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Financial Stability Assessment

The U.S. financial stability outlook remains in a medium range. Many steps have been taken since the global financial crisis to improve the resilience of the financial system. Banks are more liquid and better capitalized. Transparency has markedly increased at markets and institutions. As in the years before the crisis, though, an extended period of low funding costs and benign economic conditions has supported complacency, low volatility, and risk-taking in some markets.

Chapter 1 highlighted three key threats to financial stability. In this chapter, we discuss our overall assessment of financial stability, taking into account vulnerabilities in the financial system and its resilience to shocks. The chapter is organized in six risk categories: (1) macroeconomic, (2) market, (3) credit, (4) solvency and leverage, (5) funding and liquidity, and (6) contagion. Our new Financial System Vulnerabilities Monitor, a heat map of key risk indicators, and our Financial Stress Index contribute to this analysis.

Anniversaries provide the opportunity to take stock of where we've been and where we're going. In developing our financial stability assessment this year, we considered it especially relevant that the United States is now in the early stages of 10-year anniversaries of key events from the 2007-09 global financial crisis. Compared to 10 years ago, financial institutions, especially banks, are better capitalized and have lower leverage and more diversified sources of funding. But some financial activities remain susceptible to runs, and new risks and vulnerabilities have emerged. As before the crisis, markets have benefited from an extended period of cash influx and a long economic expansion. As then, these conditions have promoted risk-taking.

Introducing Our New Heat Map and Stress Index

The OFR developed two new monitoring tools in 2017: the Financial System Vulnerabilities Monitor (FSVM) and the Financial Stress Index (FSI).

Monitoring financial stability requires tracking vulnerabilities and stress. Vulnerabilities are the factors that can originate, amplify, or transmit a disruption in the financial system. For example, the reliance of broker-dealers like Lehman Brothers on short-term wholesale funding was a vulnerability that allowed runs on those firms in 2008. Stress is a disruption in the normal functioning of the financial system. Stress can be minor, like a brief period of uncertainty and price volatility in the equity market. Or it can be major, like the runs on Lehman and other broker-dealers in 2008.

High or rising vulnerabilities indicate high or rising risk of disruptions in the future. A high level of stress indicates a disruption today.

The OFR Financial System Vulnerabilities Monitor

The FSVM is a heat map of 58 indicators of potential vulnerabilities. It gives early warning signals for further investigation, not conclusive evidence of vulnerabilities. We investigate these signals as part of our broader monitoring and assessment.

The monitor has six categories of indicators. The categories reflect key types of risks that have contributed to financial instability in the past: (1) macroeconomic, (2) market, (3) credit, (4) solvency and leverage, (5) funding and liquidity, and (6) contagion.

The colors in the heat map mark the position of each indicator in its long-term range. For example, red signals that a potential vulnerability is high relative to its past. Orange signals that it is elevated. Movement toward red indicates that a potential vulnerability is building.

The FSVM improves upon and replaces the OFR's Financial Stability Monitor (FSM), which combined signals of vulnerabilities and stress. The FSVM focuses on

vulnerabilities alone, providing clearer and earlier signals of potential risks, while the FSI focuses on monitoring stress. The FSVM includes a category for financial institution solvency and leverage that was not in the FSM. The FSVM will be released quarterly rather than semi-annually, another improvement on the FSM.

The OFR Financial Stress Index

The FSI is a daily market-based snapshot of stress in global financial markets. It is constructed from 33 financial market indicators. The indicators are organized into five categories: (1) credit, (2) equity valuation, (3) funding, (4) safe assets, and (5) volatility.

The index measures systemwide stress. It is positive when stress levels are above average, and negative when stress levels are below average. Unlike financial stress indexes produced by others, the OFR's FSI can be decomposed into contributions from each of the five categories. It also can be broken down by the region generating the stress.

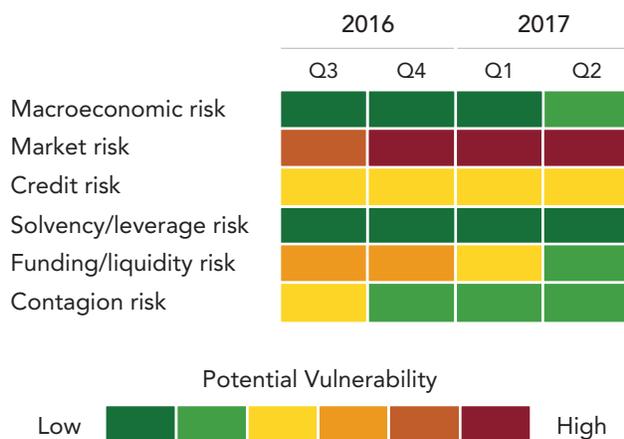
The OFR's FSI has other novel elements and methodology. It uses a dynamic process to account for changing relationships among the variables in the index. The daily frequency improves upon the weekly or monthly frequency of some other financial stress indexes.

The FSVM and FSI are part of the OFR's quantitative monitoring toolkit. They signal where the OFR needs to investigate potential vulnerabilities. We conduct those investigations using a wider set of data, qualitative information, and expert analysis. We then report our overall assessment of threats and systemwide risk in this chapter of our *Financial Stability Report* and in our *Annual Report to Congress*.

The Dodd-Frank Act mandates the OFR to monitor risks to the nation’s financial stability and to develop tools for risk measurement and monitoring. As part of fulfilling that mandate, the OFR developed two new tools in 2017: the Financial System Vulnerabilities Monitor (FSVM) and the Financial Stress Index (FSI). The FSVM measures vulnerabilities — the underlying weaknesses that can disrupt the financial system in the future. It is a modified version of the Financial Stability Monitor we have used since 2013. The FSI tracks stress in the financial system today (see [Introducing Our New Heat Map and Stress Index](#)).

Market vulnerabilities now are high, based on our FSVM heat map, as well as on our qualitative judgment (see [Figure 9](#)). Valuations in equity and fixed-income markets are stretched by historical standards. The heat map also shows elevated or high signals in certain consumer and nonfinancial business debt ratios, federal government debt and deficit levels, and some other indicators. But the signals from the heat map do not provide conclusions about financial stability. They suggest where additional investigation is needed.

