



ANNUAL REPORT

TO CONGRESS
2021

OFR

Unlike last year's report, which was written in the wake of a material threat to financial stability, this year's report was written during a remarkable economic recovery. Throughout, the Office of Financial Research (OFR) supported the Financial Stability Oversight Council (FSOC) and its members with informative financial data and insightful research-based analysis. In doing so, our Office better complements our financial regulators in gauging and developing a better understanding of complex risks to U.S. financial stability and, ultimately, economic opportunities for American households and businesses.

The Dodd-Frank Wall Street Reform and Consumer Protection Act established the OFR to serve as a research-based voice in assessing vulnerabilities that could pose risks to our financial system, while remaining agile to examine emerging threats.

Our 2021 Annual Report to Congress documents the COVID-19 global pandemic, which continues to grab headlines as it stretches into its twentieth month. And while many economic sectors have begun to recover, our report also considers other emerging threats like cybersecurity and climate change, which have traditionally not been examined more completely in terms of vulnerabilities to financial stability.

Emerging Risks

The OFR first identified cybersecurity as a potential risk to financial stability in 2016, a concern that has only increased since the onset of the COVID-19 crisis. By almost every measure, the cost of cyberattacks has surged in recent years both in terms of direct losses and the expense tied to prevention. This year's report examines how a cyberattack on critical systems or infrastructure could disrupt services and threaten stability of the financial system.

Relative to other vulnerabilities discussed in this report, climate risk is not as easily defined. Major weather events, the impacts of which the OFR has highlighted in previous reports, have yet to trigger a financial crisis on a systemic level. To be sure, climate change is a growing risk to watch, and our Office stands ready to support the FSOC with research and the data necessary to complete that research.

FROM THE DIRECTOR



Finally, as disruptions to public health and other potential stressors evolve, our Office will contribute to interagency analyses and information exchanges, and will continue to monitor, analyze, and share what we see, when we see it.

Mission Focused

With the transition to a new administration in early 2021, the OFR has remained flexible to meet the ever-changing needs of our stakeholders. To support the FSOC, our Office will continue to provide valuable data, research, and insights, while continuing to meet our own strategic initiatives.

Internationally, the OFR continues its work on data standards, most notably with our contributions to the Legal Entity Identifier (LEI), which our Office has led from a mere concept to fully operational since 2014. Also, in an effort to better monitor risks to the global financial system, the OFR continues its active involvement in the Regulatory Oversight Committee (ROC) and will take on the role of secretariat beginning in 2022.

As I enter my fourth year as Director, I am incredibly proud of my colleagues, who continued to meet our statutory mandate as Congress intended it. During these turbulent times, our Office dutifully supported the FSOC and its members by producing timely research and analysis and providing relevant financial data. The OFR remains committed to financial stability, because in its absence, households and businesses cannot reliably advance real economic opportunities. This is the seriousness with which we pursue the important mission of the OFR.



Dino Falaschetti
Director, Office of Financial Research

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EXECUTIVE SUMMARY



In this annual report, the Office of Financial Research (OFR) presents its assessment of the status of the U.S. financial system. 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 evolving risks to financial stability.

This summary discusses how the main drivers of risk to the U.S. financial system have changed since the OFR 2020 Annual Report. These observations also examine the possible implications and put them into a broader context. In addition to this summary, the Key Findings section details the extensive analysis by risk categories.



Assessing Risks in an Emerging Post-Pandemic Era



Vulnerabilities Amid a Broader Economic Landscape



Assessing Risks Inside the Markets



External Events Posing Risks to Financial System



The OFR's Performance



Assessing Risks in an Emerging Post-Pandemic Era

As we near the end of this year and move into 2022, we are approaching the two-year mark of the coronavirus outbreak in the U.S. and ostensibly entering an emerging post-pandemic era.

While the current period of growth could be stalled or reversed by any new COVID-19 variants, the landscape of financial and economic uncertainty has changed since the 2020 publication of an annual report by the OFR. It has moved away from questions about the smooth functioning of the financial markets, monetary and fiscal policy responses to the pandemic, and whether a nascent recovery was taking root.

Today's story is increasingly about macroeconomic uncertainty that could jeopardize economic growth, which had already slowed by the printing of this report. A key vulnerability is higher inflation, a risk tied to the current bottlenecks in supply chains and increased labor and energy costs.

Another category examined for potential financial risks comprises external events indirectly related to financial institutions, market activity, or macroeconomic stressors. In this category, climate change and cyber risks are closely examined for the vulnerabilities they introduce.

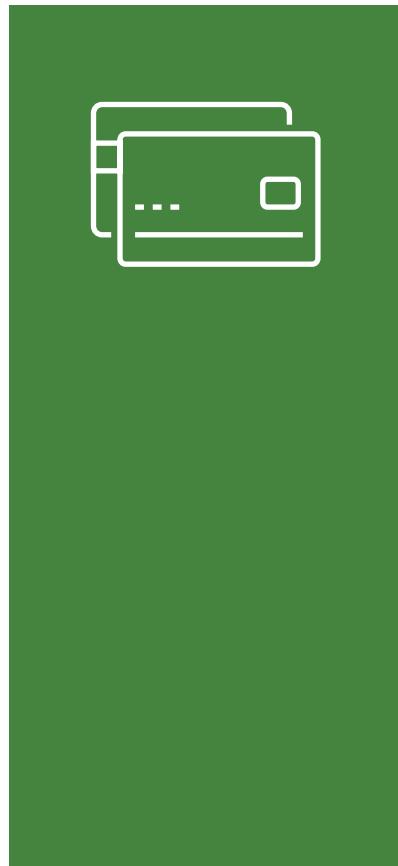
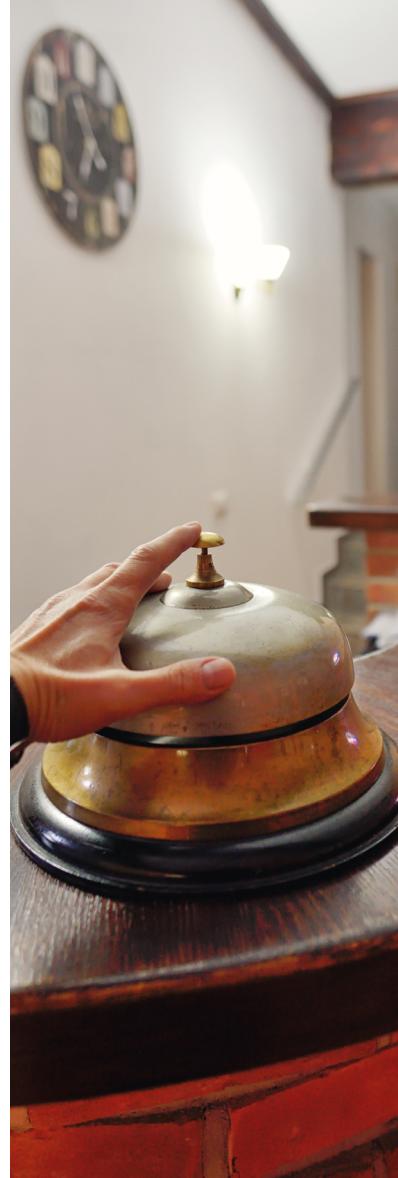


Vulnerabilities Amid a Broader Economic Landscape

An increasingly unclear outlook on economic growth puts a spotlight on credit—the engine oil that keeps the economy running, especially during periods of uncertainty. As discussed in the body of the report, vulnerabilities that could increase credit risk stem from various places.

One area of concern is whether leveraged nonfinancial corporations can continue to shoulder their high debt burdens if interest rates rise or economic growth decelerates. In commercial real estate, credit losses in the retail sector have been, and will continue to be, substantial, amid the boost to online shopping delivered by the pandemic. In the lodging sector, the probability of increased risk is uneven because hotel occupancy rates vary widely by property type and location. The most negatively affected hotels are those that host conventions or are in downtown metro areas.

The impact of the pandemic on household debt has been limited by mortgage forbearance programs and the suspension of student loan payments. However, one potential weakness comes from the added financial pressure on some households that rent, following the end of a nationwide eviction ban in August. There is also concern about the ability of some households to transition out of forbearance programs or resume student loan payments.





Assessing Risks Inside the Markets

With respect to the financial markets themselves, vulnerabilities pose potential liquidity risks. While liquidity risks were contained this year at the printing of this report, the OFR continues to study the uncertainty surrounding the impact of future investor runs in short-term funding markets.

Sudden pressure on money market funds and other alternative cash vehicles to raise large amounts of cash strained liquidity in these markets in 2020 and prompted intervention by the Federal Reserve. As regulators explore reform options, there is a continuing need to monitor the interconnectedness of these markets and their participants.

To increase the transparency of financial data, the OFR in 2021 updated its U.S. Money Market Fund (MMF) Monitor to show both the principal amount of repurchase agreement (repo) transactions and the collateral pledged against these loans.

The Short-term Funding Monitor was also upgraded to shed more light on the repo markets and to include a new collateral product that the Fixed Income Clearing Corporation (FICC) rolled out in September.

Since the 2008 financial crisis, central counterparties (CCPs) have become increasingly important to the financial system. However, there is concern about liquidity pressures tied to the risk-management practices of CCPs, as well as the degree to which the CCPs are interconnected and relatively few in number. To this end, the OFR has supported the OTC Derivatives Regulators' Forum, including serving as chair and organizing regular seminar series to evaluate the size, policies, and interconnectedness of CCPs.

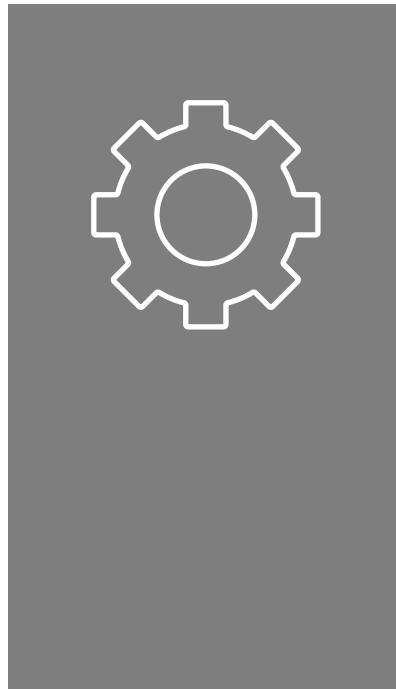
Digital assets originated as an external risk but have added new and unexpected uncertainty to the financial sector. Product innovation, proliferation, and acceptance by investment funds have made them part of the financial system. As a result, uncertainties surrounding cryptocurrencies and stablecoins introduce vulnerabilities on several levels.



External Events Posing Risks to Financial System

The costs of climate change continued to rise to new levels in the U.S. this year, as did the destruction of property and economic disruption in affected areas. Under the presidential Executive Order (EO) 14030 entitled “Climate-Related Financial Risk,” the Treasury Secretary leads the effort to assess climate risks to financial stability as chair of the Financial Stability Oversight Council (FSOC).

This year, the OFR is collaborating with the Federal Reserve on building an OFR-hosted Climate Data & Analytics Hub (Data Hub), which is currently in the pilot phase. When implemented, the Data Hub will provide FSOC and its members with data services to meet the President’s priorities. Collaboration during the pilot phase of this program will involve the OFR, the Federal Reserve, and the Federal Reserve Bank of New York, and could incorporate other members in the implementation phase.





The OFR's Performance

The OFR principally supports the FSOC and its members by supplying germane data, developing empirically supported research insights, serving on FSOC current initiative working groups, and advancing data products to help identify financial system vulnerabilities. Identifying and assessing those vulnerabilities in a year with considerable turbulence was essential for delivering on the OFR's statutory mandate. The OFR also made great strides in engaging staff members in truly consequential work while operating in a fully remote status.

Our research findings and insights in the briefs and working papers OFR produced in the 2021 fiscal year stem from our ongoing monitoring and analysis of potential vulnerabilities that can threaten U.S. financial stability. The findings and insights also arose from the research initiatives underway and our continuous evaluation of financial stability policies.

We published various papers on the repo markets and papers on counterparty credit risk and CCPs. Repo markets represent a significant funding source for various financial actors and are a key method of borrowing securities. The repo markets are also used to establish important reference rates, such as the Secured Overnight Financing Rate (SOFR). Therefore, we utilized our repo data collection information to study the key participants in the cleared repo market. In addition, we used regulatory data to examine negative rates in the bilateral repo markets, the dynamics of the tri-party repo market, and banks' counterparty risk. Finally, we outlined a framework to estimate the probability that a central counterparty could cover any specified fraction of payment defaults by its members using public disclosure data.

The OFR collects, maintains, and shares supervisory and commercial datasets with the FSOC and its members. The OFR leads FSOC's Data Committee, which addresses data gaps in forums for information sharing among the FSOC's chief data officers and representatives and, this year, oversaw the annual update to the Interagency Data Inventory, a catalog of all data collected by FSOC members.

The OFR has taken, and continues to take, several steps to address the Climate-Related Financial Risk Executive Order's directives. First, the OFR surveys relevant commercial data vendors, government agency data sets, academic data hubs, and other key sources. The OFR then identifies,

categorizes, and shares climate data with the FSOC and its members. Second, the OFR identifies data gaps linking climate change and financial stability and evaluates those gaps. Third, the OFR meets with FSOC members to discuss the potential impact of climate change and continues to monitor various economic sectors for implications on financial stability. Fourth, the OFR is developing a research agenda around climate change's risks to financial stability.

This year the OFR contributed substantially to the ongoing development of data standards. It actively participated in the Regulatory Oversight Committee (ROC), collaborating on specific committees such as the ROC's Plenary, Executive Committee, Committee on Evaluation and Standards, and Committee on Derivatives Identifiers and Data Elements. In addition, the OFR coordinated efforts in support of the Unique Transaction Identifier (UTI), Unique Product Identifier (UPI), and Critical Data Elements (CDE). The OFR also made contributions to multiple International Organization for Standardization (ISO) Technical Committee projects. They included the Natural Person Identifier (NPI), Semantic Models, Communications, and the Fintech Technical Advisory Group (TAG).

A top priority for the OFR is to implement further its Workforce Plan 2020-2024 to address in a concentrated manner the areas of retention, recruitment, and workforce development while continuing its focus on collaboration. The OFR obligated \$72 million in FY 2021—44% for labor and 56% for nonlabor expenses. In addition, the OFR made progress in filling its critical vacancies, bringing onboard staff with targeted and specialized skills. Critical positions filled this fiscal year included: Chief Counsel, Associate Director of Financial Markets, Associate Director of Analytic Systems, Enterprise Risk Manager, and considerable research, analysis, and information technology positions. The Office staff totaled 119 as of September 30, 2021.

The Office integrated an approach to planning and began building an enterprise risk management program. This ERM program will identify and mitigate potential risks to the OFR's mission, strategy, and operations. In addition, this year, the OFR introduced more secure technology solutions to the workforce, including a new cloud-based, mobile-device controls system and improved cybersecurity protocols to enhance the OFR system securities.





The year marked the second year of the OFR's cloud migration initiative, scheduled for completion by the end of September 2022. There were also improvements in data governance via creating cross-agency teams to set policies, procedures, and roles in the development, oversight, and coordination of data management, such as creating the security operations center (SOC). The SOC is designed to be a proactive entity to analyze, audit, and correlate heuristic techniques for information security.

Overall, the OFR this year has successfully met several key mission objectives, improved employee engagement, and enhanced its new security protocol initiatives.

Lastly, the OFR fully appreciates that all financial risks across all categories need a forum to communicate and exchange ideas necessary for regulatory and policymaking decisions.

As part of this effort, the OFR helped organize the Federal Reserve Bank of Cleveland's annual conference, "Financial Stability: Planning for Surprises, Learning from Crises."



KEY FINDINGS

OF RISKS TO U.S. FINANCIAL STABILITY

Overall risks to U.S. financial stability remain in the medium range. The Office of Financial Research reached this assessment after weighing the resilience of the nation's financial system against its vulnerabilities.

The financial system is far more resilient than it was when the COVID-19 pandemic began in early 2020. Government support for households and businesses hurt financially by the pandemic led to a period of growth following last year's recession. The recovery in the first half of 2021 was robust, but its momentum has slowed in the second half. Uncertainty remains due to various existing and emerging vulnerabilities, including rising inflation, the future impact of COVID-19, and a tighter monetary policy.

HOW WE DEFINE RISK—WHAT RISKS WE CONSIDER/EXAMINE—HOW WE RATE THEM

We define the pertinent risks and vulnerabilities in the following ways for our assessment.

Systemic Risk: risk to systemwide financial stability.

Vulnerabilities: underlying weaknesses that can render the financial system susceptible to instability.

Methodology: we analyze vulnerabilities to fulfill our responsibility to monitor, investigate, and report on threats to the financial stability of the United States.

Our assessment is informed in part by the OFR's monitoring of financial system vulnerabilities and our Office's broader financial system surveillance, data analysis, and research. All data in this report is cited as of Sept. 30, 2021, unless otherwise noted.

In this report, we structure our assessment around eight categories of risk:

- | | |
|--------------------------------|-------------------------|
| 1 macroeconomic | 5 contagion |
| 2 credit | 6 leverage |
| 3 market | 7 cybersecurity |
| 4 liquidity and funding | 8 climate change |

The report covers a variety of vulnerabilities monitored by the OFR and highlights the ones that merit the most discussion. We decided this based on our research, along with concerns raised by regulators, companies, and organizations in the industry among other remaining stakeholders.

While some vulnerabilities have played a role in past crises, others have not. That said, early recognition of any vulnerabilities provides more time to address them in a bid for further fortification of the U.S. financial system.

The OFR's view on the current vulnerabilities is as follows:



Macroeconomic uncertainty remains regarding the continuing impact of the virus and the pattern of inflation.

- COVID-19 variants may continue to emerge, potentially threatening to derail the ongoing recovery.
- If the global increase in prices persists for longer than currently anticipated, it could lead to a faster-than-expected rise in interest rates and, potentially, a repricing of risky assets.
- Rising inflation increases the risk of an economic slowdown, though financial conditions remain stable.



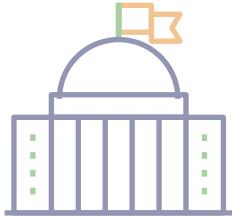
Credit risk is a concern due to high debt burdens in some sectors that could worsen.

- Nonfinancial corporate debt levels, already high before the pandemic, hit new records after the virus outbreak in the U.S. due to extraordinary monetary and fiscal stimulus and were fueled by investor demand for higher yields.
- There are elevated risks in certain commercial real estate sectors, driven by a divergence in demand, rents, and market values, depending on the real estate sector and geographic region.
- Residential real estate market risk is low due to strong home prices and the forbearance relief and eviction bans put in place, as the pandemic took hold. However, the expiration of these consumer assistance programs could burden some homeowners and renters.



Near-term market risks appear contained by the supportive nature of fiscal and monetary policies, solid corporate earnings, and risk-free rates at historically low levels.

- Equity market valuations were at record levels and market sentiment was positive at the time of this report. Share prices in certain areas reached euphoric levels in 2021.
- Bond yields are historically low and favor borrowers but adversely affect investors like retirees and pension funds as well as other institutional fixed-income investors.
- The rising value and growing types of digital assets and the advent of cryptocurrencies into mainstream investment products make them a potential source of instability.



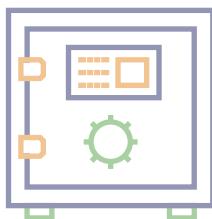
In the Treasury cash market, actions in 2020 by the Federal Reserve improved liquidity and reduced volatility, but structural vulnerabilities still exist.

- Liquidity has greatly improved since the start of the pandemic last year. Improvements in liquidity were concentrated in longer-dated and off-the-run Treasury securities.
- U.S. and foreign regulatory agencies are exploring reforms to address vulnerabilities in the Treasury and short-term funding markets, which contributed to the need for intervention by the Federal Reserve in 2020.
- The underlying causes of Treasury market stress in 2020—the limited ability of dealers to make markets during flights to liquidity—remain unaddressed. This highlights the importance of dealer intermediation and nonbank participants in critical markets.



The level of contagion risk for banks has reverted to more normal levels. However, vulnerabilities persist in connection with the central clearing process, resulting in potential sources of contagion risk.

- As measured by OFR's Contagion Index in our Bank Systemic Risk Monitor, some banks showed higher levels of contagion risk after the outbreak of COVID-19. But these values have since fallen back to pre-pandemic levels, decreasing the potential for contagion risk emanating from banks.
- The Contagion Index's higher scores for banks reflected the actions of non-depository financial institutions, such as insurers and mortgage lenders, to increase the sizes of the deposits they hold at banks.
- Market volatility in March 2020 led to an increase in estimated default risk for CCPs. The sudden demand for additional margin by CCPs among other standard practices may impose significant stress and create the potential for contagion.
- Another vulnerability is that relatively few CCPs hold material positions in the central clearing process, which increases the risk that problems at one CCP could spread quickly to others.

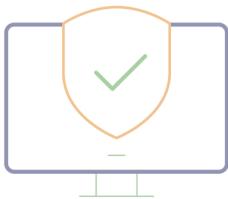


While the low interest rate environment supported the economic expansion, it also increased leverage levels, which remain high for some financial institutions.

- A decline in lending, combined with compressed net interest margins, makes it more difficult for banks to profit from traditional-deposit taking and lending activities. As a result, the biggest banks

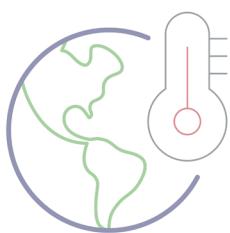
have offset the decline in lending with gains from other business lines, such as trading, investment banking, and asset management.

- As large investors in fixed-income securities, insurers continue to face investment challenges in the current low interest-rate environment; certain minimum investment returns must be met to fund their obligations.
- Although the hedge fund industry is still weary of the losses it experienced during the pandemic, some hedge funds have been taking on more risk by increasing their balance sheet leverage and exposure to riskier asset classes.



Cyber risk has grown due to the mounting economic costs inflicted by cyberattacks and the increasing expense required to guard against them.

- The price paid to address a cyberattack has gone up. In 2021, the U.S. led the world in the average cost of data breaches at \$9.05 million, up 5% year-over-year. That is more than double the \$4.24 million global average cost.
- One factor driving up the cost of data breaches is the increasing downtime companies experience following successful cyberattacks. For example, victims face an average of 23 days of downtime following a successful ransomware attack.



Although climate change has introduced vulnerabilities to the financial system, its potential risk to the financial system is still difficult to identify, assess, and forecast.

- Assessing the risk to financial stability posed by climate change is complicated by the medium- to long-term nature of the threat. At the same time, markets tend to focus on more immediate-to-intermediate threats.
- Climate change is expected to have a large and diffuse impact on various regions of the country, but at this point, it is difficult to assess how climate change will ripple through the economy and, in turn, the financial system.
- Climate models provide an expectation of long-term climate changes, but data gaps between climate and economic models impede a full understanding of how climate change is expected to translate into deeper levels of financial risks.



PART ONE

RISKS TO U.S. FINANCIAL STABILITY

Macroeconomic Risk

U.S. Economic Conditions

In 2020, the central macroeconomic developments were the COVID-19 pandemic and the sharp recession that followed. This year, by contrast, the main macroeconomic development is an initially robust recovery whose momentum has slowed. Despite setbacks from the virus variants, extraordinary fiscal and monetary stimulus as well as a strong vaccination rollout, brought the U.S. economy back to its feet.

At the same time, the recovery has been uneven across different income groups. As a result, not only did low-income households suffer from higher unemployment and lower earnings growth than high-income households, most low-income households also failed to benefit from the appreciation in asset and home prices in 2021. Nevertheless, the macroeconomic risks to U.S. financial stability have decreased significantly since 2020.

The U.S. economy rebounded strongly in 2021, with the real gross domestic

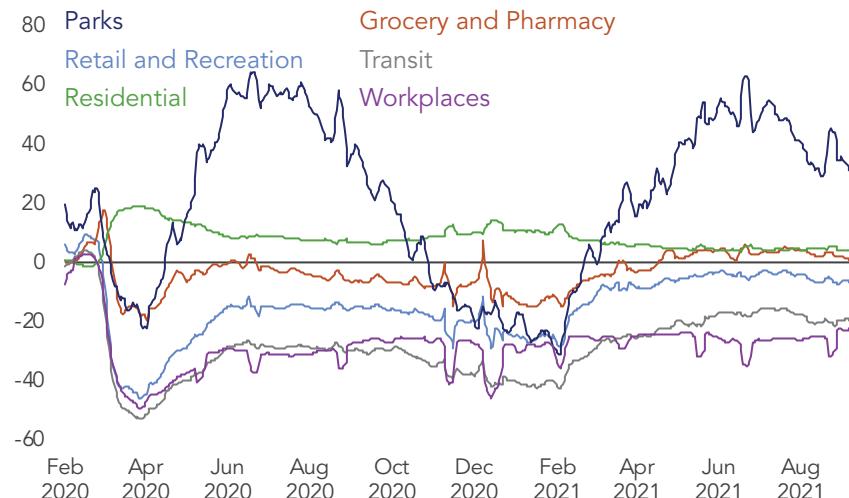
product (GDP) increasing at a seasonally adjusted annual rate of 6.3% in the first quarter and 6.5% in the second. Government assistance programs, direct economic impact payments, expanded unemployment benefits, and Paycheck Protection Program loans distributed this year appear to have had significant effects in increasing the rate of growth. GDP growth rates calculated using data from the onset of the pandemic as the base will naturally show large increases because the level of GDP had fallen considerably.

GDP growth nowcasts, the running projections produced by the Federal Reserve Banks in Atlanta and New York, initially indicated a strong and persistent recovery for this

year. However, that positive assessment became more muted with the spread of the virus variants during the second half of 2021.¹ As a result, the drivers of the growth outlooks are broad-based. They include consumption expenditures, equipment investment, residential investment, and federal government expenditures.

Other high-frequency indicators also support a positive outlook. The Google Mobility Index shows the retail and recreation sectors, transit, and grocery and pharmacy stores returning toward their pre-pandemic levels (see Figure 1). However, there are also potential signs of long-lasting changes in the patterns of economic activity. Work-

Figure 1. Google Mobility Index of Economic Activity (indexes)



Note: Measures visitor numbers to specific categories of locations every day and compares this change relative to a baseline day (index = 0) before the pandemic.

Sources: Google, Our World in Data, Office of Financial Research

places remain closed across the U.S. as several occupations that shifted toward work-from-home arrangements have yet to return to office environments.

The economic rebound led to significant gains in employment. Unemployment rates have declined significantly, most notably in leisure and hospitality sectors (see Figure 2). Employment is expected to continue expanding as more sectors of the economy reopen. In addition, the American Rescue Plan provided a large boost to personal income, compensation, savings, and consumption.

Nevertheless, employment remains far below pre-pandemic levels. Moreover, at the current monthly job growth average of 586,000, the labor market is not expected to return to pre-pandemic levels until well into 2022.

Similarly, the gradual and partial reopening of the economy and the subsequent increase in activity have led to an uptick in prices. Annual inflation rates in services and goods, both durable (goods that are not purchased often, possibly purchased every three years) and nondurable (goods consumed in a short period), have increased in recent months. In contrast

the inflation rate in food has begun to come down from its pandemic highs but has been slightly increasing (see Figure 3). In addition, some items have experienced sizable price increases this year, including used vehicles, energy, furniture, hospitality, and airfares.

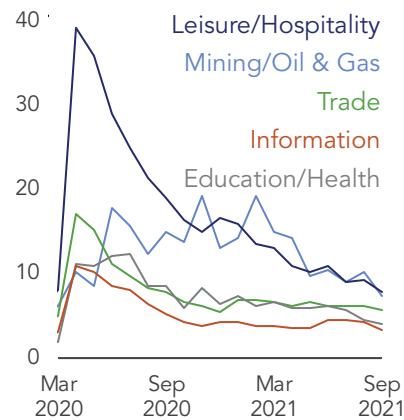
The main sources of inflation appear to stem from transitory price increases on the demand and supply sides of the economy. On the demand side, price increases have been concentrated in specific categories of goods, such as cars and other durable goods, as consumers' pent-up demand was released. On the supply side, supply-chain disruptions, production bottlenecks, and inventory shortages in manufacturing and other inputs have led to price increases for certain items such as semiconductors and lumber.

Some of the recent price increases are related to how depressed prices were during the pandemic. These factors all point to a temporary rather than long-lived increase in inflation.

Another possible driver of inflationary pressures is an acceleration in wage growth associated with labor shortages but not accompanied by any increases in productivity. Such

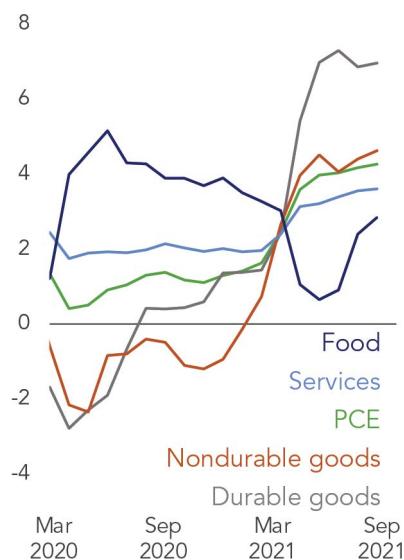
wage increases may lead to increases in labor costs that can pass through to prices. However, the strong wage growth observed recently

Figure 2. Unemployment Rate in Selected Industries (percent)



Sources: Bureau of Labor Statistics, Haver Analytics, Office of Financial Research

Figure 3. Changes in Inflation by Expenditure Category (percent)



Note: Seasonally adjusted, year-over-year changes in price indexes for aggregate personal consumption expenditures (PCE) and selected components.

Sources: Bureau of Economic Research, Haver Analytics, Office of Financial Research

coincides with similarly robust increases in productivity, casting doubt on the claim that price increases are related to labor-cost increases. Wages and salaries rose by 4% in the first quarter of 2021 compared to the first quarter of 2020. Real output per hour for all workers grew at an annual rate of 3.95% in the first quarter, closely matching the reported quarterly wage growth.

In terms of the macroeconomic risks to financial stability, a faster-than-expected rise in inflation could lead market participants to price in a sooner-than-expected interest rate hike and early removal of policy accommodation. Even transitory increases in inflation can affect market participants' inflation expectations. However, market-based measures of inflation suggest no great concern over price increases anytime soon.

Breakeven inflation rates (the difference between nominal and inflation-linked Treasury yields) are often used by market analysts and the financial press to gauge market expectations of inflation (see **Liquidity and Funding Risk**). As of September, the five-year breakeven rate was 2.5%, while the 10-year rate was 2.3%. Breakeven rates

at these levels indicate inflation is expected to be well-contained and only slightly above the Federal Reserve's 2% target.

Other measures of inflation expectations, such as survey data or the synthetic Common Inflation Expectations Index developed by the Federal Reserve, also indicate expectations are currently around the policy target.

“
Wages and salaries rose by 4% in the first quarter of 2021 compared to the first quarter of 2020.
”

This situation differs noticeably from historical episodes where market participants expected monetary policy tightening. For example, in 2004, five-year breakeven inflation rates increased by about 80 basis points in anticipation of the Federal Reserve hiking interest rates. At that time, the central bank was not operating under its average inflation target framework intended to provide an explicit guide to expectations among households, firms, and financial market participants about inflation

and the Federal Reserve's likely response to it, as it does now.

More broadly, one of the central challenges to judging risks surrounding the economic recovery is the elevated level of uncertainty that likely will persist for some time. Of course, uncertainty is always present when forming judgments about future economic and financial risks. Still it is particularly elevated in the current economic environment.

The recovery trajectory depends on various factors, but the principal one is the reopening of the economy. That, in turn, is related to slowing the disease's spread, which itself depends on vaccine availability, vaccination rates, and the ability to test and trace the spread of new variants. In the U.S., 64% of the population was fully vaccinated as of the end of September. Long-term economic prospects depend on how long the vaccines remain effective against existing variants and their ability to combat new variants.

Both vaccine hesitancy and questions about the continued effectiveness of treatments for COVID-19 are fundamental sources of uncertainty that may affect the recovery's path.

Setbacks in either of these dimensions create the risk that a new wave of infections will emerge and undermine the recovery.

Global Economic Conditions

Although global economic conditions provided only a modest tailwind for the U.S. economy going into 2021, they became a more significant boost to American economic growth in the first two quarters. U.S. exports grew at an 11% annual rate during the first half of the year. The global macroeconomic outlook provided a similarly favorable backdrop for U.S. growth.

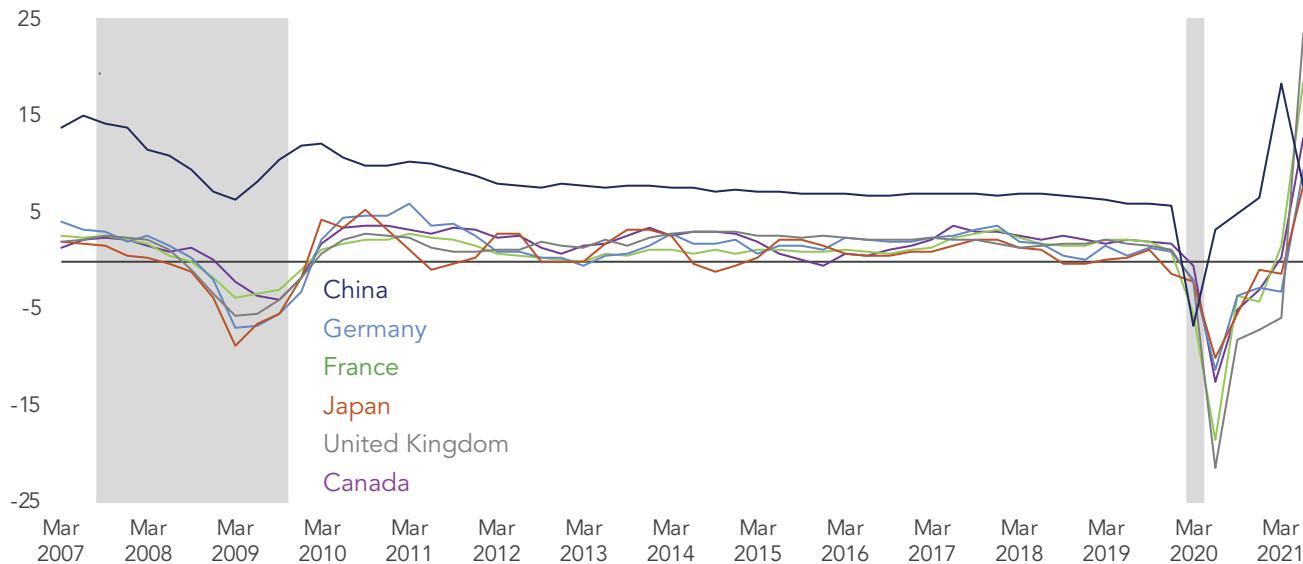
Although the economies of major U.S. trading partners contracted sharply during the second quarter of 2020, they had rebounded rapidly by the second quarter of 2021 (see Figure 4). For example, in 2020, Japan's real GDP fell 10.2% at an annualized rate, while growth in the eurozone (a monetary union of 19 member states of the European Union) contracted at the fastest pace on record.

Real activity rebounded sharply in the first half of 2021, benefiting from vaccine access and sizable fiscal support among advanced economies. Nonetheless, global growth prospects for the second half of 2021 remain weighed down due to global supply

disruptions and worsening pandemic dynamics among emerging economies.

In Europe, the winter surge in COVID-19 infections and the extension of social-distancing measures weighed on the pace of the recovery in the first half of 2021. As a result, although many Euro economies posted strong growth in the second quarter, the expected sharp rebound in European growth has been consistently marked down as a high-frequency economic indicator. Survey data suggest weaker-than-expected momentum in the third quarter of 2021. Nevertheless, the International Monetary Fund (IMF) projects that the policy actions taken in 2020 and 2021 will support the global

Figure 4. Growth in Major Economies (percent change from previous year)



Note: Data as of October 12, 2021. Real gross domestic product, percent change from corresponding quarter of previous year, seasonally adjusted. Some data are preliminary and subject to revision. Shaded areas are U.S. recessions.

Sources: OECD Main Economic Indicators, Federal Reserve Economic Database, Office of Financial Research

economic growth of 5.9% in 2021 and 4.9% in 2022.²

China was among the first countries to recover fully from the COVID-19 shock. Effective containment measures, a robust public investment response, and central bank liquidity support contributed to China's rebound. As a result, China's GDP returned to its pre-pandemic level in 2020. By contrast, other emerging markets and developing economies are not expected to do so until 2023. As a result, the IMF projects China's economy to grow 8% in 2021, a pace consistent with, and slightly higher than, its growth rate between 2015 and 2019.

Despite the generally constructive growth outlook, several downside risks could adversely affect the U.S. financial system.

The first is the risk to Chinese growth. The pace of the recovery in China has slowed in past months, and recent regulatory policies in the high-tech, education, and gaming sectors are likely to weigh on growth. Additionally, credit stress in the Chinese property sector poses a risk to financial stability and raises questions about the default resolution process in the Chinese financial system.

Policy Responses

The U.S. fiscal response has been robust, with a number of spending packages already approved and deployed by Congress in response to the pandemic and economic slowdown: the Coronavirus Aid, Relief, and Economy Security Act (CARES Act), the Paycheck Protection Program and Health Care Enhancement Act, the American Rescue Plan, the Coronavirus Preparedness and Response Supplemental Appropriations Act, the Families First Coronavirus Response Act, as well as other executive orders and enhancements included in government funding bills. The resources made available amount to \$4.7 trillion, with an estimated \$3.3 trillion already paid out.³ In addition, more government expenditures are planned in the form of an infrastructure-focused bill currently being negotiated by Congress.

Monetary policy in the U.S. is also supporting the recovery, with the federal funds rate remaining in the Federal Open Market Committee's (FOMC) target range of 0 to 25 basis points. The FOMC's November meeting minutes indicate that most committee members judged it appropriate to begin reducing the pace

of asset purchases later in the month with further reductions beginning in December. Most committee members believe that substantial progress has been made toward improved employment. The FOMC also provided an illustrative path of monthly reductions of \$10 billion in Treasury securities and \$5 billion in agency mortgage-backed securities in November with an additional \$10 billion in Treasuries and \$5 billion in agency mortgage backed securities beginning in December. The Committee believes that similar reductions in the pace of net asset purchases will likely be appropriate each month, but it is prepared to adjust the pace of purchases if warranted by changes in the economic outlook.

