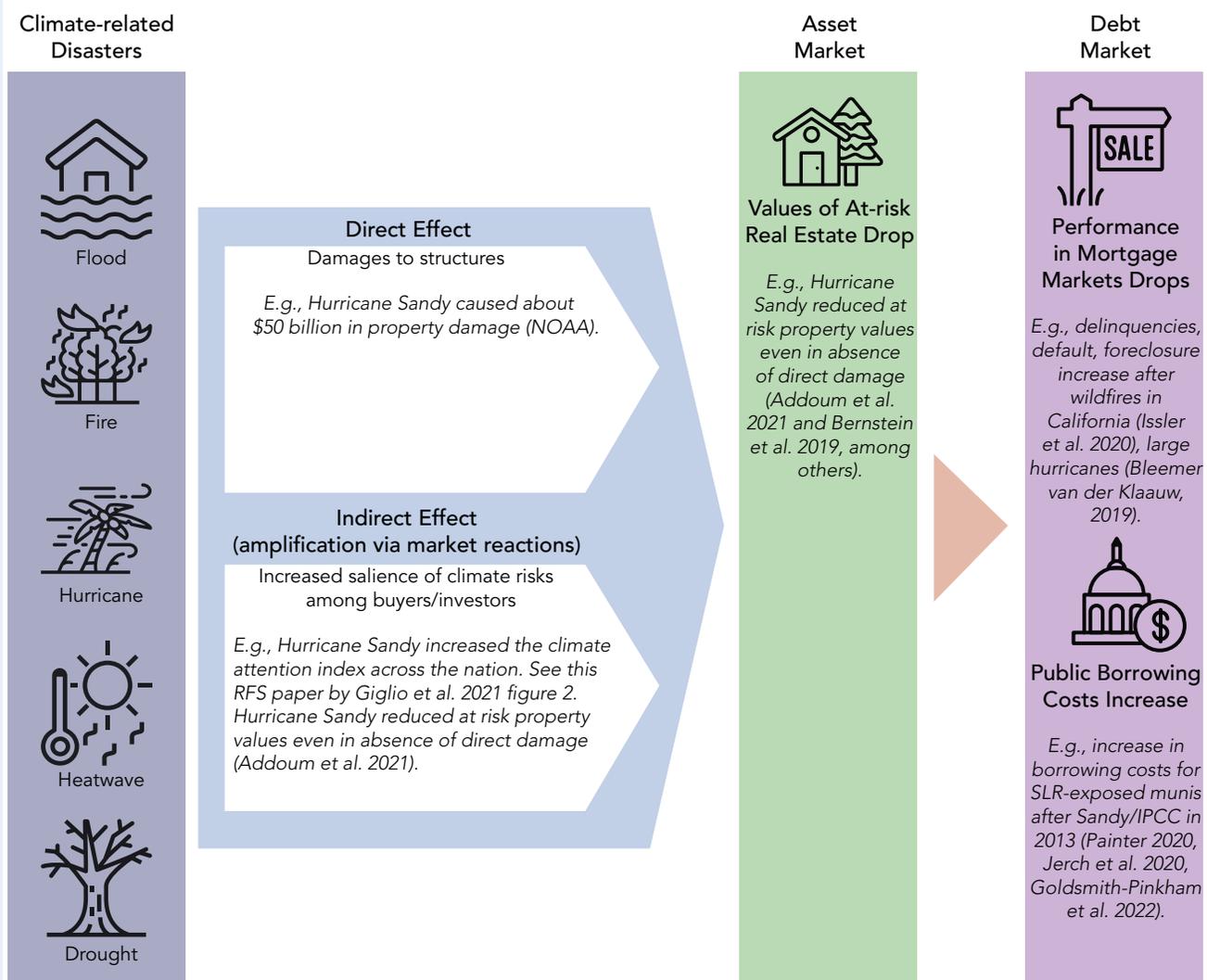
The result is that homeowners may be able to obtain mortgages in disaster-prone areas, while the originator later exits the transaction and mitigates their risk

by selling the loan. **Figure 77** displays regions where homeowners have relatively high mortgage and home equity debt levels and high flood risk.

A recent study suggests that lenders not only shift climate-related risks to mortgage

pools but that these pools may transfer this risk to GSMC securitizations.¹⁷⁶ However, the extent to which these forms of risk are concentrated in asset pools guaranteed by GSMCs is unclear. **Figure 78** shows the share of mortgages sold to GSMCs in areas

Figure 76. One Illustrative Mechanism of How Physical Climate Risk Could Affect Volatility In Financial Markets

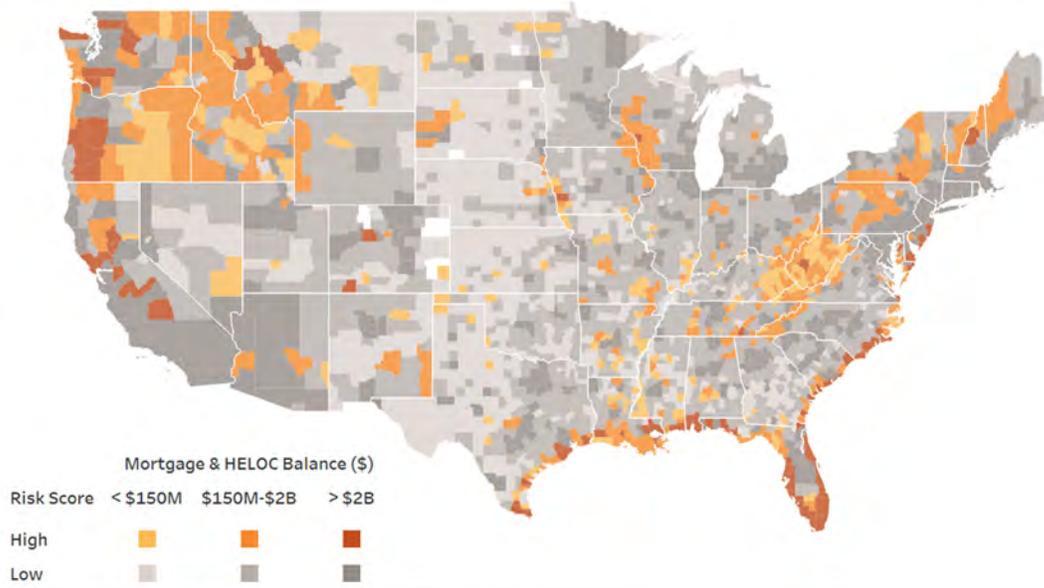


Potential sources of complications/inefficiencies:

- Potential inefficient pricing of climate risks in asset and debt markets (Hong et al. 2019, etc.)
- Potential shifting of climate risks due to NFIP/GSEs (Krousky 2018, Ouazad Kahn 2021, Bakkensen Phan Wong 2022).

Sources: See endnote 176.

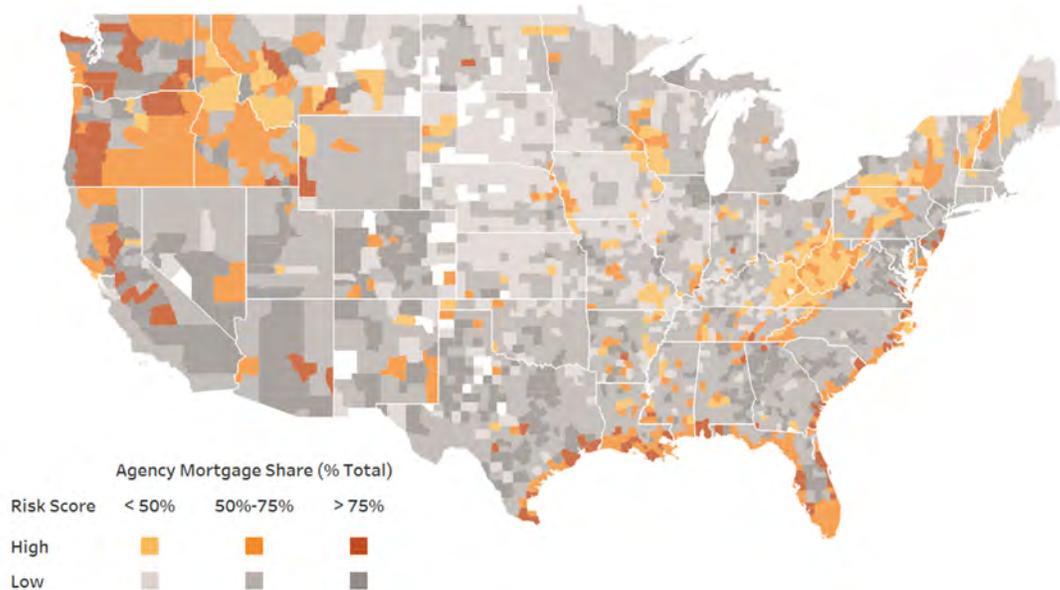
Figure 77. Mortgage and Home Equity Line of Credit Balance and Flood Risk



Note: Total mortgage and HELOC balances of households by county and split by risk score designations. Risk scores are determined from First Street. High represents the 80th percentile and above. Low represents all areas below the 80th percentile.

Sources: Equifax, First Street Foundation, Office of Financial Research

Figure 78. Agency Mortgage Share and Flood Risk



Note: Share of mortgages sold to government agencies by county and split by risk score designations. Risk scores are determined from First Street. High represents the 80th percentile and above. Low represents all areas below the 80th percentile.