Figure 9. Financial System Vulnerabilities Monitor: Aggregate Scores

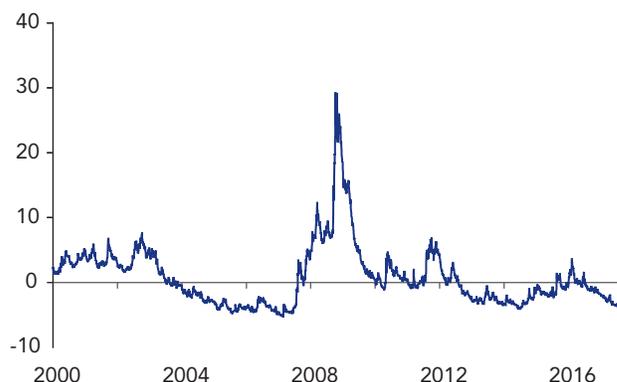


Note: Figure is excerpted from the OFR Financial System Vulnerabilities Monitor. Technical information about the monitor is available at <https://www.financialresearch.gov>.

Sources: Bloomberg Finance L.P., Compustat, Federal Financial Institutions Examination Council Call Reports, Federal Reserve Form Y-9C, Haver Analytics, Morningstar, SNL Financial LC, the Volatility Laboratory of the NYU Stern Volatility Institute (<https://vlab.stern.nyu.edu>), OFR analysis

Figure 10. OFR Financial Stress Index (points)

Financial stress levels are near post-crisis lows



Note: Technical information about this index is available at <https://www.financialresearch.gov>.

Sources: Bloomberg Finance L.P., Haver Analytics, OFR analysis

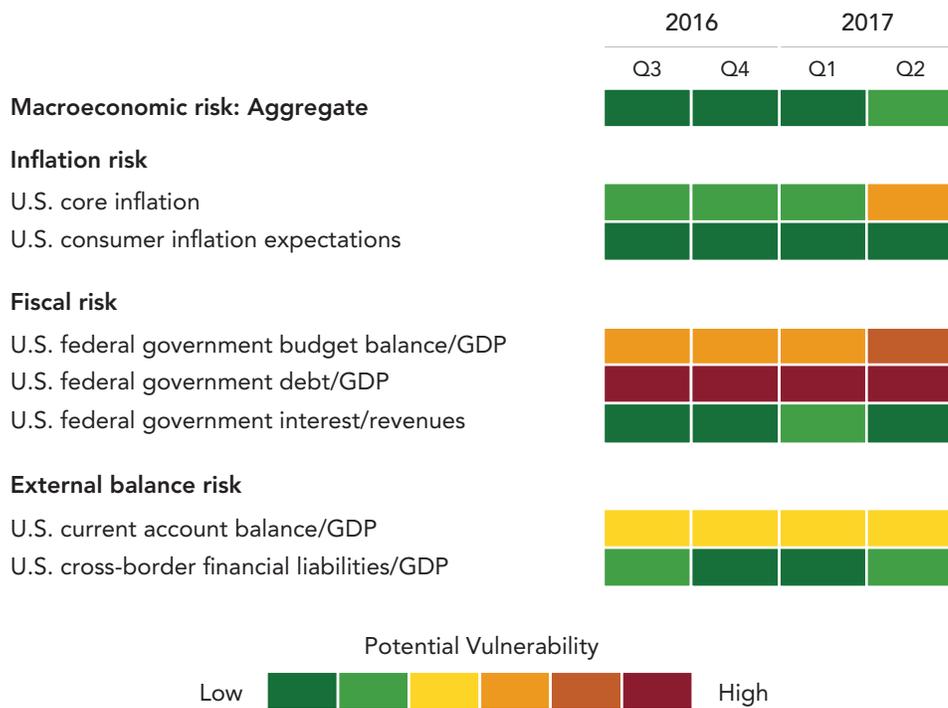
The FSI shows financial market stress near post-crisis lows in 2017 (see [Figure 10](#)). The current index reading below zero indicates that the level of stress is below average. That low reading is driven by extremely low market volatility measures.

2.1 Macroeconomic Risks are Moderate

The U.S. economy continues to expand at a moderate pace. The current U.S. economic expansion is now the third longest since 1850.

Core inflation is somewhat below the Federal Reserve’s preferred 2 percent rate, and inflation expectations remain subdued. The consensus forecast among economists is for a 2 percent rise in the Consumer Price Index over the next year, according to a variety of sources (see Bloomberg, 2017). The current rate of inflation is similar to the rate in 2005-06. However, inflation expectations are much lower now than they were then. Low inflation in a full-employment economy runs counter to expectations. There may be a greater risk of sudden shifts in inflation or inflation expectations today that could have negative financial and economic effects.

Figure 11. Financial System Vulnerabilities Monitor: Macroeconomic Risk



Note: GDP stands for gross domestic product. Figure is excerpted from the OFR Financial System Vulnerabilities Monitor. Technical information about the monitor is available at <https://www.financialresearch.gov>.

Sources: Haver Analytics, OFR analysis

Our heat map points to a potential macroeconomic vulnerability for the U.S. financial system: federal government debt and deficit levels (see Figure 11). In 2016, federal government debt as a percent of gross domestic product (GDP) reached its highest point in decades. Currently, this vulnerability is mitigated by the relatively low ratio of interest payments to federal revenue and investors' tolerance for a high level of U.S. government marketable debt. Very low interest rates make higher debt levels affordable. The federal government deficit as a percentage of gross domestic product remains elevated, which increases the debt burden over time. The Congressional Budget Office has stated that policy changes are needed to stabilize the long-term path of the federal government debt burden (see CBO, 2017).

Risks of financial and real shocks spilling over to the United States from China remain a concern, although they have eased somewhat over the past year. China's

credit overhang is still high by world standards. Direct U.S. claims on China are limited. However, China's official sector is a major investor in U.S. Treasury and agency bonds. Those holdings could be a source of contagion if China were to sell rapidly amid capital flight. There are also significant indirect exposures through other Asian markets and the global economy (see Ker, 2017).

Four of the largest five banks globally are from China, suggesting that an adverse shock to the Chinese financial system could have global consequences. Despite their size, these banks don't rank high in systemic importance compared to their international peers, according to international measures of systemic importance. However, their systemic importance is growing (see Loudis and Allahrakha, 2016).

Given China's footprint in the global economy, a relatively sharp decline in Chinese GDP growth may ultimately affect the U.S. economy. The Federal Reserve

Bank of Dallas estimated that a 1 percent decrease in China’s GDP growth would directly lower U.S. growth by 0.2 percent (see Chudik and Hinojosa, 2016). The effects of an adverse economic scenario in China could be much larger if it led to a deterioration in global and U.S. investor confidence.