In addition, under the Federal Reserve's new average inflation targeting framework announced in 2020, the central bank will permit the inflation rate periodically to rise above its target of 2% to offset periods where inflation is persistently below 2%. Thus, the new operating framework further enhances the Federal Reserve's ability to achieve its mandated goals of maximum employment and price stability in a low interest-rate environment.

Central banks in other advanced economies also maintain highly accommodative policies. For example, the European Central Bank (ECB), Bank of Japan (BOJ), Bank of England (BOE), and Bank of Canada (BOC) continue to operate at policy rates near the effective lower bound of zero. Most have also maintained the pace of their asset purchase programs.

The ECB remains committed to keeping policy accommodative to achieve its inflation target and maintain easy financial conditions, despite announcing a stepdown in its bond purchases at its September meeting. The BOJ reiterated its inflation overshooting commitment that it originally put in place in 2016. To reach that goal, Japan's central bank continues to purchase unlimited quantities of government bonds and exchange-traded funds, albeit at a slower pace since April 2021.

The BOE's short-term policy rate is positive but also at the effective lower bound, and it raised its target for asset purchases. On the other hand, the BOC, which market participants expect to tighten policy first, reduced the pace of asset

purchases as labor market conditions improved.

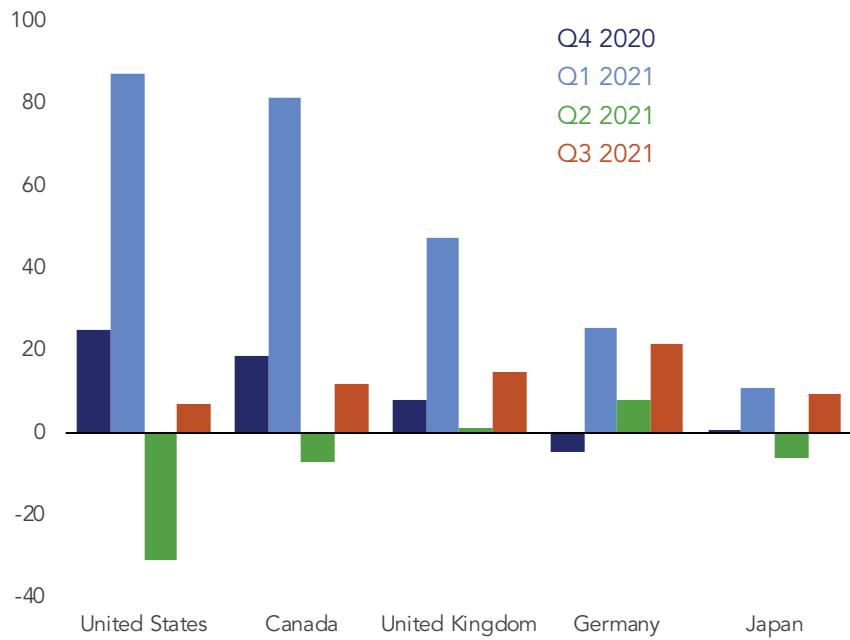
Taken together, fiscal and monetary policy measures have provided an extraordinary amount of stimulus to advanced economies. This policy accommodation provides a favorable backdrop for growth through the end of 2021. One way to measure the market's assessment of these policy interventions, and the growth outlook more generally, is by looking at changes in the slope of the yield curve. The slope can be measured, for example, as the difference between the yields on 10-year and three-month government

debt. An increase, or steepening, in the slope of the curve tends to predict expansions.

Among the major advanced economies, the yield curve has steepened, with the largest increases occurring in Canada, the U.S., and the United Kingdom (U.K.) in the first quarter of 2021 (see Figure 5). Part of this steepening was based on the evidence showing the efficacy of vaccines, notably in Israel and the U.K. This evidence led financial markets to sharply reprice reopening prospects and the rebound in growth.

The yield-curve steepening was less pronounced in

Figure 5. Changes in the Slope of the Yield Curve, Selected Advanced Economies (basis points)



Note: The change in the slope of the yield curve is defined as the quarterly change in the difference between the 10-year and three-month government bond yields.

Sources: Board of Governors of the Federal Reserve, OECD Main Economic Indicators, Federal Reserve Economic Data, Office of Financial Research

Germany and Japan. In Germany, the ECB's increased asset purchases and the uncertain growth outlook related to the reintroduction of pandemic containment measures likely contributed to limiting the increase in German yields in the first quarter of 2021. The Bank of Japan's yield-curve control policy prevents large fluctuations on the long end of the yield curve, limiting the extent of possible steepening.

Credit Risk

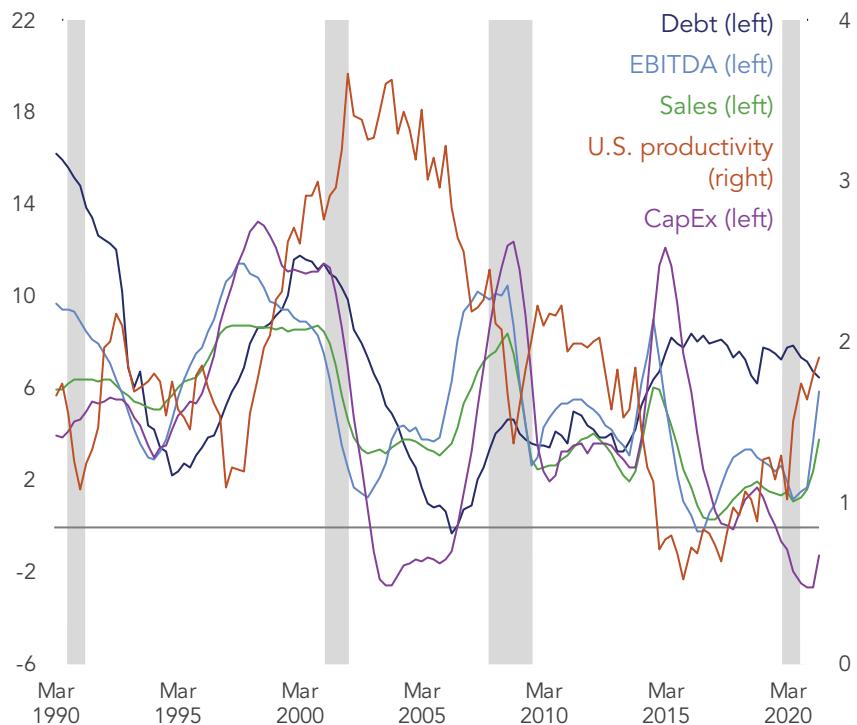
Nonfinancial Corporate Debt

High corporate leverage remains a key vulnerability but is currently mitigated by a robust earnings recovery and extraordinary government support. Over the long term, however, high debt burdens result in a corporate sector that is more fragile, riskier, and more vulnerable to shocks.

If the current corporate earnings recovery falters or interest rates rise materially, the corporate sector could be prone to a wave of defaults. Such a scenario could impose large losses on lenders and investors and affect economic activity adversely.

In the years preceding the COVID-19 recession, the rapid growth in corporate debt coincided with lower cyclical growth rates for sales, earnings, and productivity (see Figure 6).

Figure 6. Nonfinancial Firms' Five-Year Growth Rates for Key Financial Metrics (percent)



Note: Data as of the second quarter of 2021. Shaded areas indicate U.S. recessions. Shows five-year compounded annual growth rates. Sales, EBITDA, and CapEx measured as trailing four-quarter values. EBITDA refers to earnings before interest, taxes, depreciation, and amortization expense. CapEx refers to capital expenditures.

Sources: Compustat, Bureau of Labor Statistics, Haver Analytics, Office of Financial Research

This raises questions of whether higher corporate debt levels could reach a point where they have diminishing returns for the issuers and whether debt proceeds are allocated to their most productive use. A case of diminishing returns from higher debt has important implications for deleveraging and the economy. In fact, despite the massive growth in corporate debt following the 2008 financial crisis, the rolling five-year productivity growth trend remains well below that of the late 1990s and early 2000s.

In prior recoveries, higher growth rates for sales and earnings enabled companies to pay down debt. However, if earnings are weaker in the coming years relative to their past behavior in prior upturns, then it may be more challenging to deleverage from currently high corporate debt levels.

During the initial phase of the pandemic in March 2020, companies issued a record amount of debt immediately following the government's intervention to stabilize lending markets. Then, with rates lower and conditions for borrowing better, companies issued new debt to refinance existing debt at a lower cost, extend the maturity of their debt, and increase

LEVERAGED LENDING REBOUNDS IN 2021

Leveraged loans and collateralized loan obligations (CLOs) often provide funding for mergers and acquisitions, the recapitalization of a firm's balance sheet, and the ability of a firm to refinance its debt.⁴

Leveraged loans are generally made to companies with below-investment-grade credit ratings, and that are charged a higher interest rate than more creditworthy companies. The higher interest rate is due to the increased leverage and lower credit rating. CLOs are structured security products that invest in pools of leveraged loans. The CLO creates a waterfall of payments in which all loan payments are collected, carved-up, and allocated across different CLO debt classes.

At the onset of the pandemic, a lack of investor demand in the second quarter of 2020 shut down leveraged loan lending. Market conditions returned to normal by the first quarter of 2021. A moderate increase in interest rates would not likely have a significant impact on existing leveraged loans or the CLO market. Still it could slow new issuances as investors reassess the risk profiles of the borrowers. In addition, maturing loans are often refinanced by new leveraged loans which could pressure borrowers in a rising rate environment.

A continuing concern in the market for U.S. syndicated loans and CLOs is the transition away from LIBOR (see *Transition from LIBOR to Alternative Reference Rates*). We expect that the Secured Overnight Financing Rate (SOFR) will replace LIBOR in these markets. A small number of SOFR loans have already been issued.

Although some existing loan agreements lack the fall-back language to deal with the LIBOR cessation, others with contractual agreements under New York State law will transition to SOFR unless parties negotiate a different rate prior to LIBOR cessation. Federal legislation is also under active consideration to transition other legacy contracts written under U.S. law to alternative reference rates such as SOFR.

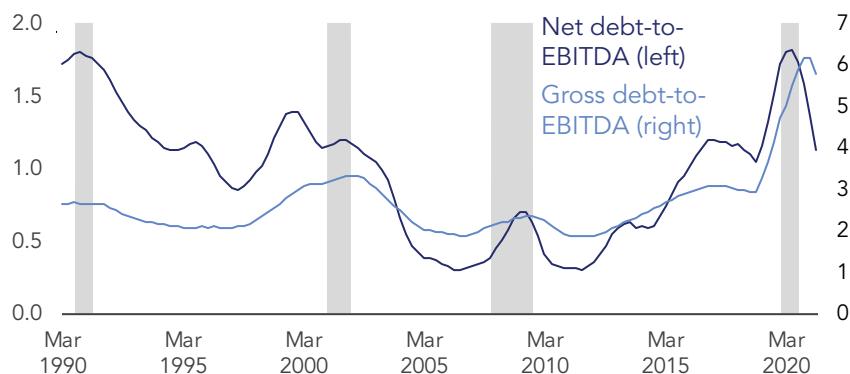
emergency cash cushions. But this wave of corporate debt issuance led to higher debt levels in the first half of 2020; at the same time, corporate earnings were declining rapidly.

As a result, the gross debt ratio of corporate issuers increased to an all-time high (see Figure 7).⁵ The net debt ratio reflects a company's debt position after subtracting cash held on its balance sheet. The net debt ratio has recently decreased sharply but remains above its historical average. If gross and net debt ratios remain at high levels, a much greater number of defaults may occur during the next economic downturn. This risk could be amplified if interest rates rise.

Low, risk-free interest rates and negative real corporate bond yields (inflation-adjusted) incentivize investors to seek higher-yielding but riskier investments. This yield-seeking behavior pushes down corporate borrowing costs, enabling lower-credit-quality companies to access capital through leveraged loan, high-yield bond, and private debt markets.⁶

Leveraged loans, high-yield bonds, and funds borrowed from the private debt markets are important sources of capital. Still, the

Figure 7. Nonfinancial Corporate Debt (ratios)



Note: Data as of the second quarter of 2021. Shaded areas indicate U.S. recessions. Ratio is a four-quarter moving average of the median for U.S. corporations, including investment grade, high yield and unrated firms. Operating leases included in debt starting in 2019. EBITDA refers to earnings before interest, taxes, depreciation and amortization.

Sources: Compustat, Office of Financial Research

TRANSITION FROM LIBOR TO ALTERNATIVE REFERENCE RATES

U.S. dollar LIBOR has played an outsized role in the capital markets. LIBOR is part of a set of globally used benchmarks, which determine borrowing costs in different currencies, and over different periods. LIBOR is calculated from reports by a panel of banks of their costs of unsecured wholesale borrowing.

However, the era of LIBOR's predominance is coming to an end. The publication of U.S. dollar LIBOR rates for overnight, one-month, three-month, six-month, and 12-month tenors will cease after June 30, 2023. Publication of U.S. dollar-denominated LIBOR rates for all other tenors will cease at the end of 2021.⁷ In addition, U.S. supervisory guidance calls for banks to stop using U.S. dollar LIBOR as a reference rate as soon as practicable and in any event by Dec. 31, 2021, making the end of the year a critical date in the U.S. dollar LIBOR transition.⁸

In the U.S., the Alternative Reference Rates Committee (ARRC), a group of private-market participants convened to help ensure a successful transition from LIBOR, chose SOFR as its recommended alternative reference in certain financial contracts. ARRC is com-

search for yield enables some companies with weak competitive positions and weak balance sheets to access relatively cheap capital.

In a credit downturn, companies that are overextended or facing operating difficulties typically enter bankruptcy and are either liquidated, restructured, or purchased by competitors. Such events are not unusual and generally do not pose a threat to financial stability. Bankruptcy is an orderly legal process that enables companies with viable businesses to restructure debts. As a result, permanently impaired businesses are liquidated, and capital is reallocated to more productive uses.

However, during the pandemic, many businesses were able to refinance their debt and avoid bankruptcy due to extraordinary government intervention. These actions mitigated the adverse impact of mass unemployment, averted a capital markets crisis, and eased strains on bankruptcy courts. But they may have also enabled inefficient and structurally challenged firms to remain afloat, which may have adverse, longer-term implications for the economy. Moreover, the extraordinary government support may have also cre-

prised of banks, asset managers, insurers, nonfinancial corporations, industry trade organizations, and federal and state financial regulators as ex-officio members.

In cooperation with the Federal Reserve Bank of New York, the OFR helped to develop, oversee, and ensure a source of data to support the use of SOFR. SOFR is based on rates in the repo market, which provides large underlying transaction volumes. Research by the Federal Reserve Bank of New York and the OFR suggest that repo markets are competitive and cover financial market participants.

On July 29, 2021, following growth in SOFR cash and derivatives markets, the ARRC recommended using the forward-looking SOFR term rates from the CME Group (CME) for use in certain markets. This marked the completion of a key step in the ARRC's transition plan.⁹

U.S. dollar LIBOR exposures were estimated to be \$223 trillion at the end of 2020. One-third of this exposure, about \$74 trillion, is in financial contracts maturing after June 30, 2023. Some of these contracts could expose the involved parties to legal and operational risks after LIBOR ceases if the contracts lack adequate fallback language.

However, there has been movement to address this risk. A New York State law—signed in April 2021—put a replacement framework for LIBOR contracts under the state's jurisdiction. Contracts not covered by New York law and that lack updated fallback language continue to provide a potential source of risk. As of this writing, federal legislation is under active consideration, marking an important step to address legacy LIBOR contracts written under other state laws.

The majority of existing LIBOR exposure will likely transition to SOFR at LIBOR's cessation. However, some exposures may transition to other reference rates that appeal to certain market participants. It is critical that these other reference rates be fit for purpose, robust, and compliant with standards set by the International Organization of Securities Commissions (IOSCO) to protect against manipulation and ensure smooth functioning.

ated expectations for future government intervention in corporate credit markets.

Commercial Real Estate

The commercial real estate (CRE) market is subject to volatile swings during economic cycles, but valuations of assets in this industry have not been particularly affected by the pandemic. However, underlying this overall trend is considerable discrepancy in levels of client demand, rents, and market values across different sectors and regions.

CRE prices have been buoyed by strong liquidity in this industry and lender support. However, this could change amid a shift in these conditions.

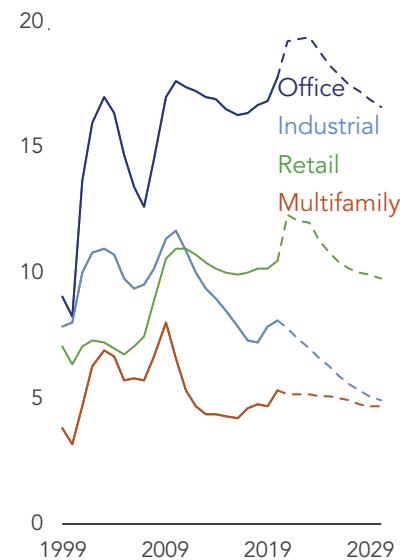
Office vacancy rates have risen modestly to 18.3% (see Figure 8). However, actual office usage has declined much more as the work-from-home response to the pandemic became widespread. This decline has had limited financial impact to date because office rentals are usually held in multiyear leases with credit-worthy tenants (see Figure 9). However, there is considerable uncertainty about whether and how demand for office space will change over the long run.

Work-from-home arrangements may become permanent for some employees.¹⁰ At the same time, remaining office-based employees may need additional space for health reasons.¹¹ A key unknown variable is how office space demand will fare in cities in large, central business districts dependent upon public transit. They include New York, Washington, Boston, San Francisco, and Chicago. More automobile-oriented cities such as Los Angeles, Dallas, and Houston may be less affected by this challenge.

Among other sectors, industrial space has performed well amid rising demand. With internet commerce increasingly replacing traditional brick-and-mortar retail stores, there is a growing desire for well-located warehouse

space. Demand is so strong that considerable additional warehouse space is being developed to meet the need.

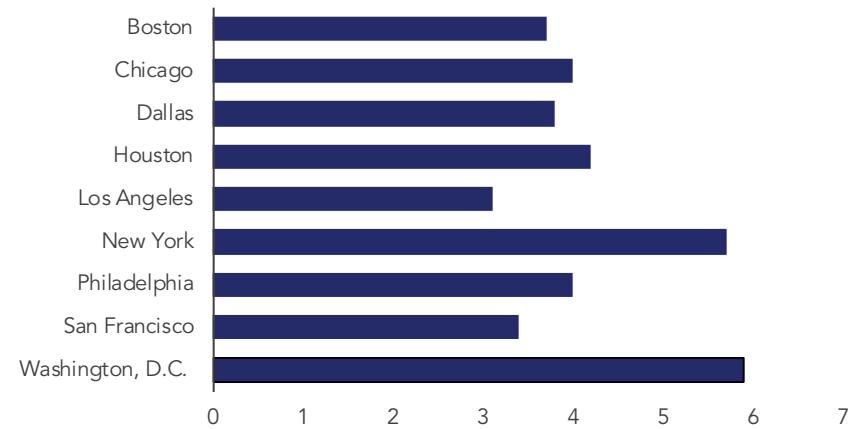
Figure 8. Vacancy Rates by Property Type (percent)



Note: Data through Dec. 31, 2020 are actual and indicated by solid lines; dashed lines are base case projections

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

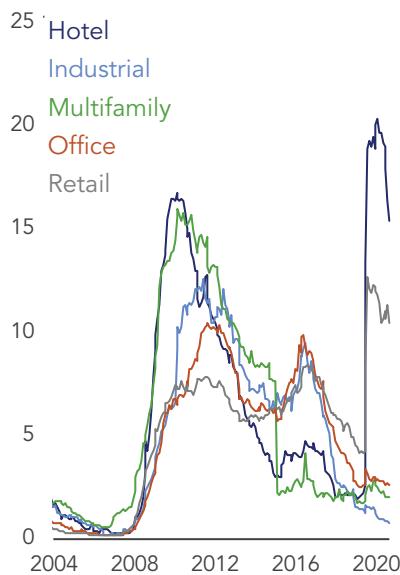
Figure 9. Average Office Lease Term by City (years)



Note: Data for office leases entered into during the fourth quarter of 2019. Data accessed June 2, 2021.

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

Figure 10. Commercial Mortgage-backed Securities 60+ Day Delinquency Rate (percent)



Note: Data as of August 2021. 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.

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

Multifamily properties have performed relatively well due to extensive federal government relief, such as expanded unemployment insurance and, most recently, direct federal aid for renters in financial difficulty.

However, there is long-term uncertainty over the direction of future employment rates and personal income. Most at risk among sectors in the multifamily space is low-rent workforce housing, where tenants are vulnerable to layoffs and, as a result, have less income to pay rent.

Another multifamily sector at risk is high-end urban housing in the most expensive metro areas. Following the pandemic outbreak in March 2020, rents on these apartments had fallen by double-digit percentages, while rents went up for suburban apartments in both major metro and rapidly growing, mid-size urban areas.¹² In recent months, consumer interest in high-end urban housing—apartments in high-cost areas—has rebounded and sent rents in an upward direction. This trend has taken place rapidly in Manhattan, for example.

The pandemic further deteriorated market conditions in the already weak retail sector. On the bright side, the pace of retail closings slowed in 2021, with new store openings now exceeding closings.¹³ But the supply of rentable retail space generally far exceeds demand with a 10.4% vacancy rate in this sector—a rate that is expected to continue rising over the short term.

Shopping malls that are not top tier are especially exposed as department stores have become endangered. As a result, these malls are increasingly likely to be forced to close.¹⁴ In addition, alternative ex-

perience-oriented uses of mall space, such as fitness facilities, entertainment venues, and restaurants, have been especially hard hit due to social-distancing measures.

Local shopping areas can also come under pressure, as online shopping continues to expand. Credit losses in the retail sector have been, and will continue to be, substantial. The retail delinquency rate of commercial mortgage-backed securities (CMBS) was 10.4% for August 2021 (see Figure 10), with many loans in varying stages of forbearance. Many retail delinquencies, especially large malls, are likely to turn into large credit losses.

Lodging has always been a volatile sector within commercial real estate, and the pandemic hit the sector especially hard. Travel, conventions, corporate gatherings, and large social events were canceled abruptly. Hotel occupancy rates have varied widely by property type and location. Hotels affected most negatively are those that host conventions or are in major downtowns.

With the economy having reopened, national occupancy rates have modestly improved but remain weak overall. The occupancy rate

Figure 11. Bank Commercial Mortgage Loan Delinquency Rates (percent)



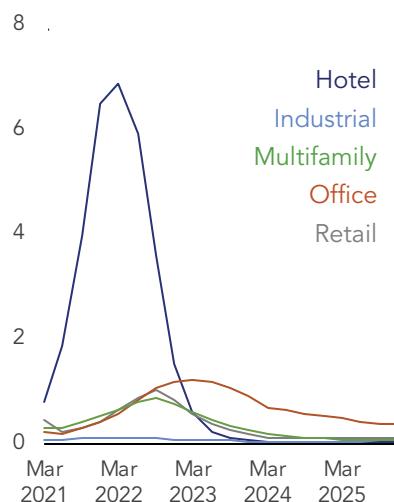
Note: Data for commercial mortgage loans owned by banks participating in Trepp's T-ALLR service. Data as of October 5, 2021. Delinquent is more than 30 days past due including nonaccrual loans.

Sources: Trepp LLC, Office of Financial Research

was 63.2% in August 2021, down by 11.3% compared to August 2019.¹⁵ Hotels are using various strategies to recover, with leisure-oriented hotels being the most successful. However, business-oriented hotels will need to encourage alternative uses to make up for reduced business travel, which seems unlikely to recover in the foreseeable future.¹⁶

Banks and other depository institutions hold about half of outstanding CRE debt. These loans accounted for 23% of the commercial

Figure 12. Forecasted Bank Loan Default Rate by Property Type (percent)



Note: Based on Trepp's stress scenario forecast. Data as of April 27, 2021.

Sources: Trepp LLC, Office of Financial Research

banking industry's total loan portfolio as of May 2021.¹⁷ Smaller banks with \$100 billion or less in assets have higher concentrations in commercial real estate loans, including higher-risk segments, such as lodging and construction and development lending, and thus have heightened exposure to CRE credit risk (see Figure 11).

However, so far in this credit cycle, the increase in nonperforming CRE loans held by banks has been very modest. According to real estate analytics firm Trepp, only 0.86% of CRE mortgage loans were nonperforming for the 325 largest U.S. banks as of year-end 2020, excluding loans in forbearance. How-

ever, under a potential stress scenario where economic conditions again deteriorate, Trepp said it expects bank CRE loan default rates to rise considerably until 2022 or 2023, especially for lodging and office properties (see Figure 12).¹⁸

Life insurers held a significant 15% of total outstanding CRE loans at the end of 2020, but insurers are less exposed to credit risk than other types of CRE lenders. They require low loan-to-value and high debt service coverage ratios, making their loans relatively low risk.¹⁹ Insurers have benefited during the pandemic from their conservative lending practices. Life insurers' 60+ day delinquency rate for CRE was 0.05% as of June 30, 2021.²⁰

Insurers own a wide range of debt backed by commercial real estate, with CMBS debt being the largest portion at 33.5%. Multi-family and office properties account for slightly under 20% of life insurers' total lending in this sector. Insurers are modestly exposed to hard-hit retail and hotel properties because they perceived these sectors as riskier prior to the pandemic.

CRE lenders that assume credit risk, typically private

debt investment funds and subordinate CMBS tranche investors, will likely absorb substantial credit losses in this cycle 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 have expanded their CRE lending market share during this period, as they are more willing to assume credit risks than regulated financial institutions.

Household Debt

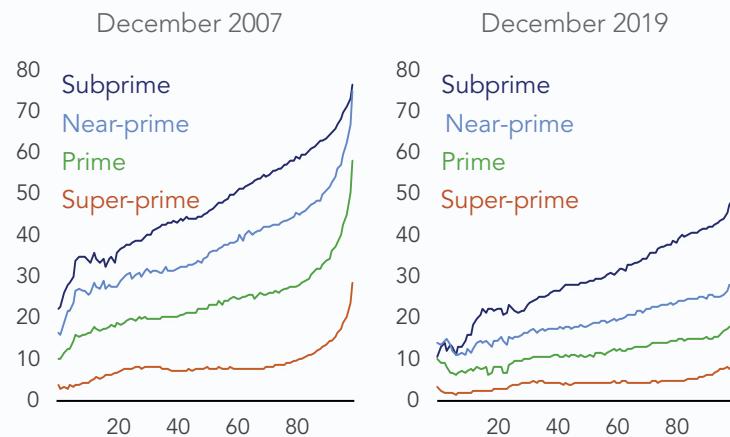
Household leverage played a pivotal role in the 2008 financial crisis. The ease of mortgage credit fed the run-up in housing prices. High household debt also contributed to the large drop in household spending during the subsequent Great Recession. Post-crisis reforms include policies that explicitly discourage excessive household leverage.²¹

Deleveraging since the 2008 financial crisis has altered the distribution of debt toward households with better credit scores. For example, in December

PRE-CRISIS LEVERAGE AS A PREDICTOR OF DELINQUENCY

Household leverage before the 2008 financial crisis was significant in predicting delinquencies during the Great Recession. Using pre-pandemic leverage to predict delinquencies during the pandemic results in weaker effects (see Figure 13). The percentiles from left to right capture the least to most leveraged households. For example, the 50th percentile includes the less leveraged half of total households.

Figure 13. Households with Newly Delinquent Accounts by Credit Quality, Great Financial Crisis vs. Pandemic (percent, leverage percent)



Note: Leverage percentile thresholds based on pooled data for household leverage during December 2007 and 2019. Household leverage is defined as the monthly debt servicing obligations as a percentage of monthly income based on Equifax estimates. The vertical axis corresponds with the proportion of households for each leverage percentile group associated with a new delinquent account from January 2008 through December 2009 (left figure) and March 2020 through August 2021 (right figure).

Sources: Equifax, Office of Financial Research

Delinquencies were uniformly higher for all credit-score groupings during the Great Recession, and the relationship between leverage and delinquencies was stronger. Specifically, 46.5% of subprime households in the middle of the distribution (50th percentile) experienced at least one new delinquency during the Great Recession, compared to 27.3% during the pandemic.

2007, 15.1% of total household debt was held by the top 1% of leveraged households. In December 2019, only 4% of the debt was held by these households.

Household leverage is low, in part, due to lower interest rates. Household debt service payments were 9.4% of disposable income during the fourth quarter of 2020, lower than it was before the pandemic.

While the pandemic brought potentially devastating effects on household finances, fiscal and regulatory measures, particularly the CARES Act, limited the financial fallout from job losses and increased household expenses. Almost all government-backed student loans received automatic payment deferrals through Sept. 30, 2021.

For homeowners, forbearance programs for conventional and government-backed mortgages allowed for payment deferrals for at least six months and, for certain other government-backed mortgages, up to 18 months. In addition, private institution mortgages were required under the CARES Act to provide at least some form of accommodation, including payment deferrals or modified payment plans.²²

The relationship between leverage and mortgage delinquencies lessened during the pandemic, as households more likely to default received relief through forbearance and other programs (see *Pre-Crisis Leverage as a Predictor of Delinquency*).

The stress of the pandemic on household finances is evident across all credit score groupings (see Figure 14). However, more households with both a high amount of debt and lower credit scores went into forbearance compared to those with similar amounts of debt and higher credit scores. Households with lower credit scores were likely more motivated to seek forbearance or learned about it from their lenders, especially after missing several payments.

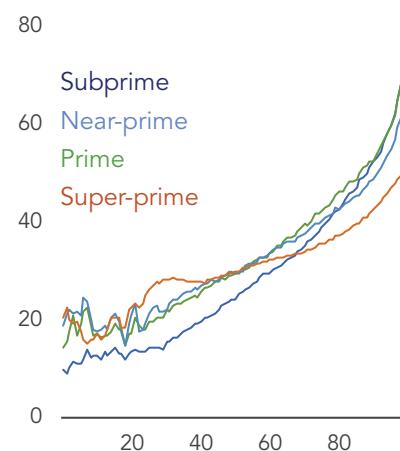
Either way, forbearance programs have provided much-needed financial flexibility for participating households. At some point, these mortgage loans will either be modified or foreclosed. Given the strong demand for housing, some borrowers should have substantial equity in their homes. Among this group, borrowers with enough equity can sell their homes to repay their mortgages, but they may also be unable to secure financing for new

home purchases while they are in forbearance.

While government and private-sector measures provided immediate relief to households, these actions could have unintended, longer-term consequences.

Most households that received forbearance on their mortgages or other debt accommodations have resumed scheduled payments. Most mortgages that went into forbearance allow for repayment over time. However, there are immediate concerns about

Figure 14. Households in Forbearance by Credit Quality (percent, leverage percent)



Note: Leverage percentile thresholds based on pooled data for household leverage during December 2019. Household leverage is defined as the monthly debt servicing obligations as a percentage of monthly income based on Equifax estimates. The vertical axis corresponds with the proportion of households for each leverage percentile group associated with an account that received forbearance from March 2020 through August 2021 based on Equifax methodology.

Sources: Equifax, Office of Financial Research

some households that transition out these programs (see **Residential Real Estate**). These households may face even higher debt levels than prior to the pandemic due to deferred payments. Reinforcing these concerns, delinquency rates were elevated for borrowers that cycled out of private forbearance programs during the latter half of 2020.

There are long-term consequences as well on how these households will fare in managing their overall debt. A large fraction of households with high debt levels going into the 2008 financial crisis remained highly levered through the beginning of the pandemic.

More than half of households in the top 30th percentile of household debt—as of December 2007—also ranked in the top 30th percentile in leverage as of December 2019. High levels of household debt contributed to the prolonged recovery following the Great Recession.

While the burden on households with high debt burdens remains a concern, there are mitigating factors that may blunt the negative consequences of this scenario. As of December 2020, 57.7% of households with deferred accounts continued to make payments.

There is also evidence that some households used at least part of their government stimulus payments for debt repayment. Revolving debt balances have declined this year. Aggregate utilization rates have declined to 27.6% in February 2021 from 30% in March 2020.

Bank regulatory reforms following the 2008 financial crisis contributed to sizable shifts in the credit risk distribution of household debt. While aggregate household debt increased by 14%, from \$11.7 trillion in January 2010 to \$13.4 trillion in December 2019, the aggregate picture masks underlying flows across strong and weak household credits.

The pandemic amplified the dichotomy in prime and subprime household debt growth. Prime household debt balances grew by 11% overall from March 3, 2020, to May 4, 2021. Subprime household debt balances declined by 33% over the same period.²³ In other words, the contraction in subprime household debt balances in the 14 months since the start of the pandemic nearly equaled the contraction that took place over a decade—from 2010 through 2019—in percentage terms.

Over the same period, debt balances held by prime households, or households with credit scores above 660, increased by 33.9%. In contrast, debt balances held by subprime households, or those with credit scores below 620, decreased by 36.1%. The decline is most pronounced for mortgage debt, where subprime household balances declined by 57.1%. While exposures to household credit risk were one of the key vulnerabilities for banks during the 2008 financial crisis, they were significantly less of a problem coming into the pandemic. After the 2008 financial crisis, depository institutions reduced their household credit risk exposures by curtailing lending to weak household credits.

The pullback of banks provided opportunities for and, in turn, shifted exposures to nonbank financial institutions. For example, nonbank financial institutions accounted for 70% of aggregate subprime auto loan issuances from January 2010 through December 2020. In comparison, banks accounted for 57% of aggregate prime auto loan issuance over the same period.

For a more comprehensive view, we estimated the relative likelihood that a

loan is issued by a bank versus nonbank credit institution based on credit score, using data spanning other loan product categories from January 2020 to December 2020 (see Figure 15). The estimates are derived from a model that controls for granular product categories, as well as seasonal effects related to issuance date. The estimates are standardized, so that negative values correspond with a relatively greater likelihood of non-bank issuance.

The figure shows that nonbank financial institutions' loans for subprime borrowers are disproportionately issued, where the absolute magnitudes are larger for lower credit scores. Loans for prime borrowers are on average more likely to be issued by banks, but by a relatively smaller magnitude. Interestingly, the region where

bank versus nonbank loan issuance becomes equally likely (where the series crosses the x-axis) is associated with a credit score of 635, which is just above regulatory thresholds for many loan products.

This reallocation of riskier household credit exposures to nonbank financial institutions is a source of concern as these types of institutions are not subject to the same level of regulatory oversight as banks. However, financial stability risks stemming from these dynamics are mitigated to some extent.

Unlike the 2008 financial crisis, today's risks are unlikely to be concentrated in a few, large, systemically important financial institutions, but rather in many, smaller institutions not as interconnected to other financial institutions. This limits systemic risk from the

widespread failure of these institutions.

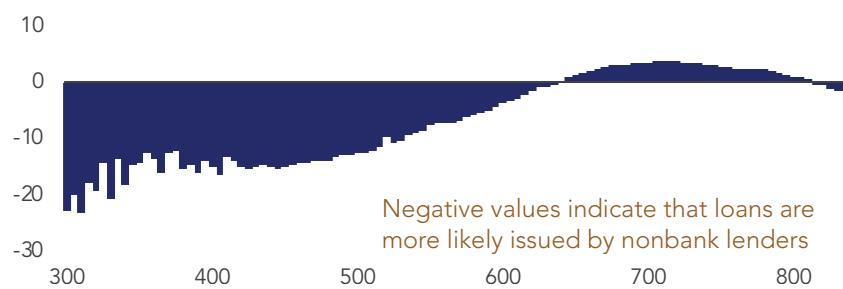
At the same time, however, systematic risks remain due in part to the reliance of most of these smaller institutions on sustained investor risk appetite and dependence on wholesale funding. There may also be other implications not directly related to financial stability. These include social consequences of limiting access to credit and greater fluctuations in the credit cycle for these subprime borrowers due to lower diversity in the types of firms that can supply credit.

Residential Real Estate

Home prices have appreciated 20% from July 2020 to July 2021 according to the S&P/Case-Shiller U.S. National Home Price Index. This rapid appreciation raises a potential concern that the housing market is becoming overheated, reminiscent of frothy home prices in the period leading up to the 2008 financial crisis.

However, the housing market's strength may be attributed to other factors such as lack of supply, low mortgage rates, and widespread work-from-home

Figure 15. Probability of a Bank-Issued Loan by Credit Score (percent)



Note: The figure displays estimates from a regression model where the dependent variable is a dummy associated with whether a new loan was issued by a bank (as opposed to a nonbank) lender. The credit scores are as of origination. The model includes account-type (granular product categories) and year-month fixed effects.

Sources: Equifax, Office of Financial Research

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 are likely to decline in 2021, given the tight supply.

First lien residential mortgage originations totaled a record \$4 trillion for 2020 (see Figure 16). Previously, the annual record was \$3.7 trillion in 2003. Approximately 65% of this activity was due to homeowners refinancing existing loans. This level of refinancing activity along with increases in mortgage rates indicate that refinancing activity is likely to drop.

Household mortgage debt is not the risk to financial stability that it was during the 2008 financial crisis. One reason is that the household sector is much less leveraged than before the 2008 financial crisis. Another reason is that new mortgage originations favor Fannie Mae and Freddie Mac conventional loan programs. Mortgages written under these programs have tighter underwriting standards compared to mortgages originated during the period leading up to the 2008 financial 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 prior to the 2008 financial crisis.

New mortgages are predominantly made for home purchases or refinancing

the current cash-out refinance as a percentage of loan refinancing to be 38%, compared to a range of 67% to 89% during 2005–2008 (see Figure 17).