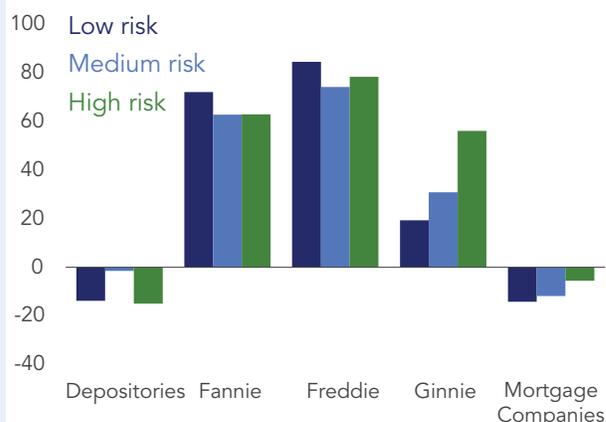
Sources: Equifax, First Street Foundation, Office of Financial Research

with different amounts of flood risk. The map shows considerable heterogeneity in mortgages held by GSMCs and flood risk.

Figure 79 uses credit registry data that provides a representative sample of the mortgage markets across financial and nonfinancial institutional holders to quantify changes in flood risk exposures by institutional holder type from 2011 to 2022. The figure is based on unpaid mortgage balances held by each institution type. The risk score, which is based on the probability that a once-in-100-year flood event will occur on a forward-looking basis, is separated by low, medium, and high chances of experiencing a flood. The results are divided into institution holder types: depositories, mortgage companies, Fannie Mae, Freddie Mac, and Ginnie Mae.

Post-crisis regulations have limited overall growth in mortgage exposures for depositories and mortgage companies. As a result, GSMCs have potentially increased their ownership of securitized mortgages and increased their overall exposure to flood-prone areas. Fannie Mae and Freddie Mac have also possibly increased flood risk exposures almost equally, while Ginnie Mae, which accounts for a relatively small fraction of mortgage flows, has seen a relatively large increase in high-risk exposures. Greater exposure to high-risk areas may increase the likelihood of losses. This is particularly true when the mortgages for high-risk areas are outside designated floodplains where flood insurance is less likely to be purchased. These patterns suggest that lenders are not broadly securitizing high flood risk exposures to GSMCs at a higher rate than those with low exposures. Nevertheless, financial regulators should

Figure 79. Long-term Changes in Institutional Climate Exposures (percent)



Note: Low- (bottom 30th percentile), Medium- (30th to 70th percentile), and High- (top 30th percentile) risk areas are based on overall rankings across 5-digit ZIP codes.

Sources: Equifax Information Services LLC, First Street, Office of Financial Research

be vigilant to ensure that policies designed to promote home ownership do not ignore or downplay present or anticipated future climate risks.

Increasing holdings of potentially high-risk mortgages, by the GSMCs, during a period of increasing weather severity could be placing additional risks on the GSMCs. Should several climate events occur, the GSMCs could be overexposed to these events. A series of events could have broad implications for the GSMC, mortgage, and financial markets.¹⁷⁷ For example, losses due to these additional risks may eventually fall to the federal government as a lender of last resort, if sufficiently severe.



PART TWO

STATUS OF THE OFFICE OF FINANCIAL RESEARCH

Review of Mission

The Office principally supports the Financial Stability Oversight Council (Council) and its member agencies by supplying germane data, developing empirically supported research insights, analysis, and highlights, and advancing data products that can point to financial system vulnerabilities and help identify threats to financial stability. Identifying and assessing those vulnerabilities in FY 2022 was essential to adhering to and delivering on our Office’s statutory mandate. In addition, the OFR collects, maintains, and shares supervisory and commercial datasets with Council member agencies; the OFR fulfills its statutory mandate in part through its centrally cleared repo data collection. The Office leads the Council Data Committee and works with the Council Systemic Risk Committee to address data gaps. The Data Committee provides a forum for information-sharing among the Council’s Chief Data Officers and representatives, coordinates action on data-related topics, and oversees the annual update to the Interagency Data Inventory. The OFR and the FSOC Secretariat collaborate to ensure proposed research and data topics, projects, and publications are consistent with the OFR’s mission and the Council’s needs.

Addressing Top Priorities

In FY 2022, the OFR launched two significant pilot programs; the Non-centrally Cleared Bilateral Repo Pilot and the OFR-hosted Climate Data and

Analytics Hub Pilot. The largely opaque repo market was seen as a potentially significant data gap for regulators, leading the OFR to create a pilot data collection project. A proposed rule governing these repo transactions was published in early 2023.

Separately, the OFR worked with the Federal Reserve and the Federal Reserve Bank of New York (FRBNY) on the OFR-hosted Climate Data and Analytics Hub pilot. The pilot entailed collecting data from multiple public sources and providing a shared space for collaboration and analytics.

In other significant highlights, the OFR:

- Assumed the role of Secretariat for the Regulatory Oversight Committee (ROC), an international organization made up of over 50 countries that are responsible for overseeing the governance of multiple globally used financial data standards, including the Legal Entity Identifier (LEI), the Unique Product Identifier (UPI), Unique Transaction Identifier (UTI), and Critical Data Elements (CDE) for over-the-counter derivatives transaction reporting;
- Enhanced the Financial Instrument Reference Database by adding new data elements from the Financial Information eXchange (FIX) Protocol;
- Participated in several U.S. and international financial data standards development initiatives in collaboration with Council member agencies;
- Published numerous working papers, including on hedge funds, central bank digital currencies, and Treasury market stress;

- Made significant progress on the OFR's Workforce Plan 2020–2024 by addressing gaps related to retention, workforce development, training, and recruitment;
- Implemented multiple new layers of information security focused on technology infrastructure and data;
- Initiated hybrid workplace flexibilities that include telework and remote work following temporary workplace provisions during the COVID-19 pandemic; and
- Assisted the Defense Advanced Research Projects Agency (DARPA) in research to address disruptions to distributed financial ledgers.

The OFR's Non-centrally Cleared Bilateral Repurchase Agreement Pilot

The multitrillion-dollar market for repurchase agreements (repo) supports short-term liquidity and price discovery by allowing financial institutions to lend or borrow cash, usually overnight, with securities as collateral. While the OFR's centrally cleared repo collection was an important first step in providing financial regulators with greater visibility into this market, non-centrally cleared bilateral repo transactions still represent a major blind spot.

This lack of visibility was felt acutely following a September 2019 repo spike and March 2020 dislocations in the Treasury market, when substantial

portions of activity in these crucial funding markets could not be observed. In the wake of these episodes of stress, market participants and regulators—Treasury, Federal Reserve, and other Council officials—called for the availability of more data on non-centrally cleared bilateral repo and supported the OFR in a pilot to collect this data.

In 2022, the OFR assembled a team of experts from across the Office to focus on closing this data gap. Senior researchers, data managers, technologists, and legal advisors conducted an outreach-and-collection pilot to shed light on this previously unobserved portion of the repo market. This team looked at market structure and size, industry data submission practices, and which institutions should be reporting these data. The OFR gained significant insight through multiple meetings with experts from several Council member agencies, the FRBNY, financial industry trade associations, and individual financial institutions, many of which are likely to be covered by a final rule. Nine firms volunteered to participate in the pilot collection, each submitting data from three days' reporting in June.

From our preliminary analysis of the pilot collection, we learned about several market practices, including the composition of collateral, the identity of counterparties, and the terms of repo agreements. Notably, we find that most non-centrally cleared bilateral repos are collateralized by U.S. Treasuries, despite much of the collateral being eligible for bilateral central clearing. In addition, relative to other repo market segments, a larger proportion of repo volumes are attributable to hedge funds or other asset

managers, and the length of terms of these repos are generally longer than other segments, with lower-quality collateral generally having longer terms.

The OFR initiated the rulemaking process to establish a permanent collection. In early 2023, the Office published a Notice of Proposed Rulemaking (NPRM) that requests public comment on data fields, formats, potential definitions for institutions that will be required to report data, and other pertinent information.

Interagency Data Inventory

The Council Interagency Data Inventory is a catalog of data collections by Council member agencies and other government organizations that started in 2011. The inventory does not contain data but rather *metadata*—data about data—on each collection. The inventory contains a brief description of each data collection and basic information, such as the collecting organization; the name and number of the form used to collect the data; and the type of collection, such as financial or supervisory. These metadata are publicly available but sometimes difficult to find. The Interagency Data Inventory is updated annually and can be used to search for data collections and analyze gaps and overlaps in collections. Each Council member agency determines which of its data collections to include in the inventory.

OFR-hosted Climate Data and Analytics Hub Pilot

In 2022, the OFR collaborated with the Federal Reserve and the FRBNY to develop the OFR-hosted Climate Data and Analytics Hub (Data and Analytics Hub) pilot, a new tool to help financial regulators assess risks to financial stability stemming from climate-related financial risk. The purpose of the pilot was twofold: to meet the Federal Reserve's request for a collaborative space with shared climate data, analytic tools, and computing power; and to enable the OFR to develop and test a scalable model for offering enhanced services to Council member agencies.

While the pilot was limited to publicly available climate data, future versions of the platform will include public, academic, and commercial data to enable research on other financial stability-related topics. The Data and Analytics Hub will provide the Council and its member agencies access to analysis-ready data, high-performance computing, and analytical and data visualization software in a secure and collaborative environment. While access to the pilot was limited to the Federal Reserve and the FRBNY, future versions of the Data and Analytics Hub aim to provide access to all Council member agencies.

Climate Data Assessment

The OFR identified and categorized over 30 climate-related data sources divided into three groups: commercial vendors, government agencies, and academia/international organizations. Climate-

related financial risk was subsequently divided into nine subcategories: agricultural production, landslides/land changes, inland flooding, temperature, hurricanes/wind, precipitation, coastal flooding/sea-level changes, water supply stress, and wildfires.

While some data are publicly available, others are restricted and require specific access agreements. A substantial proportion of the data requires specialized knowledge, and files can be significant in size. The data can also have missing information and time stamps, impacting usability.