Another potential source of uncertainty is the manner in which the United Kingdom withdraws from the European Union, as discussed in the OFR’s *2016 Financial Stability Report*. Disruptions would most affect those U.S. financial institutions with large direct financial exposures. A more disorderly exit could disrupt London’s position as a leading financial center, with repercussions for U.S. financial markets and firms.

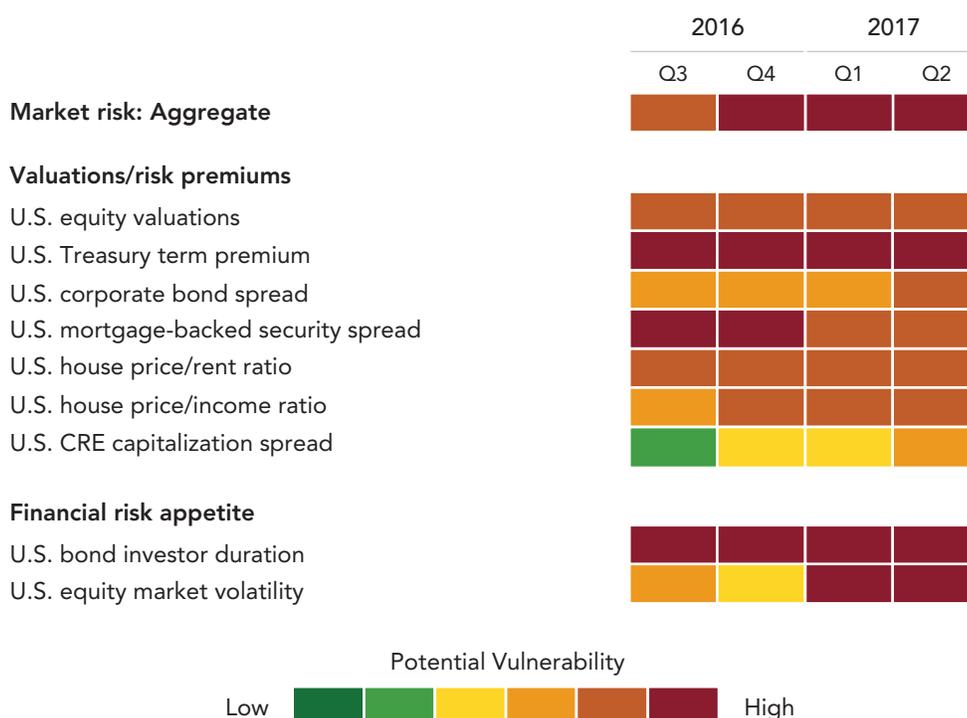
Periods of uncertainty may lower the risk tolerance of global investors in the months ahead. After the Brexit vote, economic policy uncertainty in the United

Kingdom rose to levels that were more than five times larger than in 2015. Such uncertainty can be measured using quantitative approaches that analyze newspaper articles. By those measures, growing uncertainty is highly correlated with declining cross-border banking inflows; the correlation is negative 37 percent. Banking inflows to the United Kingdom declined 11.2 percent from the end of 2015 to the end of 2016, according to data from the Bank for International Settlements.

2.2 Market Risks Remain Elevated

Market risks — risks to financial stability from movements in asset prices — remain high and continue to rise (see **Figure 12**). The OFR has highlighted in each of our annual reports the risk that low volatility and persistently low interest rates may promote excessive

Figure 12. Financial System Vulnerabilities Monitor: Market Risk



Note: CRE stands for commercial real estate. Figure is excerpted from the OFR Financial System Vulnerabilities Monitor. Technical information about the monitor is available at <https://www.financialresearch.gov>.

Sources: Bloomberg Finance L.P., Haver Analytics, OFR analysis

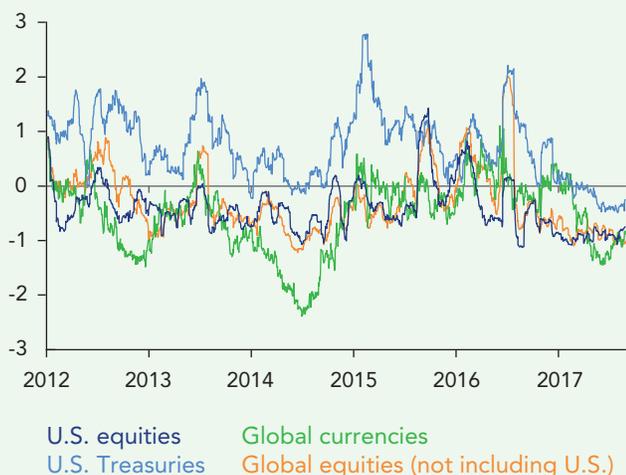
What Low Volatility May Mean for Financial Stability

Volatility indicators for most asset classes across global financial markets are currently low relative to their levels since the financial crisis (see Figure 13). U.S. equity market volatility is close to all-time lows (see Figure 14). Market volatility for U.S. corporate bonds, however, is near historical averages, as of July 2017.

There are two prominent views about what drives low-volatility environments. One view holds that low volatility simply reflects the view of market participants that the probability of a recession is low. Consensus analyst estimates call for a robust 11 percent increase in corporate earnings this year. In addition, the variation in estimates

Figure 13. Realized Volatility by Asset Class (z-score)

Realized volatility is currently low relative to historical levels

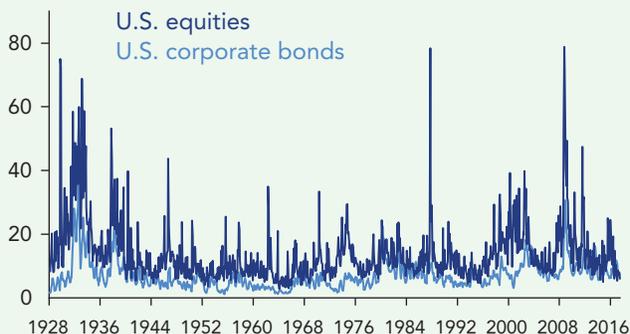


Note: Realized volatility is the standard deviation of daily returns over 30 days, expressed as annualized percent change. U.S. equities are represented by the S&P 500 index. U.S. Treasuries are the weighted average of the Treasury yield curve. Global currencies are based on weights from JPMorgan VXY (JPMVXY) index. Global equities are MSCI All Countries World Excluding U.S. Index. Z-score represents the distance from the average, expressed in standard deviations. Standardization uses data since Jan. 1, 1993.