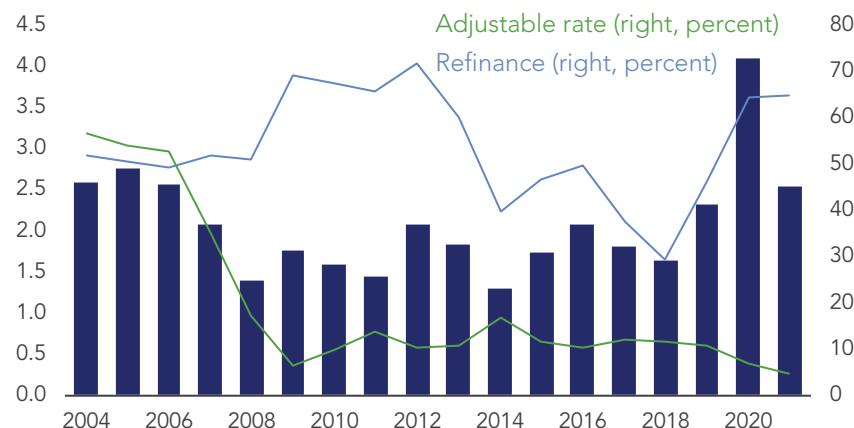
Homeowners are likely using the proceeds for home improvement and to pay down other debt. Still, high home prices increase

...[T]he 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.

existing loans for better interest rates or loan terms.²⁴ Approximately 17% were due to cash-out refinancing. Freddie Mac's Quarterly Refinance Statistics show

buyers' debt burdens despite low interest rates. These homeowners must continue to service this increased debt burden potentially during periods

Figure 16. Residential Mortgage Lending Originations (\$ trillions)



Note: Originations represent first-lien mortgages only. 2021 data reflect year-to-date values through June 30, 2021.

Sources: Inside Mortgage Finance, Office of Financial Research

of economic downturn or when home prices reverse their upward trend.

Forbearance rates for all mortgage categories have decreased since peak levels in June 2020 (see Figure 18). These rates plateaued for a time but then declined with the vaccine rollout and reopening of the economy. Yet forbearance rates in all categories remain elevated compared to pre-pandemic levels when forbearance options were limited.

Cumulative forbearance exit data from June 1, 2020, through Sept. 26, 2021, indicate a mostly positive outcome. Seventy-five percent of borrowers exited forbearance with a satisfactory resolution such as a loan modification or reinstatement. More troubling is the 16.1% of borrowers that exited forbearance without making up past payments and had no loss mitigation plan in place. CoreLogic delinquency data show a national delinquency rate of 4.2% and a serious delinquency rate of 2.8%, which is down from 4.1% in July 2020.²⁵ Still, the true delinquency rates may be masked by the various consumer assistance programs.

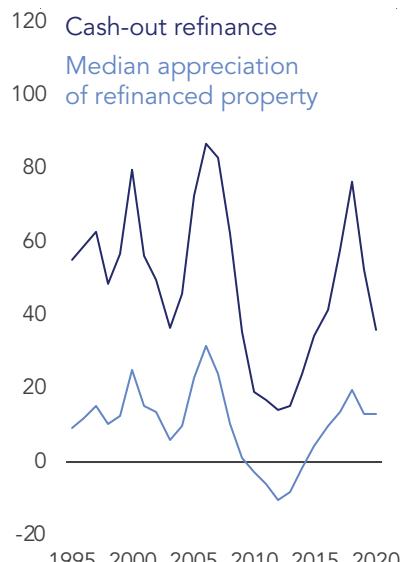
There had been moratoriums on foreclosures, but many of these programs expired by Sept. 30. The

Consumer Financial Protection Bureau (CFPB) finalized amendments to the federal mortgage servicing regulations to include temporary consumer procedural safeguards that all residential mortgage servicers must adhere to when dealing with borrowers facing foreclosure.²⁶ Servicers must ensure that at least one of these requirements has been met before referring 120-day delinquent accounts for foreclosure. They are required to step up their attempts to contact borrowers and provide them with information about repayment or other options before putting them into foreclosure. The rule is effective from Aug. 31 through Dec. 31, 2021.

Financial stability risks are low given the level of home price appreciation and the extensive support in place to renters and homeowners. However, as many of these assistance programs expire, homeowners must resume monthly payments. Mortgage servicers play a key role in working with borrowers as they exit forbearance either voluntarily or through the sunset of consumer assistance programs.

Nonbank mortgage servicers have continued to increase their market share in the servicing of agency

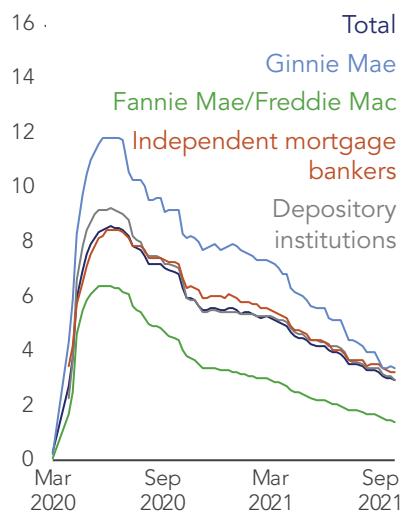
Figure 17. Freddie Mac Cash-out Refinance (percent)



Note: Data as of Dec. 31, 2020. Cash-out refinance refers to refinancings where the new loan amount exceeds the unpaid balance of the old loan by 5% or more.

Sources: Freddie Mac Quarterly Refinance Statistics, Office of Financial Research

Figure 18. Residential Mortgages in Forbearance (percent)



Note: Data as of Sept. 26, 2021. Share of residential mortgage loans in forbearance, by percent of servicers' portfolio.

Sources: MBA's Weekly Forbearance and Call Volume Survey; Mortgage Bankers Association, Office of Financial Research

single-family mortgages. At year-end 2020, nonbank mortgage servicers had a market share of 56% of agency servicing. As such, a large portion of the mortgage market is dependent on nonbank mortgage servicers working with borrowers to find a permanent solution or, in the worst case, the foreclosure and sale of properties. The success of loan modifications or workout arrangements affects government-sponsored mortgage entities, other mortgage originators, and investors.

State and Local Government Debt

Municipal bond issuers include a broad range of government organizations and sponsored entities in addition to states, counties, and cities. These entities use debt to fund a large portion of essential services in health care, education, utilities, policing, and firefighting. Municipal issuers experienced significant budgetary challenges during the pandemic as a result of a swift decline in revenues, most notably sales and income taxes. In June 2020, total revenues from states, cities, counties, transit, and other municipal issuers were expected to be \$549 billion lower than

originally expected.²⁷ However, the 2020 estimated loss was later reduced to \$330 billion following the adoption of the CARES Act and the American Rescue Plan.

Recent data indicate revenues are growing. Annual state and local government tax revenues for the March 30, 2021 year-end, rose 3.4% compared to the previous year. Recent reports from states indicate their revenue collections have rebounded. That said, concerns regarding the economic impact of the Delta and other virus variants remain.

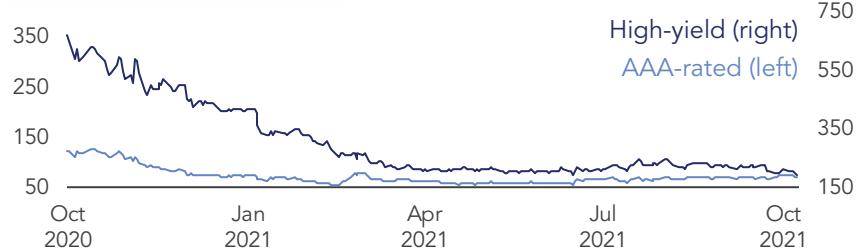
Variations in revenue collections and state and local closures contributed to higher municipal bond market volatility and yields. One measure of the relative risk of a AAA-rated municipal bond is to divide the comparable yield by the U.S. Treasury yield. The

typical ratio of the AAA-municipal to the U.S. Treasury is 70% to 80%. At the start of the pandemic, this ratio rose to above 350% (see Figure 19).

After Federal Reserve actions to stabilize markets as well as fiscal and monetary policy stimulus, the ratio, driven by declining AAA-rated municipal yields, returned to its pre-pandemic norm. However, the analogous ratio of yields on high-yield municipal bonds to Treasury yields remained elevated at close to 300% through early 2021 and have since continued to decline.

The pandemic's impact was not uniform across all states or municipalities, and the sizable changes in quarterly GDP over a short period of time increased financial stress. During the period of January 2020 through March 2021, quarterly changes in GDP were signif-

Figure 19. Municipal Bond Yields Relative to 10-year U.S. Treasuries (percent)



Note: Data as of October 12, 2021. Shows Bloomberg AAA 10-year municipal yield relative to U.S. Treasury index. High-yield municipal bonds represented by Bloomberg Barclays High-Yield Municipal Total Return Index on a yield-to-worst basis relative to U.S. 10-year Treasury yields. Municipal yields are divided by U.S. 10-year Treasury yields.

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

icant (see Figure 20). GDP declines occurred in the second quarter of 2020 and rebounded in the third quarter. For example, Nevada saw a decline of over 40% in GDP at the beginning of the pandemic, April through June, only to rebound 50% in the following quarter. Thus, while GDP snapped back sharply, it was negative overall.

Delayed tax filings and shuttered economic activity caused state and local revenues to fall significantly during the first half of 2020. Though impacts varied, state and local governments generally demonstrated flexibility by making mid-year adjustments to reduce costs. Some of these steps included targeted cuts, reduced employment, delayed infrastructure projects, deferred payments,

and use of financial reserves known as rainy-day funds.

In the second half of 2020, revenues began to recover as jurisdictions reopened their economies and federal stimulus flowed to households. The pandemic's larger impact on lower-wage earnings and services consumption also limited revenue losses, while high-wage earners typically transitioned to online work and continued to spend disposable income. On the expenditure side, critical support provided by the CARES Act helped offset pandemic spending needs.

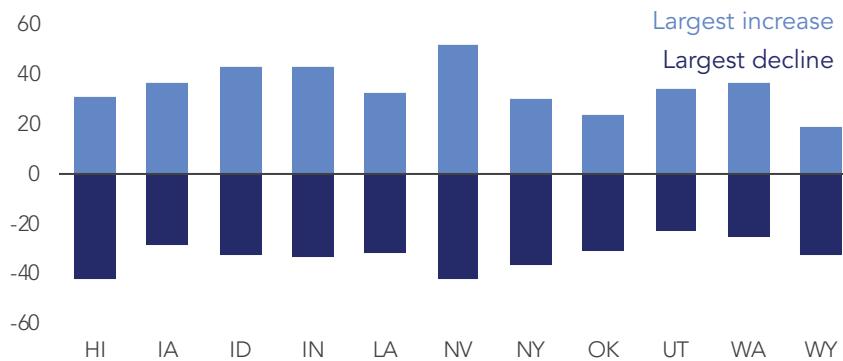
While the economy continues to recover, municipalities must balance continued pandemic-related spending with the need to replenish rainy-day funds. Some states, such as

Nevada and Hawaii, have experienced increases in revenues on a rebound in travel. Others have structural imbalances that need to be fixed and could place a significant strain on issuers.

Although states have begun to see a revitalization in their economies, these structural issues that existed prior to the pandemic are still around. Illinois is one such state that faces significant challenges with its nearly empty rainy-day fund and large underfunded pensions.

A large issuer moving from investment grade to non-investment grade (below BBB-rated) could create a crowding-out effect for other non-investment grade issuers. Specifically, the downgrade of a large issuer could flood the non-investment grade market and push up rates. Non-investment grade issuers returning to the market would then pay potentially higher yields, or be more likely to experience default, distress, or budget cuts. Though municipal rating downgrades exceeded upgrades in 2020, negative rating actions were taken at a measured pace by the rating agencies, which considered the longer-term outlook past the more immediate concerns of 2020.

Figure 20. Largest Quarter over Quarter Change in State GDP Growth, January 2020 to March 2021 (percent)



Note: The historic swings occurred between March 2020 and September 2020. Chart shows the six states with the highest, and the five states with the lowest, quarter-to-quarter gross domestic product (GDP) growth. Indiana (IN) and Nevada (NV) tied for 5th strongest growth over the period. Includes Washington, D.C.; excludes Puerto Rico and other territories.

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

Infrastructure failures, cyberattacks, and climate change also present risks to local economies and municipalities. Spending on infrastructure was reduced or delayed during the pandemic. Infrastructure spending is an umbrella term capturing more than 617,000 bridges (of which 7.5% are rated structurally deficient), 91,000 dams (of which over 2% are considered deficient, high-hazard dams), wastewater management, roads, power generation systems, and more.

Adding to aging infrastructure risk are climate change risks. Climate changes affect state and local budgets through economic losses. Roughly half of U.S. GDP output is tied to services, finance, insurance, and real estate, and these industries are negatively affected by climate change. An increase of a few degrees can destroy crops and create health hazards resulting in increased hospital visits and reduced worker output. Coastal flooding and hurricanes, fires, droughts, and extreme weather can bring about infrastructure damage.

Over the past 30 years, an estimated 37% of the \$199 billion in U.S. flood damages was due to increased precipitation.²⁸ In 2019, parts of the Midwest expe-

rienced a 200% to 600% increase in rain over the historical average, preventing 20 million acres, or 20%, of insurable crops from being planted.²⁹ Changes in weather and heat affect industries such as tourism, as well.

Municipal and state data are not robust when it comes to assessing cyber risk and the true cost of cyber attacks. Municipalities rarely disclose details regarding attacks in order to protect their image and prevent follow-on attacks.

Since 2013, less than 64% of municipalities have disclosed the amount cyber criminals requested from successful attacks, and less than 30% disclosed if a payment was made.³⁰ Of the disclosed amounts, the average payment between 2013 and 2020 was over \$800,000. True damages were far beyond this amount as cybersecurity breaches typically resulted in \$665,000 to \$40.53 million in total damages. During a cyber attack, a municipality is unable to work at full capacity for just over an average of nine days. Other costs normally involve upgrading systems, reviewing damages, training, and more.

Foreign Government Debt

2021 is a year of uneven economic and pandemic recovery for foreign countries. For some, particularly those in East Asia, the COVID-19 pandemic was well managed from the onset, and while disruptive, it did not alter the fundamentals of their economies. For many other developed and emerging market countries, however, the pandemic continues to be burdensome. The negative effects on economic growth and national wealth are especially palpable in parts of the Euro area, Latin America, and India. In Europe, for instance, the prolonged lockdowns caused those countries to continue their expansive fiscal and monetary measures. In 2020, OECD governments borrowed \$18 trillion.³¹

Average debt to GDP is now 86% globally, a 13.6% annual increase, and the highest level since World War II. Fiscal expansion is expected to continue for the remainder of 2021, with average debt to GDP surpassing 90%. Despite low interest expenditures, debt servicing is elevated. With continued large new borrowing needs and lackluster revenue growth, debt

servicing costs will become a significant part of foreign sovereign budgets. Average fiscal deficits for the United States, the United Kingdom, and Japan are expected to remain around 10% of GDP.

An important structural vulnerability concerns the ability of weaker sovereigns to continue rolling over their short-term maturity debt. Debt due in less than four years averages 40% of the typical maturity profile.³² 2020 was the first time since the emerging markets debt crisis of 1983 that six defaults took place. The average default rate peaked at 4.2% during 2020, which is five times the average of the past 30 years. Emerging markets accounted for 74% of 140 rated sovereigns last year. Among emerging markets, 55% were rated below investment grade (see Figure 21).

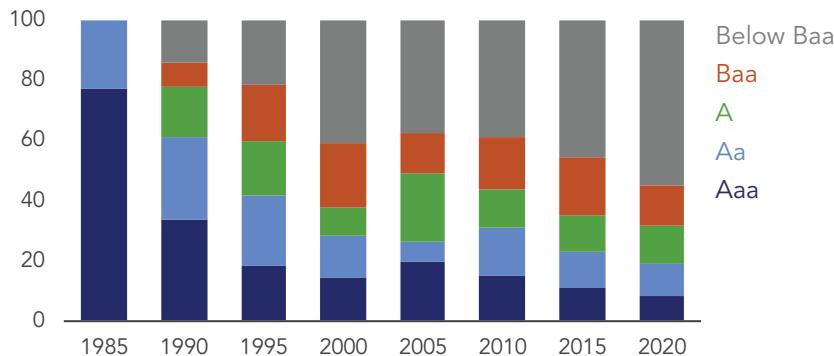
For developed economies, particularly the United States, Japan, and the larger European nations, central banks purchased over 50% of new sovereign debt issuances. In emerging markets that debt was absorbed by the banking sector and various private investors, leaving the sovereign debt markets in those countries highly vulnerable to future shocks. The risk in emerging markets would be magnified by rising U.S. Treasury yields coupled with a stronger U.S. dollar. The combination is attracting capital flows into the United States that might have otherwise flowed into those markets. Recent volatility in currencies and bond price returns in Turkey, Russia, Brazil, and other emerging markets reflect this trend.

Given the large debts incurred to address the pandemic and the associated economic damage, many

nations may be increasingly limited in their ability to withstand and address future crises. Any shocks in the short run could trigger a reassessment of sovereign debt risk, particularly for weaker issuers. In the short and medium terms, rate increases would elevate default risk significantly in weaker emerging markets.

Over the long term, the ability of most sovereigns to engage in expansive fiscal and monetary policies to mitigate the impact of economic downturns may be limited if debt burdens remain elevated. Conversely, pursuing austerity measures too quickly could hamper the recovery of these economies.

Figure 21. Sovereign Debt Credit Ratings (percent)



Note: Letter combinations denote Moody's ratings system, with Baa and above considered investment grade and below Baa considered non-investment grade or high yield.

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

Market Risk

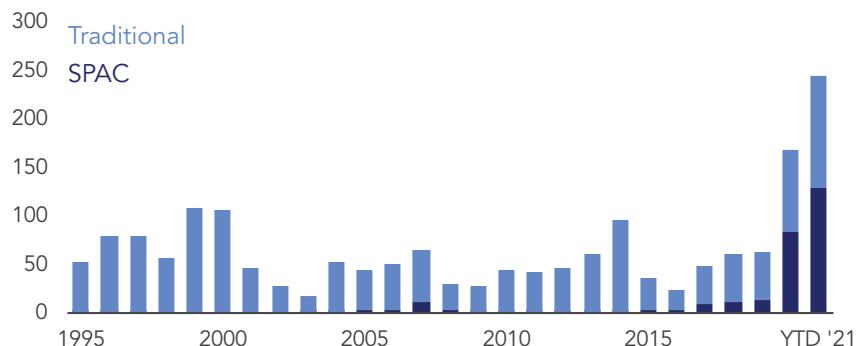
Corporate Equity and Bond Markets

The current U.S. equity bull market began on March 24, 2020, fueled by widespread optimism about future corporate earnings and continued low-interest rates. Activity in certain segments, such as “meme” stocks, pre-revenue initial public offerings (IPOs), and special purpose acquisition companies (SPACs) (public companies with no underlying business that raise money to acquire or merge with private companies), has even been described as euphoric (see *Social Media-fueled Retail Trading*).

Several factors contribute to the robustness of the equity market: 1) fiscal and monetary policies are highly supportive of economic growth; 2) corporate profits have exceeded expectations and 2021 earnings are on pace to easily surpass pre-pandemic levels; and 3) bond yields are near all-time lows, incentivizing investors to seek higher returns by taking greater risks.

However, certain factors could reduce investor risk appetite. A sharp and sustained increase in infla-

Figure 22. Initial Public Offerings: Traditional vs. SPAC (\$ billions)



Note: Data as of Sept. 30, 2021. SPAC refers to special purpose acquisition company.

Sources: Dealogic, Office of Financial Research

tion and interest rates could adversely impact economic growth and corporate earnings. Furthermore, a change in the accommodative monetary policy or withdrawal of fiscal support could impact the recovery if economic growth turns out to be weaker than expected. For now, investors are very optimistic, and companies have taken advantage of the favorable backdrop to raise capital.

Companies issued record amounts of equity this year in response to these favorable conditions. Through Sept. 30, 2021, IPO volume totaled \$245 billion, exceeding annual volumes for all prior years (see Figure 22). Included in this amount is \$128 billion raised by SPACs, a figure that exceeds the prior annual record set in 2020 of \$83 billion. Secondary equity offerings are also robust, with year-to-date volumes

ahead of all prior years except 2020.

Corporate valuations are very high when looking at stock prices relative to fundamental measures, such as earnings. As of Sept. 30, 2021, stock prices were, on average, 21 times the expected earnings over the upcoming year. The cyclically adjusted price-to-earnings ratio (CAPE)³³ was 38, a level that has only been higher at the peak of the stock market bubble in 2000. The CAPE is in its 99th percentile based on data since 1881.

However, market valuations do not appear as excessive when today's very low interest rates are considered. Risky assets such as stocks should have a higher expected return than safe assets such as Treasuries. The difference in these expected returns is referred to as the equity risk

premium. Based on the expected stream of dividends of the S&P 500 Index, the index market price, and the 10-year Treasury yield

as of Sept. 30, 2021, the implied equity risk premium is approximately 4.4%. This premium is marginally lower than the historical average

realized premium since 1926 of 4.9%, but it is well above the historical low of 2% in 1999.

SOCIAL MEDIA-FUELED RETAIL TRADING

In January 2021, U.S. equity trading volumes surged, with a record 24.5 billion shares traded on Jan. 27. Much of the surge concerned a small group of very active “meme” stocks. In particular, the share price of GameStop, a brick-and-mortar video game retailer, increased over 2,700% during January.

At one point, the daily value traded in GameStop shares exceeded that of Apple and Tesla, two stocks with much larger market capitalizations. While this event caught the attention of the media, regulators, and Congress, it did not pose a systemic threat to financial stability.³⁴ However, it did focus attention on market structure. This box addresses several market structure topics including retail investing, short selling, central clearing trade settlement, and payment for order flow.

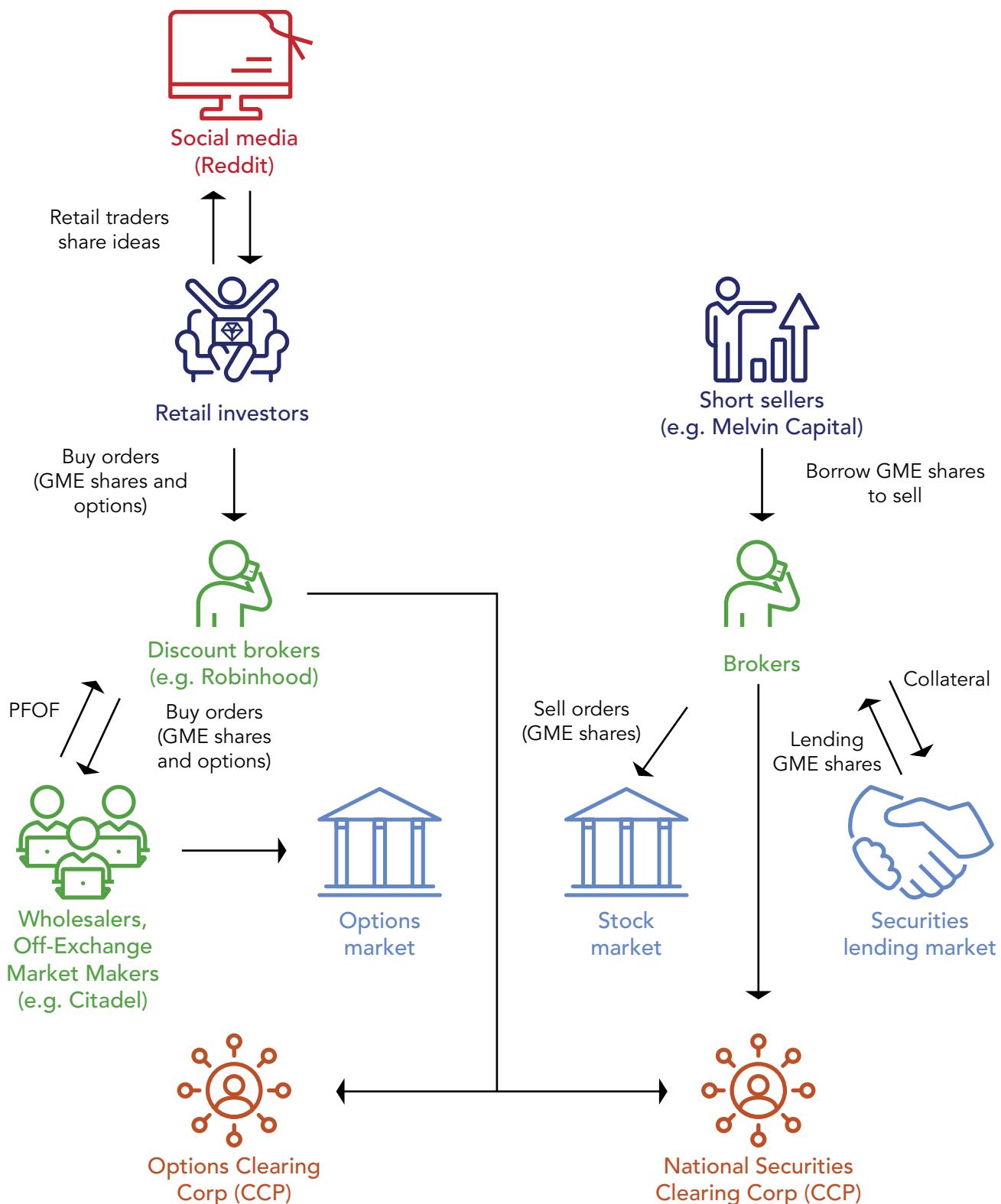
The extreme price fluctuations in GameStop and other meme stocks were not attributed to any meaningful changes in the fundamentals of these companies. Instead, the volatility was driven by a confluence of factors according to media and other reports and Congressional testimonies: 1) unusually high retail investor demand, 2) short covering by hedge funds, and 3) increased options activity (see Figure 23).

Retail investors banded together on social media forums to discuss heavily shorted shares, including GameStop and AMC Entertainment, among other less liquid small-capitalization stocks. A popular online forum operated by Reddit called “wallstreetbets” (WSB) attracted millions of retail investors. As trading volume and share prices rose, new participants were attracted to such forums. While social media-fueled trading has brought new retail participants into the market, it also raises concerns about whether these investors could transmit extreme volatility to other stocks or even broad segments of the financial system.

Retail investors often trade through discount brokers such as Robinhood that offer commission-free trades. Robinhood pioneered commission-free stock and options trading with no account minimums, a business model that attracted millions of new retail accounts. Other brokers adopted this business model beginning in October 2019. In January 2021, some of these retail investors were actively buying GameStop shares, in some cases using borrowed funds.

Leverage is a factor in creating very large price movements. Leveraged long positions included purchases of GameStop call options and shares on margin (i.e., investors borrowing

Figure 23. Key Participants and Markets Involved in GameStop (GME) Trading



Note: PFOF stands for payment for order flow. Green represents intermediaries, dark blue represents investors, light blue represents markets, and orange represents CCPs (Central Counterparties).

Source: Office of Financial Research

money from their stockbroker to purchase shares). In fact, margin loans extended by Robinhood to clients increased sharply in the first quarter of 2021.³⁵

Short positions undertaken by hedge funds with negative views on GameStop's value also often involved leverage. When an investor sells a stock short, the shares are typically borrowed from a broker and subsequently sold to another investor. At a future date, the short seller must repurchase the shares in the market and return them to the lender. If the short seller can buy the shares at a lower price, the trade is profitable. However, if the share price increases, the short seller incurs a loss, as was the case with GameStop short positions in late January. Investors who expected the stock price to decline also took positions using put options on GameStop shares. Options enable investors to obtain larger exposures and thus are a form of embedded leverage.

Before the January price surge, short interest in GameStop shares was very high. At one point, the short interest exceeded 140% of the shares available to trade, a highly unusual situation.³⁶ Participants on Reddit's WSB forum noticed and collectively purchased millions of GameStop shares, driving up the price. Short sellers were subsequently forced to close out their positions by buying GameStop shares at much higher prices. This buying, in turn, drove the price higher in what became a classic short squeeze.

As a result, some hedge funds suffered substantial losses on their short positions, which included GameStop. Melvin Capital lost a reported 53% of its original \$12.5 billion in assets under management. The firm needed a cash infusion of \$2.75 billion, raised from two other firms, Point72 and Citadel.³⁷

Short selling can improve market pricing efficiency by incorporating negative information and providing liquidity. Short selling is regulated under Securities and Exchange Commission (SEC) Regulation SHO, which restricts naked short selling in which investors take a short position without first holding or locating the shares.³⁸ In GameStop's case, it is unclear if the high level of short interest was partly due to investors with naked shorts who subsequently failed to deliver the stock at settlement.³⁹ The volatility in meme stocks suggests that short position disclosures may need to be improved.⁴⁰

Hedge funds typically operate long-short strategies. Broadly speaking, when these funds covered their short positions, some also reduced long positions in other stocks, potentially contributing to higher volatility in the broader market. Also, dealers who had sold GameStop call options to investors responded to the surging share price by buying more of the underlying stock as a hedge. This buying was another factor that may have contributed to the surge in GameStop's share price in late January.

The GameStop saga raised questions about trade settlement and payment for order flow. Clearing brokers settle equity trades with the central clearinghouse National Securities Clearing Corp (NSCC).⁴¹ As members, brokerage firms are required to place a deposit with the NSCC to cover counterparty risks until trades settle.⁴²

In late January, settlement margin requirements for specific securities, including GameStop, increased significantly.⁴³ This adversely impacted clearing members such as Robinhood that were actively trading these securities. Robinhood was notified that it owed about \$3.7 billion. Since Robinhood had about \$700 million on deposit at the NSCC, the net amount due was \$3 billion but Robinhood did not have sufficient funds available.

To reduce its clearing margin requirement, Robinhood placed temporary trading restrictions on its clients in GameStop and other securities as of Jan. 28 (restrictions were subsequently removed). This action, combined with raising external equity, enabled Robinhood to meet its margin requirement.⁴⁴ If Robinhood had failed to meet its requirement, the NSCC would likely have declared the firm in default of its clearing obligations.

A default by Robinhood could have potentially put the NSCC and its other clearing members at risk of having to make up any shortfall (see **Contagion Risk from Central Counterparties**). The NSCC could have also terminated the settlement of all outstanding and future trades submitted by Robinhood, creating confusion and losses for Robinhood's clients, and potentially imperiling Robinhood's solvency. Such an event could have undermined the trust of retail investors in the equity markets.

Under the current settlement process, trades are settled within two days of the trade execution date (T+2). Settlement refers to the process of a buyer delivering cash and a seller delivering shares. A shorter settlement time would reduce the risk of events that could affect the transfer of cash or securities ownership from the point of trade execution through settlement. The industry transitioned from T+3 to T+2 in 2017, and the NSCC is working with the industry to reduce it further.⁴⁵ Moving to T+1 would substantially reduce counterparty risk and the margin requirements of clearing members.⁴⁶

Payment for order flow did not cause the extreme price changes in GameStop's shares, but some argue that it could potentially negatively impact trade execution quality. Payment for order flow has been an industry practice since the 1980s.⁴⁷ Large market makers, such as Citadel Securities, pay brokers like Robinhood to route client orders to them to execute these trades off-exchange. In return, market makers offer modest price improvements over quotes offered on exchanges. Given the record level of off-exchange trading volume, some questioned whether this activity harms price discovery and market liquidity on stock exchanges where the National Best Bid and Offer (NBBO) is derived.

Payment for order flow is under scrutiny as to whether client orders are treated fairly. Brokerage firms are obligated to provide "best execution" to clients. This requires a broker-dealer to execute customer orders at the most favorable terms reasonably available under the circumstances, generally, the best reasonable price. Order routing practices and payments received for such are disclosed to the public under existing SEC rules.

Payment for order flow is the most important factor behind the zero-commission business model pioneered by Robinhood and adopted by almost all other retail brokers. Therefore, any change to this practice will likely have widespread implications for discount brokers.

Markets are more susceptible to sharp declines when both valuations and sentiment are extreme. Current sentiment appears high, but not as high as during periods of extreme bullishness such as the 2000

dot-com market.⁴⁸ High investor confidence is often accompanied by increased borrowing. Margin debt was a record \$912 billion as of August 2021; as a share of the overall market capitalization, margin debt

was 1.8% (see **Figure 24**). While elevated, it is below the prior peak of 2.5% in September 2008.

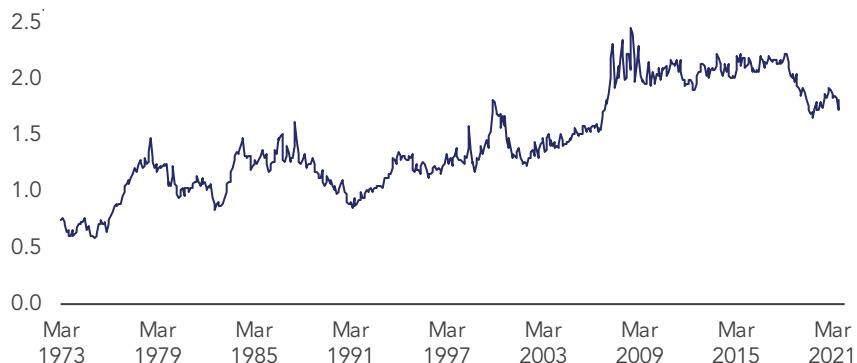
There are two key vulnerabilities facing bond investors. First, yields and credit risk premiums are very low

by historical standards. Second, duration is very high, meaning that bond prices are more sensitive to interest rate volatility.

Investment-grade corporate bond yields have increased modestly from the all-time low of 1.8% in late December 2020, largely because expectations for economic growth and inflation have increased. Meanwhile, in early July 2021, the high-yield market set an all-time low yield of 3.8%, far below the 5.4% increase in the consumer price index for that month. Credit spreads have also compressed to the tightest levels since 2007. The yield of investment-grade corporate bonds over comparable maturity Treasuries tightened to under 100 basis points in early 2021, while high-yield spreads tightened to approximately 300 basis points during mid-2021.

Low credit spreads reflect investors' high confidence regarding the earnings recovery and the ability of companies to deleverage or to refinance maturing debt. Investors expect default rates to remain low for the foreseeable future. Lower rated borrowers have seized on the favorable lending environment to issue a record amount of debt.

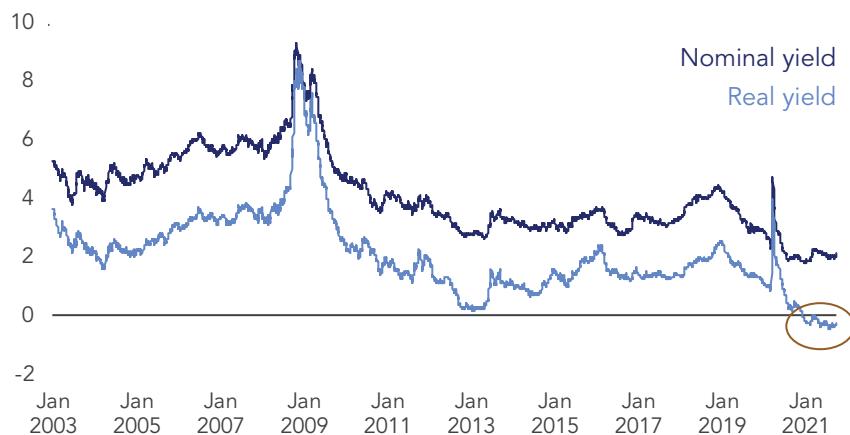
Figure 24. Margin Debt Outstanding (ratio)



Note: Data as of Aug. 30, 2021. Ratio refers to margin debt divided by market capitalization. Margin debt is sourced from NYSE ('73-'96) and FINRA ('97-present).

Sources: NYSE, FINRA, Haver Analytics, Office of Financial Research

Figure 25. Investment-grade Corporate Bond Yields (percent)



Note: Data as of Sept. 30, 2021. Nominal yield is the BofA U.S. Corporate Index (C0A0) yield to worst. Real yield is nominal yield minus expected inflation.

Sources: ICE Data Services, Haver Analytics, Office of Financial Research

Through Sept. 30, 2021, nonfinancial corporations had issued \$410 billion in high-yield bonds, 25% higher than the 2020 comparable period. Leveraged loan issuance has also set a record at \$622 billion through Sept. 30, 2021, 108% higher than the same period in 2020. Low yields are highly favorable for borrowers, but they produce lower investment

income for lenders and investors, such as retirees and institutional fixed-income investors.

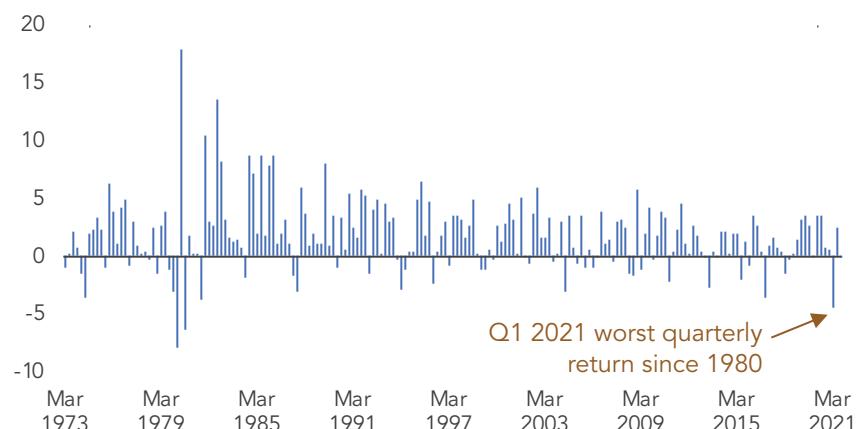
Investment grade real yields (inflation-adjusted) turned negative in December 2020 and have remained so throughout 2021 (see Figure 25). This highly unusual development for the U.S. corporate bond market was driven by

lower nominal yields and higher inflation expectations. A negative real yield distorts asset prices and has at least two important implications. The first is that it incentivizes already highly levered corporations to borrow more rather than deleverage. Companies may use debt proceeds to pursue shareholder-friendly actions (i.e., mergers and acquisitions, share repurchases, and dividends) that may add to balance sheet fragility. The second implication is that it incentivizes investors to reach for yield by investing in riskier assets, such as corporate bonds, leveraged loans, structured credit, private credit, and equities.