Agency data collections are typically in raw form, but commercial vendors offer curated data. Vendors often digest and clean agency data, apply models, and develop risk-score assessments. None of the 17 surveyed commercial vendors currently provide data across the nine risk subcategories, although several of them are adding additional capabilities. In addition, the vendor models are variable in scope and mechanics, which necessitates the need to understand the differences in their outputs. A thorough review of the academic literature, policy analyses, and environmental statutes is vital for users to gain a better understanding of climate models and their underlying data.

We identified key data gaps to further evaluate the relationship between financial stability and climate-related financial risk. These included information on the properties of residential and commercial mortgage holders, as well as distribution, supply-chain, central resource, and transportation-related data for properties and infrastructure.

Data Standards

The OFR's statutory mission includes preparing and publishing financial data standards and formats that better allow both the private and public sectors to monitor risks in the financial system. To accomplish this mission, the OFR focuses on improving the quality and utility of financial data and facilitating the aggregation, integration, sharing, access, interoperability, and exchange of these data.

Since many financial institutions operate globally, the OFR's data standards efforts have an international focus, where possible. The OFR is a leader in promoting the development, adoption, and use of financial data standards in multiple financial data standards bodies, including the Regulatory Oversight Committee (ROC), the International Organization for Standardization (ISO), and the Accredited Standards Committee X9, Inc. (ASC X9).

The OFR engages in these activities with other Council member agencies, financial and standards-setting authorities from other jurisdictions, and leaders and experts from the public and private sectors.

Regulatory Oversight Committee

The OFR is a major contributor of subject matter expertise to the work of the ROC, the global body of authorities overseeing multiple ISO standards and data, including the Legal Entity Identifier (LEI), the Unique Product Identifier (UPI), the Unique Transaction Identifier (UTI), and Critical

Data Elements (CDE) for Over-the-Counter (OTC) derivatives reporting. The UPI, UTI, and CDE all support a consistent, high-quality standard for reporting and aggregating data regarding OTC derivatives transactions—a market that has traditionally been global and opaque in terms of financial risks.

The OFR continues as a member of the ROC's Plenary, Executive Committee, Committee on Evaluation and Standards (CES), and Committee on Derivatives Identifiers and Data Elements (CDIDE).

In 2022, in a major transition, the OFR also assumed the role of Secretariat for the ROC. In this role, the OFR staff provides administrative services and other support to the organization as it helps the U.S. and other government authorities oversee the development of these financial data standards and promote their use in their own markets.

Legal Entity Identifier

The OFR continued to promote the adoption and expanded use of the Legal Entity Identifier (LEI), an international data standard, ISO 17442, for identifying the legal entities participating in a financial transaction. The LEI, on which the Global LEI System is based, consists of a 20-digit alphanumeric code and an associated set of data elements uniquely identifying a legal entity.

The OFR is committed to ensuring the quality of LEI data is sufficiently high to make it useful for industry participants and regulators. For example, through its active participation in the ROC's Committee on Evaluation and Standards (CES), the OFR contributed to improving

the quality of data describing an entity's direct-accounting consolidating parent, its ultimate-accounting consolidating parent, and other LEI data elements.

During 2022, the OFR contributed to the ROC's efforts to evaluate the Global Legal Entity Identifier Foundation's (GLEIF's) Verifiable LEI (vLEI) as part of the ROC's oversight responsibilities. The vLEI is a digital credential that combines three concepts: (1) an organization's identity, represented by the LEI; (2) a person's identity, represented by their legal name; (3) and the role the person plays for the legal entity. In its evaluation, the ROC seeks to fully understand the vLEI and the opportunities to expand the use of the LEI and the Global LEI System.

The OFR is committed to ensuring that the adoption of the LEI continues to grow. As of September 2022, nearly 2.1 million LEIs have been issued worldwide. Approximately 29% of these were issued in the U.S., with about 12% issued to U.S. entities.

Financial Instrument Reference Database

The OFR continued to enhance the Financial Instrument Reference Database (FIRD), an existing data product that is required by OFR's statute, with the inclusion of new data elements from the Financial Information eXchange (FIX) Protocol. OFR is also leveraging the X9 Industry Forum for Financial Terms Harmonization to provide industry input for future development. This body is tasked with analyzing and mapping the terms and definitions across multiple industry standards, with the results available to the

public. This is an important feedback loop for the quality of FIRD content.

International Organization for Standardization

The OFR made contributions to multiple International Organization for Standardization (ISO) Technical Committee 68 (TC 68) projects. TC 68 is responsible for developing and maintaining standards for the global financial services industry. The OFR is an active member of Subcommittee 8 (Reference Data for Financial Services), Subcommittee 9 (Information Exchange for Financial Services), and other groups.

ISO TC 68/Subcommittee 9 (SC 9) Working Group 1 (WG 1): Semantic Models

The ISO 20022 standard describes a common platform to develop messages for financial services and is used for a diverse number of financial data standards initiatives. All information within the model is used by TC 68/SC 9/WG 1 as a basis for the semantic transformation of data into the Web Ontology Language (OWL). The OFR contributes subject matter expertise in technical discussions and demonstrates ontology best practices and development, knowledge graphs, and platforms used in semantic technology.

ISO 24366: Natural Person Identifier (NPI)

The OFR actively participated in developing ISO 24366 Natural Person Identifier (NPI) — a data standard that uniquely identifies the natural persons

relevant to any financial transaction. This standard was published in October 2021.¹⁷⁸ Following this event, ISO TC 68 began developing a complementary standard, ISO 2466-2, to describe the requirements for: (1) the identification of natural persons, (2) the verification of their identity documentation and data, and (3) the issuance, use, and management of the lifecycle of the identifier.¹⁷⁹ ISO 24366-2 aims to guide and help enable implementation of ISO 24366. In the development of the NPI, the OFR made key contributions, drawing on its leadership and experience in developing and implementing ISO 17442 Legal Entity Identifier (LEI).

ISO TC 68 Advisory Group 5 (AG 5): Digital Currencies

The OFR contributed to the development of the TC 68 advisory group (AG5) report on central bank digital currencies (CBDC) and non-fiat digital currencies. A key aim of this report was to identify use cases for these currencies and provide recommendations to the ISO TC 68 Plenary covering data standards that support these use cases. The OFR ensured that U.S. expertise was brought to bear in preparing this report by providing close coordination with the leadership of ASC X9.

ISO TC 68/Advisory Group 3 (AG 3): Standards Best Practices

The OFR contributed to the work of ISO TC 68 Advisory Group 3 (AG3) Standards Best Practices. AG3 is charged with identifying and documenting practices that should apply when: (1) revising existing

TC 68 standards or developing new standards, (2) monitoring and evaluating the performance of ISO Registration Authorities, and (3) maintaining, publishing, and accessing code sets. To this work, the OFR contributed subject matter expertise, as well as analytical, drafting, and editing skills. The results of this work are set to be presented in two reports in 2023: “Standards Best Practices for ISO TC 68” and “Results of Discussions of ISO TC 68/AG 3 Regarding ISO Registration Authorities–Issues.”

ISO TC 68 Study Group 4 (SG 4): Communications

The OFR is the convener of TC 68’s Communications Group (SG4) which is responsible for facilitating the sharing of news and articles relevant to the work of TC 68’s subcommittees and subgroups. This leadership role allows the OFR to stay closely abreast of the large number of activities and events across TC 68.

Accredited Standards Committee X9, Inc.

The Accredited Standards Committee X9, Inc (ASC X9) is accredited by the American National Standards Institute (ANSI) to develop and maintain voluntary consensus data standards for the U.S. financial services industry. ASC X9 is the U.S. voting body for ISO. The OFR is a board and executive committee member and holds leadership positions on multiple subcommittees.

In its role as chair of the X9D Subcommittee, which is responsible for developing standards for financial instruments, the OFR leads X9’s Industry

Forum for Financial Terms Harmonization. This body is developing a common data dictionary, using open data standards to align terms and definitions widely used in the financial sector.

The OFR is the vice chair of the X9A Subcommittee, responsible for developing standards for retail card and mobile-based payments and contributing to international work in these areas. The OFR was also elected to chair the X9A1 Blockchain working group to address gaps in the security, integrity, and accessibility of blockchain and distributed ledger technology for emerging payments and financial services. The OFR led the development of a proposal for a Risk Assessment Framework for Bank Provided Crypto Asset Payment Custodial and Payment Services. This was presented to X9's Real-Time Payments Study Group for additional support and partnership.

Tools for Risk Measurement and Monitoring

Short-term Funding Monitor

The OFR began publishing the Short-term Funding Monitor (STFM) in September 2020. During FY 2021, the STFM became one of the OFR's most heavily used financial stability monitoring tools. The data application programming interface for the STFM is often accessed more than 1,000 times per day. In Q3 FY 2021, the OFR expanded the STFM with a new set of time series designated the final vintage (or

version). This set of time series reflected all errors corrected from the preliminary vintage published daily. These series make the STFM an even-more-valued resource for academic researchers seeking a greater understanding of short-term markets.

There were two significant, though less visible, changes in 2022. First, the OFR's Data Operations team adapted to changing market practices in the form of the new sponsored general collateral financing product from FICC. Second, the volume of the new product is too low to affect published aggregates at this time, but with assistance from FICC, the OFR prepared the new data source and captured data from the beginning of trading.

The Data Operations staff also streamlined operational procedures to reduce the need for manual oversight of the daily data feed. This will allow the OFR to handle larger feeds in the future with fewer staff resources.

Financial Stress Index

The Financial Stress Index (FSI) is a daily index that monitors stress in the financial system. It is constructed from 33 financial market indicators—such as yield spreads, valuation measures, and interest rates—that represent the five categories of credit, equity valuation, funding, safe assets, and volatility. The FSI shows the financial stress contributions of several categories (credit, equity valuation, funding, safe assets, and volatility) as well as three regions (the U.S., other advanced economies, and emerging markets). During periods when financial stress is above average, the FSI is positive, and when stress is below average, the FSI is negative.