Sources: Bloomberg Finance L.P., OFR analysis

Figure 14. Volatility by Asset Class (percent)

Current volatility levels are low when viewed from the perspective of a broader sweep of time



Note: Data as of July 31, 2017. Values reflect monthly volatility based upon daily returns.

Sources: Calculated based on data from the Center for Research in Security Prices © Center for Research in Security Prices (CRSP®), the University of Chicago Booth School of Business; Global Financial Data; OFR analysis

across forecasters is low for corporate earnings, economic growth, and inflation. Low variation may imply low uncertainty about the underlying fundamentals.

The other view holds that low volatility may serve as a catalyst for market participants to take more risk. By this logic, low volatility makes the financial system more fragile. This phenomenon is known as the volatility paradox. There are a number of channels through which low volatility may contribute to greater leverage and risk-taking (see OFR, 2017c). Low volatility may lull investors into underestimating the odds of a volatility spike. Investors may also reduce their hedging activity, understating the risk in their positions.

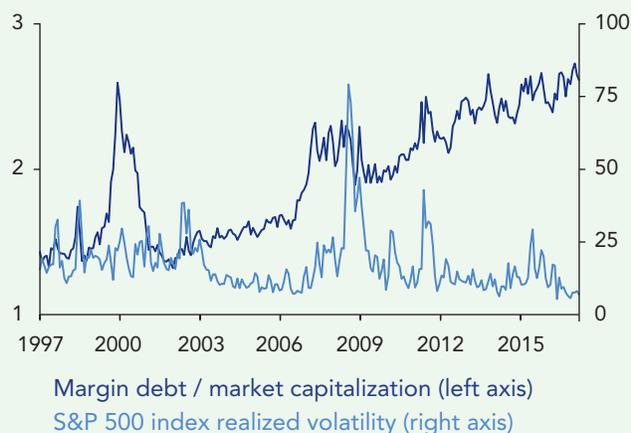
While distinguishing which view is true for the current low-volatility environment is difficult, there is some evidence that investors have increased leverage in recent years. The margin debt balances relative to market capitalization on the New York Stock Exchange are displayed in Figure 15. The ratio increased from 2002 to 2007

amid low volatility, declined after the crisis, and has been climbing since the crisis as volatility again reached long-term lows. This ratio is not a complete measure of investor leverage, as it doesn't include other means through which investors can take on leverage, such as derivatives positions. Some large investors continue to be highly leveraged and, for that reason, may be susceptible to a sudden increase in volatility. For example, the top decile of macro and relative-value hedge funds has been leveraged about 15 times in recent quarters. Combined, these funds account for more than \$800 billion in gross assets, about one-sixth of all hedge fund assets.

Data from the Commodity Futures Trading Commission (CFTC) indicate a similar pattern of increasing leverage for speculative traders. The CFTC provides information on futures positions for hedge funds and other investors, which they refer to as "non-commercial" or speculative traders. As of May 2017, the net short position on the

Figure 15. Margin Debt Balance over Market Capitalization and S&P 500 Index 30-Day Realized Volatility (percent)

Realized volatility has fallen as investors increased margin debt

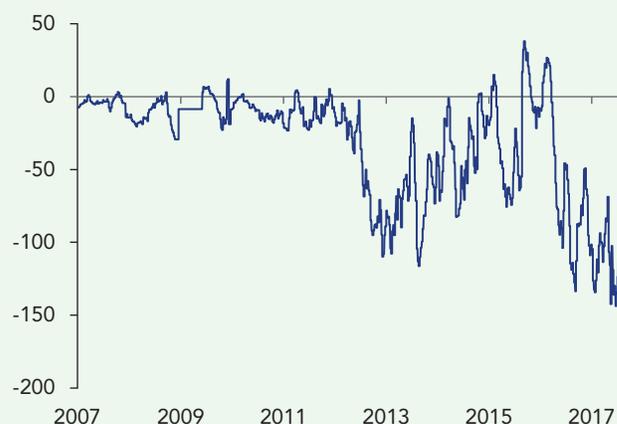


Note: Data as of June 30, 2017. Values are the New York Stock Exchange (NYSE) market capitalization and margin debit balances of its members. Dealer margin debit balances may reflect positions on securities not listed on the NYSE. Realized volatility is the standard deviation of daily returns over 30 days expressed as annualized percent change.

Sources: Haver Analytics, OFR analysis

Figure 16. Net Speculative Positions on VIX Futures (thousands of positions)

Speculators increased short bets on volatility



Note: VIX stands for the Chicago Board Options Exchange Volatility Index.

Source: Bloomberg Finance L.P.

Chicago Board Options Exchange Volatility Index (VIX) futures of non-commercial traders sat at levels higher than before the crisis (see Figure 16). Common volatility strategies involve taking short positions in longer-dated contracts and long positions in shorter-dated contracts. Reduced hedging in these strategies would imply shorting in the aggregate, consistent with Figure 16.

Low volatility may increase risk-taking in other ways as well. Correlations of returns across markets tend to be muted when volatility is low and increase sharply when markets become more volatile. Low correlations could entice investors to accumulate risky exposures, believing they are diversified. Prolonged periods of low volatility may further decrease correlations and encourage risk-taking. They can also encourage the use of yield-enhancing strategies that are more likely to incur extraordinary losses to the investor if prices sharply decline.

In summary, there is some evidence that investors may have adapted to the low-volatility environment by increasing risk exposures and leverage. These activities may reduce their resilience to a large volatility shock.

risk-taking and create vulnerabilities. In 2017, strong earnings growth, steady economic growth, and increased expectations for stimulative fiscal policy have provided further support to asset valuations. The increase in already-elevated asset prices and the decrease in risk premiums may leave some markets vulnerable to a large correction. Such corrections can trigger financial instability when important holders or intermediaries of the assets employ high degrees of leverage or rely on short-term loans to finance long-term assets. Historically low volatility levels reflect calm markets, but could also suggest that the financial system is more fragile and prone to crisis (see **What Low Volatility May Mean for Financial Stability**).

Equity valuations are high by historical standards. The cyclically adjusted price-to-earnings ratio of the S&P 500 is at its 97th percentile relative to the last 130 years. Other equity valuation metrics that the OFR monitors are also elevated (see Berg, 2015; OFR, 2015; OFR, 2016).