Across these markets, high investor risk appetite could drive risk premiums to extreme lows. Further, as prices across these asset classes increase, so do the value of underlying assets backing corporate debt. This in turn enables companies to borrow even more, further increasing leverage and potential fragilities.

Another vulnerability is interest rate risk. Bond duration—a measure of bonds' price sensitivity to interest rate changes—is near a recent all-time high. For example, the duration of the ICE BofA U.S. Corporate & Government Index, a broad

Figure 26. Fixed Income Quarterly Returns (percent)



Note: Total returns refer to the ICE BofA U.S. Corporate & Government Index (B0A0).

Sources: ICE Data Services, Office of Financial Research

market index of corporate and government bonds, was 7.5 years in September 2021. This is just shy of the record 7.7 years in July 2020 and above the long-term average of 5.7 years.

Given current duration, a one percentage point increase in interest rates would lead to as much as a 7.5% decrease in market value, approximately \$1.9 trillion, for the broad market index. In fact, the first quarter 2021 increase in Treasury yields resulted in a 4.4% decrease in bond returns, the largest quarterly decline since 1980 (see Figure 26).

Low yields go together with high duration risk. If interest rates suddenly rise, as seen on a limited scale during the first quarter of 2021, then bond prices will decline. Large price

declines can transmit stress to market participants and result in adverse feedback loops. Price declines may prompt investors to sell, resulting in further price declines and more selling, adversely impacting market liquidity and price discovery. Investor leverage amplifies this adverse feedback loop.

High valuations and high duration may not present a threat to financial stability in the near term due to the extraordinary government support and ongoing U.S. economic recovery. However, history shows that markets can be ill prepared for sharp interest rate increases (see *Bond Market Massacre of 1994*).

Investors do not appear to expect interest rates to rise sharply in the foreseeable future, encouraging a

reach for yield. Examples of investor reach for yield include investing in longer maturity securities with higher duration risk, and investing in riskier credits (i.e., leveraged loans, high yield bonds, and private debt) offering higher yields.

If the consensus outlook is wrong and interest rates spike higher, the resulting decline in asset prices could transmit high volatility across financial markets. The impact on liability-driven investors, such as insurers and pension funds, may be minimal. However, mutual funds, hedge funds, and many foreign investors with large bond holdings may be prompted to sell. Large-scale selling could impair market liquidity and amplify price declines.

Digital Assets

In 2018, the OFR Annual Report discussed how digital financial assets, namely cryptocurrencies, had gained prominence. These assets use blockchain technology, a form of distributed ledger that can record and transfer ownership in a decentralized way. The 2018 report evaluated the potential for cryptocurrencies to introduce new risks to financial stability and concluded that they could

THE BOND MARKET MASSACRE OF 1994

The 1994 bond market sell-off captured widespread attention and resulted in large losses for fixed-income investors, but did not ultimately pose a threat to the financial system. Nonetheless, it is a useful case study of what happens when abrupt changes in the interest rate policy catch investors off guard.

In January 1994, bond yields were at historically low levels and inflation seemed negligible. A month later, the Federal Reserve unexpectedly increased short-term interest rates for the first time in several years. It continued to increase rates throughout the year. This monetary policy shift prompted 10-year Treasury yields to increase by almost 200 basis points from January to early May 1994, rising from 5.6% to 7.5%. The increase spilled over into the mortgage market.

Bond investors incurred losses for the full year and some leveraged investors sustained very large losses. Margin calls caused forced selling of positions. Several hedge funds sustained large losses, and one fund, Askin Capital Management, was forced to liquidate its \$2.5 billion portfolio of mortgage derivatives.⁴⁹ Askin's prime broker, Kidder Peabody, also suffered large losses. Several nonfinancial corporations, including Procter & Gamble, Air Products & Chemicals, Gibson Greetings, and Merrell Dow, incurred large losses on interest rate derivative positions.

In December 1994, Orange County, California, sustained \$1.6 billion in losses from heavily concentrated and leveraged positions in interest rate derivatives.⁵⁰ The municipality's prime brokers liquidated the county's collateral in a fire sale, amplifying the price decline across financial markets. As a result, Orange County became the largest municipality in U.S. history to file for bankruptcy.

amplify market and liquidity risk but did not currently pose new or significant risks. The 2019 OFR Annual Report reached the same conclusion while noting that the U.S. regulatory regime would need to address these new technologies.

This year, three related developments show how digital assets could increasingly introduce volatility into the financial markets:

1. The market capitalizations of many digital assets have increased dramatically. The market capitalization of Bitcoin, for example, rose from less than \$200 billion in September 2020 to a peak of over \$1 trillion in April 2021. This pattern is not limited to Bitcoin; the market capitalization of all cryptocurrencies increased from under \$350 billion to over \$2.4 trillion from September 2020 to April 2021.
2. Digital assets are increasingly more integrated with mainstream financial markets, attracting more interest from both institutional and retail investors. Coinbase, the largest U.S.-based trading platform for such assets, went public on April 14, 2021 and now trades on the Nasdaq. Also, a growing number of investment funds

said they plan to invest in digital assets, and popular payment apps, including PayPal and Venmo, now allow users to buy and hold some cryptocurrencies. Visa has pilot projects to settle transactions using USD Coin (USDC), a digital asset whose value is tied to the U.S. dollar. All these links increase the potential for volatility in digital asset prices to spread to traditional financial markets and institutions. Some observers have commented that sharp swings in digital asset prices have begun to influence prices in traditional asset markets.⁵¹

3. Digital assets are being used in an increasing set of new financial arrangements that may introduce new types of risk. Trade in digital asset-based derivatives continues to grow, with daily volume surpassing \$200 billion in the first half of 2021.⁵² The leverage available through derivatives trading has the potential to increase the impact of digital asset price volatility. In addition, blockchain-based financial arrangements known collectively as Decentralized Finance (DeFi) have become increasingly popular. These

arrangements aim to use automatically executing contracts to perform intermediation, such as collateralized lending, which have been conducted traditionally by financial institutions.

While there may be benefits, such as increased efficiency and lower costs, automatic liquidation of positions when prices fall can lead to fire-sale dynamics. DeFi arrangements also have the potential to raise unique technical risks to financial markets, as demonstrated by several notable hacks and cases of fraud that resulted in significant losses.

To evaluate the risks that digital assets pose to financial stability, it is useful to distinguish between those whose prices fluctuate freely, such as Bitcoin, and a class of digital assets called stablecoins, which are meant to maintain a constant value relative to an existing currency or asset. For example, market prices of Bitcoin continue to be highly volatile, as illustrated when they fell nearly 40% in one week in May 2021. Such volatility shows that these assets represent a speculative investment rather than an effective means of payment or a store of value.⁵³ As a result, we refer to Bitcoin and

other coins in this first category as crypto assets. The second category of digital assets, stablecoins, raise a distinct set of financial stability considerations (see *Stablecoins and Central Bank Digital Currencies*).

Some of the large price swings in crypto assets appear to reflect changing expectations about regulation of these assets in different jurisdictions.⁵⁴ This type of uncertainty may decline as regulatory regimes become more established. However, as with so-called meme stocks, crypto asset prices appear to be particularly vulnerable to social media posts and shifts in investor sentiment (see *Social Media-fueled Retail Trading*), especially since most crypto assets have no intrinsic value and generate no cash flow. In addition, large energy consumption required by some crypto asset protocols have raised environmental concerns that may threaten the long-term viability of these assets.⁵⁵

The growth in the market capitalization of crypto assets, together with their continued price volatility and increasing integration with traditional financial markets, has likely increased their overall risk to financial stability. There is growing recognition of

this: over 20% of market participants surveyed by the Federal Reserve in early 2021 cited crypto assets as a risk to financial stability.⁵⁶

Evidence of increased use of crypto assets as collateral, or increased use of leveraged positions, would lead to higher credit and solvency risks. Also, the decentralized, global nature of crypto asset trading can lead to elevated risk of market manipulation, fraud, and outright theft. Such episodes may create not only credit risk, but also reputational risk for financial institutions and their investors.

Increased trading of contracts tied to crypto assets on highly interconnected exchanges may raise contagion risk. Risks are heightened to the extent that these new instruments do not fit into existing regulatory frameworks.⁵⁷ Increased provision of regulatory data is essential for effective risk monitoring.

STABLECOINS AND CENTRAL BANK DIGITAL CURRENCIES

Trading in decentralized financial markets can be facilitated by having a means of payment and a short-term store of value that can be transferred directly through blockchain.⁵⁸ The high volatility in prices of crypto assets makes them unsuitable for this purpose. The market has responded by creating another type of crypto asset known as a stablecoin, which is a cryptographic token designed to maintain near-constant value relative to an existing currency or financial asset.

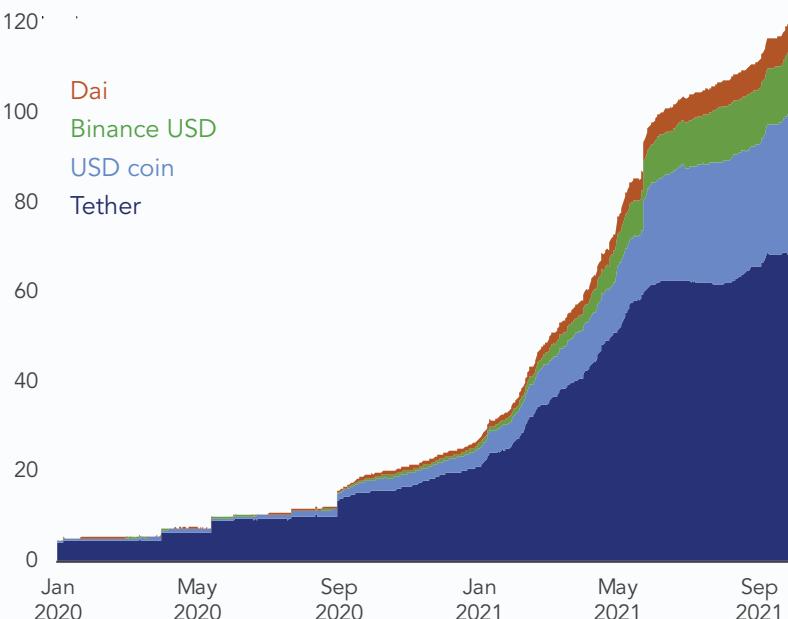
Dozens of stablecoins have been created, with most of them tied to the U.S. dollar. However, some stablecoins are tied to the euro and other currencies, while others are linked to gold and baskets of crypto assets.⁵⁹

Stablecoins fall into two broad groups, asset-backed and algorithm-based, depending on their approach to maintaining a stable value. Most of them are asset-backed, meaning that assets are acquired by the protocol to back the value of stablecoins when they are created. Asset-backed stablecoins may allow holders to redeem their stablecoins on demand or according to a specified schedule.

Algorithm-based stablecoins make up the second group. They typically hold assets worth much less than the face value of the stablecoins outstanding and rely instead on prespecified algorithms to increase or decrease the supply of stablecoins as market conditions change. If the value of the stablecoin begins to decrease, for example, the algorithm may promise future rewards to individuals who hold their stablecoins (or buy more) instead of selling them.

Tether is probably the best-known asset-backed stablecoin and has the largest market capitalization and daily trading volume; other asset-backed stablecoins include USD Coin and Binance USD (see Figure 27). Each of these

Figure 27. Market Capitalization of Select Stablecoins (\$ billions)



Note: Data as of Sep. 30, 2021.

Sources: Coinmarketcap.com, Office of Financial Research

coins is linked to the U.S. dollar and reports holding sufficient assets to fully back all of their tokens, although standards for reporting the precise composition of these assets are lacking. Some stablecoins, such as Dai, are linked to the U.S. dollar but backed by other crypto assets. Dai tokens are created when a user borrows from the protocol, using other crypto assets as collateral, and are destroyed when the loan is repaid. Asset-backed stablecoins have seen substantially larger usage than algorithm-based versions.

Current levels of stablecoin use are unlikely to pose a significant risk to financial stability, but that could change if usage grows at a rapid pace. Increased use of stablecoins to create leverage on trading platforms and in DeFi arrangements could raise the risk of fire sales and contagion to other markets following a decline in digital asset prices. If a stablecoin was used widely in payments, any disruption to its value or liquidity could negatively affect the financial system and economy.

For example, a stablecoin arrangement could be vulnerable to events akin to a run on a bank. Fearing that a stablecoin could begin to lose value, holders may rush to sell or redeem and drive down its value, intensifying the run. The stablecoin arrangement could potentially collapse, disrupting transactions and leaving some holders facing losses. Such a collapse could spread to other payment systems.

It bears emphasizing that run-like events could occur even for stablecoins fully backed by assets. A stablecoin that is 100% backed by short-term, liquid assets denominated in U.S. dollars is similar to a money market mutual fund in that it aims to meet the liquidity needs of holders while maintaining a value at or very close to par. In September 2008, and again in March 2020, some money market mutual funds experienced runs by their investors that ended only after the U.S. Treasury and the Federal Reserve intervened. Under the right set of conditions, stablecoins could face similar runs.⁶⁰

This comparison also highlights that the precise assets held by a stablecoin arrangement may prove important in determining its ability to weather financial stress. There were no runs on government money market mutual funds, which hold only obligations of the U.S. government and government-sponsored enterprises, in either 2008 or 2020.

However, runs did occur on prime funds even though these funds only hold short-term obligations of highly rated corporations. A lack of transparency about the assets backing existing stablecoin arrangements is worrisome in this regard. In February 2021, Tether reached an agreement with the New York State Attorney General's office that included a fine of \$18.5 million to settle charges that it made false statements about the assets backing its coins.⁶¹

Even if a stablecoin is initially backed 100% by short-term government liabilities, strong incentives may emerge over time to earn a higher return by holding slightly riskier and less-liquid assets.⁶² There are many historical examples of intermediation arrangements that offered to redeem liabilities at par while ultimately holding assets that were not entirely liquid and entailed some risk.⁶³ The historical evidence indicates that, when such arrangements operate without government guarantees or an effective lender of last resort, runs often occur.

The collapse of a large stablecoin arrangement could have spillover effects on other financial markets and institutions, in addition to exacerbating the volatility of crypto asset prices. Ef-

forts by a stablecoin to satisfy redemption requests or maintain the coin's value could result in fire sales of assets held by the arrangement, which has the potential to spread distress to other institutions holding similar assets.

In addition, losses in the value of their stablecoin holdings, or the loss of access to those holdings, could lead affected individuals or institutions to default on their obligations, potentially creating a cascade of defaults that extend well beyond the digital asset sector. If the stablecoin is used in multiple countries, the consequences of a loss in value would be global in nature.⁶⁴ The absence of a regulatory framework in the U.S. for addressing these types of vulnerabilities heightens the financial stability risks associated with stablecoins.

Central banks around the world have begun to consider introducing their own form of digital money. A central bank digital currency (CBDC) would be a digital asset whose value is tied to an existing currency. A recent survey indicates that over 80% of central banks are actively considering the implications of introducing CBDC, and more than half are conducting experiments or proof-of-concept work.⁶⁵

A CBDC could potentially fill the need for a digital form of money without raising the financial stability concerns discussed above. Because a central bank creates a nation's currency, it could guarantee the convertibility of a digital currency into traditional currency in all circumstances. If holders of a hypothetical CBDC in the United States wished to exchange their coins for traditional dollars, the Federal Reserve would always be able to support that conversion. Proponents of CBDC have cited other potential benefits, including promoting competition and resilience in the payments system, encouraging financial inclusion, and facilitating fiscal transfers such as those made to qualifying households during the COVID-19 pandemic.

In practice, a CBDC could take one of several forms. It could be a cryptographic token like the stablecoins discussed above or could be implemented by allowing individuals and businesses to open accounts at the central bank. It should be noted that a CBDC can be created without requiring a central bank to become involved in retail operations. Private payment service providers could offer a type of stablecoin fully backed by the safest and most liquid asset: central bank reserves. This type of arrangement sometimes called "synthetic CBDC," can, in many ways, be functionally equivalent to a digital currency offered directly by a central bank.⁶⁶

While a CBDC should be immune to the run risk faced by stablecoins, a different type of financial stability issue arises: runs into CBDC.⁶⁷ Currently, when there is a run on a bank or other intermediation arrangement, depositors and investors largely shift their funds to another intermediary. While some funds may be withdrawn in cash, holding and safeguarding large amounts of cash is impractical. As a result, while a run creates strains in some parts of the financial system, other parts tend to experience an inflow of assets.

A CBDC could potentially change this pattern. Suppose bank depositors and other short-term investors consider a CBDC to be a safe and attractive alternative in periods of financial stress. In that case, runs on banks and other intermediaries could become more frequent and more severe. Moreover, these runs would cause a loss of funding to the financial system, making them particularly costly. This could be offset if a central bank lends to the banking system in an amount equal to the shift to CBDC.⁶⁸ However, such actions would have the

effect of shifting risk from depositors to a central bank in times of crisis.

It may be possible to mitigate the possibility of a run into CBDC by appropriate design choices. For example, a central bank could place limits on the amount of CBDC an individual can hold, or charge fees to discourage holding large quantities of CBDC. Alternatively, there could be a limit on the total amount of CBDC available.⁶⁹ However, such policies are untested, and it is unclear whether maintaining them during times of financial stress would be feasible.

Both stablecoins and CBDC also have the potential to create changes in the structure of the financial system that could raise additional risks. Because both types of digital money offer users an alternative to bank deposits, they may reduce banks' access to this source of low cost and stable funding. A loss of bank funding, in turn, may restrict lending in the economy.⁷⁰

In addition, banks may respond by increasing their reliance on wholesale funding sources, which could leave them more susceptible to a loss of funding in periods of financial stress. Appropriate design choices may be possible to mitigate these issues, but there is substantial uncertainty about how effective such mitigation measures would be.

Like many innovations, stablecoins and CBDC have the potential to bring substantial economic benefits while, at the same time, introducing new risks. Developments in this area merit close monitoring.

Liquidity and Funding Risk

Markets

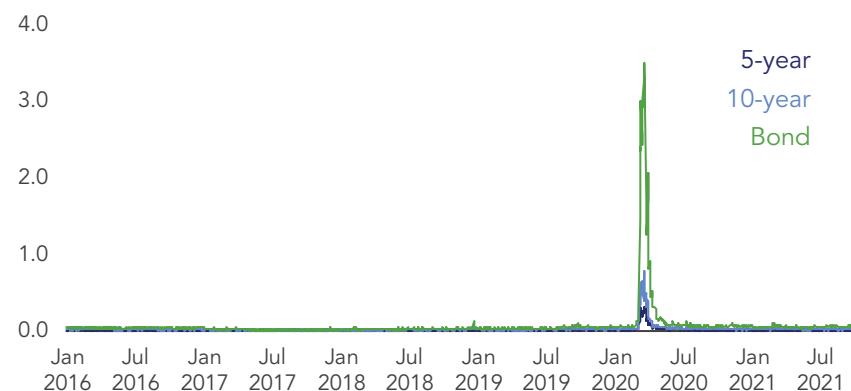
Liquidity has greatly improved since the start of the pandemic last year. A key characteristic of a liquid market is when the price the buyer is willing to buy (the bid) and the price at which the seller is willing to sell (the ask) are not far apart. As liquidity concerns have moderated, Treasury bid-ask spreads have narrowed (see Figure 28).

The success of the Federal Reserve's temporary measures in stabilizing the

Treasury market is notable considering the large amount of Treasury debt issuance since the onset of the pandemic (see Figures 29 and 30). Between February 2020 and May

2021, total marketable debt outstanding increased from \$17 trillion to \$21 trillion. Initially, cash management bills issued to fund emergency cash needs caused the average maturity of

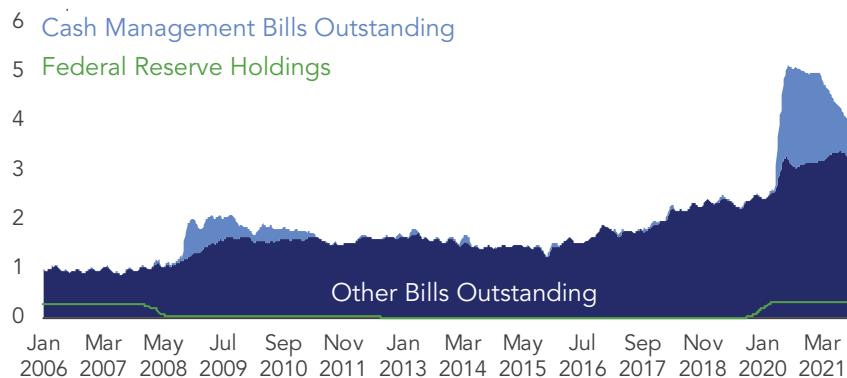
Figure 28. Bid-ask Spreads for Off-the-run Treasuries (price per \$100 face value)



Note: Spreads are differences between asking prices of sellers and bid prices of buyers for third-off-the-run Treasuries. Off-the-run Treasuries are outstanding notes issued before the most recent and most traded (liquid) on-the-run Treasuries.

Sources: Refinitiv Eikon, Office of Financial Research

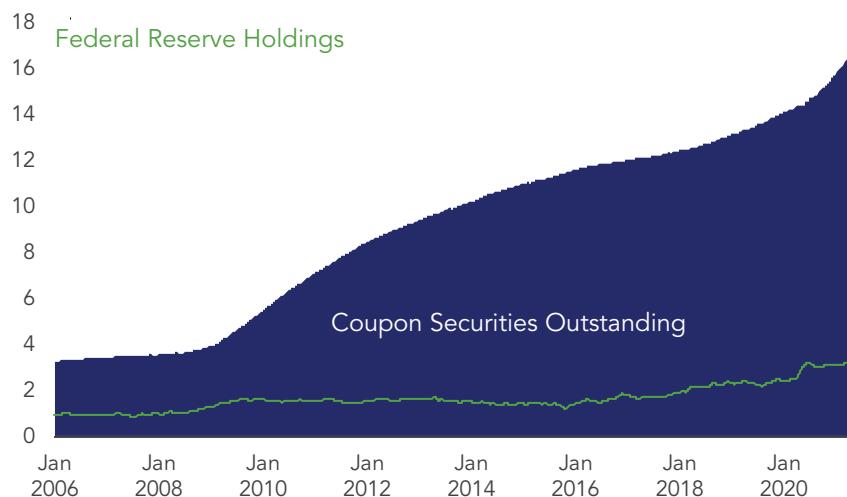
Figure 29. Outstanding Treasury Bills and Federal Reserve Holdings (\$ trillions)



Note: Data as of Sept. 29, 2021. Outstanding bills are estimated using issuance data. Shows outright Federal Reserve holdings.

Sources: TreasuryDirect Auction Data, Federal Reserve Economic Data, Office of Financial Research

Figure 30. Outstanding Treasury Coupon Securities and Federal Reserve Holdings (\$ trillions)



Note: Data as of Sept. 29, 2021. Outstanding coupon securities are estimated using issuance data. Shows outright Federal Reserve holdings.

Sources: TreasuryDirect Auction Data, Federal Reserve Economic Data, Office of Financial Research

Treasury debt outstanding to fall below 63 months in late 2020.

Despite the extraordinary amount of short-term Treasury issuances in response to the pandemic, the increase in the supply of bills did not cause short-term yields to increase signifi-

cantly. Yields remained near zero likely due to the overwhelming demand by investors for cash-like instruments and the view by market participants that monetary policy would remain accommodative for the foreseeable future. Subsequently, the Treasury then substantially increased

longer maturity coupon auction sizes to replace the initial bill issuances with longer term debt. As the pace of additional expenditures began to slow, bill auction sizes declined, and net new bill supply began to decline relative to issuance of new coupon securities. This resulted in an expansion of the weighted average maturity to 67 months by the end of March 2021. This shift toward longer-dated debt may have contributed to declining bill yields and rates on short-term securities such as repo.

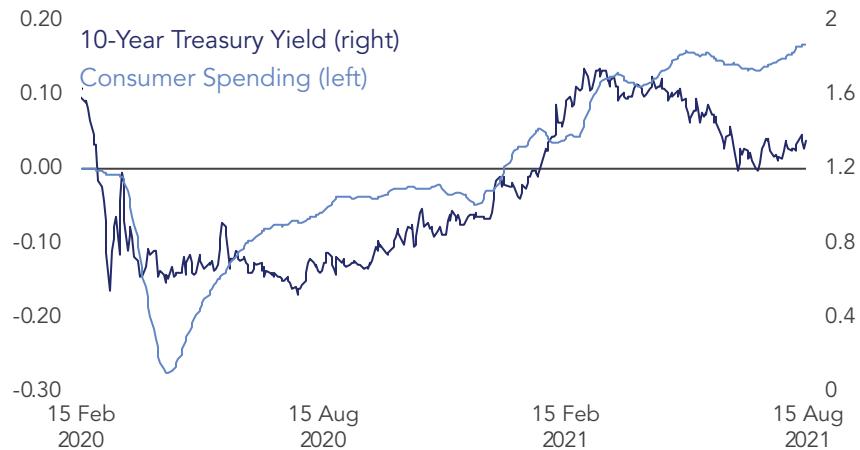
The Federal Reserve continues to be a leading buyer of Treasuries. At the end of May 2021, the Federal Reserve held a record 28% of all Treasury coupon securities and 7% of all Treasury bills outstanding in these markets. As the Federal Reserve determines when it will return to normal monetary policy making, it may need to consider how cutting its holdings of these assets could impact the smooth functioning of the Treasuries market.

This year's increase in bond yields occurred in the context of the unprecedented sudden reopening of the economy and the Federal Reserve's new average inflation targeting framework. The yield on

10-year bonds rose from 0.64% at the end of April 2020 to a high of 1.74% on March 31, 2021 (see Figure 31). The rise in yields coincided with both a broad increase in consumer spending and the positive news about vaccine development and distribution. Yields on 10-year bonds remained elevated through May 2021 and then reversed course, falling from 1.58% at the end of May 2021 to 1.28% at the end of July 2021. This decline in yields coincided with increased spread of the Delta variant of the coronavirus as infection rates increased and hospitalizations jumped sharply in some states. Throughout this period, and despite large expected economic growth, Treasury yields remained near historically low levels.

Much like the Treasury cash market, the Treasury repo market has remained calm since March 2020. However, the increased supply of reserves, or bank deposits with the Federal Reserve, has affected Treasury repo markets. The Federal Reserve determines the total size of its liabilities, which continued to increase through open market purchases since the Fall of 2019. These purchases accelerated in March 2020, and then steadied in June 2020.

Figure 31. Treasury Yields and Consumer Spending (percent)



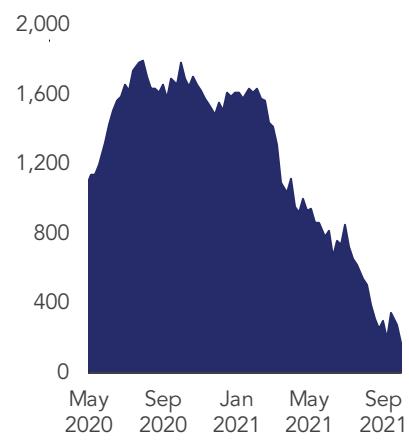
Note: 10-year Treasury Yields are interpolated by the Treasury from the daily yield curve. Consumer spending is a one-month moving average for all U.S. consumers derived from Affinity data.

Sources: U.S. Department of the Treasury Constant Maturity Yields, Opportunity Insights Economic Tracker, Federal Reserve Economic Data, Office of Financial Research

However, while the size of its liabilities is determined by the Federal Reserve, changes in the size of other liabilities of the Federal Reserve can change the level of reserves with banks, such as changes in the Treasury General Account (TGA), which represents cash that the United States Treasury holds with the Federal Reserve (see Figure 32).

In April 2020, the Treasury began to build up its holdings in anticipation of further stimulus spending. However, between December 2020 and March 2021, the TGA fell from \$1.6 trillion to \$779 billion. When this account declined, the supply of reserves going to the private sector expanded.

Figure 32. Treasury General Account Cash Balance (\$ billions)



Note: The Treasury General Account represents cash the Treasury holds with the Federal Reserve.

Sources: Federal Reserve Economic Data, Office of Financial Research

The supply of reserves is an important determinant of repo rates. For instance, the September 2019 repo rate spike occurred when reserves were particularly low.⁷¹ Following January

THE MULTIFACETED, MULTILAYERED, INTERDEPENDENT FINANCIAL SYSTEM: WHAT ARE THE RISKS IF THINGS GO WRONG?

The U.S. economy runs on transactions among households, businesses, and various government and private entities. These transactions, in turn, run through financial institutions and the markets they do business in, comprising the U.S. financial system.

Transferring funds from institutions to borrowers is one of the essential roles of the financial system. Financial firms act as intermediaries between households or institutions with money to lend or invest and borrowers raising funds through loans or the capital markets. Financial institutions handle payments and market trades, and provide insurance, asset management, and advisory services for earning income and managing risk.

In a well-functioning financial system, the needs of borrowers and lenders and the demands of buyers and sellers are met. Most transactions take place among financial firms with assets priced accordingly and payment and risk management systems working as intended. The solvency of counterparties is rarely an issue. The smooth flow of funds from lenders to borrowers increases the capacity of the U.S. economy to generate new projects, jobs, and businesses.

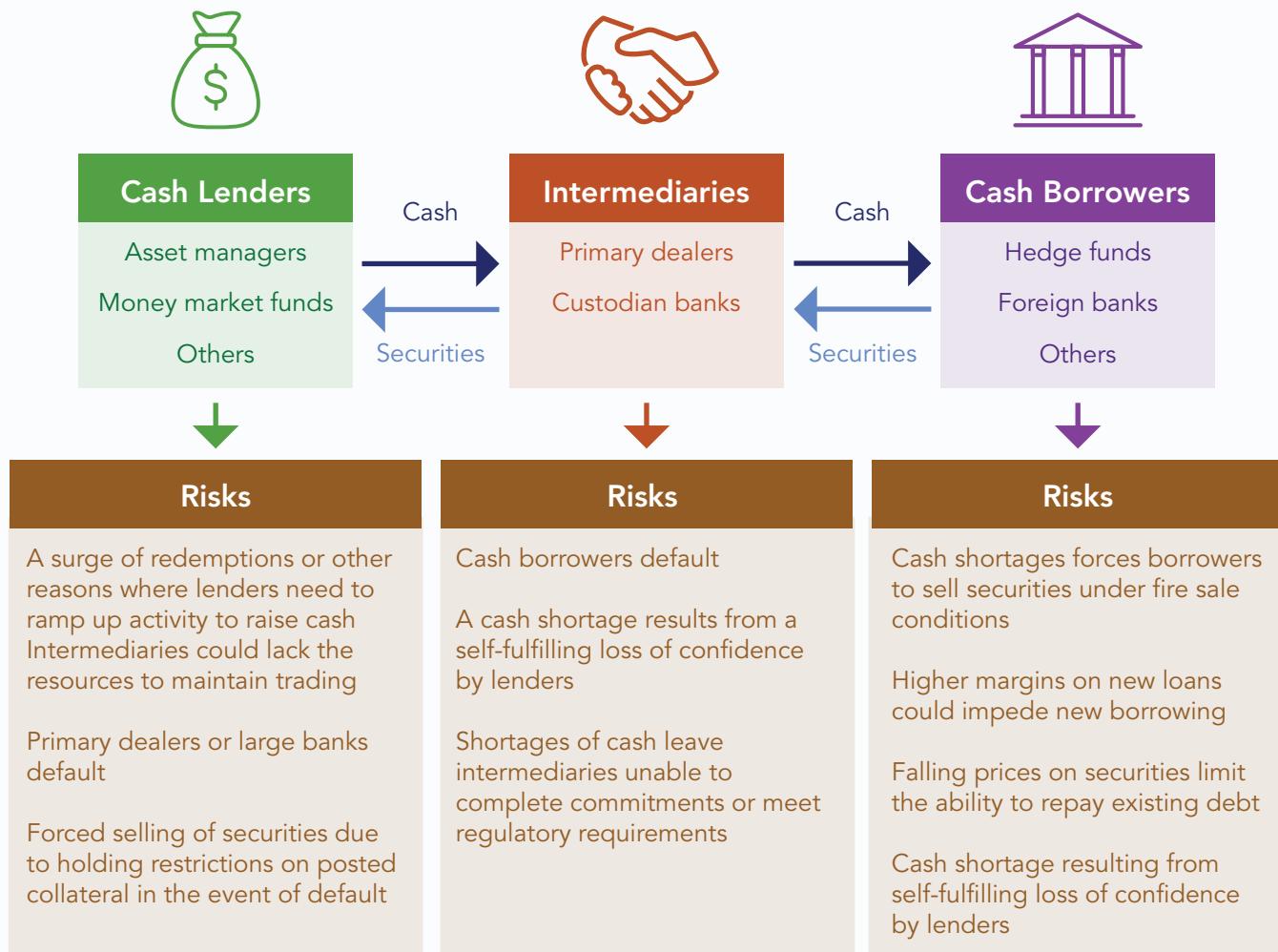
However, during times of economic or financial stress, things can go awry. A simple illustration is that of a traditional bank that takes deposits from consumers and uses those funds to make loans to businesses. A run on the bank could disrupt the flow of cash, as depositors lose faith in the bank and make withdrawals. This would deny funds to the businesses that depend on the banks for loans.

The modern financial market has become far more complex. The flow of monies from borrowers to lenders occurs through a variety of financial instruments that span the various timeframes and risk tolerances. These instruments range from loans, stocks, and bonds to commercial paper and money market fund shares, providing capital to businesses to expand operations and to consumers to purchase homes, goods, and services. In the modern U.S. financial system, banks are not the sole intermediaries. Increasingly, the financial system is reliant on nonbank financial institutions to transfer money through financial markets. This is known as “market-based finance.”

The repo market has become an increasingly critical link among financial intermediaries and provides an important example of market-based finance (see Figure 33). In the repo market, financial institutions lend or borrow cash using securities as collateral. Funds invested with money market funds or other asset managers are transferred to cash borrowers such as hedge funds and foreign banks through intermediaries. The cash borrowers then use these funds to purchase securities issued by the Treasury, U.S. government agencies, or corporations.⁷² The daily volume of transactions in the repo market exceed \$2 trillion. Data from OFR’s cleared repo collection shows that most of these transactions occur within a tight window between 7:30 and 8:30 a.m. Eastern time.⁷³

Figure 33. The Repo Market and Its Risks

The repurchase agreement (repo) market transfers cash and securities among a variety of financial firms through intermediaries. This key short-term funding market is exposed to multiple sources of risk.



Sources: Office of Financial Research

When the repo market is working well, large amounts of cash flow quickly and safely among varying types of institutions, meeting the needs of borrowers and lenders. However, since market-based finance directs cash through multiple layers of intermediation, through asset managers to dealers and large banks and finally to hedge funds and other cash borrowers, there are several ways the system can break down.

First, each of the three groups of participants is exposed to their own risks: cash lenders may face a surge in redemptions, dealers may have demands placed on them associated with their roles in securities markets and traditional banking that may require funds, and cash borrowers may have margin requirements on other trades in their portfolios. These exposures would be present even if they did not participate in the repo market since these are standard risks that each group faces in the ordinary course of their business.

However, the multilayered nature of market-based finance means that these risks may be compounded by the interconnectedness of its participants. Lenders in the repo market are

directly exposed to the intermediaries but are also indirectly exposed to the counterparties that the intermediaries have exposure to. Hedge funds borrowing from intermediaries are exposed to dealers that may run on their repo borrowing, but are also indirectly at risk since the dealers may face a run from the money market funds. In the extreme, financial institutions may lose confidence in the ability of their counterparties to repay monies owed, decreasing systemwide liquidity, and bottlenecking markets at a time when their smooth functioning is most needed.⁷⁴

The interconnectedness of different institutions through market-based finance makes the system potentially fragile at multiple points and reinforces the need for the monitoring of risks to the financial system that span across different types of entities and markets that fund the U.S. economy.

2021, with the TGA decreasing and reserves increasing due to ongoing Federal Reserve purchases, rates in the repo markets and Treasury bill rates began to decline toward zero.

At the same time, decreased bill issuance and the end of the exemption of Treasuries from banks' Supplementary Leverage Ratios (SLR) may have contributed to the overall decline in repo rates. Among these different forces driving repo rates lower, it is difficult to disentangle exactly which was most important in the decline. This difficulty is compounded by the fact that many of these forces have common causes and few are mutually exclusive.

General collateral repo rates declined to the low end of the Federal Reserve's target range for the Federal Funds rate. With repo rates this low, the Overnight Reverse Repur-

chase Facility (ON-RRP) provided an alternative investment option for money market funds and other qualified counterparties. Volumes in the ON-RRP facility increased from essentially zero in early 2021 to \$500 billion each day by May 2021.

The ON-RRP rate increased to 5 basis points in mid-June. This further increased facility volumes which reached a record level of \$1.6 trillion on Sept. 30, 2021. General collateral rates moved in lockstep with the increase in the ON-RRP rate. The Broad General Collateral Rate increased from 0 to 5 basis points on June 17 and remained at the same level through the end of September 2021.

While the ON-RRP facility appeared to provide an effective floor on general collateral rates, there was a substantial amount of negative rate repo activity early this year in the cleared

bilateral segment of the repo market. These transactions are cleared in the United States by the Fixed Income Clearing Corp.'s DVP Service (DVP).

A recent OFR brief finds that these negative rates stemmed from two sources. The first is low general collateral rates as well as lower bilateral rates than general collateral rates. Another reason is that primary dealers may be willing to lend at lower rates in bilateral markets to secure collateral that is particularly valuable.⁷⁵

Dealer demand for this prized collateral is high in advance of Treasury auctions. If such Treasury collateral is not secured, it can result in delivery failures. Failures to deliver Treasuries can have a domino effect on other market participants, who may be engaged in other transactions that require securing collateral.

Overall, measures taken by policy makers since March 2020 seem to have kept Treasury and repo markets calm. Nonetheless, the underlying cause of Treasury market stress, the limited ability of dealers to make markets during flights to liquidity, remains unaddressed. If, as Federal Reserve Vice Chair Randal Quarles recently suggested, the Treasury market “may have outpaced the ability of the private market infrastructure to support stress,” then policies to enhance liquidity in times of market stress should be considered. Several potential solutions to enhancing liquidity in times of market stress in the Treasury market have been proposed. These include broader use of central clearing for cash and repo markets, regulatory relief for banks investing in Treasuries, and the recently announced standing repo facility. Given the rapid increase in Treasury issuance and expectations for further issuance in the future, a careful examination of each of these options will be necessary to determine the best way to ensure adequate liquidity during times of market stress without imposing significant costs to either Treasury or market participants.