In FY 2022, the FSI was negative from October to February, then was marked by repeated periods of financial stress peaking in March, May, and July, continuing into FY 2023. This stress was driven mostly by the volatility and equity valuation categories across the FSI regions of the United States, other advanced economies, and emerging markets.

U.S. Money Market Fund Monitor

The OFR's U.S. Money Market Fund Monitor (MMFM) tracks the investment portfolios of money market funds. The MMFM converts data from the SEC's Form N-MFP2 data into a user-friendly format that allows users to chart fund characteristics, such as the types of assets held, investments by country, and counterparties involved. After surging in FY 2020, a record of 30%, money market fund total flows began a steady decline through the end of FY 2022. While remaining well above pre-COVID crisis levels during FY 2022, flows have oscillated during the year. Since the middle of FY 2021, fund participation in the Federal Reserve's reverse repurchase agreement (RRP) facility has gained significantly. As a result, activity in mid-FY 2022 peaked at around \$2 trillion.

Bank Systemic Risk Monitor

The OFR's Bank Systemic Risk Monitor (BSRM) is a collection of key indicators for monitoring systemic risks posed by the largest banks. The BSRM allows users to easily assess a bank's systemic risk capital surcharge, total assets, leverage, and

reliance on short-term wholesale funding. Features include systemic importance scores for U.S. and international banks and the OFR's Contagion Index, which reflects the financial system's exposure to these banks' activities and results. Components of the score focus on the size of a bank and its broader impact on the financial system based on:

1. The extent of the bank's network of obligations within the financial system,
2. The unique proposition of its offerings and services not replaced easily by others,
3. The complexity of the bank's operations as it pertains to the various assets classes in which it is involved, and
4. The coverage it provides across international borders.

Users have access to data tabs, customizable charts, and the OFR's Contagion Index, which considers size, leverage, and relationships with other financial institutions to reveal a potential loss that could spill over into the rest of the financial system if a given bank were to default.

Research and Analysis Center

The Research and Analysis Center (RAC) conducts applied and long-term research and analysis to support the stability of the U.S. financial system. The Center produces financial stability monitors, research, evaluation of financial stability policies, and briefings for the Council and other stakeholders. RAC makes certain results of

its work available to the public to promote transparency and engagement.

Working papers allow members of the OFR staff to disseminate preliminary research findings in a format intended to generate discussion and comments among an expert audience.¹⁸⁰ Titles published¹⁸¹ in 2022 included:

- Hedge Funds and Treasury Market Price Impact: Evidence from Direct Exposures
- Central Bank Digital Currency: Stability and Information
- Cash-Hedged Stock Returns
- Aggregate Risk in the Term Structure of Corporate Credit
- Financial Intermediary Funding Constraints and Segmented Markets

Briefs by OFR staff appeal to a broad audience.¹⁸² These papers analyze the stability implications of financial and regulatory policy, as well as recent developments in the financial system. Titles published¹⁸³ in 2022 included:

- U.S. Commercial Real Estate Has Proven Resilient, but Emerging Risks Could Generate Losses for Lenders
- Treasury Market Stress: Lessons from 1958 and Today
- Negative Rates in Bilateral Repo Markets

RAC broadened the OFR blog to highlight topical issues that may interest a wider audience.¹⁸⁴ Topics covered by blog posts¹⁸⁵ in 2022 included:

- Non-centrally Cleared Bilateral Repo

- Rising Interest Rates Help Insurers, but Market Volatility Poses Risk to Some
- OFR Finds Large Cash Holdings Can Lead to Mismeasuring Risk

RAC regularly collaborates with outside researchers to identify and better understand threats to financial stability and ways to mitigate them. During 2022, RAC hosted or co-hosted research events, including:

- a one-day virtual symposium on November 4, 2021, for Ph.D. students to present cutting-edge research discussing important financial stability issues;
- “Financial Stability: Planning for Surprises, Learning from Crises,” which was co-hosted by the Federal Reserve Bank of Cleveland and held virtually November 17-19, 2021; and
- a one-day virtual conference on climate risk and financial stability, which was held September 9, 2022, in which experts presented research and held panel discussions on asset valuations, credit markets, stress testing, financial system externalities, and other topics.

OFR researchers presented their analyses and findings at various conferences, including:

- The Arizona State University Sonoran Winter Finance Conference;
- The Office of the Comptroller of the Currency (OCC) Research Symposium on Systemic Risk and Stress Testing in Banking;
- The Young Scholar Finance Consortium;

- The Eastern Finance Association’s annual meeting;
- The Federal Reserve Short-Term Funding Markets Conference with the University of Maryland;
- The SFS Cavalcade Conference;
- The Canadian Economics Association’s annual meeting; and
- The Society for Computational Economics’ 28th International Conference on Computing in Economics and Finance.

DARPA Cooperation

In 2022, the OFR provided subject matter expertise for the Department of Defense’s Defense Advanced Research Projects Agency (DARPA) EcoSystemic program, to address disruptions to distributed financial ledgers.

Integrated Planning

The OFR’s integrated-planning framework increases the line of sight between what we do and why we do it, ensuring strategic alignment and helping to make the Office a great place to work. The framework includes a cycle of leadership conversations about the OFR’s strategy, enterprise risk, tactical planning, resources, performance, and trade-offs. These conversations resulted in a data-driven map of the OFR’s priorities tied to its strategic objectives, the work required to advance the mission, the resources needed to move forward, and increased clarity about progress toward strategic goals.

This integrated map organizes and guides the work of the OFR, enabling a better

understanding of high-priority areas, improved monitoring, and reporting on financial stability risks—including those that originate outside the financial system. The plan is responsive to the emerging priorities of the Council and the Administration: short-term funding, asset management (hedge funds), digital assets (crypto assets), climate-related financial risks, and cybersecurity.

In 2022, the OFR revisited its *Strategic Plan 2020–2024* to ensure the discussion of strategic goals accurately reflects current work. The OFR made minor adjustments to its objectives to incorporate and demonstrate the accomplishments made in the OFR’s organizational culture and operations.

The OFR continued to meet its mission requirements and monitor financial stability throughout the COVID-19 pandemic while also providing support to the FSOC Secretariat and Council member agencies. On March 14, 2022, the OFR began re-entry into the office with a transition period through May 20, 2022. The OFR implemented hybrid workplace flexibilities that included telework and remote work.

Investments

The OFR’s annual budget and workforce plan cascade from the Office’s integrated-planning activities. The OFR Director consults with the Council Chairperson to establish the OFR annual budget and workforce plan. The OFR is funded through semiannual Financial Research Fund assessments.

The OFR obligated \$78.5 million in FY 2022, 45% for labor and 55% for nonlabor expenses. This funding directly supported

the OFR's strategic priorities. A significant portion of the nonlabor expenses is the cost of the data needed to execute the OFR's unique research mission (\$10.3 million), which enables the OFR to achieve its statutory mandates.

The OFR leverages the Treasury's shared-services programs, spending roughly \$8.6 million per year for support services for the OFR's human capital (e.g., payroll, recruitment, benefits, and agency-wide systems for training), finance (i.e., budget and acquisition), security processing, and travel programs. In addition, the OFR is assessed by the Department of Treasury approximately \$4.4 million annually for the use of Treasury's IT circuits.

Committed to retaining and recruiting a diverse workforce, the Office made significant progress on its *Workforce Plan 2020–2024* by addressing retention, workforce development, training, and recruitment gaps. This effort included the development of an OFR-wide competency model and the completion of a competency assessment for all staff and leaders; investment in professional development in the areas of data science, contract management, agile project management, change management, human-centered design, and leadership; and deployment of additional communication channels to convey key leadership messages across the workforce.

Recruitment remains a top priority. In 2022, the OFR grew its team by 14%, reducing gaps in subject matter expertise. The OFR filled multiple critical leadership positions, including the Associate Director of Financial Institutions and a Supervisory Information Technology Specialist. The

Office also added considerable expertise and bench strength to its research, analysis, information technology, operations, and public affairs teams.

The OFR shared job opportunity announcements broadly—including through our diversity, equity, and inclusion (DEI) partners—and enlisted advertising space from trade journals to social science communities to expand awareness about employment opportunities with the OFR. In addition, the OFR encouraged flexibility in work locations, broadening the applicant pool nationally to attract the best talent.

The OFR's Technology Center implemented multiple new layers of security focused on the safeguarding of infrastructure and data. The OFR took a proactive approach to create a new security operations facility, allowing significant advances toward a zero-trust architecture, in line with the federal mandate that all agencies should be compliant with zero trust by 2024. The Technology Center completed its four-year migration from Treasury-hosted services, hardware, and equipment to a cloud environment. OFR now operates fully within a cloud-based environment.