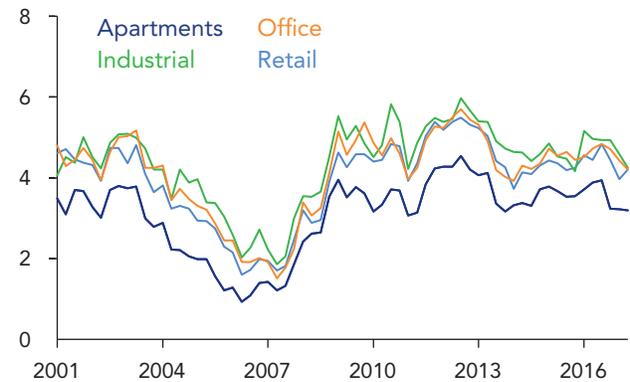
Real estate is another area of concern. U.S. house prices are elevated relative to median household incomes and estimated national rents, although these ratios are well below the levels observed just before the financial crisis. Growth in commercial real estate prices — highlighted in our *2016 Financial Stability Report* — slowed in 2017. Capitalization rates for most types of commercial real estate are close to multi-decade lows, suggesting lofty valuations; however, their spreads to U.S. Treasury rates are in line with historical norms (see **Figure 17**).

Valuations are also elevated in bond markets. Long-term U.S. interest rates and term premiums remain low, despite a long span of steady economic growth, low unemployment, and gradual Federal Reserve monetary tightening. Treasury term premiums are negative. Risk premiums in corporate bonds have fallen to near post-crisis lows (see **Figure 18**).

Duration — the sensitivity of bond prices to interest rate moves — has steadily increased since the crisis. In early 2017, the duration of the Barclays U.S. Aggregate Bond Index reached an all-time high of just over 6 years. It averaged about 4.5 years in the mid-2000s. The Barclays index has a market capitalization of close to

Figure 17. Capitalization Rate Spread to U.S. 10-Year Treasury Notes (percentage points)

Across property types, cap rate spreads to Treasuries are in line with historical norms

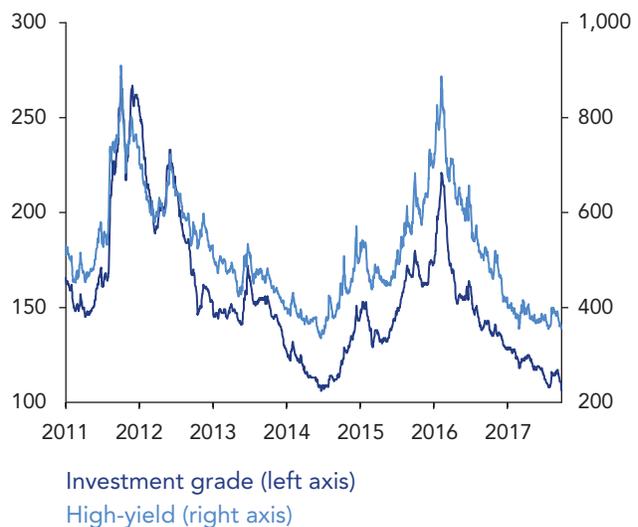


Note: Data as of June 30, 2017. The capitalization rate is the ratio of net operating income to property value.

Sources: Bloomberg Finance L.P., Haver Analytics, OFR analysis

Figure 18. U.S. Corporate Bond Spreads (basis points)

Spreads are near cyclical lows



Note: Spreads are option-adjusted.

Source: Haver Analytics

Figure 19. Market Value Impact of 100 Basis-Point Rate Shock (\$ billions, inflation-adjusted)

Interest rate sensitivity has increased to an all-time high



Note: Analysis applies to the Barclays U.S. Aggregate Index. Values are in 2017 inflation-adjusted dollars.

Sources: Bloomberg Finance L.P., Haver Analytics, OFR analysis

\$20 trillion and includes Treasury securities, corporate bonds, asset-backed securities, and mortgage-backed securities.

At current duration levels, a 1 percentage point increase in interest rates would lead to a decline of almost \$1.2 trillion in the securities underlying the index (see [Figure 19](#)). But that estimate understates the potential losses. The index does not include high-yield bonds, fixed-rate mortgages, and fixed-income derivatives. A sudden decline in bond prices would lead to significant distress for some investors, particularly those that are highly leveraged. For example, in the “bond massacre” after interest rates suddenly spiked in 1994, Orange County, California, filed for bankruptcy due in part to losses on its mortgage derivatives portfolio. The potential market losses from an interest rate spike are now much higher than they were in 1994, adjusted for inflation (see [Figure 19](#)). Market participants also may overreact to an interest rate spike, as arguably happened during the 2013 bond market sell-off known as the taper tantrum.

Investor willingness to accept higher duration risk is another example of potential market excess. Two factors have driven durations higher. First, the underlying

bonds that make up the Barclays index have longer maturities than in the past. The longer the maturity of a bond, the higher the duration. Second, interest rates have declined substantially, which has increased the average duration of the index, weighted by the size of issuance for each bond in the index.

Several mitigating factors offset the potential systemic spillovers from increased duration risk exposures. First, investors such as pension funds and insurance companies have long-duration liabilities that provide a hedge to any market losses in their fixed income portfolios. Second, the Federal Reserve has been very clear about its intention to raise interest rates gradually. This approach has reduced market uncertainty about interest rates. Third, market expectations for inflation remain modest, which for now caps any material increase in longer-term bond yields. Duration risks may be contained as long as interest rates and inflation remain within market expectations.