One outstanding issue concerns the limited visibility regulators have into crucial segments of the repo market. The disruptions Treasury markets experienced in March 2020 illustrated the increasingly important role of hedge funds in the Treasury market. However, financial regulators have only a very limited view into much of hedge fund financing of their positions. While the SEC’s Private Fund Statistics show \$1.4 trillion in hedge fund repo borrowing in first quarter 2020, the only segment of the repo market in which transaction data on hedge fund borrowing is provided is the DVP service. The OFR estimates hedge funds borrowed less than \$250 billion in that market segment in first quarter 2020. Much of the remaining borrowing is likely from uncleared bilateral transactions, and the only data available on that market segment is the OFR’s pilot collection in 2015. Expanding visibility into the uncleared bilateral segment of the market would allow policy makers to better capture exposures of hedge funds and other nonbank financial actors to sudden changes in liquidity.

Financial Institutions

Market turmoil in March 2020 once again highlighted vulnerabilities with open-ended funds, in particular, prime money market funds. During this time, investors withdrew substantial amounts from these funds as they redeemed their shares for cash. Subsequent flows back into prime money market funds, combined with renewed risk-taking and the continued mismatch in liquidity of shares relative to the underlying assets, potentially increase risks to financial stability.

Through August 2021, excluding reorganized and liquidated funds, assets in prime money market funds were up 3.2% since March 2020.⁷⁶ At the same time, the share of commercial paper and deposits included in underlying assets are near pre-pandemic levels, while the share of U.S. Treasury debt and certain government securities are at or near pre-pandemic levels.⁷⁷

Investors use money market funds as a cash-management tool because they promise safety and liquidity, regardless of the value and liquidity of the underlying assets. An imbalance between the

value and liquidity of a fund and its underlying assets can create a first-mover advantage for investors and precipitate a run.⁷⁸ Runs, in turn, can depress asset prices.

Stresses on money market funds and the broader money markets in March 2020 led to increased redemptions and, in turn, stressed the short-term funding markets. Over a two-week period from March 11 to March 24, net redemptions at publicly offered prime institutional money market funds amounted to roughly \$100 billion, or 30% of assets.⁷⁹

Flows out of retail prime money market funds and tax-exempt funds were lower than outflows from institutional prime funds.⁸⁰ Similar to actions taken during the 2008 financial crisis, the Federal Reserve stepped in to support money markets through its Money Market Mutual Fund Liquidity Facility, slowing redemptions and easing stress in the funding markets.⁸¹ Fund sponsors also provided support (see *Sponsor Support to Money Market Funds*).

Money market funds are a key provider of short-term funding (see Figure 34). They held over \$4.9 trillion in assets at the end of

September 2021. The U.S. government and the Federal Home Loan Banks (FHLBs) are the largest recipients of funding from government and Treasury funds. Banks, particularly foreign-owned banks, are the largest recipients of funding from prime money market funds. The sudden investor withdrawals from prime funds in March 2020 reduced the availability of short-term funding for foreign banks, prompting the Federal Reserve to ease pressure through a central bank swap credit facility.

The SEC's 2010 and 2014 regulatory reforms boosted the liquidity of MMFs, but

Figure 34. Select Money Market Instruments

	Money Market Fund		Money Market Fund		Money Market Fund	
	Outstanding Amount (\$ trillions)	Share of Outstanding Amount (percent)	Outstanding Amount (\$ trillions)	Share of Outstanding Amount (percent)	Outstanding Amount (\$ trillions)	Share of Outstanding Amount (percent)
	Q4 2008	Q4 2008	Q4 2019	Q4 2019	Q2 2021	Q2 2021
Treasury Bills due in one year	2.41	24.60	4.11	25.25	5.76	36.56
Federal Home Loan Bank Obligations	1.26	NA	1.03	60.07	0.67	45.10
Repurchase Agreements	3.52	15.80	4.37	26.87	4.80	33.07
Commercial Paper	1.60	39.50	1.05	22.70	1.09	13.52
Certificates of deposits	2.88	17.40	6.72	3.98	9.06	0.86

Note: FHLB amounts includes term obligations. Certificates of deposits excludes insured deposits.

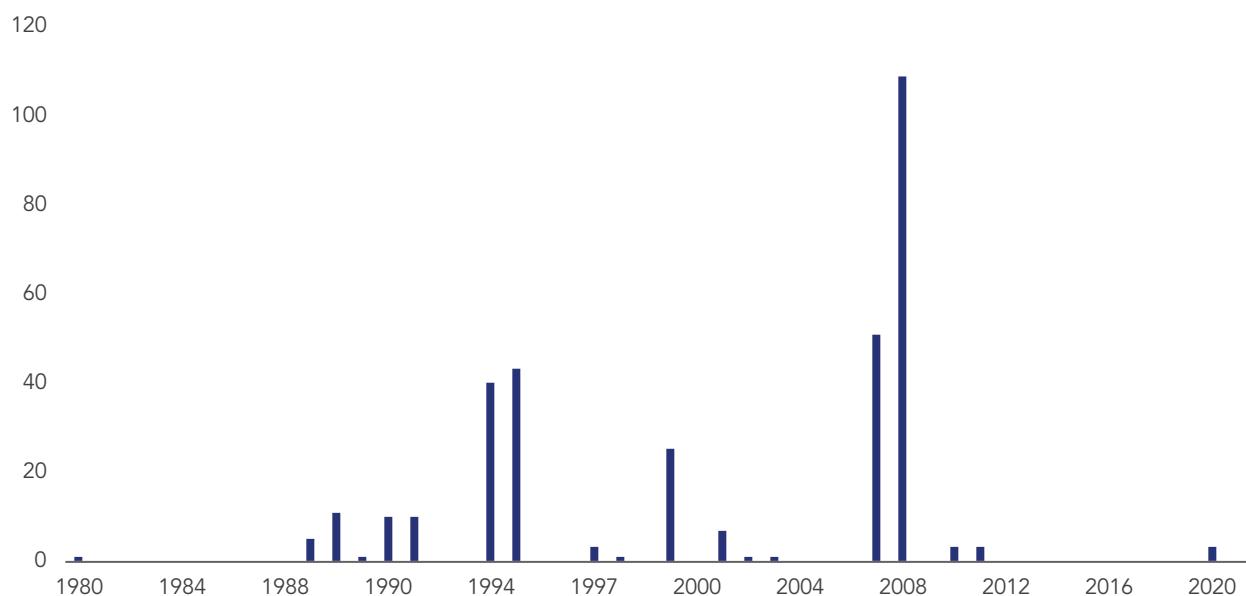
Sources: Federal Reserve Board, Haver Analytics, Federal Home Loan Banks Office of Finance, Office of Financial Research

SPONSOR SUPPORT TO MONEY MARKET FUNDS

Sponsors can help prevent money market funds from letting the net asset value of their shares drop below \$1 and mitigate potential spillovers to affiliate funds and short-term funding markets more broadly.

Both Moody's Investors Service and the SEC have identified several events over the years where some fund sponsors chose to provide support or take other measures to maintain either price stability or share liquidity (see **Figure 35**). The SEC data show that some sponsors' support extends beyond prime funds to government and municipal money market funds.⁸²

Figure 35. Estimated Number of Money Market Funds Supported by Sponsor (count)



Note: Estimated number of money market funds supported or for which a Securities & Exchange Commission No-Action Assurances were obtained. The chart does not comprehensively list every instance of sponsor support of a money market fund or request for no-action assurances to provide support, but rather summarizes some of the more notable instances of sponsor support. The years 1990, 1994 and 1997 include multiple instances shown separately. The chart also includes no-action relief requests sought by many money funds as a precautionary measure that were not drawn upon, but it excludes routine fee waivers or expense reimbursements, contributions to offset historical capital losses in anticipation of a fund liquidation, and routine inter-fund lending or purchase of shares.

Sources: Securities and Exchange Commission, Moody's Investors Service, Office of Financial Research

Voluntary support over several decades may have lessened investors' perception of the risk in money market funds; however, uncertainty about the availability of sponsor support has fueled runs.⁸³ The implicit support connects the health of a sponsor to the stability of a fund's net asset value; however, the sponsor's ability to provide support has not been a focal point for regulators.

they did not completely eliminate the risk of investor runs. The reforms also tightened the quality of assets held by money market funds, allowed for gates and fees on redemptions in certain circumstances, and required prime institutional funds to float their net asset values.⁸⁴

Despite these reforms, prime institutional money market funds had outflows of 30% in aggregate during March 2020. It is possible these funds would have experienced further stress without government support.

The SEC is currently evaluating several reform options identified by the President's Working Group on Financial Markets to make money market funds more resilient under stress.⁸⁵ They include changes to the fund structure that reduce losses for remaining investors, new liquidity risk tools that deter runs, and a new regulatory framework governing sponsor support (see Figures 36A and B).

A combination of the proposals may mitigate the knock-on effects of risks posed by money market funds but is unlikely to eliminate liquidity risk in

the underlying short-term wholesale funding markets for a couple of reasons.

One reason is that other investment funds also experienced heavy outflows contributing to the stress in the funding markets in March 2020. These included dollar-denominated off shore prime funds, some private liquidity funds, and ultra-short corporate bond mutual funds.⁸⁶ These funds serve a similar purpose as money market funds but are subject to varying degrees of regulatory oversight and portfolio transparency.⁸⁷ Arguably, investors in these products have the same

Figure 36A. The President's Working Group on Financial Markets Proposals for Money Market Fund (MMF) Reforms

Liquidity Reform Option	Description	Mechanism for Enhancing Market Stability
Remove tie between MMF weekly liquidity assets and fees and gates.	Funds can impose fees / gates when in the best interest of fund, not at specific level.	Attempts to reduce the likelihood of gates to diminish investors' incentives to engage in preemptive runs.
Reform conditions for imposing redemption gates.	Require that a fund notify, or obtain permission from, the SEC to implement gates, soft gates or that fees come before gates. Another option could be to lower the weekly liquid asset threshold at which gates could be imposed.	Attempts to lessen the triggers for investors to engage in preemptive runs.
MMF liquidity management changes.	Creating new liquidity requirements, such as bi-weekly liquidity requirements, or imposing penalties on managers for falling below required liquidity thresholds.	Attempts to reduce the likelihood of destabilizing redemptions by creating additional liquidity requirements that get disclosed to investors.
Countercyclical weekly liquid asset requirements.	Weekly liquid asset requirements decline when redemptions are large or SEC provides relief.	Attempts to reduce the likelihood of destabilizing redemptions by reducing potential investor redemption pressure associated with liquidity requirements during period of stress.

Sources: President's Working Group on Financial Markets, Securities and Exchange Commission, Office of Financial Research

Figure 36B. The President's Working Group on Financial Markets Proposals for Money Market Fund (MMF) Reforms

Stability Reform Option	Description	Mechanism for Enhancing Market Stability
Floating net asset values (NAVs) for all prime and tax-exempt MMFs.	Requires funds to sell and redeem their shares at a price that reflects the market value of a fund's portfolio.	Attempts to reduce the likelihood of destabilizing redemptions by eliminating the dollar threshold trigger and providing more transparency of pricing associated with the underlying fund holdings.
Minimum balance at risk (MBR).	A portion of each shareholder's fund balance is available for redemption on a delayed basis. This effectively ensures the redeeming investor shares in any losses incurred by the fund during the specified timeframe.	Attempts to reduce the likelihood of destabilizing redemptions by subordinating a portion of redeeming shareholder's asset so they absorb costs associated with redeeming their shares.
Swing pricing requirement.	Adjust NAV downward when redemptions exceed threshold. This effectively imposes trading costs on redeeming investors.	Attempts to reduce the likelihood of destabilizing redemptions by imposing on redeeming investors the cost of their redemptions.
Require liquidity exchange bank (LEB) membership.	The establishment of a private LEB that would be capitalized through initial member contributions and ongoing commitment fees. The LEB would provide external liquidity support through the purchase of eligible assets from MMFs that need cash during times of stress.	Attempts to reduce investors' incentive to run by establishing a chartered bank to serve as an emergency liquidity backstop for its members.
New requirements governing sponsor support.	Establish regulatory framework for when the sponsor would be required to provide support.	Attempts to reduce investor incentive to run by providing clarity on when sponsors of MMFs can provide support to them and the potential level of backstop.

Sources: President's Working Group on Financial Markets, Securities and Exchange Commission, Office of Financial Research

incentive to run when markets are under severe stress. SEC Form PF data have also showed a dash for cash in private liquidity funds, with aggregate commercial paper and deposit holdings declining 34% and 23%, respectively.⁸⁸

Another reason is that the proposed reforms do

not solve the problem of limited market liquidity as the illiquidity of many underlying money market instruments means investors will still likely have a strong incentive to run.

While money market funds can reliably sell liquid assets, such as Treasury bills, to meet initial withdrawals,

they may eventually be forced to meet redemptions by selling less-liquid instruments into a stressed market. In such cases, fund investors would have a strong incentive to redeem their shares early.

Last year's financial stress precipitated widespread runs in similar cash man-

agement products with floating net asset values (NAVs), such as dollar-denominated offshore prime funds, local government investment pools, and ultra-short corporate bond mutual funds.

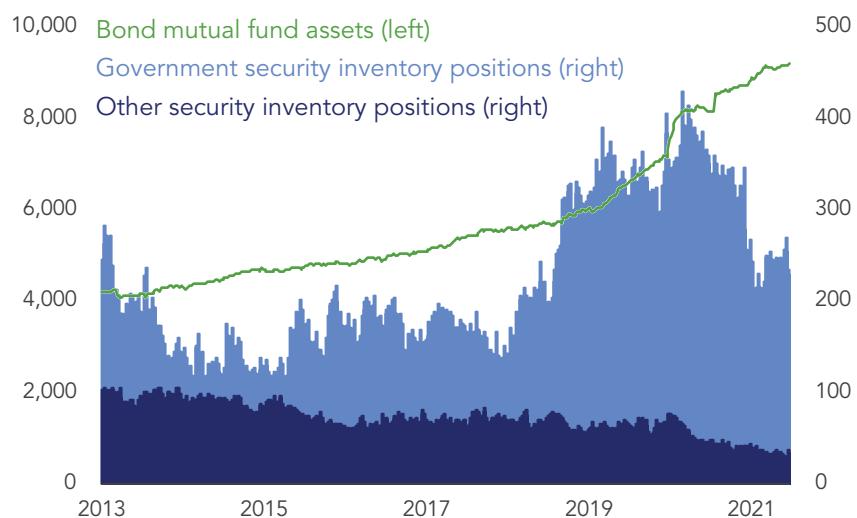
Bond mutual funds are vulnerable in ways similar to

money market funds and other cash management products because they offer daily liquidity against assets that take longer to sell in an orderly way. This makes them vulnerable to panic-driven runs, which can become worse by reducing inventories of less liquid, over-the-counter (OTC)

securities used by dealers to maintain orderly buying and selling (see Figure 37).

Bond funds, including open-ended funds and exchange-traded funds (ETFs), supplied more than \$6 trillion in funding as of year-end 2020. In 2008, open-ended funds contributed about 6% of credit provided, compared to 7% from depository institutions. At year-end 2020, their shares were about 12% and 9%, respectively.⁸⁹

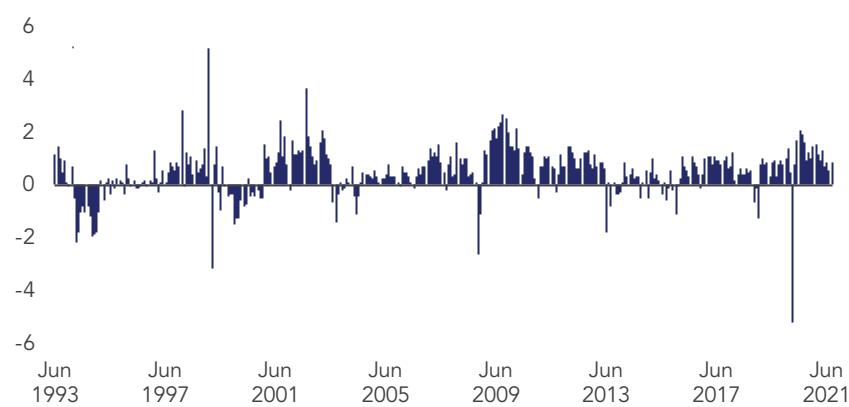
Figure 37. U.S. Primary Broker Dealer Security Inventory Positions and Bond Fund Assets (\$ billions)



Note: Bond funds include exchange-traded, open-ended, and money market funds.

Sources: Emerging Portfolio Fund Research, Federal Reserve Bank of New York, Haver Analytics, Office of Financial Research

Figure 38. Taxable Bond Fund Flow Rate (percent)



Note: Data as of August 31, 2021. Includes taxable open-ended and exchange-traded fund flow rates.

Sources: Morningstar Direct, Office of Financial Research

In March 2020, U.S. bond mutual funds suffered unprecedented high outflows (see Figure 38). In aggregate, net outflows exceeded \$250 billion, or about 5% of their assets under management (see *Exchange-Traded Fund Vulnerability to Liquidity Risk*).

Simultaneously in March 2020, primary dealers were unable or unwilling to accommodate the surge in liquidity demand as investors sold their investments for cash. Amid this de-risking, corporate bond spreads widened considerably, and new bond issuance came to a halt.

Ultimately, fund outflows subsided in the last week of March 2020 and reversed in the first week of April 2020. The reason was probably the Federal Reserve's an-

nouncement about extraordinary direct intervention in the corporate bond market.

The SEC's Liquidity Rule 22e-4 requirements⁹⁰ and tools may have helped funds better prepare for covering large redemptions requests. The rule requires funds to set a manager-determined minimum level of highly liquid holdings, impose a limit of 15% on the illiquid positions of mutual

funds, and categorize the liquidity of its investments in one of four buckets.⁹¹ However, the requirements may also have created a false sense of precision in asset liquidity classification. Liquidity risks are difficult to measure in advance. Liquidity is highly dependent on supply and demand and can change quickly.⁹²

EXCHANGE-TRADED FUND VULNERABILITY TO LIQUIDITY RISK

Exchange-traded funds (ETFs) are different from other types of open-ended funds in their vulnerability to liquidity risk. Moreover, liquidity mismatches tend to be more pronounced for fixed-income ETFs than for equity ETFs, since stocks are more easily traded than bonds.⁹³ In-kind creation and redemption in ETFs⁹⁴ reduces but does not eliminate the need for fund sponsors to conduct cash transactions. However, the task of mitigating liquidity mismatches between ETFs and their underlying holdings lies with Authorized Participants (APs).

There are significant differences among ETFs in that they create and redeem shares either through cash or in-kind. For equity ETFs, the creations and redemptions are largely in-kind, while for fixed-income ETFs, there is a small but growing trend toward the use of cash.

Recent analysis suggests that fixed-income ETFs with more illiquid assets are more likely to create and redeem shares in cash rather than in-kind.⁹⁵ This growing trend of using cash raises questions both for fund sponsors and APs alike. ETFs raise financial stability concerns if the illiquid underlying assets cannot be exchanged in-kind for ETF shares and instead must be liquidated for cash during heightened distress.

These concerns may be elevated in periods of market turmoil if fund investors were seeking abnormally high levels of redemptions at the same time that fund assets were most difficult to sell. However, the need for cash is not prevalent in ETFs that conduct in-kind creation and redemption where illiquid underlying assets do not have to be sold. Some ETFs offer APs the ability to conduct creations and redemptions in cash; the rest require APs to transact in-kind.

A crucial component of the creation and redemption process is understanding the composition of the creation basket, and how it may differ from the ETF's holdings. Since the SEC's ETF Rule went into effect at the end of 2019, many ETF sponsors have been granted more flexibility to create custom baskets that differ from the ETF portfolio.⁹⁶ One consequence of this flexibility is that fixed income ETF sponsors have optimized their redemption baskets to discourage runs by including a disproportionate share of riskier or less liquid holdings.⁹⁷

The effect of this behavior on financial stability is mixed. On the one hand, discouraging runs on bond ETFs may minimize fire-sale incentives by ETF sponsors in times of distress.⁹⁸ On the other hand, if larger day-to-day changes in bond ETF redemption baskets induce greater uncertainty about the composition or quality of these baskets, then APs may reduce their willingness to provide liquidity to those ETFs or their underlying bonds.

APs should be able to capture arbitrage profits and provide liquidity when intraday ETF prices diverge from their underlying securities. However, in periods of financial stress, APs may be reluctant to hold or trade illiquid underlying assets, especially given the uncertainty about the quality or liquidity of assets that would be received from an in-kind redemption.

In effect, APs can step away from the market and reduce their provision of liquidity, which can lead to wider bid-ask spreads in ETFs and larger premiums or discounts to fund net asset values. It is important to note that, in general, when ETF prices diverge from the underlying NAVs, it is not obvious which price is the "correct" price, especially when the underlying assets are relatively illiquid. Some market participants and regulators have argued that, during March 2020, ETF prices provided price discovery, and that the underlying NAVs reflected stale prices.⁹⁹

Contagion Risk

Contagion Index

Contagion occurs when losses at some financial institutions spill over onto the balance sheets of others, creating a widening cascade of losses industrywide. Firms under stress may be forced to liquidate assets to meet margin calls or regulatory capital constraints, thus

depressing asset prices and forcing further liquidations by other institutions. This downward spiral can accelerate, threatening the solvency of a widening set of financial entities.

The OFR's contagion index measures the extent to which different financial institutions are potential sources of contagion. The index is constructed based on three key factors: size, leverage, and degree of

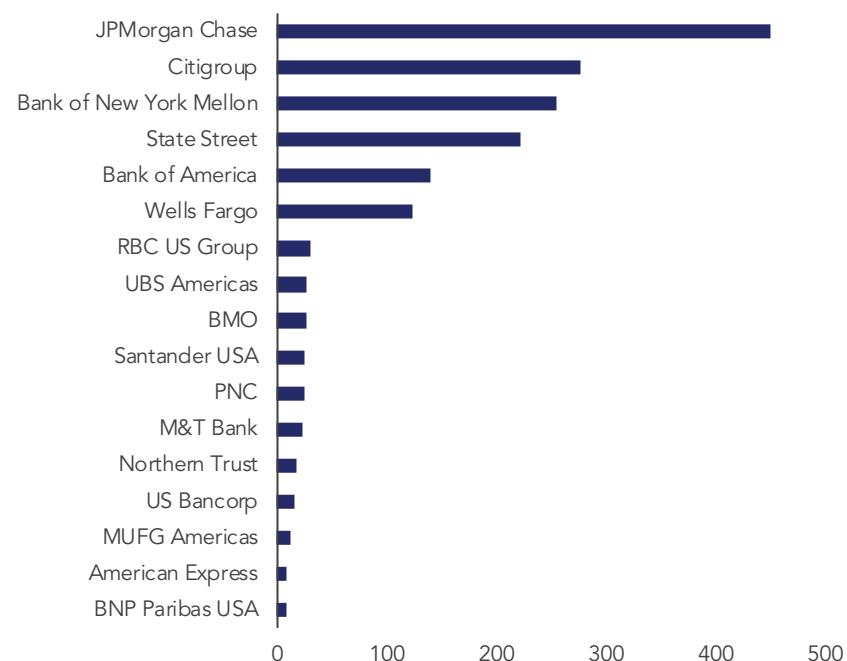
connectivity to other financial institutions. The index measures the potential for generating loss spillovers to other financial institutions if a given firm were to default. It does not measure the likelihood of default, which depends on the quality of assets, liquidity, and many other factors.

The contagion index score of a firm is expressed in dollars and reflects the maximum potential shortfall

in payments that firm could pass on to other financial entities. Only unsecured liabilities to other financial institutions are included in the calculation; secured liabilities and liabilities to nonfinancial entities such as retail depositors are not included. The contagion index scores of global systemically important banks (G-SIBs) are particularly large due to the sizes of these institutions and their degrees of financial connectivity (see Figure 39). If these firms failed, they would trigger the largest spillover effect on the rest of the financial system.

Since the onset of the pandemic, some banks experienced significant increases in their contagion index values. These changes were due primarily to increases in bank deposits by nondepository financial institutions such as insurance companies, mortgage lenders and servicers in response to market conditions following the start of the pandemic. More recently, contagion index values have moderated as bank deposits have been returning to more normal levels.

Figure 39. Contagion Indexes of the Top 20 U.S. Banks (\$ billions)



Note: Data as of second quarter 2021.

Source: Office of Financial Research

Contagion Risk from Central Counterparties

Since the 2008 financial crisis, CCPs have become increasingly important in the global financial system. CCPs can reduce contagion by shortening intermediation chains and provide 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.¹⁰⁰

cial system.¹⁰⁰

Although disruption of the markets in March 2020 tested the resilience of CCPs, none defaulted. There were only isolated instances of clearing members failing to meet margin calls. Nevertheless, the stresses at that time highlighted that some of the risk management practices that protect CCPs from default can have significant spillover effects on the rest of the financial system.

Margin calls on members can increase dramatically during a crisis and trigger a rapid drain on liquidity. If disorderly liquidations ensue, asset prices could

fall, heightening contagion risk throughout the financial system.

The CCPs that clear equities and equity options—National Securities Clearing Corp. (NSCC) and Options Clearing Corp.—were responsible for a significant increase in initial margin calls between December 2019 and March 2020. Initial margins are paid by members and clients in accordance with the risk of their positions.

In aggregate, there was about a \$175 billion increase in the net initial margin posted for the top 10 CCPs in the U.S. (see **Figure 40**). This aggregation reflects the additional collateral collected by the CCP to protect itself against possible future losses resulting from a member default.

More telling is the speed with which additional margin was demanded, as indicated by the first quarter 2020 spike in demands for additional margin aggregated from all U.S. CCPs (see **Figure 41**). Additional margin is often demanded of members when market volatility increases. In mid-March 2020, these margin calls amounted to around \$75 billion in aggregate. The March 2020 quarter was not completely exceptional as

there were also sizable one-day margin calls subsequently, including December 2020.

This point can be illustrated by the margin calls in January 2021 at the NSCC. On Jan. 28, the NSCC made large initial margin calls on brokerages due to settlement concerns over “meme

equity” valuations (see *Social Media-Fueled Retail Trading*). Due to the sharp rise in these equities’ prices and the degree of margin-based purchases, the NSCC became concerned that several brokerage client accounts could not fund the settlement of positions in the event of a

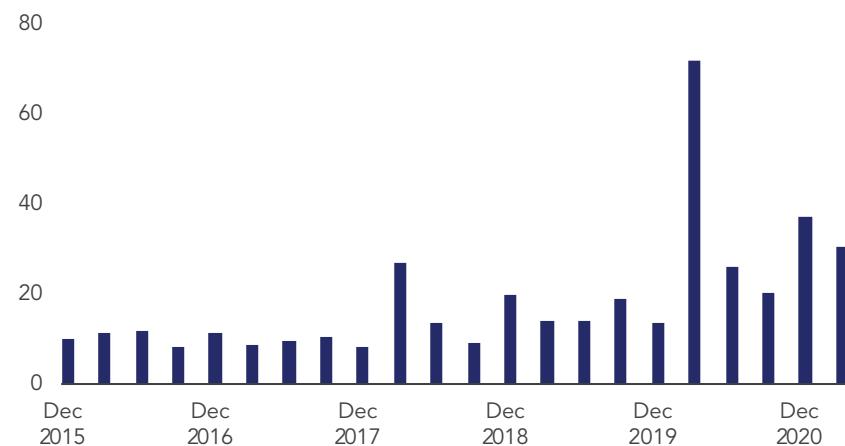
Figure 40. Net Quarterly Change in Initial Margin for U.S. CCPs (\$ billions)



Note: CCP stands for central counterparty. The margins changes presented are for the largest 10 U.S. CCPs by margin and waterfall collateral value.

Sources: Clarus CCPView, Office of Financial Research

Figure 41. Maximum One-Day Call for Initial Margin for U.S. CCPs (\$ billions)



Note: CCP stands for central counterparty.

Sources: Clarus CCPView, Office of Financial Research

sudden intraday reversal in prices. As a result, the NSCC raised margin requirements industrywide to \$33.5 billion from \$26 billion.

In response to the increased margin calls, several electronic and app-based brokerages, such as Robinhood, had to raise fresh capital to meet the margin calls. These brokerages also lowered their risk by restricting certain trades, including those funded using margin accounts or options.

In March 2021, the NSCC applied to the SEC to change the deposit liquidity calculation that determines the amount brokers are required to post ahead of the expiration of stock options.¹⁰¹ The change to the supplemental liquidity deposits would require that these deposits be calculated daily, instead of in advance of monthly equity options expirations. The objective of the proposed changes is to alleviate intraday margin shortfalls and reduce the risk of illiquidity stemming from client-cleared trades.

Initial margin calls tend to increase during periods of market volatility, which can lead to contagion in two ways: 1) The drain in liquidity can lead to sudden declines in asset prices as

firms race to raise cash or secure high-quality collateral to meet the margin calls. 2) If a member is unable to do so, it will be in default and its positions will be sold or closed out.

Moreover, a member's default at one CCP could cause its positions to be closed out at the other CCPs where it's a member. Thus, defaulting on a single margin call may have significant knock-on effects.

The risk management practices of central clearing counterparties can place a strain on members' liquidity through another channel, namely, the collection of variation margin payments. Members owe the CCP variation margin on positions that lose value compared to the previous day; these are matched by variation margin payments due to members that have taken the opposite side of these positions. However, at some CCPs, the former payments are due at the end of a given trading day, whereas the latter are due at the start of the subsequent trading day.

The temporary mismatch—between the amounts in payments owed and received—helps to protect the CCP but can place significant strain on the liquidity of the members. Indeed, this happened at

several European CCPs in March 2020, when members complained that they did not receive payments from the CCPs until the day after they had to make payments to them.¹⁰²

CCP Default Risk

The size and interconnectedness of the major CCPs are potential sources of systemic risk. Unlike major banks, where default risk can be inferred (albeit imperfectly) from the market prices of credit default swaps, there is no comparable market-based instrument for estimating CCP default risk. However, the Federal Reserve collects quarterly estimates from each G-SIB of the default risk of CCPs where they are members.

For each CCP, these estimates exhibit a considerable amount of agreement but they differ substantially depending on members' assessment of a CCP's risk management practices. The default estimates also vary from quarter to quarter depending on general financial market conditions.

The distribution of estimated default risk for 19 CCPs registered in the United States is shown in Figure 42. The CCPs differ in the volume and type of

assets they clear, which span derivatives, equities, energy, and various commodities. In each quarter, OFR computes the average of the members' default estimates for that CCP. The distribution of these averages in each quarter is presented as a box plot. The figure shows that the median estimate has stayed at about 1% per annum over the period.

However, differences between the most and least risky CCP have widened significantly since 2019. Market volatility in March 2020 led to an increase in estimated default risk for those CCPs at the high end of the distribution. The fact that no CCPs defaulted on their obligations during the March quarter provides reassurance that they have robust risk management practices. However, some of these practices—notably

sudden demands for additional margin—may impose significant stress on their members and create the potential for contagion.

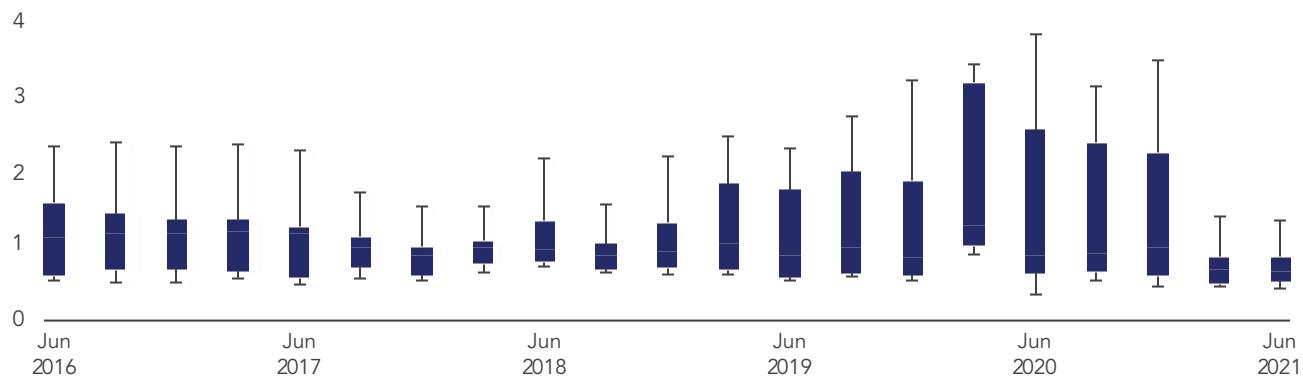
Leverage in the Financial System

Banks

Capital ratios declined for the commercial banking industry during 2020, as asset growth of 17% outpaced a 5% increase in the growth of total bank equity. Much of the asset growth was in securities rather than loans. Banks' regulatory capital ratios declined modestly, but these ratios remain in compliance with the higher minimum capital levels established after the 2008 financial crisis (see *Stress Test Results Reflected in Large Banks' Capital Requirements*).

While banks are well capitalized today, some of them may find it harder to main-

Figure 42. Distribution of Annualized CCP Default Risk Estimates, June 2016 to June 2021 (percent)



Note: Data from Form Y-14 Schedule L through second quarter 2021. CCP stands for central counterparty. Shows median, interquartile range, and 5th and 95th percentiles of CCP default risk estimates.

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

tain these current levels of capital in the future due to greater challenges in replenishing equity from retained earnings. Demand for commercial, industrial, and retail loans rose during

the second quarter of 2021, according to the July 2021 Federal Reserve Senior Loan Officer Survey. However, this upward trend started from a relatively low base.

Banks have seen their profits hurt by narrowing net interest margins and their lower risk appetite for lending (see **Figure 43**). Fortunately, the nation's most systemically important banks have so far offset lower profits with gains from other lines of business, such as trading, investment banking, and asset management.

STRESS TEST RESULTS REFLECTED IN LARGE BANKS' CAPITAL REQUIREMENTS

In connection with higher capital levels mandated for banks, the Federal Reserve relies on stress tests using hypothetical scenarios to gauge how prepared banks are today to withstand a shock to the financial system in the future.

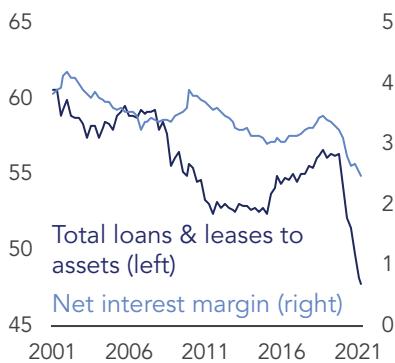
The June 2021 hypothetical scenario included a severe global recession triggering substantial stress on commercial real estate and corporate debt markets, and assumed a 55% decline in equity prices. Under that scenario, the 23 largest banking firms tested would collectively lose more than \$470 billion, with nearly \$160 billion in losses from commercial real estate and corporate loans.¹⁰³ The good news is that projections showed that all banks' capital ratios would remain above their minimum regulatory requirements in all periods.

Under the Federal Reserve's capital framework for banking firms with more than \$100 billion in total assets, capital requirements are in part determined by supervisory stress test results. The metric known as the stress capital buffer (SCB) gives regulators a risk-sensitive, forward-looking assessment of capital needs with a minimum level of 2.5%.¹⁰⁴

As part of the reforms following the 2008 financial crisis reforms, global systemically important banks (G-SIBs) today incur a capital surcharge of at least 1%.¹⁰⁵ These banks can use these surcharge monies to continue lending to households and businesses or take other steps to support the economy, as long they are done in a safe and sound manner. But the future likelihood that banks would use this buffer is untested.

The 2020 OFR Annual Report highlighted the risk to banks' net interest margins from a combination of low returns and increased deposits.¹⁰⁶ Since then, this risk has grown due to increasingly lower interest rates. Part of the reason is that bank deposits and reserves increased sharply

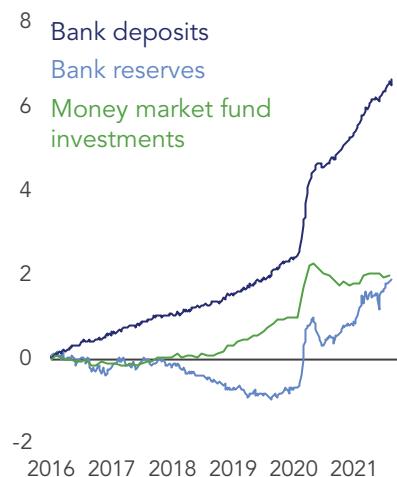
Figure 43. Bank Loans and Net Interest Margins Fall (percent)



Note: Data as of June 30, 2021. End of quarter data. Includes all insured commercial banks. Total loans equals gross loans minus unearned income. Net interest margin equals total interest income less total interest expense (annualized) as a percent of average assets.

Sources: Federal Deposit Insurance Corporation, Haver Analytics, Office of Financial Research

Figure 44. Change in Bank Deposits, Reserves, and Money Market Fund Investments (\$ trillions)



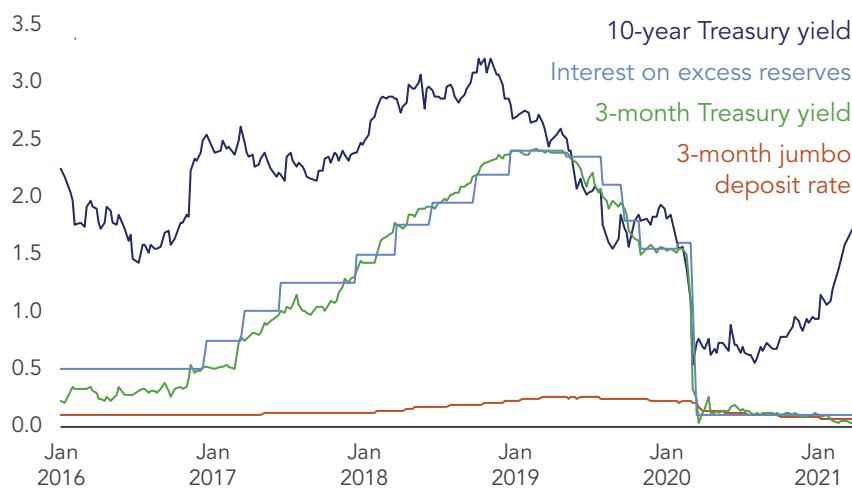
Note: Data as of June 30, 2021. End of quarter data. Includes all insured commercial banks. Total loans equals gross loans minus unearned income. Net interest margin equals total interest income less total interest expense (annualized) as a percent of average assets.