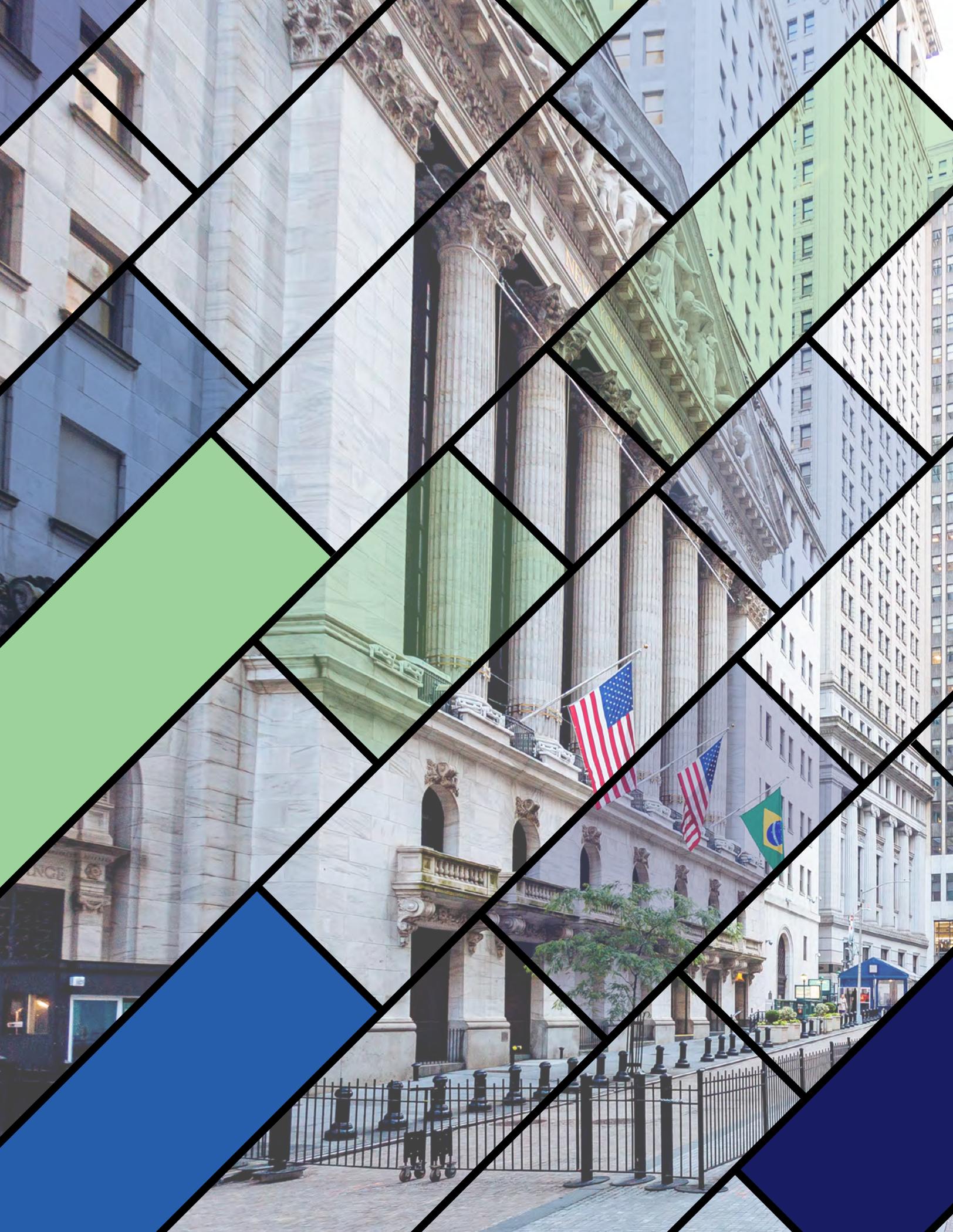
Teams across the Technology Center reviewed (in association with the data and analytics hub pilot) new methodologies and strategies for managing the fast-growing use of data and refining the OFR's IT services. The focus on improving data management practices resulted in the successful implementation of new tools, processes, and procedures.

Figure 80. OFR Funds Obligated in Fiscal Years 2017-22 (\$ thousands)

	2017	2018	2019	2020	2021	2022
Compensation	37,379	31,991	18,095	19,205	23,271	25,612
Benefits	13,054	10,932	6,860	7,100	8,552	9,461
Benefits to former employees			292			
Labor total	50,433	42,923	25,247	26,305	31,823	35,073
Travel	447	147	156	75	6	37
Transportation			2			
Communication and utilities	179	131	68	116	125	135
Printing and reproduction	22	8	7	7	3	7
Other services	31,823	26,353	26,648	25,815	31,245	31,957
Supplies and materials	6,508	5,649	6,118	9,837	8,377	10,231
Equipment	3,459	679	309	519	632	1,065
Nonlabor total	42,438	32,967	33,308	32,785	40,388	43,432
TOTAL	92,872	75,890	58,555	59,497	72,211	78,505

Note: Other services include rent and administrative support for human resources, conferences and events, facilities, and procurement.

Source: Office of Financial Research



GLOSSARY

Adverse selection

When sellers have more information than buyers have, or vice versa, about some aspect of product quality. Adverse selection can impose a higher risk on the less-informed party.

Authorized participant

A liquidity provider to an exchange-traded fund. When there is a shortage of exchange-traded fund shares in the market, the authorized participant creates more shares. When there is an excess supply of shares, the participant redeems shares to reduce the number of shares on the market.

Bank for International Settlements (BIS)

An international financial organization that serves central banks in their pursuit of monetary and financial stability, helps to foster international cooperation, and acts as a bank for central banks.

Bank Recovery and Resolution Directive (BRRD)

A directive of the European Union that establishes a common approach among EU countries for recovery and resolution of failing banks.

Basel Committee on Banking Supervision (BCBS)

An international forum for bank supervisors that aims to improve banking supervision worldwide. The BCBS develops guidelines and supervisory standards, such as standards on capital adequacy, the core principles for effective banking supervision, and recommendations for cross-border banking supervision.

Basel III

A comprehensive set of global regulatory standards to strengthen the regulation, supervision, and risk management of the banking sector. The measures include bank and banking system regulation to strengthen firms' capital, liquidity, risk management, and public disclosures to reduce the banking system's vulnerability to shocks.

Blockchain

The common name for cryptographic distributed ledger technology used to record online transactions. Blockchains are the basis of cryptocurrencies.

Bond duration

The measure of a bond's market price sensitivity to interest rate changes,

measured in years. Price risk rises as duration increases.

Brokered deposit

A government-insured deposit that a bank obtains through a brokerage. These funds may leave the bank quickly when a competitor offers a higher rate.

Call report

A quarterly report of a bank's financial condition and income that all federally insured U.S. depository institutions must file.

Capital

The difference between a firm's assets and its liabilities, capital represents the net worth of the firm or the firm's book equity value to investors.

Capital requirement

The amount of capital a regulator requires a bank to have to act as a cushion to absorb unanticipated losses and declines in asset values that could otherwise cause a bank to fail.

Coronavirus Aid, Relief, and Economic Security (CARES) Act

The Coronavirus Aid, Relief, and Economic Security Act of 2020, stimulus legislation to buffer the consequences of the COVID-19 pandemic and related economic shutdowns.

Central clearing

A settlement system in which securities or derivatives of a specific type are cleared by one entity that guarantees the trades, such as a clearinghouse or central counterparty. Central clearing is an alternative to

bilateral or over-the-counter trading (see over-the-counter derivatives).

Central Bank Digital Currencies (CBDCs)

A digital liability of a central bank that is widely available to the general public.

Central counterparty (CCP)

An entity that interposes itself between counterparties to contracts traded in one or more financial markets. A CCP becomes the buyer to every seller and the seller to every buyer to help ensure the performance of open contracts.

Clearing

A system that transfers ownership of securities when they are traded and makes related payments.

Clearing bank

A commercial bank that facilitates payment and settlement of financial transactions, such as check clearing or matching trades between the sellers and buyers of securities and other financial instruments or contracts.

Clearing member

A member of, or a direct participant in, a central counterparty that is entitled to enter into a transaction with the CCP.

Collateral

Any asset pledged by a borrower to guarantee payment of a debt.

Collateralized loan obligation (CLO)

Securities that hold pools of corporate loans and are sold to investors in tranches with varying levels of risk.

Commercial mortgage-backed securities (CMBS)

Securities collateralized by commercial mortgages.

Commercial paper

Short-term (maturity of up to 270 days), unsecured corporate debt.

Comprehensive Capital Analysis and Review (CCAR)

The Federal Reserve's annual exercise to ensure that the largest U.S. bank holding companies have robust, forward-looking capital planning processes that account for their unique risks and sufficient capital for times of financial and economic stress. The CCAR exercise also evaluates the banks' individual plans to make capital distributions such as dividend payments or stock repurchases.

Concentration risk

Any single exposure or group of exposures to the same risk with the potential to produce losses large enough to threaten a financial institution's ability to maintain its core operations.

Consumer price index (CPI)

A measure of the average change over time in the price of a representative basket of consumer goods and services.

Contagion

A contagion is the spread of an economic [financial] crisis from one market or region to another and can occur at both a domestic and international level.

Counterparty risk

The risk that the party on the other side of a contract, trade, or investment will default.

COVID-19 pandemic

A highly contagious respiratory illness caused by a coronavirus and declared a pandemic in 2020 by the World Health Organization.

Credit default swap (CDS)

A bilateral contract protecting the buyer against the risk of default by a borrower. The buyer of CDS protection makes periodic payments to the seller and, in return, receives a payoff if the borrower defaults. The protection buyer does not need to own the loan covered by the CDS.

Credit default swap spread

The premium paid by the buyer of credit default swap protection to the seller.

Credit rating agency

A private company that assesses the creditworthiness of a borrower or a financial instrument.

Credit risk

The risk that a borrower may default on its obligations.

Crypto asset

Digital financial assets (crypto assets) based on blockchain cryptographic technology. Bitcoin is the most widely used cryptocurrency.

Cybersecurity risk

The vulnerability of information technology and computer systems to unauthorized

access. Innovations such as quantum computing may increase the ability of nefarious players to access encrypted data.

Decentralized finance (DeFi)

Arrangements that aim to provide financial products or services without relying on a traditional financial intermediary. Instead, these products and services are automated to some degree using smart contracts, a type of computer code stored on a blockchain that self-executes when certain conditions are met.