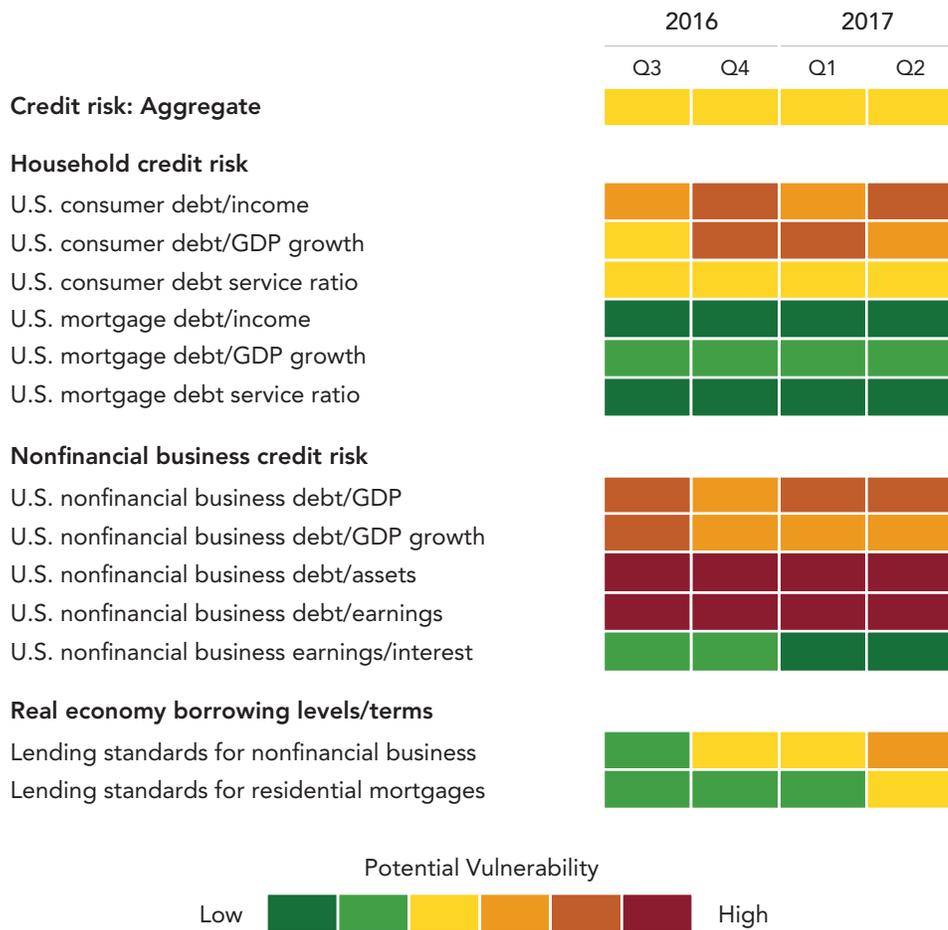
2.3 Credit Risks Elevated in Nonfinancial Corporate, Student, and Auto Debt

Some measures of credit risk — the risk of borrowers or counterparties not meeting financial obligations — have moderated from last year. However, the OFR’s Financial System Vulnerabilities Monitor suggests that credit risk in the nonfinancial private sector is elevated, primarily in the nonfinancial corporate sector. Household credit risk is moderate overall, but there are some excesses that may be vulnerabilities.

Corporate credit risks. Growth in nonfinancial corporate debt continues, although at a slower pace than in 2016. A growing economy and improving profits have boosted interest coverage ratios and reduced default rates. These are positive developments, but there are two primary concerns.

First, nonfinancial business leverage ratios, which compare debt to assets and earnings, exceed their peak in the prior cycle and are flashing red on the heat map (see [Figure 20](#)). Business debt levels are at all-time highs. Unusually low global interest rates have boosted

Figure 20. Financial System Vulnerabilities Monitor: Credit Risk



Note: GDP stands for gross domestic product. Figure is excerpted from the OFR Financial System Vulnerabilities Monitor. Technical information about the monitor is available at <https://www.financialresearch.gov>.

Sources: Compustat, Haver Analytics, OFR analysis

demand for higher-yielding securities, particularly from foreign investors. High-yield loan issuance has also grown rapidly in recent years as demand for floating-rate securities has increased.

Second, covenant quality may be weakening. Corporate bond and loan covenants are meant to protect existing investors. For example, covenants may limit a borrower’s total leverage or restrict its business activities. Historically, weaker covenants accompany issuance booms and may signal lower credit quality (see Ayotte and Bolton, 2009). Investors may demand higher yields when covenants weaken. However, covenant protections

weakened in 2017, while high-yield spreads actually trended lower (see Figure 21). More specifically, high-yield “covenant-lite” bonds are speculative-grade bonds that lack certain key covenants. These bonds represented a record 51 percent of issues in the rolling three-month period ending in July, according to Moody’s Covenant Quality Indicator. Covenant-lite loans represent 69 percent of leveraged loans outstanding, down from 73 percent in 2016 but still historically high. Leveraged loans are commercial loans provided by groups of lenders. The loans are packaged into securities and sold to other banks and institutional investors.

Figure 21. Moody's Covenant Quality Indicator (score)

Weaker covenant protections are a vulnerability



Note: The weakest-level protection threshold is a lower bound, as defined by Moody's, for assessing covenant quality. The vertical axis is inverted so that a downward trend represents poorer covenant quality.

Source: Moody's Investors Service

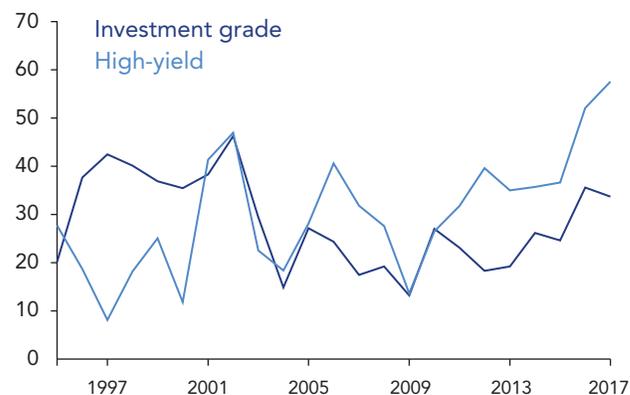
On the positive side, many companies have rolled over existing debt at lower interest rates, while also lengthening maturities of their debt. These steps make servicing the outstanding debt less costly and boost these companies' creditworthiness. In 2017, almost 60 percent of high-yield bond deals, by count, included repayment of debt as a use of proceeds. This is the highest level since at least 1995 (see Figure 22).

Defaults by energy and materials companies led overall non-investment-grade default rates higher in 2015, following a decline in commodity prices. But the trend in default rates changed after commodity prices rebounded. Excluding commodities-related companies, the default rate for non-investment-grade, nonfinancial corporations has held steady at about 2 percent in recent years.

Household credit risks. Household credit risks are rising, but appear to be concentrated in the non-mortgage segment of that market. Mortgage debt risks remain moderate after the major deleveraging following the financial crisis. Auto and student loans account for much of the recent growth in household debt and delinquencies (see Figure 23). Student loan delinquencies have been elevated since 2012. Auto loan delinquencies

Figure 22. Share of New Bond Deals Used for Repayment of Debt (percent)

Share of high-yield deals used to repay debt has reached record high

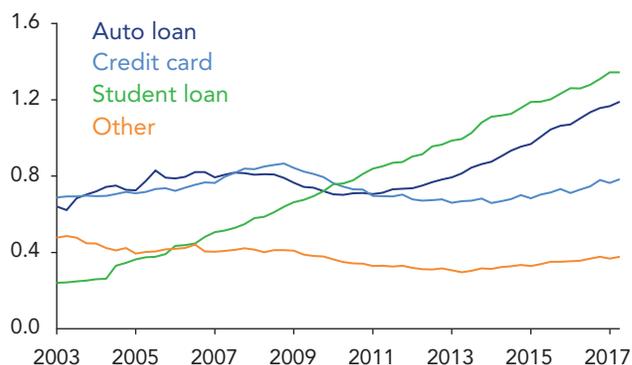


Note: Values represent the share of new bond issuance based on count of deals, not dollar amount, where the use of proceeds is reported to include repayment of debt.