Sources: Federal Deposit Insurance Corporation, Haver Analytics, Office of Financial Research

(see Figure 44). From January 2020 to July 2020, bank deposits rose by \$2.3 trillion, while reserves grew by \$1.3 trillion, mostly for the largest banks. Money also moved into alternative types of deposits, such as money market funds, and rose to \$1 trillion over the same period before decreasing gradually.

The increase in bank deposits compounded the negative effect of declining interest rates on banks' net interest margins (see Figure 45). But after March 2020, spreads between rates on deposits and rates on other

Figure 45. Interest Rates, Deposits Rates, and Interest on Reserves (percent)



Note: 10-year Treasury and 3-month Treasury bill rates are Wednesday levels. Data as of March 29, 2021, due to the three-month jumbo deposit rate series being discontinued.

Sources: Federal Reserve Board of Governors H.15 Selected Interest Rates and Interest Rate on Reserves Releases, Federal Deposit Insurance Corporation National Rates and Rate Caps, Office of Financial Research

short-term investments narrowed. The flow of deposits caused banks' net interest margins to fall from 3.28% at the end of 2020 to 2.56% at the end of the first quarter of 2021.

At the same time, something unexpected happened; and as a result, risk tied to the effect of low rates on banks' profits should be closely monitored. Higher interest rates on longer-term investments, such as 10-year Treasuries, did not increase net interest margins. While further research is necessary, possible explanations include lower loan demand, banks less interested in lending at longer maturities, or banks less willing to take on more deposits.

Insurance Companies

Insurers ended 2020 with healthy levels of capital to absorb losses (see Figure 46). However, they continue to face earnings challenges in the low interest-rate environment. For some time, insurers have been hurt by the decline in the margins between their investment yields and interest rates guaranteed or assumed on some of their products.

To boost their investment yields, insurers have extended the maturities of their securities and taken on more credit risk. They have also increased their investments in less liquid and sometimes more complex securities. Although bond holdings are still the

largest investments for life insurers, the share of bond holdings in their portfolios has declined while those of mortgage loans and alternative investments have increased (see Figure 47).

Insurers use securities lending, secured Federal Home Loan Bank (FHLB) advances, and other capital markets products to improve overall investment yields. For example, total FHLB borrowings held by insurance companies have been increasing since 2014 (see Figure 48) and grew noticeably in the first quarter of 2020. Insurers have continued to increase their liquidity, with levels remaining elevated through June 2021. This could increase risks for FHLBs because insurers' additional demands for FHLB borrowings could require these banks to increase their own funding at an inopportune time.

Insurers report on their statutory financial statements the fair value of collateral pledged to the FHLBs. They also calculate and report their total FHLB borrowing capacity. As of June 2021, the fair value of the collateral pledged by insurers to the FHLBs was \$179 billion, while the insurers reported their total borrowing capacity to be \$332 billion.

Figure 46. Insurer Risk-based Capital (percent)

	2017	2018	2019	2020
Life	466	420	430	425
Property & Casualty	312	308	313	307
Health	306	310	313	334

Note: Values reflect average actual amounts of adjusted capital as a percent of risk-based capital required for each category.

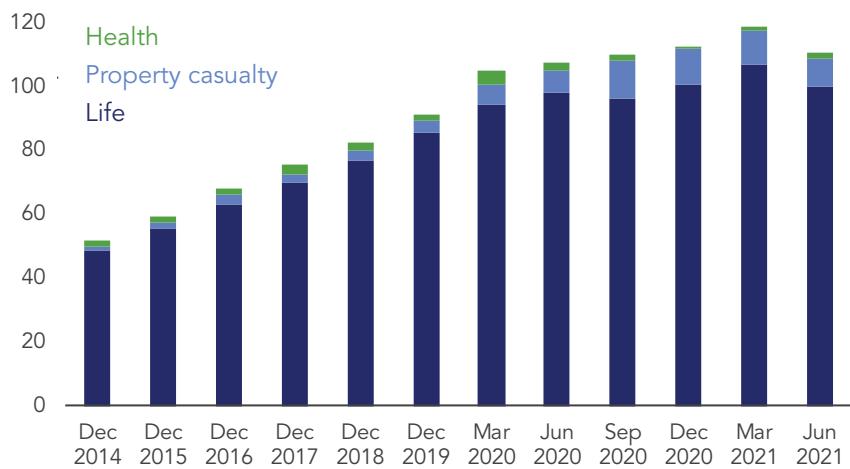
Sources: Insurers' annual statutory filings accessed through S&P IQ Pro, (formerly known as S&P Market Intelligence), Office of Financial Research

Figure 47. The Changing Composition of Life Insurers' Investment Portfolios Composition (percent)



Sources: Insurers' annual statutory filings accessed through S&P Capital IQ Pro (formerly known as S&P Market Intelligence), Office of Financial Research

Figure 48. Loans to Insurers by Federal Home Loan Banks (\$ billions)



Note: Data as of June 30, 2021.

Sources: Insurers' quarterly and annual statutory filings accessed through S&P Capital IQ Pro (formerly known as S&P Market Intelligence), Office of Financial Research

Low interest rates reduced insurers' profit margins on variable annuities with guarantees, long-term care insurance, and guaranteed universal life insurance. Product design changes to mitigate thinner margins have only somewhat helped. The negative impact on profit margins has required some insurers to absorb substantial charges to reserves, a trend that could continue absent an increase in interest rates.

Some insurers are taking steps to exit product lines that are less profitable or have unpredictable liability profiles. Often, buyers of these product lines, such as private equity firms, have had to identify or hire product expertise to complete the acquisitions.

The purchasers obtain large holdings of assets associated with these product lines, for which they may take on more risk to try to enhance investment returns. In many cases, these investments are originated by them, or an affiliate, and include private debt, bank loans, or CLOs. These riskier asset profiles could potentially amplify shocks to the industry, particularly in a market downturn.

Through Sept. 30, 2021, U.S. property and casualty (P&C) insurers did not have to pay out large claims re-

lated to COVID-19 business interruption policies. However, they are increasingly exposed to large claims from natural disasters that historically have not been major sources of risk. More wildfires, winter storms, and the advent of a global pandemic have increased the frequency and severity of risk, resulting in higher losses and more costs to the insurers. The 2020 Atlantic Hurricane season set a record with 30 storms, surpassing the 2005 season. P&C companies also face the risk of high claims from a single large event. In the winter of 2021, U.S. storms Uri and Viola contributed to the highest level of first-quarter insured catastrophe losses on record despite historical records showing the first quarter to be a light catastrophe loss quarter.

P&C companies often rely on reinsurance to manage and offload some of their underwriting risks, particularly those related to catastrophes. Most reinsurers reported underwriting losses for 2020 that were driven by catastrophe and coronavirus-related losses.¹⁰⁷ Pricing for reinsurance renewals went up during the January 2021 season.

Despite higher reinsurance rates and an improving

economy, the first three months of 2021 produced significant losses from winter storms in the United States, floods in Australia, and the blocking of the Suez Canal by a grounded container ship. These larger, more frequent catastrophes hurt profits for both insurers and reinsurers. The risk appetite and capacity of reinsurers determine the type and willingness of new business that P&C companies write.

Hedge Funds

Hedge funds engage in trading strategies across multiple asset classes to produce significant, risk-adjusted returns for their investors. In the process, hedge funds give institutional and high-net-worth individual investors opportunities to garner returns that are less correlated to broad market returns.

At the same time, however, the complexity of funds' strategies, the interconnectedness of funds in the financial system, and the limited regulations governing them carry potential risks to financial stability. When funds deleverage and sell their positions, market prices may decline substantially in a form of fire-sale risk. Furthermore, losses incurred by one

hedge fund can also spill over to its counterparties and across the financial system (see *The Collapse of Archegos*), creating potential contagion risk.

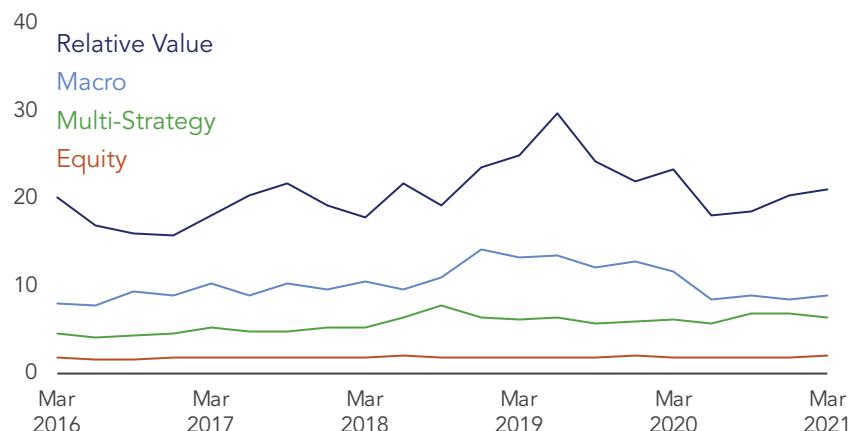
In response to the March 2020 market turmoil, hedge funds lowered their gross leverage and risky asset exposures. Gross leverage, or balance sheet leverage, is the market value of assets on a fund's balance sheet (GAV) divided by investor equity value (NAV). But funds stopped this deleveraging by the third quarter of 2020 and began to lever up again, which increased their risks tied to higher debt levels and greater asset exposures.

Because leverage varies by investment strategy, it is informative to examine leverage patterns within each strategy and assign larger funds a greater weight when combining the data. Larger funds may pose greater risks to the financial system, as they potentially have larger trades that are more likely to impact market prices.

Leverage strategies show (see Figure 49) that, from the end of 2019 to the end of the second quarter of 2020, funds reduced their leverage ratios.

However, from the second quarter of 2020 to the

Figure 49. Leverage by Strategy (ratio)



Note: Data as of the first quarter of 2021. Leverage is gross assets divided by net assets based on Form PF Questions 8 and 9, respectively. Leverage ratios represent weighted averages based on gross assets.

Sources: SEC Form PF, Office of Financial Research

first quarter of 2021, the average relative value of a hedge fund increased its gross leverage from 18.1 to 21.0, while the leverage ratios of multi-strategy funds increased from 5.7 to 6.4. Similarly, macro funds increased their leverage from 8.5 to 8.9. Leverage increases were 16%, 13%, and 5%, for relative value, multi-strategy, and macro funds, respectively.

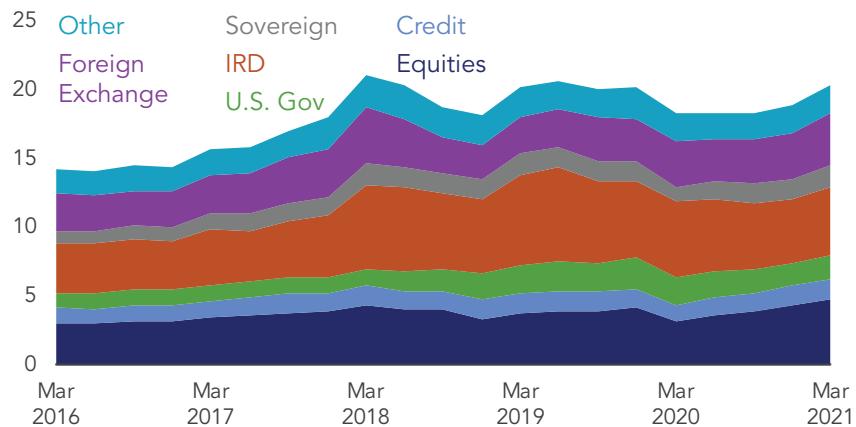
The risk that hedge funds take is better measured by gross notional exposures, which comprise the total long and short positions funds take on in cash securities and derivatives. From the second quarter of 2020 to the first quarter of 2021, hedge funds increased their exposure to riskier assets, such as equities and corporate bonds, and lowered their holdings of

safer assets such as U.S. Treasuries (see Figure 50). Total exposure to equities rose from \$3.7 trillion to \$4.7 trillion over the same period, while exposure to credit instruments rose from \$1.4 trillion to \$1.6 trillion. By contrast, total Treasury exposures fell from \$1.8 trillion to \$1.7 trillion.

Some of the increased risk-taking by hedge funds coincided with their fund performance following the March 2020 turmoil. After significant losses in early 2020, hedge funds subsequently posted strong returns tied to better returns in their riskier assets later in the year. The average hedge fund earned a 10.9% gross return in the fourth quarter of 2020, according to the Hedge Fund Research (HFR) fund-weighted composite index.

Hedge funds continued to perform strongly in 2021 with HFR-reporting funds producing on average a 10.1% return over the first six months of 2021.

Figure 50. Gross Notional Exposure (\$ trillions)



Note: Data as of the first quarter of 2021. Exposures represent the values 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

THE COLLAPSE OF ARCHEGOS

Archegos Capital Management was not a hedge fund, but rather a family investment office. That said, the default of Archegos on its debt obligations earlier this year raised questions about the financial stability of the broader hedge fund sector. The reason is that Archegos used strategies similar to those of hedge funds and other leveraged asset managers.

Archegos managed about \$10 billion in net assets at the end of 2020. Its investments were concentrated in the technology, media, and entertainment sectors. The firm used leverage to increase its gross asset exposure to an estimated \$120 billion, partly using total return swaps (TRS)¹⁰⁸ with bank counterparties. Total return swaps are said to provide synthetic leverage.

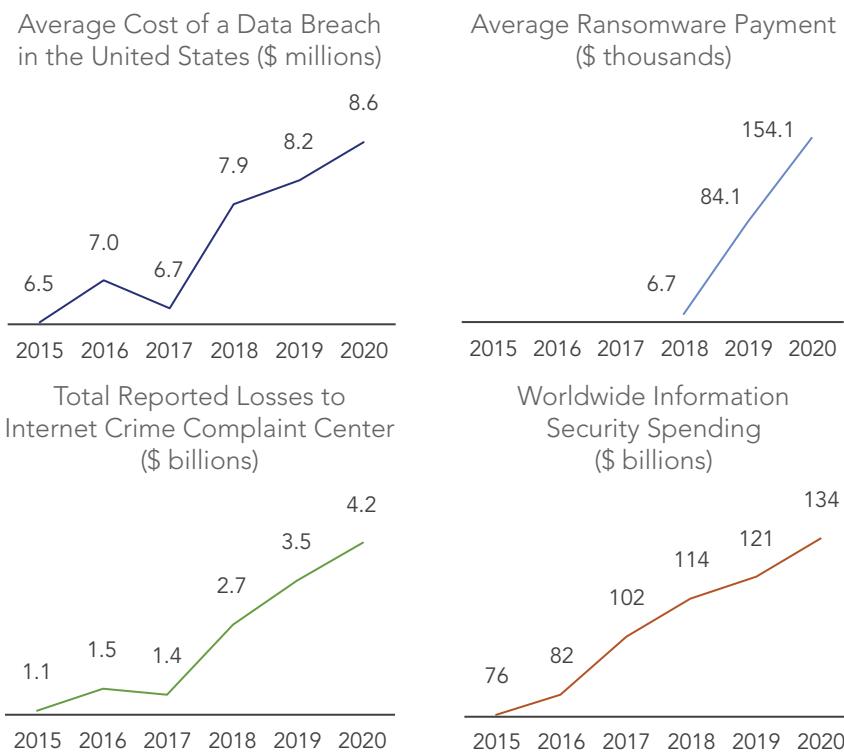
During the week of March 22, 2021, one of Archegos' key holdings, ViacomCBS, suffered a price drop due to a newly announced stock sale and Wall Street analyst downgrades. This set of events triggered a decline in prices across media-related stocks. Due to its large, concentrated media holdings, Archegos' positions deteriorated, and it became subject to margin calls and payment obligations. It quickly became apparent that Archegos would no longer be able to meet its obligations. Toward the end of that same week, bank counterparties started selling off large positions of Archegos' exposures that were held as collateral against the total return swaps.¹⁰⁹

The fire sales of Archegos' assets triggered sharp price declines, and some of the firm's counterparties sustained large losses for failing to exit their positions

quickly enough. For example, Credit Suisse and Nomura reported losses of about \$6 billion and \$3 billion, respectively. There were also spillover losses to other managers and investors that held those securities. The large counterparty losses, estimated to be greater than \$10 billion in total, also triggered a pullback in lending to hedge funds.

The Archegos episode illuminated financial vulnerabilities related to synthetic leverage obtained from counterparties and fire-sale risks associated with asset managers' concentrated holdings. While regulatory efforts are being made to address the lack of transparency around synthetic leverage through the creation of a swap data repository, the success of such efforts will still hinge on prudent risk management by multiple market participants.

Figure 51. The Surging Cost of Cyberattacks and Prevention



Notes: Ransomware payment values are based on confirmed ransom payment amounts. Worldwide information security spending values are based on annual forecasts from the previous year.

Sources: IBM Security and Ponemon Institute Cost of Data Breach Report, Coveware Quarterly Ransomware Report, Federal Bureau of Investigation Internet Crime Report, Gartner, Office of Financial Research

Cybersecurity Risk

The Cyber Risk Landscape

Almost every measure of the total economic cost of cyberattacks has surged in recent years, both in terms of direct losses and the cost of prevention (see Figure 51). Between 2015 and 2020, direct losses from internet crimes increased by 282%, while the cost of prevention in the form of spending on information security increased by 77%. Businesses' investments in basic cybersecurity have helped prevent simple attacks, as reflected in the declining number of data breaches since 2017. However, these investments have been inadequate to defend against a rising tide of more sophisticated attacks with greater impact.¹¹⁰

Since 2015, the average cost of a data breach in the United States has increased 147% to \$8.6 million. Globally, about one in six businesses suffering a cyberattack in 2020 reported the impact was severe enough to threaten the company's solvency or viability.¹¹¹

The biggest driver of this trend has been ransomware, a type of cyberattack that uses malware to encrypt a victim's files and effectively bar access. Then the attacker demands a ransom in exchange for restoring access to the victim's files. The attacker may also seek to extort the victim, or the victim's customers and business partners, by stealing sensitive data and threatening its public release. In some cases, if a victim steadfastly refuses to pay the ransom, the attacker may threaten additional cyberattacks like a denial-of-service attack aimed at crashing the victim's website.

The severity of ransomware attacks began to increase sharply in mid-2019. This increase coincided with the formation of criminal networks that specialize in different aspects of ransomware attacks, dubbed ransomware-as-a-service. On the dark web, developers offer customized malware and brokers sell stolen network access

credentials. The existence of this market has lowered the cost to criminals of preparing and launching a sophisticated ransomware attack that, in turn, has led to more attacks and greater ransom demands.

Since 2015, the average ransomware payment has increased more than 500%. From 2015 to 2019, the highest ransom demand known was \$15 million, rising to \$30 million in 2020.¹¹²

The most damaging cyberattacks have been perpetrated by advanced persistent threat (APT) perpetrators—so called for their ability to penetrate secure networks and remain undetected for long periods of time. In the past year, APT conspirators have exploited weaknesses in widely used software and disrupted critical energy infrastructure.

Some APT perpetrators are state-affiliated entities whose primary motivation is espionage. Many others are economically motivated and specialize in ransomware attacks. They operate with the tacit consent of the nation-state that harbors them, somewhat like cyber privateers.¹¹³

The intent of APT conspirators influences whether a cyberattack is likely to pose

a systemic risk. APT perpetrators intent on maximizing disruption could launch a cyberattack targeting components of critical infrastructure intended to cause downstream cascading failures. They could also time the attack to coincide with a period of heightened fragility.

The severity of ransomware attacks began to increase sharply in mid-2019.

Such a combination of targets and timing would be most likely to precipitate or exacerbate a broader crisis. For example, an APT scheme could target an electrical station powering a critical financial institution during a market sell-off.

Cyber Risk and Financial Stability

Most cyberattacks affect only a single organization and produce limited damage. Systemic cyber risk involves an attack on critical systems or infrastructure, causing the disruption of services not just locally but extensively through a cascade of adverse effects. The result could be the

prolonged degradation of organizations' operational capabilities or damage to their assets.¹¹⁴ Although no cyberattack in the U.S. has risen to this level, the trend in more severe attacks increases the likelihood of a systemic cyber risk event.

The May 2021 Colonial Pipeline cyberattack could have become a systemic cyber risk event if the resulting outage had lasted much longer. The pipeline that normally supplies about 45% of all oil deliveries to the U.S. East Coast was shut down for five days. That caused panic buying by consumers that led to gas stations selling out and creating fuel shortages in some major cities.¹¹⁵

Financial markets mostly remained calm during the outage, in part, because of confidence that normal operations would be restored before local fuel depots were significantly depleted. If the outage had lasted beyond two weeks, it would have been exceedingly difficult for other sources to offset the missing supply leading to higher gasoline prices nationally.¹¹⁶ In such a situation, it is difficult to say how financial markets would have responded to such a prolonged outage and what may have been the effect on financial stability.¹¹⁷

Although the consequences of an individual cyberattack are difficult to predict, the characteristics of a network that make it vulnerable to systemic cyber risk can be identified. There are three channels through which an individual cyber risk event can become a threat to financial stability: a lack of substitutability, a loss of confidence, and a loss of data integrity.¹¹⁸

The execution of processes critical to the normal functioning of the financial system are carried out over networks of financial services firms. These networks often exhibit a core-periphery structure in which a few large institutions act as well-connected hubs that link many smaller firms at the periphery. Examples of key hubs are central banks, large custodian banks and financial market utilities (FMUs), such as payment, clearing, settlement, and messaging systems.¹¹⁹

The core-periphery structure of financial networks makes them resilient to random failure at an individual firm but leaves them vulnerable to a cyberattack on a hub. If an attack caused an outage at a key financial hub, it would be difficult to replace its services without severely degrading network performance. In the case of a key

hub like payment networks, a slowed system could create problems for firms that rely on just-in-time liquidity. If an outage was prolonged, the perception of higher counterparty risk could create and then spread credit problems among institutions, and consequently threaten financial stability.

Financial networks process high volumes of data and require robust information and communications technology (ICT) infrastructure to operate. In recent years, financial institutions have increasingly outsourced portions of their ICT infrastructure to third-party providers. These third-party providers use their relative technical expertise and large operating scales to deliver a high-quality ICT infrastructure at reduced cost. Many financial institutions have sought to maximize these benefits by turning to cloud services that pool ICT resources to serve multiple customers.

The inherent economies of scale involved in cloud computing mean that a handful of large technology companies dominate the marketplace, which gives rise to concentration risk. A cyberattack that causes a major disruption or an outage at a large cloud-services provider could then si-

multaneously deny multiple financial institutions access to their ICT infrastructure.

Financial institutions are required to have a disaster-recovery plan in place, but the migration of operations to on-premises equipment or to a different cloud service after sustaining a cyberattack may require a lengthy amount of time for some institutions to resolve. The impact on financial stability depends on the number of institutions affected and whether the services of a key hub were also impaired.

The financial services sector is one of the most interdependent and highly connected sectors in the economy. Businesses and households rely upon the financial sector for essential services like making payroll and paying for goods and services. Financial services firms rely on each other to execute transactions and are further linked to each other through loans and counterparties. The financial services sector is linked to the technology sector through the supply of critical ICT infrastructure.

Both the financial and technology sectors ultimately depend on a reliable electricity supply and other physical infrastructure. Because of automation, the electrical grid and other

physical systems, in turn, are increasingly reliant upon the technology sector. These links form a complicated network of interdependence with the potential to transmit stress along many different pathways. Cyber risk manifests as the transmission of stress along technological pathways.¹²⁰ Stress transmitted along channels of credit, markets, and liquidity risk is financial contagion.

This stress can spread either sequentially (for example, when the smooth functioning of one or more systems is conditional on that of another system), or simultaneously (for example, when two systems

As with financial contagion, the interconnectedness of the financial system amplifies the potential damage caused by a cyber risk event.¹²³ Every supplier, partner, or client represents another potential entry point for attackers to compromise the rest of the network. Supply chain attacks seek to exploit the cyber defense weaknesses of one organization to gain access to the systems of another. These attacks can flow downstream (for example, a software vendor pushes an update with embedded malicious code) or upstream (for example, an infected email attachment comes from a client).

Financial institutions are required to have a disaster-recovery plan in place, but the migration of operations to on-premises equipment or to a different cloud service may require a lengthy amount of time for some institutions to resolve.

use the same hardware or version of software).¹²¹ A study by the Federal Reserve found that a cyberattack that impaired the payment abilities of just 24 small financial institutions simultaneously had enough systemic impact to cause at least one of the top five largest banks to breach its liquidity threshold.¹²²

The cross-border nature of supply chains and their extensive use of third-party vendors in some industries means the potential victims of a supply chain attack can be separated by many degrees and unaware of their common cyber risk exposure until the attack already happened.¹²⁴ This unacknowledged risk is

one reason why the consequences of a cyber risk event are so unpredictable.¹²⁵ There is no historical example of a cyberattack causing a cascade of adverse effects that triggers financial contagion and threatens financial stability, but this does not mean it is impossible.

A cyberattack that compromises the data integrity of a key hub in a financial network by altering or destroying financial records that could lead customers and market participants to lose confidence in a specific market or the broader financial system. Financial stability could be threatened if market participants were reluctant to extend liquidity or credit. For example, the data systems of FMUs contain information that is not available anywhere else. The financial system is tolerant of short interruptions to the critical services of FMUs as long as there is confidence that service will be restored before the end of the day.¹²⁶ If the time necessary to restore and validate data backups extends beyond a day, the financial system could be more seriously impaired.¹²⁷

While an FMU recovers its data, its services would likely be unavailable, which could strain liquidity at some financial institutions

or inhibit consumers from accessing accounts for personal expenditures. Uncertainty about which backup version represents a trusted state before the cyberattack could raise doubts that transactions previously considered final will remain final.¹²⁸ Even after services are restored, disputes or confusion about ownership rights and financial positions could linger. Some institutions may respond by hoarding liquidity. In a worst-case scenario, investors and depositors may react collectively by demanding the return of funds or cancelling accounts.

News of a cyberattack on one financial institution could cause negative information spillovers that affect investor confidence in the whole industry. This may occur if, after a cyberattack becomes known to the public, there is significant uncertainty about whether the root cause makes other organizations vulnerable. This uncertainty is made worse by the delay with which detailed information about an attack becomes available. In about 40% of detected network intrusion cases, the victim was unaware of the attack until notification by an external source. In half of those cases, the attackers had already been in the victim's

network for 49 or more days.¹²⁹

Uncertainty about the scope of a cyberattack raises investors' demand for information about the attack, but the high cost of acquiring that information prevents them from becoming fully informed. As a result, investors discount the value of related companies amid speculation that they too may soon announce they are victims. For example, news of a large-scale data breach at Equifax in September 2017 caused its share price to decline 35% over five days. Its competitors, TransUnion and Experian, suffered no data breaches but still experienced share price declines of 16% and 6%, respectively, over the same period. This spillover effect diminishes over time as investors become more informed, but the damage may already have been done by that point. A similar dynamic was observed in the past with regards to banks' solvency after a depositor run on one unhealthy bank led to runs on healthy banks.¹³⁰

Cyber Insurance

Cyber insurance plays an important role in cyber risk management by providing coverage that helps offset losses from attacks. Cyber insurance can help firms that have been attacked to avoid financial distress, thereby mitigating systemic risk that could originate from a firm's inability to make payments or insolvency. Although cyber insurance is not a solution to cyber risk, it allows organizations to transfer residual risks they cannot manage internally.

For organizations seeking to acquire cyber insurance, the application process may include a vulnerabilities audit to reveal deficiencies that can be remedied to improve resiliency and meet insurers' minimum standards. To help organizations prevent and mitigate cyber incidents, many policies include benefits such as risk profile assessment tools and technical advice on how to respond to an incident.

Cyber insurance coverage is not standardized and comes in a variety of forms. The simplest coverages include cyber risk as part of a policy package covering a variety of risks. However, the most advanced coverages must be purchased on a standalone basis.

Terms of cyber insurance coverage are quite varied; policies must be analyzed carefully to evaluate what is and, even more importantly, what is not covered. Associated risks that may be covered include liability coverages, out-of-pocket related costs, data restoration, ransomware payments, notification costs, crisis management, and hardware replacement costs.

The purchase of cyber insurance has grown in recent years as attacks have become more costly and affected a wider range of industries. Some organizations choose to purchase coverage, while others are required to do so by their customers or regulators. These take-up rate, or the proportion of companies purchasing coverage, across industries has grown from 38% in 2018 to 47% in 2020, according to insurance broker Marsh McLennan (see **Figure 52**). In some industries, more than 60% of organizations are estimated to have cyber coverage, including: education, hospitality and gaming, healthcare, communications, media, and technology.

Financial institutions have the lowest take-up rate of cyber insurance among all industries (33% in 2020), despite ranking as the

third most-common target for cyberattacks.¹³¹ Some financial institutions choose not to purchase standalone cyber policies, although they have some coverage as part of a general policy. This approach is less comprehensive compared with standalone cyber insurance. U.S. banking regulators do not require banks to purchase cyber insurance but encourage institutions to review all policies for gaps in cyber coverage.¹³²

Cyber insurance coverage is not standardized and comes in a variety of forms.

Cyber insurance policies with sizable limits are a specialized coverage primarily written by a small but growing number of insurers with the requisite underwriting capability. The cybersecurity expertise and data analysis necessary to underwrite cyber policies with large coverage limits requires considerable resources. The top five underwriters control approximately half of the U.S. cyber insurance market, measured by direct premiums written.¹³³

The cyber insurance market is more concentrated than

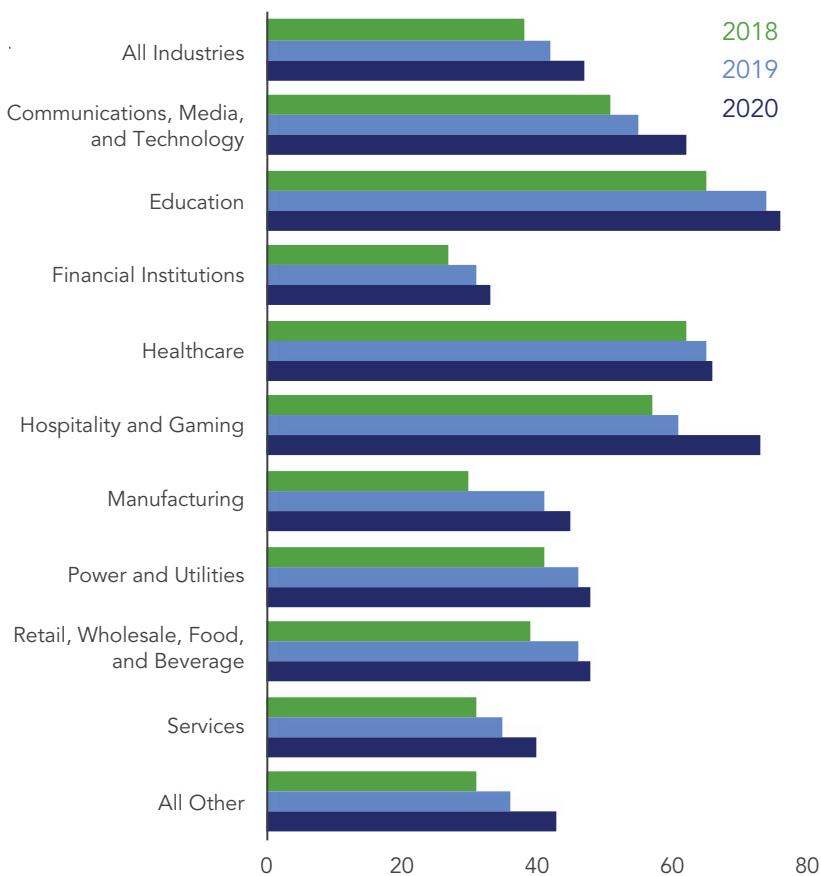
the property and casualty insurance market.¹³⁴ Many new participants have entered the industry in recent years, but a lack of profitability prevents them from increasing market share.¹³⁵

The greater frequency and severity of cyberattacks has driven up demand for policies while also causing loss ratios to rise. Starting in 2019, insurers' cyber losses began to outpace premium growth (see Figure 53). Insurers have responded by reducing what they are willing to cover, tightening underwriting standards, and sharply increasing premiums.

During the first quarter of 2021, the average premium increase for cyber policy renewals was 18%, compared with 11.1% and 7.7%, respectively, in the prior two quarters.¹³⁶ Cyber insurance may become difficult to purchase without an improvement in the cybersecurity practices of insured companies to contain the frequency and amount of claims.

Cyber insurers are likely to continue tightening policy language to reduce their exposures to outsized losses. A lack of standard language can result in litigation over coverage terms. One example is "act of war" exclusions, which have been invoked by

Figure 52. Cyber Insurance Take-up Rates for a Selected Large Broker's Clients, by Industry (percent)



Note: Does not include traditional lines of insurance that provide some form of cyber risk coverage. Does not include Marsh McLennan clients that did not also use the company as their insurance broker to obtain cyber coverage.

Sources: Marsh McLennan, Office of Financial Research

insurers following cyberattacks attributed to groups affiliated with foreign governments. If the exclusion is invoked successfully, the insurer's obligation to pay the claim is eliminated. An example of such litigation currently in the courts involve claims related to the damage caused by the 2017 NotPetya cyberattack that the Department of Justice attributed to the Russian Main Intelligence Directorate.¹³⁷ Given that

most severe and widespread cyberattacks are ultimately attributed to APT perpetrators affiliated with foreign governments, the value of a cyber policy to cover losses from such attacks could become an open question.

Like other coverage, cyber policies require insurers to assume risk. However, the assumption of cyber risk by an insurer has unique aspects. Cyber insurers

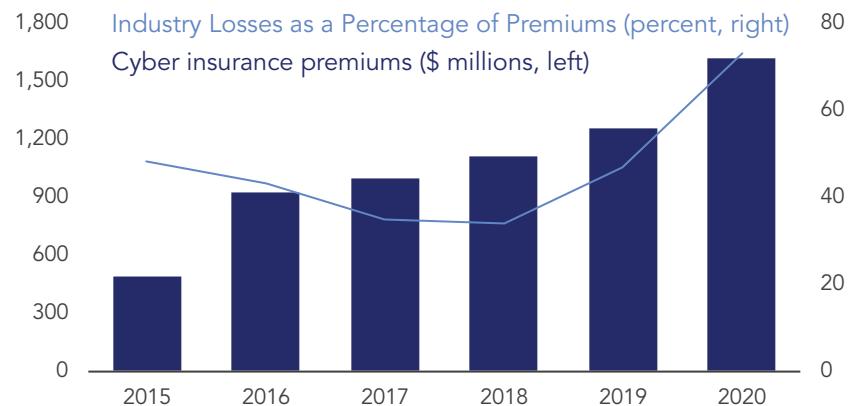
are exposed to their own internal cyber risks due to the heavily computerized nature of their operations. By writing cyber policies, insurers add to their existing operational risks. This increasingly makes them targets of cyber attacks as perpetrators hope to get information on the clients for additional attacks.

The lack of a long history of claims and loss data makes it difficult to perform an underwriting analysis on the risk profile of cyber insurance as a business line. Insurers manage risk profiles by diversifying uncorrelated exposures. Additionally, they use risk management techniques such as policy limits, deductibles, coinsurance, and reinsurance, all of which limit the likelihood of large losses from a single event. Although insurers also use these techniques to manage cyber risk aggregations, the global nature of cyber risk limits the benefit of diversification as a risk management tool.

Emerging Cyber Threats

The cyber threat landscape has fundamentally changed during the last two years and will continue to evolve rapidly. The arrival and growth of new technologies will increase connectivity

Figure 53. Cyber Insurance Premiums Have Failed to Keep Pace With Insurers' Losses (\$ millions, 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.

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

and change social patterns in a way that increases exposure to cyber risk. For example, 5G communications technology is poised to accelerate the internet of things, the mass deployment of smart sensors that collect, share, and analyze vast quantities of data.

In this new environment, cyberattacks are likely to become more commonplace and further blend the distinctions between cybercrime, cyber terror, and cyber war. A new term—hostile cyber activity—is emerging within the insurance industry to describe attacks aided by nation-states to undermine or destabilize public life, but fall short of acknowledged war. The exponential growth of data that tracks many aspects of daily life will provide robust training sets for advanced artificial

intelligence to learn how better to imitate human behavior and communication.

This possibility presents a cyber risk, since about one-quarter of all successful cyberattacks are initiated by some form of social engineering.¹³⁸ Phishing is a form of social engineering in which an attacker sends a spoofed email designed to trick a human victim into revealing network access credentials or other sensitive information. Artificial intelligence algorithms trained on large quantities of stolen personal information may soon be capable of producing, at low cost, high volumes of individually tailored and persuasive phishing attacks.

Future social engineering attacks may also employ deep fakes, which is a convincing synthetic likeness

of a person produced from voice and video recordings. These attacks have the potential to manipulate insiders into unwittingly helping attackers bypass cybersecurity protocols.¹³⁹ At present, it is too costly to use deep fake technology for a common cyberattack, but that may soon change as personal information and advanced computing power become more available.

In its 2020 annual report, the OFR warned that the emergence of quantum computing technology could become a new source of cyber risk. The exponentially greater computational power of a quantum computer would make it possible to solve the mathematical problems that

and the communications between components of critical infrastructure, like satellites.