Defined-benefit pension plan

A plan where members' pension benefits are determined by formula, usually tied to years of service and earnings during service, regardless of the assets in the plan. This contrasts with a defined-contribution plan such as a 401(k), where benefits are determined by returns on a portfolio of investments.

Depegging

A situation where the value of a crypto asset deviates from the value of the bank-issued currency it is linked to. For example, if a cryptocurrency is pegged to the dollar, it becomes depegged if its value falls below \$1.

Depository institution

A financial institution, such as a bank or credit union, that has liabilities in the form of deposits.

Depository Trust & Clearing Corporation (DTCC)

A company that processes and clears trades as the central clearing house for the U.S. capital markets and repository for the derivatives market.

Derivative

A financial contract whose value is derived from the performance of underlying assets or market factors such as interest rates, currency exchange rates, or commodity, credit, and equity prices. Derivatives transactions include structured debt obligations, swaps, futures, options, caps, floors, collars, and forwards.

Discount window

The Federal Reserve's traditional facility for making collateralized loans to depository institutions.

Disruption

A sudden decline in market prices due to a shock that upends the expected behavior of the financial system.

Distributed ledger technology

See *blockchain*.

Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act)

The short name for the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010. The objective of the Act is to promote financial stability.

Emerging markets

Developing countries where investments are often associated with both higher yields and higher risks.

Eurozone or euro area

A group of 19 European Union countries that have adopted the euro as their currency.

Exchange-traded fund (ETF)

An investment fund whose shares are traded on an exchange. Because ETFs are exchange-traded products, their shares are continuously priced, unlike mutual funds, which offer only end-of-day pricing. ETFs are often designed to track an index or a portfolio of assets.

Federal funds (fed funds)

Overnight interbank borrowing of reserves at the Federal Reserve.

Federal funds rate

The interest rate at which depository institutions lend fed funds to each other.

Federal Home Loan Banks (FHLBs)

Eleven U.S. government-sponsored banks that provide funding for member financial institutions, mostly through advances secured by mortgages.

Federal Open Market Committee (FOMC)

A twelve-member body within the Federal Reserve System that sets national monetary policy, including setting the target range for the federal funds rate.

Feedback loop (negative)

The downward price pressure created when parties meet margin payment obligations on some securities by liquidating positions in other related securities.

Fiat money

A government-issued currency that is not backed by a physical commodity, such as gold, but rather by the government that issued it.

Financial crisis

A significant, sustained drop in asset prices, income streams, credit, and liquidity, resulting from an event that shocks the financial system, usually triggering government interventions and bailouts.

Financial stability

The condition in which the financial system can provide its basic functions, even under stress. Those basic functions are (1) credit allocation and leverage, (2) maturity transformation, (3) risk transfer, (4) price discovery, (5) liquidity provision, and (6) facilitation of payments.

Financial Stability Board (FSB)

An international coordinating body that monitors financial system developments on behalf of the Group of 20 (G-20) nations. The FSB was established in 2009 and is the successor to the Financial Stability Forum.

Financial Stability Oversight Council (Council)

A government body created by the Dodd-Frank Act, consisting of the heads of all federal financial regulatory agencies and others, with a statutory mandate to identify risks and respond to emerging threats to financial stability. Chaired by the Secretary of the U.S. Treasury, the Council consists of 10 voting members and five non-voting members, including the OFR Director.

Fintech

Financial technology, usually referring to firms that operate on technology-based business models.

Fire sale

The disorderly liquidation of assets to meet margin requirements or other urgent cash needs, which can drive prices below their fundamental value. The quantities sold are large relative to the typical volume of transactions.

Fiscal policy

The use of government spending and taxes to influence the economy.

Forbearance (debt forbearance)

An agreement between borrowers and lenders, or a government mandate, to suspend payments temporarily without being considered in default. Under the CARES Act, mortgage servicers were required to grant payment forbearance, for 180 days, to borrowers experiencing financial hardship and who had mortgages backed by the government.

Form N-MFP

A monthly disclosure of portfolio holdings submitted by money market funds to the Securities and Exchange Commission, which makes the information publicly available. SEC Rule 30b1-7 established the technical and legal details of N-MFP filings.

Generally Accepted Accounting Principles (GAAP)

Accounting rules published in the United States by the Financial Accounting Standards Board.

Global systemically important banks (G-SIBs)

Banks annually identified by the Basel Committee on Banking Supervision

as having the potential to disrupt international financial markets. The designations are based on banks' size, interconnectedness, complexity, dominance in certain businesses, and global scope.

Government-sponsored enterprise (GSE)

A financial service entity created by the federal government and perceived as being implicitly guaranteed by the government. The GSEs include Fannie Mae, Freddie Mac, Sallie Mae, Farmer Mac, the Federal Home Loan Banks, the Farm Credit System, and the National Veteran Business Development Corporation.

Government-sponsored mortgage companies (GSMCs)

Financial services corporations established by Congress to make mortgage loans more readily available to the public. GSMCs include the Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation (Freddie Mac).

Gross notional exposure (GNE)

A measure of total portfolio leverage, for example, in a hedge fund. GNE is calculated as the summed absolute values of long and short notional positions, including both securities and derivatives.

Hacktivist

Someone who infiltrates computer systems and networks to promote a social or political agenda.

Hedge fund

A pooled investment vehicle available to accredited investors such as wealthy individuals, banks, insurance companies, and trusts. Hedge funds can charge a performance fee on unrealized gains, borrow more than half of their net asset value, short-sell assets they expect to fall in value, and trade complex derivative instruments that cannot be traded by mutual funds.

Hedging

An investment strategy to offset the risk of a potential change in the value of assets, liabilities, or services. An example of hedging is buying an offsetting futures position in a stock, interest rate, or foreign currency.

High-quality liquid assets (HQLA)

Assets such as central bank reserves and government bonds that can be quickly and easily converted to cash even during a stress period. U.S. banking regulators require large banks to hold HQLA to comply with the Liquidity Coverage Ratio.

High-yield debt

Bonds and other financial instruments rated below investment grade that pay a higher interest rate than investment-grade securities because of the perceived credit risk; also known as non-investment grade or speculative.

Initial margin

A percentage of the total market value of securities an investor must deposit up front to purchase securities with borrowed funds.

Intraday credit

An allowance by banks for customers to borrow money or overdraw accounts during a single day, at no charge, as long as it is repaid by the close of business that same day.

Interest coverage ratio

A calculation of earnings divided by interest expense. Interest expenses that are equal to or greater than earnings before interest and taxes (EBIT) or earnings before interest, taxes, depreciation, and amortization (EBITDA) are unsustainable.

Interest rate swap

A swap in which two parties exchange interest rate cash flows, typically between a fixed rate and a floating rate (see *swap*).

Intermediation

Any financial service in which a third party or intermediary matches lenders and investors with entrepreneurs and other borrowers in need of capital. Often, investors and borrowers do not have precisely matching needs and the intermediary's capital is put at risk to transform the credit risk and maturity of the liabilities to meet the needs of investors.

International Monetary Fund (IMF)

An international organization that provides credit to developing nations and those in economic distress, typically conditional on economic and financial reforms.

Intervention

Action taken by the government to regulate or provide financing to unstable financial markets or institutions.

Inverted yield curve

When yields on long-term bonds are lower than those on short-term bonds, the yield curve is said to be inverted. An inverted yield curve is seen as a sign of a possible recession.

Investment-grade debt

Securities that credit rating agencies determine carry less credit risk. Non-investment grade securities, also called speculative-grade or high-yield debt, have lower ratings and a greater risk of default.

Legal Entity Identifier (LEI)

A unique 20-digit alphanumeric code to identify each legal entity within a company that participates in global financial markets.

Leverage

Leverage is created when an entity enters into borrowings, derivatives, or other transactions resulting in investment exposures that exceed equity capital.

Leverage ratios (banks, insurance companies, hedge funds)

For banks, the leverage ratio is the Tier 1 (highest quality) capital of a bank divided by its total assets plus its total exposures to derivatives, securities-financing transactions, and off-balance-sheet exposures. For insurance companies, the leverage ratio is assets to policyholder surplus. For hedge funds, the leverage ratio is gross asset value divided by net asset value.

Leveraged loan

Broadly, leveraged loans are loans to companies with non-investment grade

(below BBB) ratings. Often, a leveraged loan is a loan for which the obligor's post-financing leverage—as measured by debt-to-assets, debt-to-equity, cash flow-to-total debt, or other such standards unique to particular industries—significantly exceeds industry norms. Leveraged borrowers typically have a diminished ability to adjust to unexpected events and changes in business conditions because of their higher ratio of total liabilities to capital.

Liquidity

A market is liquid when buyers and sellers can easily trade financial instruments in customary volumes without a material impact on price.

Liquidity Coverage Ratio

A Basel III standard that requires large banks maintain enough high-quality liquid assets to meet anticipated liquidity needs for a 30-day stress period.

Liquidity risk

The risk that a firm will not be able to meet its current and future cash flow and collateral needs, even if it has positive net worth.

Liquidity transformation

Funding illiquid assets with liquid and demandable liabilities.

Living wills

Resolution plans required of U.S. banks with \$50 billion or more in total consolidated assets and nonbank financial companies designated by the Council for supervision by the Federal Reserve. Each living will must describe how the company could be resolved in a rapid, orderly way in the event of failure.

Lockdown

Stay-at-home orders from a government to its citizens.

Macroeconomic risk

Risk from changes in the macroeconomy or macroeconomic policy.

Macroprudential supervision

Supervision to promote the stability of the financial system as a whole. See *microprudential supervision*.

Margin call

A requirement by a creditor that a borrower increase the collateral pledged against a loan in response to reductions in the collateral's value.

Margin requirement

Rules governing the necessary collateral for a derivative, loan, or related security intended to cover, in whole or in part, the credit risk one party poses to another.