Sources: Dealogic, OFR analysis

Figure 23. U.S. Nonmortgage Household Debt (\$ trillions)

Growth is driven by auto and student loans



Note: Data as of June 30, 2017. "Other" includes consumer finance loans (sales financing, personal loans) and retail loans (clothing, grocery, department stores, home furnishings, gas, etc.).

Sources: Federal Reserve Bank of New York, OFR analysis

have been rising since 2015, although they are below their 2011 peak. Considering their rapid growth and declining credit quality, these areas bear monitoring. However, given their limited linkages to important markets or institutions, a problem in these markets is currently unlikely to threaten U.S. financial stability.

There are signs banks are tightening their lending standards for consumers. In the Federal Reserve’s October Senior Loan Officer Opinion Survey on Bank Lending Practices, more banks reported tightening lending standards on credit cards and auto loans than reported weakening the standards or leaving the standards unchanged. Banks reported standards unchanged for other types of consumer loans. Future changes in lending standards bear watching. Research shows these standards typically tighten just before

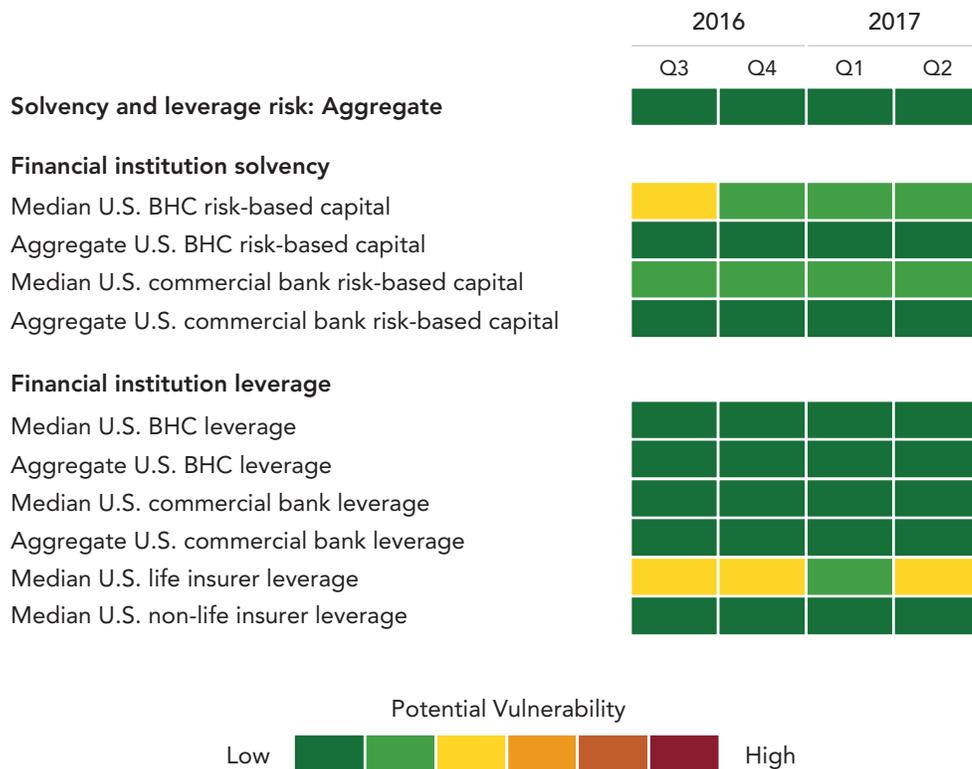
and during recessions (see Bernanke and Lown, 1991; Schreft and Owens, 1991).

2.4 Solvency and Leverage Risks Are Low for Banks, But Some Nonbanks Bear Monitoring

The failure or near-failure of large financial institutions has been a central source of stress during serious financial crises, including the 2007-09 global crisis. The OFR heat map now includes indicators of solvency and leverage for U.S. banks, bank holding companies, and insurance companies (see Figure 24).

Based on these measures, bank solvency and leverage risks are near their lowest levels since 1990. The heat map measures bank solvency risk by the amount of risk-based

Figure 24. Financial System Vulnerabilities Monitor: Solvency and Leverage Risk



Note: BHC stands for bank holding company. Figure is excerpted from the OFR Financial System Vulnerabilities Monitor. Technical information about the monitor is available at <https://www.financialresearch.gov>.

Sources: Bloomberg Finance L.P., Federal Financial Institutions Examination Council Call Reports, Federal Reserve Form Y-9C, Haver Analytics, OFR analysis

capital that banks hold in excess of regulatory requirements. It measures bank leverage by tangible assets over tangible equity. Higher leverage equates to higher solvency risk, all else equal. Tangible capital ratios were better gauges of bank solvency during the crisis than regulatory capital ratios (see Demirguc-Kunt, Detragiache, and Merrouche, 2013). For insurance companies, leverage is measured as assets divided by equity on a Generally Accepted Accounting Principles (GAAP) basis.

Large banks have higher capital, higher capital requirements, and lower leverage today than before the crisis. The eight U.S. global systemically important banks (G-SIBs) have significant capital and liquidity buffers above regulatory minimum requirements, which further reduces their risk of insolvency.

The largest U.S. banks are also now required to hold capital to remain solvent and continue lending through a severe global recession. The largest banks passed their most recent round of Federal Reserve supervisory stress tests. The most severe hypothetical scenario projected \$383 billion in loan losses for the 34 participating bank holding companies over nine quarters. The test assumed stress in corporate loans and commercial real

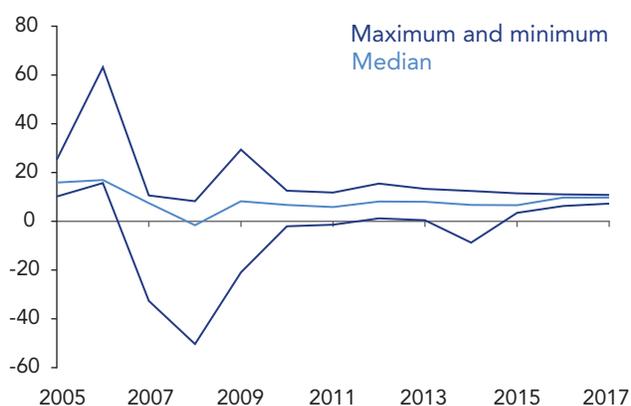
estate. Overall, the risk-weighted capital ratios of the 34 holding companies would fall from the actual level of 12.5 percent in 2016 to a minimum of 9.2 percent in the stress scenario.