Currently available quantum computers are not yet powerful enough to break common encryption keys, and it may be a decade or more before that changes. But less powerful quantum computer technology may rapidly proliferate in the next five to 10 years as applications in the private sector, like financial modeling, drive demand that accelerates development.¹⁴¹ The federal government is coordinating its quantum research and development efforts through the Subcommittee on Quantum Information Science within the National Science

“
Future social engineering attacks may also employ deep fakes, a convincing synthetic likeness of a person produced from voice and video recordings.

underpin the most popular encryption methods in a matter of hours, compared with trillions of years using conventional computers.¹⁴⁰ An attacker with access to a sufficiently advanced quantum computer could potentially crack the encryption keys that safeguard financial transactions

and Technology Council. Standard protocols for postquantum cryptography are expected to be drafted and released in 2024. However, adoption of these new protocols could extend into the mid-2030s or later.

Climate Change Risk

Climate Change and its Risks

Climate change is the trend toward higher average global temperatures and accompanying environmental shifts such as rising sea levels and more severe weather events. Climate change poses physical and transition risks¹⁴² to the financial system (see Figure 54), but not enough is known to judge the threats these risks pose to U.S. financial stability.

More frequent and severe storms, droughts, floods, and wildfires, among other physical risks, could mean more damage to property and more supply chain disruptions. In some cases, damage could even be done to the U.S. financial system. In addition, financial losses could come from reductions in economic activity or changes in asset values.

Policy and technological innovations will create opportunities, but could still be disruptive to segments of the economy and alter consumer demand. These policies and technologies can help mitigate the

impact of climate change and the transition to a net-zero economy. However, policy changes or poorly crafted policies are likely to increase the risk to financial markets and the economy.

Whether there is resulting fallout—and the pace at which it will happen—is difficult to anticipate for various reasons. However, chief among them are legal and regulatory changes (see *Government Efforts to Address the Financial Risks of Climate Change*) and the public and private sectors' environmental, social, and governance (ESG) commitments and actions.



More frequent and severe storms, droughts, floods, and wildfires, among other physical risks, could mean more damage to property and more supply chain disruptions.



The impact on the private sector and the public sector could be inaccurate if they fail to account for legal and regulatory changes

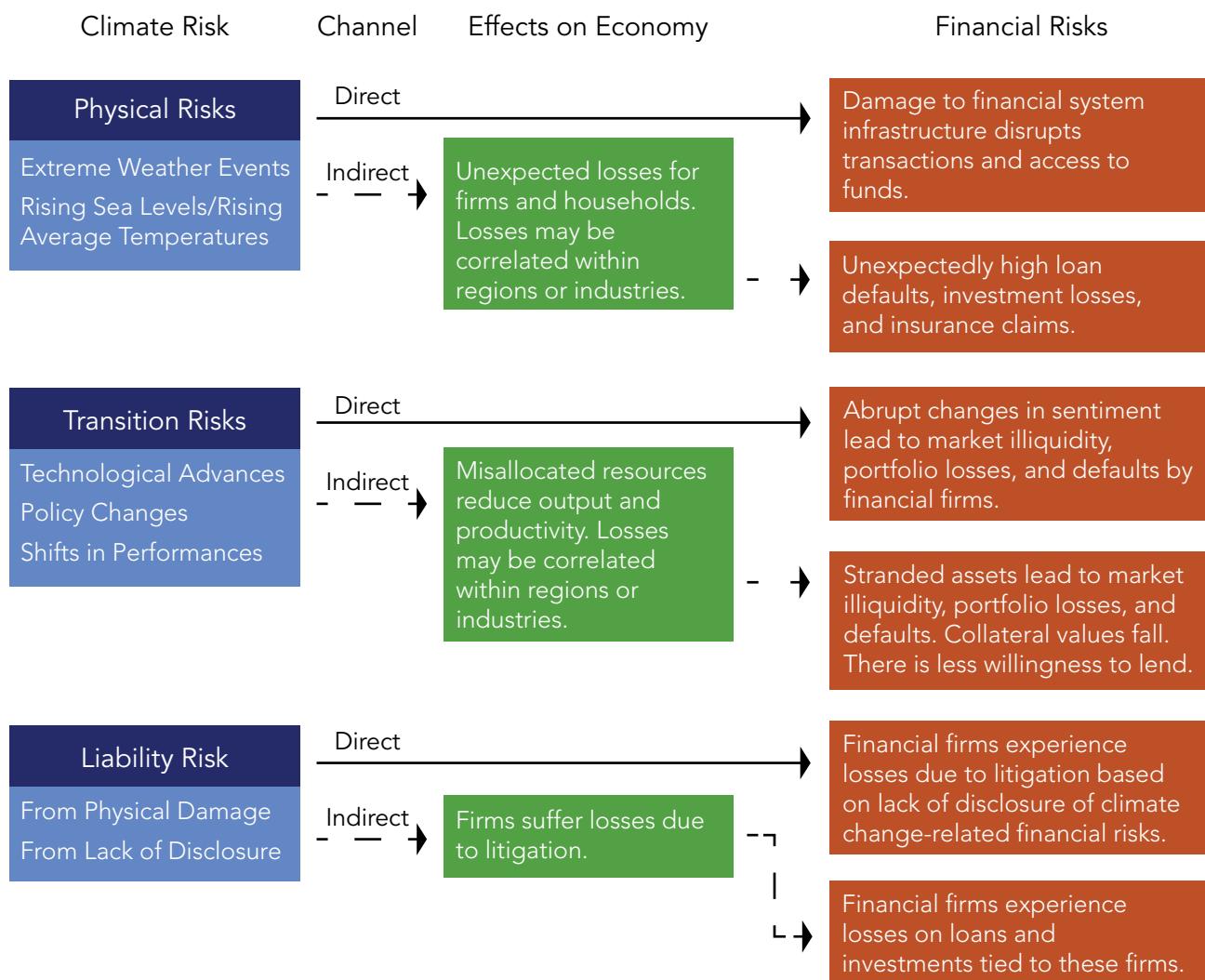
and ESG commitments and actions. Examples include climate-related litigation compensation for environmental damage, bodily harm, and failures to disclose risks or policy changes that cause economic or financial harm to particular firms and individuals.

Potential Climate Change Effects on Financial Risks and Stability

While climate change may pose a threat to U.S. financial stability, it is difficult to quantify the precise impact long-term. As regional segments of the U.S. experience effects from climate change, which may increase in severity over time, they are expected to adapt. Some of the most significant risks may fall beyond the typical time horizon covered by our annual assessments.

Lack of existing data also impedes the assessment of the financial stability implications of climate change. Current empirical studies are hampered by the limited time series available to document climate change-related risk effects on financial asset prices. Regardless of past data necessary for these

Figure 54. Channels for Climate Change-Related Financial Risks



Note: Liability risk is sometimes included among transition risks and other times considered a separate risk category.

Source: Office of Financial Research

studies, historical data may be minimally relevant in helping to predict future effects of climate change. As the science and climate evolve, and as more data becomes available, we may better understand how climate change's physical and transition risks affect U.S. financial stability.

The OFR assesses the physical and transition risks

of climate change through a framework that includes macroeconomic risk, market risk, credit risk, and liquidity risks to financial stability:

- Macroeconomic risk: research anticipates climate change will lower GDP, but loss estimates widely vary. The physical damage and transition changes could affect some regions and indus-

tries more than others.

- Market risk: physical and transition climate change-related events could result in financial asset repricing and market volatility. There is already evidence of price discounting for equities and bonds tied to more carbon-intensive or climate-sensitive underlying assets.¹⁴³ However,

GOVERNMENT EFFORTS TO ADDRESS THE FINANCIAL RISKS OF CLIMATE CHANGE

Under the executive order issued by President Biden, the National Economic Council, the U.S. Treasury, and the Office of Management and Budget were directed to assess the risks climate change poses to financial assets.¹⁴⁴

As part of this executive order, the Secretary of the Treasury, as the Chair of the Financial Stability Oversight Council (FSOC), has engaged with FSOC members to assess the climate-related risk to the stability of the U.S. financial system. The OFR is directed to assist the Secretary of the Treasury and FSOC, including collecting data, as appropriate, and developing of research.

Separately, several U.S. financial regulators have issued recommendations and plans for addressing the risks of climate change, examples include:

- The Commodity Futures Trading Commission issued a report in 2020 focused on establishing an economywide price on carbon.¹⁴⁵
- The Federal Reserve is studying the issues through its recently established Supervision Climate¹⁴⁶ and Financial Stability Climate committees.
- The Federal Housing Finance Agency is examining how to factor climate change risks as regulator of government-sponsored housing enterprises Fannie Mae and Freddie Mac.¹⁴⁷
- The Securities and Exchange Commission is focused on updating disclosure requirements and identifying ESG-related misconduct.¹⁴⁸
- The Office of the Comptroller of the Currency appointed a climate change risk officer and announced its membership in the Network for Greening the Financial System.

Global efforts to address the financial risks of climate change are also at an early stage. The Financial Stability Task Force for Climate-Related Financial Disclosure made recommendations for voluntary disclosures based on seven principles for effectiveness.¹⁴⁹ Effective disclosures are relevant, complete, clear, consistent, comparable, reliable, and timely. These could prove useful, but regulators or self-regulatory organizations will need to standardize such disclosures to make them consistent and comparable within specific financial industries.

Seven countries and the European Central Bank are each conducting climate change related stress tests on their banking systems in 2021 and 2022.¹⁵⁰ Regulatory agencies and banks typically use stress testing to measure the adequacy of capital relative to potential economic shocks. Climate change scenario analysis differs from the traditional Federal Reserve stress tests conducted each year. Climate change scenario analysis is exploratory in nature and seeks to understand and evaluate the potential impact of climate change on banks' risk profiles and strategies and may improve the understanding of the related financial risks and the data required to analyze them.

The global property and casualty industry has experienced an increase in insured losses (inflation-adjusted) over 50 years from storms, floods, and fires...

incorporating climate change risks into valuation models is hindered by the fact that these risks are complex.

- Credit risk: businesses, households, and counterparties could default at higher-than-anticipated rates due to physical and transition climate change-related events. Lenders with insufficient allowances for loss and capital could become insolvent if their exposures to such risks are too high.
- Liquidity risk: it is difficult to anticipate cases in which climate change causes liquidity risk without first causing market, credit, or operational risk.¹⁵¹ An important exception is a sudden change in investor sentiment that

leads to stranding of some financial assets while hoarding others.

- Operational and liability risks: in addition to the obvious risk of physical damage to financial sector infrastructure, there are potential liability risks associated with the failure of processes used by financial firms to account for climate change-related financial risks and their disclosure.

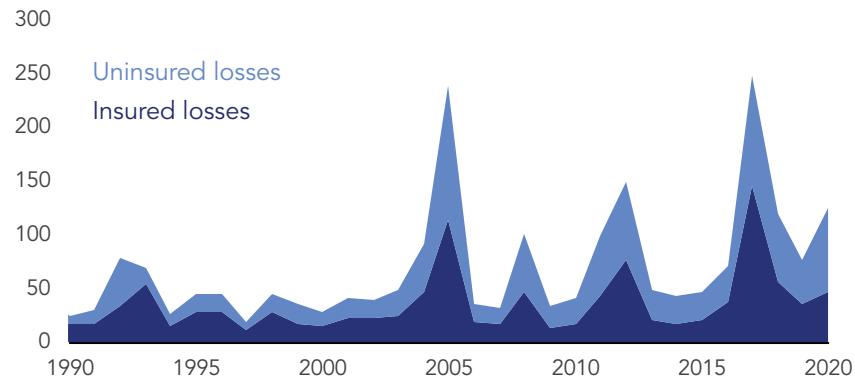
to climate change. The global property and casualty industry has experienced an increase in insured losses (inflation-adjusted) over 50 years from storms, floods, and fires, according to a 2021 report by the Geneva Association Task Force on Climate Change Risk Assessment for the Insurance Industry.¹⁵² U.S. insurers' losses from these natural disasters have similarly risen over time (see Figure 55).

Financial Sector Efforts to Account for Climate Change Risks

Among the financial industry's sectors, the insurance industry is the most advanced in accounting for the physical risks in assessing financial risks tied

Modeling climate change-related financial risks requires forward-looking methodologies and granular data.¹⁵³ Uncertainty about the timing and severity of the physical effects of climate change and the transition effects of changes in policy, regulation, technology, and sentiment are not readily captured in the methodologies that exist today.

Figure 55. Incurred Losses from U.S. Weather and Climate Disaster Events (\$ billions)



Note: Losses in constant 2021 dollars. Disasters include tropical cyclones, severe thunderstorms, flooding, wildfires, drought and winter weather.

Sources: Aon, Office of Financial Research



PART TWO

STATUS OF THE OFFICE

Review of Mission

Established by statute, the Office of Financial Research (OFR) principally supports the Financial Stability Oversight Council (FSOC) and its members by supplying germane data, developing empirically supported research insights and highlights, and advancing data products that can point to financial system vulnerabilities. Identifying and assessing those vulnerabilities in 2021 was essential to adhering to and delivering on our Office's statutory mandate.

Steady Progress

The OFR made great strides in engaging staff members to collaborate in various new frameworks to support climate data research, national and global committees, and internal programs. As part of its pursuit for organizational excellence, the OFR continued this year to foster a culture of accountability and professional development at every level. These efforts allowed further progress to improve communications and employee engagements through roundtables, town halls, and a newly developed newsletter.

Collaborations

Support for the FSOC and Its Members

The OFR supports the FSOC and its members by providing research and analysis to help identify threats to financial stability, fulfilling FSOC requests for research and analysis, and working with FSOC members on research and data projects. In addition, the OFR collects, maintains, and shares its supervisory and commercial datasets with the FSOC and its members.

The Office leads the FSOC Data Committee and works with the FSOC Systemic Risk Committee to address data gaps. The Data Committee provides a forum for information-sharing among the FSOC's Chief Data Officers and representatives, coordinates action on data-related topics, and oversees the annual update to the Interagency Data Inventory. In addition, the OFR's Director serves as a nonvoting member of the FSOC, and the OFR and the FSOC Secretariat collaborate to ensure proposed research and data topics, projects, and publications

are consistent with the OFR's mission.

Additionally, this year, the OFR began collaborating with the Federal Reserve on developing an OFR-hosted Climate Data and Analytics Hub (Data Hub), currently in pilot phase. When implemented, the Data Hub, will provide the FSOC and its members with data services to support the Dodd-Frank Act and meet the priorities—of President Biden—on climate-related financial risks. The collaboration will draw from professionals at the OFR, the Federal Reserve Board, and the Federal Reserve Bank of New York (FRBNY), initially, and will incorporate other members throughout the implementation phase of the project.

...[T]he OFR began collaborating with the Federal Reserve on developing an OFR-hosted Climate Data and Analytics Hub (Data Hub), currently in pilot phase.

Conferences Co-sponsored

On Nov. 19-20, 2020, the OFR joined the Federal Reserve Bank of Cleveland to host its annual financial stability conference. The conference convened virtually in 2020 for the first time; the focus was the impact of the COVID-19 pandemic on the financial system and the economies and financial markets worldwide and provided an authentic, severe stress event through which we could glean specific lessons and apply particular remedies.

Panels and presentations of research papers covered macroprudential and mone-

tary policy, financial market frictions and liquidity, and networks and contagion. In addition, participants from industry, regulatory agencies, and academia shared their insights in keynote addresses and panel discussions.

Financial Research Advisory Committee (FRAC)

The FRAC provides advice to the OFR, bringing diverse perspectives from the financial services industry to inform the OFR's research and data agendas. The FRAC meets twice each year and is governed according to the Federal Advisory Committee Act. The meetings' agendas and minutes are publicly available.

In April 2021, the committee discussed how risks to financial stability could arise from low interest rates and how policies and programs launched in response to COVID-19 might have promoted inflation and created other vulnerabilities. The FRAC also discussed the potential effects of climate change on financial stability. Finally, in September 2021, the committee discussed potential risks to financial stability stemming from the transition to alternative reference rates. In addition, the committee received a briefing from and discussed the impacts of cybersecurity on the financial system

with a staff member of the National Security Agency.

FINANCIAL RESEARCH ADVISORY COMMITTEE MEETINGS

April 28, 2021

Virtual meeting. The 17th meeting of the FRAC included discussions of interest rates, inflation, and the potential effects of climate change on financial stability.

September 29, 2021

Virtual meeting. The 18th meeting of the FRAC included discussions surrounding the transition from LIBOR to SOFR.

COVID-19 Response Plan

The OFR remains committed to providing a safe, healthy workplace for our entire workforce, especially during the COVID-19 pandemic. Despite the disruption brought on by the pandemic, the OFR met its mission requirements and continued to monitor financial stability while also providing support to the FSOC Secretariat and FSOC members.

The OFR invoked temporary full-time remote work to limit the risk of employees being exposed to the virus, implementing a three-phased return to the office approach consistent with federal and local COVID-19 guidelines.

Facilities

The OFR enhanced its facility entry protocols in response to COVID-19 by using self-diagnosing, contact tracing, and social distancing requirements. In addition, the OFR will continue to monitor the COVID-19 pandemic and work in close coordination with the U.S. Department of the Treasury to protect its staff.

Integrated Planning

During this fiscal year, the OFR engaged in a process-improvement effort to strengthen the OFR's strategic, tactical, risk, and performance planning and reporting cycles. This work focused on streamlining and sequencing critical planning and decision-making activities and resulted in an updated integrated planning framework at the enterprise level. The framework integrates

decision-making about strategic priorities, the research plan, initiatives, and resources, resulting in a data-driven map of the work needed to advance the mission. In addition, it enables intelligent trade-off choices about labor and nonlabor resources, ensuring the OFR sustainably delivers the best results for its stakeholders over time.

The OFR Director consults with the FSOC Chairperson to establish the OFR annual budget and workforce plan. In addition, the OFR is funded by semiannual

assessments from bank holding companies with \$250 billion or more in consolidated assets. These companies are identified as global systemically important banks regardless of asset size and nonbank financial companies supervised by the Federal Reserve.

The OFR obligated \$72 million in FY 2021, 44% for labor, and 56% for nonlabor expenses (see Figure 56), supporting its strategic priorities. A significant portion of the nonlabor expenses stems directly

Figure 56. Funds Obligated in Fiscal Years 2016-2021 (\$ thousands)

	2016	2017	2018	2019	2020	2021
Compensation	32,485	37,379	31,991	18,095	19,205	23,271
Benefits	11,322	13,054	10,932	6,860	7100	8,552
Benefits to former employees				292		
Labor total	43,807	50,434	42,923	25,247	26,305	31,823
Travel	556	447	147	156	75	6
Transportation				2		
Communication and utilities	62	179	131	68	116	125
Printing and reproduction	26	22	8	7	4	3
Other services	35,794	31,823	26,353	26,648	22,548	31,245
Supplies and materials	8,312	6,508	5,649	6,118	9,524	8,377
Equipment	5,997	3,459	679	309	519	632
Grants	320					
Nonlabor total	51,067	42,439	32,967	33,308	32,785	40,388
TOTAL	94,874	92,873	75,890	58,555	59,497	72,211

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

Source: Office of Financial Research

from the data needed to execute the OFR's unique research mission (\$28 million), which supports the OFR's unique mandates.

The OFR leverages the Department of the Treasury's shared services programs, spending roughly \$10 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 pays the Department of Treasury approximately \$5 million annually for use of its IT circuits.

The Office continued to implement its Workforce Plan 2020-2024 activities to address identified gaps regarding retention, workforce development, training, and recruitment, including focusing on collaboration and conducting a competency assessment.

The OFR is committed to retaining and recruiting a diverse workforce. As part of the recruitment process, the OFR shared announcements broadly – including through our diversity, equity, and inclusion partners. The OFR also leveraged advertising spaces from trade journals to social science communities to expand awareness about

employment opportunities. These efforts enabled the OFR to recruit talent and close key subject matter expertise gaps effectively.

Positions filled this fiscal year included the Chief Counsel; Associate Director of Financial Markets; Associate Director of Analytic Systems; Enterprise Risk Manager; and considerable

The OFR is committed to retaining and recruiting a diverse workforce.

needs and educate staff on pursuing individual learning opportunities. In addition, the OFR explored options and prepared to conduct a formal competency assessment to include competency model development and a competency gap analysis. The primary expected outcome is a clear identification of competencies and skills needed to accomplish the OFR's mission now and in the future. This assessment will further assist in workforce development, retention efforts, and targeted recruitment for a high-performing workforce.

research, analysis, information technology, and communications positions. With almost all the leadership team in place, managers focused on developing their staffs, identifying workforce needs critical to future mission success, and building their teams. In addition, as part of integrated planning, senior management regularly reviewed the organizational structure to ensure the OFR is positioned to meet its strategic priorities.

This fiscal year, the Office focused on training to further develop employees by organizing team training events to address identified

Enterprise Risk Management

As part of its integrated approach to planning, after hiring the Enterprise Risk Manager, the OFR began developing an enterprise risk management program in the second half of FY 2021. The program is intended to ensure that risks to the OFR's mission, strategy, and operations are identified and addressed. The framework aligns to the Treasury's risk program and follows enterprise risk management leading practices, such as integrating risk considerations into budget formulation. During FY 2021, the OFR created an internal governance framework for risk management and internal controls and incorporated risk management into its strategic and tactical planning efforts. The OFR also worked with leadership and subject matter experts to identify risks and opportunities that could affect mission outcomes.

The framework focuses on making all internal guidance documents easy to find, access, and use.

Internal Guidance Documents (IGD)

A strategic review resulted in a refreshed framework for internal guidance documents, a set of internal policies and procedures, that better meet the OFR's needs and provides improved governance across the Office. The framework focuses on making all internal guidance documents easy to find, access, and use. In addition to the framework, this review resulted in improved resources for end-users and document authors. These improvements included enhanced templates, a section with answers to frequently asked questions, and job aids for document creation. To support the framework, the OFR dedicated resources to updating its internal website for maintaining and sharing policies and procedures—improving user experience — and to ensuring that policies and procedures provide the most current information.

Information Technology

Remote Capabilities

The OFR relied heavily on the resilience of its IT division during the fiscal year, given the COVID-19 pandemic and fully remote workforce. We rolled out more secure solutions, such as a new mobile device, cloud-based controls system that allows us to manage better and monitor the mobile workforce. Based on employee satisfaction and measured productivity, we can gauge our success at providing excellent service without disruptions or impediments to the successful execution of the mission of the Office.

Cybersecurity

The pandemic brought many opportunities for potential harm to government systems due to remote work arrangements. Hackers made attempts to breach government systems through remote employee computers using commercial networks. Users and businesses were targeted indiscriminately, and the Treasury was no exception. However, the efforts and

upgrades made by the Technology Center ensured OFR systems and information remained secure.

As a result of this increased threat level, the OFR contracted a large IT firm with extensive experience to assist in our assessments, audits, and updates of our security services contracts, Interagency Agreements (IAA), and Memorandums of Understanding (MOU). With these revisions, the OFR initiated the creation of the Security Operations Center (SOC). The SOC, although not fully operational as of this report, is designed to be a proactive entity to analyze, audit, and correlate heuristic techniques for information security. The roadmap for creating such a system follows the methodology used by other government agencies, FireEye and Microsoft. The OFR is using these methods to secure its data. In addition, these proven methods, adopted by the Department of Homeland Security, are used to detect, isolate, and recover from a breach.

Data Collection and Management

The OFR does not collect or store any National Security Sensitive data; however, we configure and maintain our systems as if we are collecting such data. The OFR IT systems have layers of security and configurations that follow a model of zero trust and least privilege. Additionally, the OFR IT works with the Data Center to ensure proper classification and management of data received or obtained.

Cloud Migration

FY 2021 marked the second year of the OFR's cloud migration initiative; the project is scheduled for completion by the end of FY 2022. The OFR has already achieved many of the intended benefits. We avoided the expenditures intended to replace all the infrastructure as it became obsolete; the cost avoidance will total approximately \$12M from FY 2019 to the end of FY 2022. The OFR is following the government's cloud-first initiatives with excellent results.

Information Technology Work Products

This year the OFR's Technology Center, with the assistance of the Data Center, finalized and deployed the Short-term Funding Monitor (STFM) and the initial iteration of the Financial Instrument Reference Database (FIRD). The data used in the STFM is different than all other data collections managed by the OFR. For example, the new collection is executed daily and monitors data imported from the Federal Reserve Board at 7 a.m. The OFR IT division receives, validates, verifies, and curates the data to be published to the STFM before 3 p.m. the same day. It marks the first collection that requires off-hours support and same-day results.

Employee Engagement

The OFR Director remains committed to building and maintaining sound working relationships with employees and supporting team building, emphasizing public service. As a continued effort to improve and sustain OFR's culture and employee engagement, the Director hosted small group sessions to connect virtually on an individual level, engaging in informal conversations with employees.

The Director continues to prioritize transparency in conducting business and by managers reviewing the Federal Employee Viewpoint Survey (FEVS) results, which resulted in an Office-wide action plan to improve employee engagement and organizational culture. The plan is shared Office-wide and status updates are provided on an ongoing basis to highlight progress in completing the action items toward improving the work environment and employee engagement.

OFR management strongly encourages employee participation in taking the annual survey and developing the resulting action plan. The Office's 2020 FEVS

results demonstrate the OFR is making great strides in improving organizational culture, collaboration, and engagement. Every survey question result had a positive increase from the 2019 FEVS results. In addition, many of the 2020 FEVS question results showed significant improvement, with gains of over 25%.

The Office started the OFR Employee Roundtable discussion series. The roundtable is a virtual, quarterly meeting organized and hosted by the Deputy Director of Operations to continue the strong focus on Office-wide communication and engagement. Each session focused on a different aspect of working within the OFR to facilitate discussions and identify actionable ideas that can make the OFR a better place to work. Topics included collaboration, workforce development and training, and the OFR FEVS action plan. Also, the Office relaunched its "Lunch and Learn" series virtually, highlighting diverse topics and divisions to foster connections and awareness across the Office. Topics featured the OFR's Office of Chief Counsel, Data Strategy and Standards teams, Data Science, and internal Operations.

Organization Performance Management

The OFR updated its enterprise-wide organizational performance measurement and management system in support of the integrated planning framework. The framework includes developing and implementing an internal system to gather, maintain, and report on enterprise performance metrics. This effort created a streamlined repository for current and historical performance data and laid the foundation for future data visualizations and decision-making dashboards to feed directly into strategic discussions across the OFR.

Data Products

The Dodd-Frank Act sets forth the development of tools for measuring and monitoring financial vulnerabilities and risks, as well as the collection of data on behalf of the Financial Stability Oversight Committee, as two of the OFR's duties. The OFR addresses its statutory mandate in part through its centrally cleared repo data collection and by publishing several web-based financial stability monitoring tools.

Financial Stress Index (FSI)

This daily index, monitors stress in the financial system, is constructed from 33 financial market indicators such as yield spreads, valuation measures, and interest rates and can be decomposed by region or type of stress. The FSI's tracking of stress indicators in the U.S. and globally provided valuable insight as markets plunged in the first quarter of 2020 and served as an effective tool for navigating uncertainties throughout the COVID-19 pandemic.

The FSI is positive when financial stress is above average and negative when below average. While not

reaching the stress levels seen during the 2008 financial crisis, the FSI showed that the rise of stress indicators in the initial phase of the COVID-19 pandemic outpaced the rate of increase in stress shown in 2008. After the initial financial shock in March 2020, when market-stabilizing measures were initiated, the FSI accurately showed steady decreases in stress back to pre-COVID levels in FY 2021. While the FSI is a daily snapshot in time and not a predictive tool, it proved to be a reliable and accurate source of information during a period of significant financial stress.

Interagency Data Inventory

The FSOC Interagency Data Inventory, started in 2011, is a catalog of data collections by FSOC members and other government organizations. The inventory does not contain data, but rather metadata—data about data—on each collection. 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 data collections. Each FSOC member de-

termines which of its data collections to include in the Inventory, which 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.

U.S. Money Market Fund Monitor (MMFM)

The OFR's MMFM tracks the investment portfolios of money market funds. In FY 2021's market of dips and spikes, the MMFM offered the critical ability to examine and track individual funds and market trends, as well as connections between money market funds and securities issuers in the U.S. and abroad. The MMFM converts data from the Securities and Exchange Commission'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 a record 30% in FY 2020, Money Market Fund (MMF) total flows began a steady decline through the end of the

year. While remaining well above pre-COVID crisis levels during FY 2021, flows began steadily climbing back toward FY 2020 highs. Flows were primarily driven by Treasury repos and the Federal Reserve's reverse repo program, which saw levels more than double those seen in FY 2020. Both principal and collateral values were also made available for download in FY 2021, allowing users to monitor pledged collateral margins for repo agreements.

Bank Systemic Risk Monitor (BSRM)

The OFR's 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 international and U.S. banks, and the OFR's Contagion Index, which reflects the exposure of the financial system to the activities and results of these banks.

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.
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 to the rest of the financial system if a given bank were to default.

In FY 2021, the OFR's Contagion Index remained steady compared to FY 2020, except for one financial institution. That institution saw a 17% increase in its contagion index score between March 2020 and March 2021. The increase was driven largely by a growth in deposits by non-depository financial institutions.

Short-term Funding Monitor (STFM)

The OFR began publishing the 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 (API) for the STFM is often accessed more than 1,000 times per day.

The STFM was expanded in Q3 (April through June) with a new set of time series designated the "final" vintage (or version). This set of time series reflects all errors corrected from the "preliminary" vintage published daily. These series make the STFM an even more valued resource for academic researchers seeking to understand short-term markets.

Financial Instrument Reference Database (FIRD)

The Dodd-Frank Act requires the OFR to prepare and publish a Financial Instrument Reference Database in a manner easily accessible to the public. The OFR delivered the first

phase of our response to this mandate in November 2020.

In preparing the FIRD's initial phase, the OFR developed a foundational Data Dictionary, leveraging the International Organization for Standardization (ISO) 20022 financial message standard that is available on a free and open basis. This international data standard covers most financial instruments and supports the creation of financial messages for communicating buy and sell transactions, and interest and dividend payments.

ISO 20022 also contains the granular data elements that form the reference data for financial instruments. For example, users can look up the term "interest rate" in the Data Dictionary and easily view and understand how ISO 20022 defines this term.

During FY 2021, the OFR focused on adding the Algorithmic Contract Types Unified Standards (ACTUS) Data Dictionary to the FIRD. ACTUS is an open source software project that organizes financial instruments by patterns in the cash flow and obligations of a contract via an extensive set of parameters.

Climate Data Assessment and Climate-related Data Hub Pilot

In response to President Biden's Executive Order on Climate-Related Financial Risk, the OFR launched two ongoing data initiatives. The first is to assess potential sources of climate data for use in financial stability research. The second is a joint project with the Federal Reserve Board to develop a pilot climate data and analytics hub.

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. Climate change risk was subsequently divided into one of 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 of the data are publicly available, other data are restricted and require specific access agreements. A substantial proportion of the data need specialized knowledge to utilize and can be significant in size. The data can also have missing information and time stamps, thus impacting usability. While agency data collections are typically in raw form, 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 classifications;

although, several of them are building out additional capabilities. In addition, the vendor models vary, which necessitates the need to review and understand output variances. This need for standardization is complicated because the models are “black boxes,” a third-party model where the underworking data are not transparent to the user. Some academia and international sources also provide models, but the majority exclusively provide research papers, issue regulations, or policy analysis. Nevertheless, these tools can better understand the models, dangers, and changes of climate modeling.

The team also identified data gaps when connecting financial stability and climate change. Among the gaps were: 1) the understanding of residential and commercial mortgage holders; and 2) knowledge of local transportation, distribution, supply chains, and central resources for property and infrastructure data.

OFR-hosted Climate Data and Analytics Hub pilot

In June 2021, the Federal Reserve requested to leverage the OFR’s data hosting and analytic capabilities to support the Federal Reserve’s research on climate-related financial risk. The Federal Reserve was interested in collaborating through a cloud-based data and analytics hub and requested access for banks in the Federal Reserve System. After initial discussions, the OFR determined that acquiring publicly-available climate data and making the data and analytical tools available through a central hub would meet stakeholders’ short-term needs.

The OFR and the Federal Reserve Board agreed the first step toward this initiative would be a small pilot to determine the feasibility of a longer-term solution.

The OFR-hosted Climate Data and Analytics Hub pilot is a collaboration between the OFR and the Federal Reserve Board. The purpose is twofold: to meet the Federal Reserve Board’s request for a collaboration space with shared climate

data, analytic tools, and computing power; and to enable the OFR to develop and test a scalable model for enhanced services to FSOC and its members. Pilot participants include researchers, analysts and support staff of the OFR, the Federal Reserve, and the Federal Reserve Bank of New York. The pilot hub will provide access to public climate data, analysis, and high-performance computing tools in a secure, cloud-based environment. The pilot will consist of a six-month development and test period followed by a six-month implementation period. At the conclusion of the pilot, a retrospective will be held to document lessons learned, assess the scalability of the initiative, and document future requirements.

Data Standards

U.S. and International Leadership in Financial Data Standards

This year, the OFR continued to make substantial gains toward fulfilling its mission to promote financial stability by delivering high-quality financial data standards. The OFR participated in U.S. and international standards development initiatives in collaboration with FSOC members. In addition, the OFR serves as a leader promoting the adoption and use of financial data standards.

The OFR's objective is to improve the quality and utility of financial data and facilitate aggregation, integration, sharing, access, and exchange of financial data. Moreover, the OFR engages in these activities with FSOC members, international counterparts of FSOC members, and leaders and experts from the public and private sector.

Examples of OFR's Participation in U.S. and International Data Standards Initiatives

This past year, the OFR participated in U.S. and international data standards initiatives through the following bodies: Regulatory Oversight Committee, International Organization for Standardization, and Accredited Standards Committee X9, Inc. As illustrated in Figure 57, the OFR participated in 32 working groups.

Regulatory Oversight Committee (ROC)

The OFR continued to contribute to the work of the Regulatory Oversight Committee (ROC), including the ROC's Plenary, Executive Committee, Committee on Evaluation and Standards (CES), and Committee on Derivatives Identifiers and Data Elements (CDIDE).

In October 2020, the Financial Stability Board (FSB) transferred the role of international governance body to the ROC, expanding their responsibilities considerably. The ROC now

governs the following new international data standards for reporting over-the-counter (OTC) derivatives transactions to trade repositories: Unique Transaction Identifier (UTI), Unique Product Identifier (UPI), and Critical Data Elements (CDE). Previously, the ROC had the singular responsibility to oversee the Global Legal Entity Identifier (LEI) System. The LEI, itself, is an international data standard (ISO 17442) for identifying the legal entities pertinent to a financial transaction.

Among its expanded responsibilities as the international governance body of the UTI, UPI and CDE, the ROC will oversee the service provider for the UPI system (i.e., the entity that will issue UPI codes and operate the UPI reference data library). This provider, which was designated by the FSB in May 2019, is the Derivatives Service Bureau (DSB) of the Association of National Numbering Agencies (ANNA).

Legal Entity Identifier (LEI)

First published by the International Organization for Standardization (ISO) in June 2012, but updated and republished in August 2020, the LEI standard (ISO 17442) specifies the parties

Figure 57. Participation in U.S. and International Data Standards Initiatives

1 Regulatory Oversight Committee

- 1.1 Plenary
 - 1.2 Executive Committee
 - 1.3 Plenary – Oversight Arrangements Group
 - 1.4 Plenary – Task Force on Secretariat Services
 - 1.5 Committee on Evaluation and Standards
 - 1.6 Committee on Evaluation and Standards – Data Quality Working Group
 - 1.7 Committee on Evaluation and Standards – Level 2 Data Working Group
 - 1.8 Committee on Derivatives Identifiers and Data Elements
 - 1.9 Committee on Derivatives Identifiers and Data Elements – CDE Message Group
-

2 International Organization for Standardization, TC 68 – Subcommittee 8

- 2.1 AG 1 – ISO 10962, Advisory Group on Classification of Financial Instruments (CFI)
 - 2.2 WG 1 – ISO 10962, Classification of Financial Instruments (CFI)
 - 2.3 WG 7 – ISO 24366, Natural Persons Identifier (NPI)
 - 2.4 WG 8 – ISO 4914, Unique Product Identifier (UPI)
-

3 International Organization for Standardization, TC 68 – Subcommittee 9

- 3.1 WG 1 – ISO 20022 Semantic Models
 - 3.2 SG 1 – Review of ISO 20022 Standards Release Comments
-

4 International Organization for Standardization, TC 68 – Advisory and Study Groups

- 4.1 AG 3 – Standards Best Practices
 - 4.2 AG 5 – Digital Currencies
 - 4.3 TAG 1 – Fintech Technical Advisory Group
 - 4.4 SG 4 – Communications
-

5 International Organization for Standardization, TC 322

- 5.1 WG-1 – Sustainable Finance Framework
-

6 Accredited Standard Committee X9, Inc.

- 6.1 Board of Directors
- 6.2 Executive Committee
- 6.3 X9D Securities Subcommittee
- 6.4 X9D Securities Subcommittee – Chair
- 6.5 X9D Securities Subcommittee – ISO 24366 NPI Mirror Group
- 6.6 X9D Securities Subcommittee – ISO 6166 ISIN Mirror Group
- 6.7 X9D Securities Subcommittee – ISO 20022 Mirror Group
- 6.8 X9D Securities Subcommittee – X9D1 ANSI X9.145 FIGI
- 6.9 X9D Securities Subcommittee – X9D1 ANSI X9.6 CUSIP
- 6.10 X9D Securities Subcommittee – Industry Forum for Financial Terms Harmonization
- 6.11 X9C Corporate Banking Subcommittee – Real-Time Payments Study Group
- 6.12 X9 Board of Directors – ISO 20022 Market Practice Industry Forum

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

Source: Office of Financial Research

to 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 that uniquely identify a legal entity.

Through its active participation in the CES's Level 2 Working Group, the OFR contributed to improving the quality and additional sources of "Level 2" LEI data. Level 2 LEI data includes data about an entity's "direct accounting consolidating parent" and their "ultimate accounting consolidating parent." Also, through its active participation in the CES's Data Quality Working Group, the OFR contributed to improving the quality of other elements of LEI data. As a representative of the Treasury, a member of the ROC, the OFR is committed to ensuring that the quality of LEI data is sufficiently high to make it useful for industry participants and regulators.