Mark to market

Accounting for the value of an asset at its current market price rather than in other ways, such as historical cost.

Market liquidity

The ability of market participants to sell large positions with limited price impact and low transaction costs.

Market making

The process in which an individual or firm stands ready to buy and sell a particular stock, security, or other asset on a regular and continuous basis at publicly quoted bid-ask prices. Market makers usually hold

inventories of the securities in which they make markets. Market making helps to keep financial markets efficient.

Market risk

The risk that an asset's price will change at unexpected magnitudes.

Maturity transformation

Funding long-term assets with short-term liabilities. This practice creates a maturity mismatch that can pose risks when short-term funding markets are constrained.

Metadata

Data about data. Metadata include information about the structure, format, or organization of other data.

Metadata catalog

An organized way to present metadata for discovery, exploration, and use of the related data.

Microprudential supervision

Supervision of the activities of a bank, financial firm, or other components of a financial system. See *macroprudential supervision*.

Monetary policy

Government or central bank use of interest rates and money supply or asset purchases to affect the economy.

Money market fund (MMF)

A fund that typically invests in short-term government securities, certificates of deposit, commercial paper, or other highly liquid and low-risk securities.

Mortgage-backed securities (MBS)

Debt-based securities (similar to bonds) that consist of bundles of mortgages. Banks bundle together the mortgages they sell to homeowners and then resell those bundles to investors, who receive periodic payments from the monthly mortgage payments made by the homeowners.

Mutual fund

A pooled investment vehicle that can invest in stocks, bonds, money market instruments, other securities, or cash, and sell its own shares to the public; regulated by the SEC.

National Association of Insurance Commissioners (NAIC)

An organization that represents U.S. state insurance regulators. Through the NAIC, regulators establish accreditation standards and practices, conduct peer review, and coordinate their regulatory oversights of insurance companies.

Net asset value (NAV)

The value of an entity's assets minus its liabilities per share. For example, a mutual fund calculates its NAV daily by dividing the fund's net value by the number of outstanding shares.

Non-investment grade debt

Instruments rated below investment grade that pay a higher interest rate than investment-grade securities because of the perceived greater credit risk; also known as speculative or high-yield debt.

Off-balance-sheet

Assets or entities that are not recorded on a company's balance sheet. Rather, they

are explained only in notes to financial statements.

Off-the-run Treasury securities

Treasury securities outstanding in the market that precede the most recent issue, usually traded less frequently than on-the-run securities.

On-the-run Treasury securities

The most recently issued Treasury securities. These are often traded more frequently than their off-the-run predecessors.

Operational risk

The risk of loss from internal control inadequacies or failures—problems of lapses by people, processes, or systems—or from external events.

Option

A financial contract granting the holder the right, but not the obligation, to engage in a future transaction on an underlying security or real asset. For example, an equity call option provides the right, but not the obligation, to buy a block of shares for a fixed period at a fixed price. A put option provides the right, but not the obligation, to sell an asset for a fixed period at a fixed price.

Originate

To extend credit after processing a loan application. Banks, for example, originate mortgage loans and either hold them or sell them to other financial market participants. The distribution can include a direct sale or a securitization.

Overnight Reverse Repo Facility (ON RRP)

An investment established by the Federal Open Markets Committee that supports a floor on short-term rates by acting as an alternative investment for nonbank financial institutions such as money market funds (MMFs) and government-sponsored enterprises (GSEs).

Over-the-counter (OTC) derivatives

Derivatives contracts negotiated privately between two parties, rather than traded on a formal securities exchange. Unlike standard exchange-traded products, OTC derivatives can be tailored to fit specific needs, such as the effect of a foreign-exchange rate or commodity price over a given period.

Pandemic

A disease or illness that affects a significant portion of the globe.

Pegged

A crypto asset whose value is linked to the value of a bank-issued currency.

Pension Benefit Guaranty Corporation (PBGC)

The agency that insures pension benefits; it has two programs—one for single-employer pension plans and one for multiemployer plans—to pay benefits to retirees in private, defined-benefit pension plans when sponsors cannot pay.

Physical risks

The potential for destruction or damage of physical assets, adverse impact on economic activity, and other losses from natural disasters and extreme weather

events. Climate-related financial risk is a driver of increased physical risks.

Price discovery

The process of determining the prices of assets in the marketplace through the interactions of buyers and sellers.

Primary dealer

Banks and securities broker-dealers designated by the Federal Reserve Bank of New York (FRBNY) to serve as trading counterparties when it carries out U.S. monetary policy. Among other things, primary dealers are required to participate in all auctions of U.S. government debt and to make markets for the FRBNY when it transacts on behalf of its foreign official account holders. A primary dealer buys government securities directly and can sell them to other market participants.

Private equity (PE)

Investment funds that acquire companies, restructure them to improve their bottom line, and then seek to sell them at a profit. Companies held by PE are not listed on public exchanges, and shares of PE are available to institutional investors but not the general public.

Real estate investment trust (REIT)

Corporations that invest in income-producing real estate and pay most of their taxable income to shareholders as dividends.

Regulatory Oversight Committee (ROC)

The global body of authorities overseeing multiple International Organization for Standardization (ISO) standards and data, including the Legal Entity Identifier (LEI),

the Unique Product Identifier (UPI), Unique Transaction Identifier (UTI), and Critical Data Elements (CDE) for Over-the-Counter (OTC) derivatives reporting.

Reinsurance

The risk management practice that insurers use to transfer some of their policy risk to other insurers. A second insurer, for example, could assume a portion of liability in return for a proportional amount of premium income.

Repo

The short form of *repurchase agreement*.

Repurchase agreement (repo)

A transaction is the sale of assets, combined with an agreement to repurchase the assets at a future date at a prearranged price. Repos are commonly used as a form of secured borrowing. The assets underlying the repo are used as collateral to protect the cash lender against the risk that the securities provider fails to repurchase the assets underlying the repurchase agreement.

Resilience

The ability of the financial system or parts of the system to absorb shocks and continue to provide basic functions.

Resolution plans

Plans required of U.S. banks with \$50 billion or more in total consolidated assets and nonbank financial companies designated by the Financial Stability Oversight Council for supervision by the Federal Reserve. Each plan, or living will, must describe how the company could

be resolved in a rapid, orderly way in the event of failure. See *living wills*.

Risk management

The business and regulatory practice of identifying and measuring risks and developing strategies and procedures to limit them. Categories of risk include credit, market, liquidity, operations, model, and regulatory.

Risk-based capital

The amount of capital a financial institution holds to protect against losses based on the risk weighting of different asset categories.

Risk-weighted assets

Bank assets or off-balance-sheet exposures weighted according to risk categories. This asset measure is used to determine a bank's regulatory risk-based capital requirements.

Run risk

The risk that investors lose confidence in a market participant because of concerns about solvency or related issues and respond by pulling back their funding or demanding more margin or collateral.

Secondary Market Corporate Credit Facility (SMCCF)

A Federal Reserve facility to support trading of outstanding corporate bonds and corporate bond exchange-traded funds.

Secured Overnight Financing Rate (SOFR)

An interest rate benchmark used as an alternative to LIBOR to set rates on

financial products. The SOFR, which is based on repurchase agreement (repo) rates, reflects the general cost of large-bank borrowing that is backed by Treasury securities as collateral. The OFR's repo data collection supports the production of the SOFR.

Securities lending/borrowing

The temporary transfer of securities from one party to another for a specified fee and time period, in exchange for collateral in the form of cash or securities.

Securitization

A financial transaction in which assets such as mortgage loans are pooled, securities representing interests in the pool are issued, and proceeds from the underlying pooled assets are used to service and repay the securities.

Settlement

The process of transferring securities and settling by book entry according to a set of exchange rules. Some settlement systems can include institutional arrangements for confirmation, clearance, and settlement of securities trades and safekeeping of securities.

Shock

A sudden change in fundamental economic drivers and expectations that can stress the economy and financial system.

Soft-landing

A cyclical slowdown in economic growth that avoids a recession.

Spread

The difference in yields between private debt instruments and government securities of comparable maturity.

Stable net asset value

A characteristic of some money market funds in which the value of a single share remains the same, usually \$1, even when the value of the underlying assets shifts.

Stablecoin

A variety of cryptocurrency that seeks to maintain a fixed value backed by reserves.

Standing facilities

Operations to execute monetary policies of the Federal Reserve and European Central Banks.

Standing Repo Facility (SRF)

A standing repurchase agreement in which the Federal Reserve guarantees to buy a security from an investor and then sell it back the next day at a price differential representing a specific rate of interest. This supports smooth market functioning by putting a ceiling on the amount of interest paid by investors in repo agreements.

Stimulus

A fiscal or monetary policy to increase the cash flow in circulation and boost the economy.

Stress test

An exercise that shocks asset prices by a prespecified amount, sometimes along with other financial and economic variables, to estimate the effect on financial institutions or markets. Under the Dodd-Frank Act, banking regulators run

annual stress tests of the largest U.S. bank holding companies.

Swap

An exchange of cash flows agreed by two parties with defined terms over a fixed period.

Systemic risk

Risk to systemwide financial stability.

Tail risk

The perceived low-probability risk of an extreme event or outcome.

Tier 1 Capital Ratio and Common Equity Tier 1 (CET1) Capital Ratio

Two measurements comparing a bank's capital to its risk-weighted assets to show its ability to absorb unexpected losses. Tier 1 capital includes common stock, preferred stock, and retained earnings. Common Equity Tier 1 capital excludes preferred stock.

Tranche

A portion of a securitized asset pool. From the French word meaning "slice."

Transition risks

Risks to businesses and economies from technological advances, changes in government policies, and shifts in consumer preferences. Climate-related financial risk is a potential driver of increased transition risks, though more research into the nature of those risks is needed.

Transmission Protection Instrument (TPI)

The TPI enables the Eurosystem (members of the ECB whose currency is the euro)

to "make secondary market purchases of securities issued in jurisdictions experiencing a deterioration in financing conditions not warranted by country-specific fundamentals."

Volcker Rule

A provision of the Dodd-Frank Act that limits proprietary trading by commercial banks and their affiliates.

Vulnerabilities

Underlying weaknesses that can render the financial system susceptible to instability.

Weighted average maturity (WAM)

A measure of the average amount of time until the bonds, mortgages, or other securities in a debt-based investment (like a money market fund or a mortgage-backed security) mature and thus cease producing payments to investors.

Wholesale funding

Bank funding provided by federal funds borrowing, repurchase agreements, foreign deposits, brokered deposits, and other short-term borrowing. Wholesale funding is considered less stable than funding provided by core deposits.

Yield curve

A graphical representation of the relationship between bond yields and their respective maturities. Generally, the curve slants up because longer-term bonds have higher yields than short-term debt securities. When that relationship does not hold, the yield curve is said to be inverted or flat.

ENDNOTES

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- 94 Federal Home Loan Bank obligations do not carry an explicit U.S. government guarantee.
- 95 The Commission is proposing for public comment amendments to 17 CFR 270.2a-7 (rule 2a-7) and 17 CFR 270.31a-2 (rule 31a-2) under the Investment Company Act of 1940, Form N-1A under the Investment Company Act and the Securities Act, and Forms N-MFP and N-CR under the Investment Company Act. See Securities and Exchange Commission. *Proposed Rule: Money Market Fund Reforms*. Release no. IC-34441, File no. S7-22-21, December 14, 2021: SEC. <https://www.sec.gov/rules/proposed/2021/ic-34441.pdf>. The principal regulation behind money market funds is rule 2a-7 under the Investment Company Act, which was promulgated in 1983 and most recently amended in 2014. A mutual fund chooses whetherto comply with rule 2a-7. A fund that does so may represent itself as a money market fund, rather than, for example, an ultrashort-term bond fund. Rule 2a-7 imposes credit quality, maturity, and liquidity requirements with respect to the securities that a money market fund may acquire. These requirements are designed to reduce the interest rate, liquidity, and credit risks of money market fund portfolios and, therefore, reduce the fluctuation in their net asset value. See Securities and Exchange Commission. *Valuation of Debt Instruments and Computation of Current Price Per Share by Certain Open-End Investment Companies (Money Market Funds)*. Final Rule, Washington, D.C.: Federal Register 48, no. 138 (July 18, 1983). <https://www.sec.gov/rules/final/1983/ic-13380.pdf>.
- 96 The defining feature of money market funds is that, in contrast to other mutual funds, they seek to maintain a stable net asset value (NAV) or share price. Methods of achieving a stable price per share include the utilization of amortized cost or penny rounding of the share price and sponsor support. The Investment Company Act of 1940 and applicable rules generally require mutual funds to calculate current NAV per share by valuing their portfolio securities for which market quotations are readily available at market value, and other securities and assets at fair value, as determined in good faith by the board of directors. In the Investment Company Act Release No. 8757, the Commission permitted money market funds to determine their NAV using valuation methods that facilitate the maintenance of a stable share price. (Ibid.). While the SEC changes in 2014 require institutional prime and tax-exempt funds to float their net asset value, the fluctuations in the floating net asset value of these funds have typically been minuscule, allowing for penny-rounding per share price of the funds. See Securities and Exchange Commission. *Final Rule: Money Market Fund Reform; Amendments to Form PF*. Release no. 33-9616, IA-38791 IC-31166; FR-84; File no. S7-03-13. <https://www.sec.gov/rules/final/2014/33-9616.pdf>.
- 97 Under the proposal, a money market fund would continue to be able to (1) impose redemption fees to address fund dilution under rule 22c-2, and (2) suspend redemptions to facilitate an orderly liquidation of the fund under rule 22e-3. The proposal only removes the ability to impose fees and gates under rule 2a-7.
- 98 The proposal would require an institutional prime and tax-exempt fund to adjust its current NAV per share by a swing factor reflecting the estimated cost of selling a pro rata share of its entire portfolio (a vertical slice) equal to the net redemptions for the pricing period. In addition, if the institutional fund has net redemptions for a pricing period that exceed the market impact threshold—defined as 4% of the fund’s net asset value divided by the number of pricing periods the fund has in a business day, or such a smaller amount of net redemptions as the swing pricing administrator determines—the swing factor would also include market impacts. A pricing period would be the period from the calculation of one share price to the next.
- 99 Government funds can hold up to 20% of their portfolios in nongovernment securities or can hold agency securities not explicitly guaranteed by the U.S. government (e.g., Federal Home Loan Bank system obligations). As a result, a credit event related to any of these securities could trigger a drop in the shadow price, thereby creating incentives for shareholders to redeem shares ahead of other investors. For example, during summer 2011, government money market funds experienced large redemptions as concerns intensified over the U.S. debt ceiling impasse and the possibility of a downgrade in government securities.
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- 102 In general, fund flows are sensitive to movement in market rates as well as credit and liquidity concerns. Flows are typically high during bond market expansion when interest rates are falling or low and bond returns are rising, whereas flows are low or negative when interest rates are rising and bond returns are negative.

- 103 Historically, banks and other large intermediaries were counted on to fill the role of market maker in fixed-income markets, provide liquidity, and keep markets functioning smoothly. Over time, however, their ability and willingness to fill that void has waned with the same perceived risks of stressed markets that drove market participants to seek that liquidity in the first place. Additionally, empirical evidence suggests that the Volcker Rule has led dealers to further reduce their bond market liquidity provision in stress periods. Also see Bao, Jack, Maureen O'Hara, and Xing (Alex) Zhou. 2018. "The Volcker Rule and corporate bond market making in times of stress." *Journal of Financial Economics* 130, no. 1 (October): 95–113. <https://www.sciencedirect.com/science/article/abs/pii/S0304405X18301491>.
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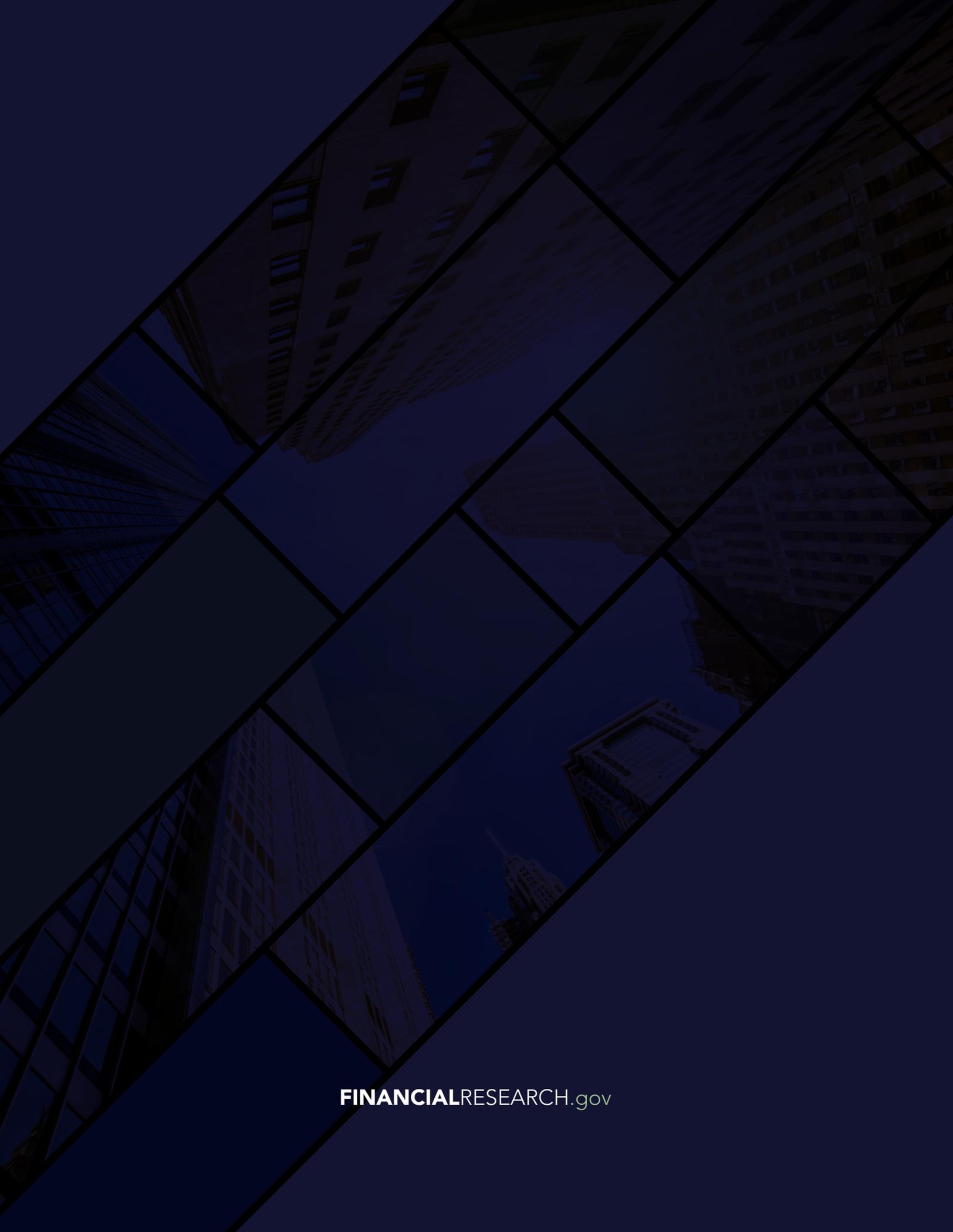
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