The OFR is also committed to ensuring that adoption of the LEI continues to grow. As of September 2021, more than 1.9 million LEIs have been issued worldwide. Approximately 32% of these were issued in the United States, and approximately 13% were issued to U.S. entities. The

total number of LEIs issued represents a year-to-date increase of 10%, which follows a 15% increase in 2020.

Unique Transaction Identifier (UTI), Unique Product Identifier (UPI) and Critical Data Elements (CDE)

In August 2020, ISO published the international UTI standard (ISO 23897), which specifies the elements to uniquely identify a financial transaction. In October 2021, ISO published the international UPI standard (ISO 4914), a standard that specifies the elements to identify OTC derivative products reportable to trade repositories. In between these two events, the definitions, formats, and allowable values of critical data elements (CDE) reported to trade repositories was incorporated into the ISO 20022 standard and published.

Through its active participation in the Plenary's Oversight Arrangements Group (OAG) and the CDIDE, the OFR contributed to the ROC and the Derivatives Service Bureau (DSB), final-

izing a joint Memorandum of Understanding (MOU) on governance arrangements of the UPI.

To achieve the UPI and CDE milestones, the OFR worked closely with other Council members represented on the ROC, the international counterparts of these agencies, DSB, and SWIFT.

Task Force on ROC Secretariat Services

The OFR served as Chair of the ROC Task Force on Secretariat Services and led the effort to establish a permanent secretariat for the ROC, as the FSB's temporary provision of this service ends in December 2021. Given OFR's past leadership, the OFR will provide the ROC with a secretariat starting in January 2022.

International Organization for Standardization (ISO)

In the past year, the OFR continued contributing to multiple ISO Technical Committee 68 (TC 68) projects. TC 68 is responsible for developing and maintains standards for the

global financial services industry. The OFR was an active member of Subcommittee 8 (Reference Data for Financial Services), Subcommittee 9 (Information Exchange for Financial Services), and other groups:

- ISO 4914 Unique Product Identifier (UPI)

ISO published the international UPI standard (ISO 4914) in October 2021. As a member of this group, the OFR actively contributed to analysis that enabled this milestone to be reached.

- ISO 24366 Natural Person Identifier (NPI)

In September 2021, ISO published ISO 24366 Natural Person Identifier (NPI), an international data standard to uniquely identify the natural persons relevant to any financial transaction. The OFR was a key contributor to this effort based on our past leadership and development for the LEI. This project also resided under a working group of ISO TC 68.

- ISO TC 68 – Semantic Models

The OFR continued to participate in the working group of ISO TC 68 focused on semantic models in the context of

ISO 20022. Information within these models is used by the working group as a basis for semantic transformation into the Web Ontology Language (OWL). As a member of this group, the OFR contributes to education efforts about ontology best practices and development. With input from the OFR, the group submitted two technical reports (TRs) to Subcommittee 9 of TC 68.

- ISO TC 68 – Communications

The OFR accepted the role of Co-Chair of the Communications Committee of ISO TC 68. This Committee publishes articles and news on the website and LinkedIn account of TC 68.

- ISO TC 68 – Financial Technology (FinTech) Technical Advisory Group (TAG)

The OFR continued to serve as Chair of the FinTech TAG, which provides a forum for members to share and discuss information and ideas relevant to financial technology topics. The group hosted quarterly presentations as part of its Speaker Series.

Accredited Standards Committee X9, Inc. (ASC X9)

ASC X9 is accredited by the American National Standards Institute (ANSI) to develop and maintain voluntary consensus standards for the U.S. financial services industry. ASC X9 is the U.S. voting body to ISO. The OFR chairs the subcommittee X9D Securities Subcommittee that develops and maintains data standards for the financial industry.

The OFR continued to contribute to the work of ASC X9 as a member of the Board and Executive Committee and as a member of several of the groups under the X9D Securities Subcommittee.

- Natural Person Identifier (NPI)

The OFR continued to Chair the X9D mirror group to the ISO TC 68 working group focused on developing the international NPI standard (ISO 24366).

- Legal Entity Identifier (LEI)

In August 2020, ISO published an updated edition of the LEI standard (ISO 17442, Parts 1

and 2). Upon publication, X9D with OFR as Chair, reviewed this edition to obtain American National Standards Institute (ANSI) approval to re-adopt it as a U.S. standard. In late September 2020, ANSI approved the readoption.

- X9D Industry Forum for Financial Terms Harmonization

The OFR Chaired and launched the new X9D Industry Forum for Financial Terms Harmonization. This public forum is charged to review and harmonize current industry-wide differences in financial data terms, meanings and definitions, with the eventual goal of creating a data dictionary/data glossary available for industry use.

potential operational and security risks that require monitoring. The OFR's Data Strategy and Standards team broadened its communication with the Treasury's Office of International Financial Markets (IFM) and Office of Cybersecurity and Critical Infrastructure Protection (OCCIP). At the requests of these offices, the OFR conducted research and provided advice on topics including digital currency, digital identity and blockchain.

Migration of U.S. Payments Transactions to ISO 20022

The OFR conducted research and provided advice to Treasury's IFM and OCCIP on the scheduled migration of U.S. payments transactions to the ISO 20022 international standard and the planned use of this standard by the Federal Reserve System in its FedNow program. In anticipation of the launch of this program in 2023, the OFR has been participating in several working groups of ISO and ASC X9 to serve as an information source for the Treasury.

Support to Treasury Offices and the Council's Secretariat

Executive Orders of the President and requests from the administration were directed to the Treasury and the FSOC for analysis and guidance. Many of these focused on standards, and standards organizations, which are key components identifying areas of

GLOSSARY

Accommodation

Expansionary monetary policy in which a central bank seeks to lower borrowing costs for businesses and households to make credit more easily available.

Activities-based approach

An approach to examining risks to financial stability by examining a diverse range of financial products, activities, and practices.

Adverse selection

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

Agency mortgage-backed securities

Securities made up of mortgages purchased by housing finance agencies Fannie Mae, Freddie Mac, and Farmer Mac, or guaranteed by housing finance agency Ginnie Mae. The agencies set underwriting requirements for the loans they will purchase or guarantee.

Alternative Reference Rates Committee (ARRC)

A committee that includes banks, asset managers, insurers, and industry trade organizations as well as federal and state financial regulators as ex-of-ficio members; the committee chose the Secured Overnight Financing Rate (SOFR) as its recommended alternative to U.S. dollar LIBOR.

Aruoba-Diebold-Scotti Business Conditions Index

Index designed by Federal Reserve Bank of Philadelphia researchers to track real business conditions at high frequency by using a mix of economic and financial indicators.

Asymmetric information

When one party to a transaction has greater material knowledge than the other party.

Attestation

In an attestation engagement, a certified public accountant is engaged to issue or does issue an examination, review, or agreed-upon procedures report on subject matter, or an assertion about the subject matter that is the responsibility of another party. Under the Sarbanes-Oxley Act of 2002, independent auditors attest to and report on public company managers' assessments of internal controls over their companies' financial reporting.

Auditor opinion

Statements auditors include in their reports on company finances. Auditors issue adverse opinions when they have concerns that the statements have not been prepared along accepted principles or that the data supporting the statements have been misrepresented. They issue clean opinions when they find no significant exceptions to accepted accounting practices and disclosure requirements. Auditors issue opinions with an explanation for various reasons, including when they want to call out something that might be material.

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.

Bagehot's Dictum

Theory of Walter Bagehot, a 19th century writer and banker, who proposed central banks should lend freely and often against good collateral and at high interest rates to quell a financial panic.

Bail-in

The approach to a failed or near-failed entity in which its creditors write down their claims to make the entity solvent, as opposed to the provision of government support.

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 holding company (BHC)

Any company that has direct or indirect control of one or more banks and is regulated and supervised by the Federal Reserve under the Bank Holding Company Act of 1956. BHCs may also own nonbanking subsidiaries such as broker-dealers and asset managers.

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

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.

Brexit

An abbreviation for "British exit," the departure of the United Kingdom from the European Union.

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.

Business development company (BDC)

Type of closed-end fund that primarily invests in small or developing companies. BDCs are often publicly traded companies and are regulated by the Securities and Exchange Commission.

The Three C's

Connectedness, correlation, and contagion – three key sources of systemic risk.

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 conservation buffer

Additional capital banks are required to hold outside periods of financial stress, meant to be drawn down during times of stress. This buffer is intended to prevent breaches of minimum required capital ratios.

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.

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 clearing-house or central counterparty. Central clearing is an alternative to bilateral or over-the-counter trading (see over-the-counter derivatives).

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.

Charge-off rate (for banks)

Realized loan losses as a percent of total loans. The net charge-off rate subtracts recoveries on written-down debt from gross charge-offs.

Circuit breakers

A market regulatory mechanism to stop trading in the public markets when prices of certain instruments drop more than a predefined amount.

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.

Coasean lens

A perspective of contemporary British economist and Nobel laureate Ronald Coase that deemphasized oversight and regulation in favor of rewarding accessible information in competitive markets to reveal systemic risk and create opportunity.

Collateral

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

Collateralized debt obligation (CDO)

Securities that hold a pool of debt and are sold to investors in tranches with varying levels of risk. Leading up to the 2007-09 financial crisis, many CDOs consisted of repoaled residential mortgage-backed securities (RMBS).

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.

Commercial Paper Funding Facility (CPFF)

A Federal Reserve facility that finances commercial paper issuance.

Committee on Capital Markets Regulation

An independent research organization created in 2006 and focused on policy reforms to develop efficient and stable capital markets.

Committee on Payments and Market Infrastructures (CPMI)

A standing committee of the Bank for International Settlements. Representatives are senior officials of member central banks. The CPMI promotes safety and efficiency of payment, clearing, settlement, and related activities, and it serves as a global standard-setting body in this area.

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.

Conditional Value-at-Risk (CoVaR)

CoVaR indicates an institution's contribution to systemic risk, calculated as the difference between value-at-risk (VaR) of the financial system when the firm is under distress and the VaR of the system when the firm is in its regular, median state.

Contingent convertible (CoCo) bonds

Hybrid capital securities structured as debt but that absorb losses in accordance with their contractual terms when the capital of the issuing bank falls below a certain level. Due to their loss-absorbing capacity, CoCos can be used to satisfy regulatory capital requirements.

Council of Economic Advisers (CEA)

An agency within the Executive Office that advises the President of the United States on economic policy.

Countercyclical capital buffer

A component of Basel III requiring banks to build capital buffers during favorable economic periods. The buffers can be used to absorb losses in unfavorable periods.

Counterparty risk

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

Covenant-lite loans

Loans that do not include or include weak versions of typical covenants to protect lenders, such as requiring the borrower to deliver annual reports or restricting loan-to-value ratios.

COVID-19

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 gap

A metric in which the ratio of debt-to-gross domestic product (GDP) is measured against its statistically estimated long-run trend.

Credit rating agency

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.

Credit Risk Transfer (CRT) bonds

CRT bonds allow Fannie Mae, Freddie Mac, and sometimes reinsurance companies, to transfer mortgage credit risk to private investors.

Cryptocurrency

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

Current expected credit loss (CECL)

Accounting framework for creating reserves for credit losses. Requires firms applying U.S. Generally Accepted Accounting Principles to hold credit loss allowances equal to expected credit losses for the lifetime of certain assets.

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.

Cybersecurity Assessment Tool

A tool designed to complement the National Institute of Standards and Technology's Cybersecurity Framework. The Federal Financial Institutions Examination Council developed the tool to help financial institutions identify and address cybersecurity risks and determine their level of cybersecurity maturity in addressing those risks.

Dash to cash

A simultaneous move by participants in money and capital markets to raise cash by selling assets, including Treasuries, and to withdraw from investment funds, creating volatility and price drops.

Debt securitization

The aggregating of debt instruments into a pool backing the creation of one or more securities.

Default waterfall

The financial safeguards available to a central counterparty to cover losses arising from the default of one or more clearing members.

Defensive draws

A strategy by borrowers to draw down their credit lines to raise cash in advance of need.

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.

Depository institution

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

Depository Trust & Clearing Corporation

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.

Derivatives counterparties

Parties to a derivatives transaction, either trading with each other bilaterally (over the counter) or via a central counterparty.

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.

Distress Insurance Premium (DIP)

A systemic risk indicator that measures the hypothetical contribution a financial institution would make to an insurance premium that would protect the whole financial system from distress.

Distress ratio

The portion of high-yield debt at face value trading at distressed levels.

Distributed ledger technology

See blockchain.

Dodd-Frank Act

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.

Dodd-Frank Act Stress Test (DFAST)

Annual large bank stress tests required by the Dodd-Frank Act. A 2018 law change means banks with assets less than \$100 billion no longer go through DFAST.

Duration risk

The risk associated with the sensitivity of the prices of bonds and other fixed-income securities to changes in the level of interest rates.

Economic Growth, Regulatory Relief and Consumer Protection Act of 2018

Law that adjusted some provisions of the Dodd-Frank Act, as well as instituting tax law changes.

Emerging markets

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

European Central Bank's (ECB) Public Sector Purchase Program (PSPP)

A process by which the ECB (or "Eurosystem") buys assets, including sovereign bonds, to help maintain stability in various countries.

The European Securities and Markets Authority

The European Union's securities market regulator.

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.

Fallen angel

Bond downgraded from investment grade to non-investment grade.

Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA)

A law that requires federal banking agencies to take action when an insured depository institution's capital declines below a predefined level, and in the case of bank failures, enact a resolution that is the least burdensome to taxpayers.

Federal Financial Institutions Examination Council (FFIEC)

An interagency body that prescribes uniform principles, standards, and report forms for the federal examination of financial institutions. The FFIEC makes recommendations to promote uniformity in banking supervision.

Federal funds (fed funds)

Overnight interbank borrowing of reserves at the Federal Reserve.

Federal funds rate

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 Housing Finance Agency (FHFA)

Agency responsible for supervision, regulation, and housing mission oversight of Fannie Mae, Freddie Mac and the Federal Home Loan Bank System; it is also the conservator of Fannie Mae and Freddie Mac.

Federal Open Market Committee (FOMC)

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

Federal Reserve's emergency section 13(3)

A section of the Federal Reserve Act that allows emergency lending from the Federal Reserve to financial institutions and others in "unusual and exigent circumstances" with the approval of the Secretary of the Treasury.

Feedback loop (negative)

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

Financial contagion

When financial or economic shocks initially affect only a few financial market participants and then spread to other parts of the financial system and countries. The risk of contagion increases with the number and complexity of interconnections.

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 market utility (FMU)

As defined by the Dodd-Frank Act, "any person that manages or operates a multilateral system for the purpose of transferring, clearing, or settling

payments, securities, or other financial transactions among financial institutions or between financial institutions and the person."

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 (FSOC)

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

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.

Foreign and International Monetary Authorities (FIMA) Repo Facility

Allows foreign central banks and international monetary authorities with which the Federal Reserve doesn't have swap agreements to borrow dollars against Treasury securities.

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.

Form PF

A periodic report of portfolio holdings, leverage, and risk management submitted by hedge funds, private equity funds, and related entities. The report is filed with the Securities and Exchange Commission and the Commodity Futures Trading Commission, which keep the information confidential. The Dodd-Frank Act mandated the reporting to help the FSOC monitor financial stability risks.

Funding gap

The difference between rate-sensitive assets and liabilities. One measure of the funding gap ratio is liabilities due in one year minus liquid assets, divided by total assets.

Funding liquidity

The availability of credit to finance the purchase of financial assets.

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.

Global systemically important insurers (G-SIIs)

Insurance companies annually identified by the Financial Stability Board for having the potential to disrupt international financial markets because of their size, market position, and global interconnectedness.

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.

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.

Haircut

The discount at which an asset is valued when pledged as collateral. For example, a \$1 million bond with a 5 percent haircut would collateralize a \$950,000 loan.

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 (see qualified hedge fund).

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-frequency trading

The use of computerized securities trading platforms to make large numbers of transactions at high speeds.

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.

Incurred-loss accounting framework

An accounting framework for firms in which loan loss allowances are equal to the losses related to recognized credit impairments. Compare CECL.

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.

Institutional loans

When referring to the leveraged loan market, term loans originated by bank syndicates and sold to institutional investors.

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.

International Organization of Securities Commissions (IOSCO)

IOSCO is the international body for securities regulators, and is the recognized standard setting organization for the securities industry. IOSCO works closely with the G-20 forum of nations and the Financial Stability Board on global financial regulatory 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.

LIBOR

Formerly known as the London Interbank Offered Rates, estimates of the interest rates at which banks can borrow from other banks in London wholesale markets, as measured by a daily survey. LIBOR is still a widely used reference rate system, but is being phased out under regulatory direction.

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 FSOC 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.

LTV (loan-to-value) ratio

The amount of a loan as a percent of the estimated value of the asset serving as the loan's collateral.

Lockdown

Stay-at-home orders from a government to its citizens.

Macroeconomic risk

Risk from changes in the macroeconomy or macroeconomic policy.

Macroprudential policy

Government policy promoting the stability of the financial system as a whole, in contrast to policy focused on individual markets or institutions.

Macroprudential supervision

Supervision to promote the stability of the financial system as a whole. See microprudential supervision.

Main Street Lending Program

Lending facilities created in 2020 to support small and medium-size businesses and non-profit organizations and their employees. These facilities include the Main Street New Loan Facility, the Main Street Expanded Loan Facility, the Main Street Priority Loan Facility, the Nonprofit New Loan Facility, and the Nonprofit Expanded Loan Facility.

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 discipline

The idea that markets can rein in risk through individual participants behaving in their own interest. This should result in markets pricing risk effectively and curbing excessive risk-taking. See moral hazard.

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 a 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 and 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

A fund that typically invests in short-term government securities, certificates of deposit, commercial paper, or other highly liquid and low-risk securities.

Money Market Mutual Fund Liquidity Facility (MMLF)

A facility established in 2020 to allow the Federal Reserve Bank of Boston to provide loans to eligible financial institutions to purchase assets from certain types of money market funds.

Moral hazard

When people do not guard against risk because they expect someone else to pay for the losses arising from that risk.

Mortgage call report

A quarterly report of mortgage activity and company information created by state regulators and administered electronically through the Nationwide Mortgage Licensing System & Registry (NMLS).

Municipal Liquidity Facility (MLF)

A program created in 2020 to allow the Federal Reserve to buy short-term debt issued by state and local governments with loss protection provided by the U.S. Treasury.

Multilateral organizations

Organizations formed by multiple countries to address international problems. Examples include the World Bank and the International Monetary Fund.

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.

Narrow spread

A small difference between buyers' and sellers' prices (the bid-ask) in a liquid market.

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.

National Institute of Standards and Technology (NIST)

Cybersecurity Framework Voluntary guidance, based on existing standards, guidelines, and practices, for critical infrastructure organizations to better manage and reduce cybersecurity risk. The framework focuses on using business drivers to guide cybersecurity activities and considering cybersecurity risks as part of an organization's risk management process.

Nationally Recognized Statistical Rating Organization (NRSRO)

Credit rating agency registered with and regulated by the SEC.

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.

Network model

A model consisting of a set of nodes, or financial institutions, and a set of payment obligations linking them, to show how financial interconnections can amplify market movements.

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.

Nonprofit New Loan Facility; Nonprofit Expanded Loan Facility

Facilities created by the Federal Reserve in the summer of 2020 to lend money to nonprofit organizations.

Notional derivatives exposure

The reference amount from which contractual payments will be calculated on a derivatives contract; generally not an amount at risk.

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, for a fixed period to buy a block of shares 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.

Orderly liquidation authority (OLA)

Provision in the Dodd-Frank Act that allows the Federal Deposit Insurance Corporation to unwind a large, complex company. An OLA serves as a backup to bankruptcy court proceedings.

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.

Over-the-counter (OTC) derivatives

Derivatives contracts negotiated privately between two parties, rather than traded on a formal secu-

rities 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.

Overnight Indexed Swap (OIS)

An interest rate swap in which a fixed-rate price index is swapped against the overnight reference rate.

Own Risk and Solvency Assessment (ORSA)

An internal process undertaken by an insurer or insurance group to assess the adequacy of its risk management and current and prospective solvency positions under normal and severe stress scenarios.

Pandemic

A disease or illness that affects a significant portion of the globe.

Passporting

Legal arrangement that allows firms from European Union nations to sell their services across the Union without having to comply with each country's separate regulations.

Pension Benefit Guaranty Corporation (PBGC)

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.

Pension funded ratio

The ratio of a pension plan's assets to the present value of its obligations.

Pension Obligation Bonds (POBs)

Taxable municipal securities issued by state or local governments to borrow to meet pension obligations.

Paycheck Protection Program Liquidity Facility (PPPLF)

A program for the Federal Reserve to extend credit to lenders participating in the Small Business Administration's Paycheck Protection Program, which provides potentially forgivable loans to small businesses to fund their payrolls.

Pension risk transfer

The transfer of pension risk from a pension plan to another party, usually through insurance or annuity contracts, longevity swaps, or other contractual arrangements.

Pipeline risk

The risk that loans being accumulated for sale cannot be sold at the expected prices or at all.

Price discovery

The process of determining the prices of assets in the marketplace through the interactions of buyers and sellers.

Primary Credit Rate

The interest rate the Federal Reserve charges banks for discount window borrowings.

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 accountholders. A primary dealer buys government securities directly and can sell them to other market participants.

Primary Dealer Credit Facility (PDCF)

A facility for the Federal Reserve Bank of New York to make collateralized loans to primary dealers, which are the banks and securities broker-dealers designated to serve as trading counterparties in carrying out U.S. monetary policy.

Primary Market Corporate Credit Facility (PMCCF)

A Federal Reserve facility to provide credit to, and purchase new bonds from, large investment-grade corporations.

Prime broker

Companies that provide hedge funds and other investors with services such as lending cash and securities.

Qualifying hedge fund

Hedge fund advised by a large hedge fund adviser and with a net asset value of at least \$500 million. Large hedge fund advisers are advisers that have at least \$1.5 billion in hedge fund assets under management.

Real estate investment trust (REIT)

Corporations that invest in income-producing real estate and pay most of their taxable income to shareholders as dividends.

Regulation SCI

A regulation adopted by the Securities and Exchange Commission that applies to entities that directly support six key securities market functions: (1) trading, (2) clearance and settlement, (3) order routing, (4) market data, (5) market regulation, and (6) market surveillance.

Reinsurance

The risk management practice of insurers to transfer some of their policy risk to other insurers. A second insurer, for example, could assume the portion of liability in return for a proportional amount of the premium income.

Repo

Short form of repurchase agreement.

Repurchase agreement (repo)

A transaction in which one party sells a security to another party and agrees to repurchase it at a certain date in the future at an agreed price. Banks often do this on an overnight basis. A repo is similar to a collateralized loan.

Reserve requirements

The funds banks are required to hold on deposit with the Federal Reserve.

Residential mortgage-backed securities (RMBS)

A security that is collateralized by a pool of residential mortgage loans and makes payments derived from the interest and principal payments on the underlying mortgage loans.

Resilience

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 assets

Assets that carry risk of default. Such assets include loans, bonds, commodities, and other investment vehicles. U.S. Treasury securities are generally considered free of default risk.

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 retention

When issuers of asset-backed securities must retain at least part of the credit risk of the assets collateralizing the securities. The regulation also prohibits a securitizer from directly or indirectly hedging the credit risk.

Risk spreads

The difference in yields of riskier assets versus perceived safer assets such as Treasuries and bank deposits.

Risk-based capital

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.

Runnable funding

Funds that can be withdrawn from a financial institution on short notice. Uninsured bank deposits, shares of money market funds, wholesale borrowings, commercial paper, and repurchase agreements are among runnable sources of funding.

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.

Sarbanes-Oxley Act of 2002

Law aimed at curbing corporate fraud exposed in several financial scandals, including those at Enron and WorldCom. The law laid out numerous accounting and accountability requirements for companies, managers, and accountants.

Search for yield (reach for yield)

Accepting greater risks in hopes of earning higher returns when interest rates on high-quality investments are low.

Secondary Market Corporate Credit Facility (SMCCF)

A Federal Reserve facility to support trading of outstanding corporate bonds and corporate bond exchange-traded funds.

Section 13(3) authority

A section of the Federal Reserve Act that allows emergency lending from the Federal Reserve to financial institutions and others in "unusual and exigent circumstances" with the approval of the Secretary of the Treasury.

Secured Overnight Financing Rate (SOFR)

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.

Securities Information Processors (SIPs)

Established by Congress and the SEC, the SIPs link the activities of U.S. markets into a single data feed.

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.

Shadow banking

Credit intermediation performed by nonbank companies or financed by runnable liabilities without a government guarantee.

Shock

A sudden change in fundamental economic drivers and expectations that can stress the economy and financial system.

Single-name CDS

A credit default swap where the underlying instrument is tied to one specific issuer or entity.

Skin in the game

When originators of loans or other risky instruments keep at least part of the risk for themselves.

Spread

The difference in yields between private debt instruments and government securities of comparable maturity.

SRISK

A systemic risk indicator based on the capital that a firm is expected to need if there is another financial crisis; short for "systemic risk."

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

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.

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.

Subcommittee on Quantum Information Science within the National Science and Technology Council (SCQIS)

The SCQIS coordinates federal research and development in quantum information science and related technologies under the auspices of the executive branch's National Science and Technology Council's Committee on Science.

Supplementary leverage ratio

Under Basel III, the ratio of a bank's Tier 1 (high-quality) capital to its total leverage exposure, which includes all on-balance-sheet assets and many off-balance-sheet exposures.

Swap

An exchange of cash flows agreed by two parties with defined terms over a fixed period.

Swap Data Repository (SDR)

A central recordkeeping facility that collects and maintains a database of swap transaction terms, conditions, and other information. In some countries, SDRs are referred to as trade repositories.

Swap execution facility

A trading platform market participants use to execute and trade swaps by accepting bids and offers made by other participants.

Society for Worldwide Interbank Financial Telecommunications (SWIFT)

Provides messaging services and interface software between wholesale financial institutions. SWIFT is organized as a cooperative owned by its members.

Syndicated loans

Financing provided by a group of lenders.

Systemic risk

Risk to systemwide financial stability.

Systemic risk indicators

Measures of the risks financial firms may pose to the financial system.

Tail risk

The perceived low-probability risk of an extreme event or outcome.

TED spread

The difference between three-month U.S. dollar LIBOR and Treasury bill rates.

Ten-year, 10-year forward rate

The interest rate investors expect to receive on 10-year Treasury securities in 10 years.

Term Asset-Backed Securities Loan Facility (TALF)

A Federal Reserve facility to finance asset-backed securities, such as securitized equipment leases, as well as credit card, auto, and other loans.

Tier 1 Capital Ratio and Common Equity Tier 1 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.

"Too Big To Fail" (TBTF)

The belief that the biggest financial firms will always be bailed out by the government if necessary. In 1984, the Comptroller of the Currency stated that the 11 largest banks could not be allowed to fail.

Total Loss-absorbing Capacity (TLAC)

A mix of long-term debt and equity that global systemically important bank holding companies are required to have to absorb losses and implement an orderly resolution without resorting to taxpayer-funded bailouts or extraordinary government measures.

Tranche

A portion of a securitized asset pool. From the French word meaning "slice."

Triparty repo

A repurchase agreement in which a third party, such as a clearing bank, acts as an intermediary for the exchange of cash and collateral between two counterparties. In addition to providing operational services to participants, agents in the U.S. triparty repo market extend intraday credit to facilitate settlement of triparty repos.

U.S. dollar swap line arrangements

Standing facilities with the Federal Reserve that allow key central banks to exchange domestic currency for U.S. dollars to satisfy dollar liquidity demand in their own markets.

Value-at-Risk (VaR)

A tool for market risk management that measures the risk of loss of a portfolio. The VaR projects the maximum expected loss for a given time horizon and probability. For example, the VaR over 10 days and with 99 percent certainty measures the most one would expect to lose over a 10-day period, 99 percent of the time. The problem is the other one percent, see tail risk.

Variable annuity

A tax-deferred insurance company contract where the owner can choose investment options whose values fluctuate with the underlying securities, much like mutual funds. Variable annuities may also include guarantees of minimum payments, which may exceed the value of the investment accounts.

Variation margin

Payment made by clearing members to the clearinghouse based on price movements of the contracts these members hold. See initial margin.

VIX

Chicago Board Option Exchange (CBOE) Volatility Index, a measure of 30-day expected volatility in the U.S. stock market.

Volcker Rule

Provision of 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.

Warehouse loans

A line of credit with a bank for nonbank lenders to use mortgages being accumulated for sale as collateral.

Weekly Economic Index

A Federal Reserve index of 10 daily and weekly economic indicators. It reflects what annualized percent change in gross domestic product would be if conditions persisted for a quarter.

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.

Work from home (WFH)

Historically an unconventional alternative to working in corporate office space. As a result of COVID-19 and various lockdowns, WFH increased in 2020. WFH is possibly a long-term trend with significant implications for commercial real estate, telecommunications, and other sectors.

Yield curve

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.

Zero lower bound

Previously, zero was said to be the lowest interest rate possible, constraining options for monetary policy. Negative interest rates are now common internationally, though not in the United States.

ENDNOTES

1 The Atlanta Federal Reserve's GDPNow figure came in significantly above 2% for the first half of 2021. However, it fell to between 1% and 2% in the third quarter. The New York Federal Reserve had nowcasted a GDP growth rate of between 3.5% and 4.5% for the third quarter before suspending publication of the model due to volatility induced by the pandemic.

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3 U.S. Government. 2021. "The Federal Response to COVID-19." USASPENDING.gov, July 31. <https://www.usaspending.gov/disaster/covid-19?publicLaw=all>.

4 The U.S. syndicated leverage loan market is approximately \$1.3 trillion. The CLO market holds about \$700 billion in syndicated loans.

5 Median debt ratio is based on a sample (3,400 firms as of Q2 2021) of investment grade, high yield, and unrated U.S. nonfinancial firms. The sample consists of many smaller, unrated companies with high debt ratios.

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- 22 The Coronavirus Aid, Relief, and Economic Security Act of 2020, Section 4013. <https://www.congress.gov/116/bills/hr748/BILLS-116hr748enr.pdf>
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39 SEC fails-to-deliver data shows failed deliveries of GameStop shares during January 2021 and earlier periods. However, fails-to-deliver can occur for reasons other than naked short selling. Fails-to-deliver can also occur with either short or long sales, making them an imperfect measure of naked short selling.

40 FINRA Rule 4560 requires broker-dealers to maintain records of and report certain short positions in customer accounts. In July 2021, as a response to meme stock volatility, the U.S. House of Representatives Committee on Financial Services passed H.R. 4618, the Short Sale Transparency and Market Fairness Act, which would target (if it becomes law) improved disclosures of short positions. <https://www.congress.gov/bill/117th-congress/house-bill/4618/text>.

41 The NSCC is a subsidiary of Depository Trust and Clearing Corp. (DTCC).

42 National Securities Clearing Corp. Rules and Procedures dated October 8, 2021, Rule 4. https://www.dtcc.com/~/media/Files/Downloads/legal/rules/nscc_rules.pdf.

43 Clearinghouses, like the NSCC, evaluate each member's customer holdings as a portfolio. Clearinghouses use a volatility multiplier, looking at specific stock holdings, to quantify risk. The clearinghouse may assign significant additional margin requirements based on how much of one stock a clearing member's customers hold. See Robinhood blog, Jan. 29, 2021. <https://blog.robinhood.com/news/2021/1/29/what-happened-this-week>.

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47 Since 1994, the SEC has taken the position that "disclosure is the appropriate response to issues raised by payment for order flow" and acknowledged that such payments "may result in lower execution costs, facilitate technological advances in retail customer order-handling practices, and facilitate competition among broker-dealers."

48 Surveys measuring investor optimism and certain valuation metrics were higher during the dot-com boom relative to the present.

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77 The share of U.S. Treasury and government holdings exclude the exposure to the Federal Reserve Bank of New York through its Reverse Repurchase Agreement Facility (RRP). As of Aug. 31, 2021, prime funds held \$136.8 billion in the Federal Reserve RRP, which was 18% of prime fund investments. At the end of March 2020, prime funds held \$49 billion in exposure, or 5% of prime fund investments. Prime funds' demand for the RRP is driven by the low interest rate environment and fewer attractive investment alternatives, as well as the June 30, 2021, rate and counterparty limit increases in March 2021 and September 2021.

78 Money market funds with floating net asset values may use amortized cost to value debt securities if the remaining maturities are 60 days or less. Directors of the fund must, in good faith, determine that the fair value of the debt securities is their amortized cost value, unless the particular circumstances warrant otherwise. (SEC Money Market Fund Reform; Amendments to Form PF, 1940 Act Release No. 31,166 (July 23, 2014). <https://www.sec.gov/rules/final/2014/33-9616.pdf>)

79 SEC Release No. IC-34188; File No. S7-01-21, Request for Comment on Potential Money Market Fund Reform Measures in President's Working Group Report. <https://www.sec.gov/rules/other/2021/ic-34188.pdf>. Daily money market flows are from iMoneyNet, a commercial data source that captures approximately 70% of industry activity. SEC Form N-MFP provides weekly flows data. From March 9 to March 20, outflows from institutional public prime funds (as proxied by their presence in commercial databases) totaled \$90 billion, or 27% of assets.

80 Retail prime funds recorded net redemptions of 9%, about \$40 billion of assets, from March 13 to March 26. The 10-day period when institutional and retail prime fund flows peak two-week periods do not coincide. For example, the two-week period for institutional prime funds begin a few days before that for retail prime funds, in part because institutional prime funds experienced heavy redemptions earlier than retail prime funds.

81 Other Federal Reserve facilities also supported money market funds indirectly by supporting the funding markets.

82 SEC. 2013. Money Market Fund Reform. Amendments to Form PF, Release No. IC-30551. June 5. <https://www.sec.gov/rules/proposed/2013/33-9408.pdf>; Moody's Investor Service. 2010. Moody's Investor Service, Sponsor Support Key to Money Market Funds. Aug. 9.; Schroeder, Richard. 1989. "Money Funds Seen As Secure Despite One Funds Failure." Buffalo News. July 26. https://buffalonews.com/news/money-funds-seen-as-secure-despite-one-firms-failure/article_57338e93-2450-547a-8525-06ed3eda0c74.html; and Ehrbar, Al. 1994. "The Great Bond Market Massacre." Fortune Magazine. Oct. 17.

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87 Different restrictions and limitations on permitted investments and different levels of reporting requirements.

88 Private liquidity funds are unregistered funds that invest in a portfolio of short-term obligations in order to maintain a stable net asset value or minimize principal volatility for investors. Many of these funds are securities lending reinvestment pools and other short-term investment funds. These funds are not subject to SEC 2a-7 rules. However, private liquidity funds and their parallel accounts are required to file Form PF and report basic identifying and operational information. The SEC quarterly Private Funds Statistics report summarizes Form PF reporting and includes some data on liquidity funds, <https://www.sec.gov/divisions/investment/private-funds-statistics.shtml>.

89 Federal Reserve, Financial Accounts of the United States.

90 The SEC adopted the Liquidity Rule to ensure that mutual funds implement effective liquidity risk management programs to help ensure the ability of funds to pay redeeming shareholders promptly and avoid dilution to remaining shareholders, and to temper the first mover advantage in times of market stress. Investment Company Liquidity Risk Management Programs, Investment Company Act, SEC Release No. 32315 (Oct. 13, 2016), <https://www.sec.gov/rules/final/2016/33-10233.pdf>.

91 It also permitted swing pricing, an adjustment to net asset values designed to impose associated trading costs on shareholders engaging in redemptions or purchases. This tool has not been implemented.

92 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.

93 The concept of liquidity mismatch is not strictly limited to fixed-income ETFs. Other ETFs that track relatively illiquid underlying assets face similar issues.

94 In-kind creation occurs when authorized participants (APs) transact directly with the ETF sponsor by delivering a basket of component securities in exchange for new shares of the ETF. In-kind redemption is the opposite. In-kind creation is contrasted with cash creation, where the AP pays the cash value of the ETF shares instead of delivering securities. The majority of U.S. listed ETFs use in-kind creation and redemption. One consequence of in-kind creation and redemption is that it transfers the liquidity risk of selling underlying securities from the fund sponsor to the APs and other secondary market participants. The remaining shareholders in the ETF do not bear any portion of the liquidation costs. See Hill et al. (2015) for a more detailed introduction to creation and redemption. Hill, Joanne M., Dave Nadig, and Matt Houghan. 2015. *A Comprehensive Guide to Exchange-Traded Funds (ETFs)*. Charlottesville: CFA Institute Research Foundation Books. May 1. <https://www.cfainstitute.org/en/research/foundation/2015/a-comprehensive-guide-to-exchange-traded-funds-etfs>.

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96 SEC. 2019 "Exchange-Traded Funds." Final rule, Federal Register 84, no. 206 (October 24):57162-57238. <https://www.federalregister.gov/documents/2019/10/24/2019-21250/exchange-traded-funds>.

97 Todorov, Karamfil. 2021. "The Anatomy of Bond ETF Arbitrage." *BIS Quarterly Review*, March. https://www.bis.org/publ/qtrpdf/r_qt2103d.htm.

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101 Notice of Filing of Proposed Rule Change to Amend the Supplemental Liquidity Deposit Requirements dated March 18, 2021. <https://www.sec.gov/rules/sro/nscc/2021/34-91350.pdf>

102 Liquidity risks arising from margin calls. European Systemic Risk Board. (June 2020) https://www.esrb.europa.eu/pub/pdf/reports/esrb.report200608_on_Liquidity_risks_arising_from_margin_calls_3~08542993cf.en.pdf?8380a2a90041200ca6e5c008138a127e

103 Board of Governors of the Federal Reserve System. 2021. "Federal Reserve Board Releases Results of Annual Stress Test..." Press Release, June 24. <https://www.federalreserve.gov/newsevents/pressreleases/bcreg20210624a.htm>.

104 Board of Governors of the Federal Reserve System. 2020. "Federal Reserve Board Announces Individual Large Bank Capital Requirements." Press release, Aug. 10. <https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200810a.htm>.

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106 2020 OFR Annual Report pages 93-94. <https://www.financialresearch.gov/annual-reports/2020-annual-report/>.

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