Bank profits are gradually starting to improve as interest rates rise, but remain relatively low. Since the recession, the U.S. G-SIBs' return on equity has converged at around 10 percent (see Figure 25). In the years leading up to the crisis, commercial banks with assets of \$10 billion or more reported returns on equity averaging 12-17 percent (FDIC, 2017b). Earnings are the first buffer against loss. Capital is the second. Low long-term interest rates have helped stabilize the economy, but may make banks and other financial institutions more vulnerable in the long run. That is, while higher capital ratios mean there are larger capital buffers in place now, the ability of banks to replenish those buffers when they are depleted is restrained by low earnings.

Modest returns can also create incentives to pursue riskier lines of business. For example, G-SIB lending to nonbank financial firms has increased markedly (see Figure 26). Available data do not show where these nonbanks invest the funds they borrow from banks.

Figure 25. U.S. G-SIB Returns on Average Equity (percent)

G-SIB profitability has converged at modest levels

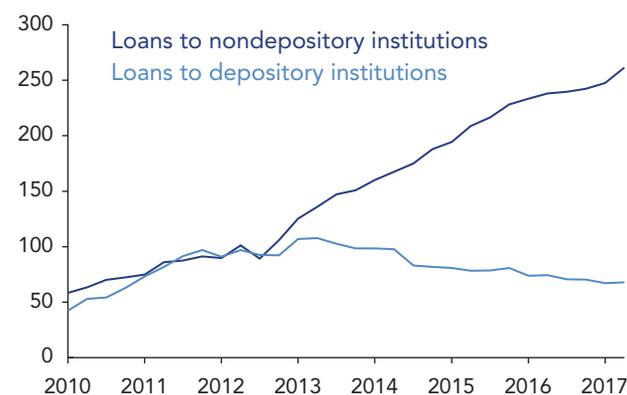


Note: Data as of June 30, 2017. G-SIB stands for global systemically important bank.

Sources: SNL Financial LC, OFR analysis

Figure 26. U.S. G-SIB Depository vs. Nondepository Loans (\$ billions)

G-SIB loans to nondepository institutions have quadrupled since 2010, while loans to banks have stagnated



Note: Data as of June 30, 2017. G-SIB stands for global systemically important bank.

Sources: SNL Financial LC, OFR analysis

Through this channel, banks may be indirectly exposed to risks that supervisors are seeking to discourage them from taking directly. That is, banks may be exposed to nonbank borrowers taking risks the banks themselves would have taken on in the past.

Insurance company leverage is moderate overall, as shown in the heat map. However, the heat map indicator may understate the future risks of derivatives exposures, which are substantial for some life insurers. Changes within the insurance industry affect these trends. Since the crisis, insurers are typically managed more conservatively, using less leverage. As noted in Chapter 1, some life insurers have branched out into noncore business activities.

Nonbank broker-dealer leverage, which is not reflected in the heat map, also merits close monitoring. The largest U.S. broker-dealers are now mostly affiliated with bank holding companies. At the same time, changes in bank regulation may be encouraging activities to shift to broker-dealers not affiliated with bank holding companies. Since the 2010 launch of Basel III,

the post-crisis international bank regulation framework, nonbank broker-dealer assets as a share of total broker-dealer assets have risen from 14 percent to 19 percent. The largest nonbank broker-dealers — those with more than \$10 billion in assets — are substantially more leveraged than their bank-affiliated peers (see [Figure 27](#)). OFR research on the repurchase agreement (repo) market suggests that the introduction of more-stringent bank capital regulation was associated with an increase in the number of nonbank broker-dealers active in the triparty repo market (see Allahrakha, Cetina, and Munyan, 2016). Unlike regulation of banks, regulation of broker-dealers has changed little since the crisis. This analysis also illustrates how regulation can encourage activities to migrate among financial firms.

2.5 Vulnerabilities Remain in Funding and Liquidity

The resilience of market liquidity remains a concern, as discussed in earlier OFR financial stability reports. Liquidity risks are difficult to measure in advance of stress. Our heat map also suggests several other potential vulnerabilities that merit consideration (see [Figure 28](#)).

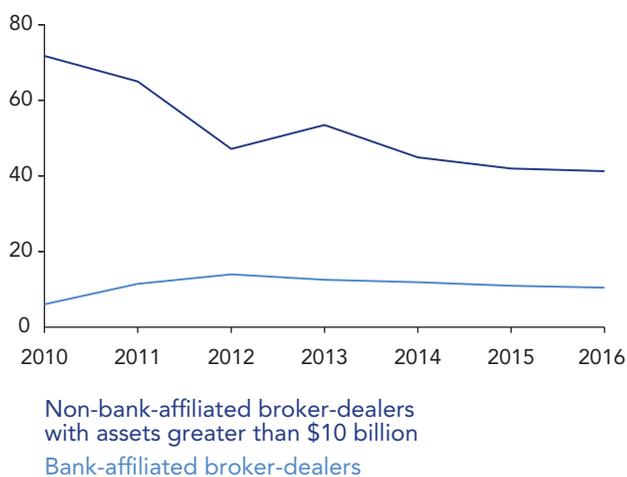
Funding liquidity is the availability of credit to finance a firm's obligations. Funding liquidity is subject to run risk — the risk that investors will lose confidence and pull their funding from a firm. Market liquidity reflects the ability of a market participant to buy or sell an asset in a timely manner at relatively low cost. A lack of market liquidity may lead to fire-sale risk — the risk that market participants won't be able to sell securities without creating a downward price spiral.

U.S. G-SIBs have steadily increased their reliance on runnable liabilities over the past several years ([Figure 29](#)). Runnable liabilities include borrowings under repurchase agreements and securities loans, commercial paper issued, money market accounts, and uninsured deposits. Runnable liabilities for the average U.S. G-SIB increased from 37 percent of total liabilities in 2009 to 53 percent by the end of 2016.

Indicators of market liquidity are mixed. Some of the indicators used in the heat map related to market

Figure 27. Average Broker-Dealer Leverage (times)

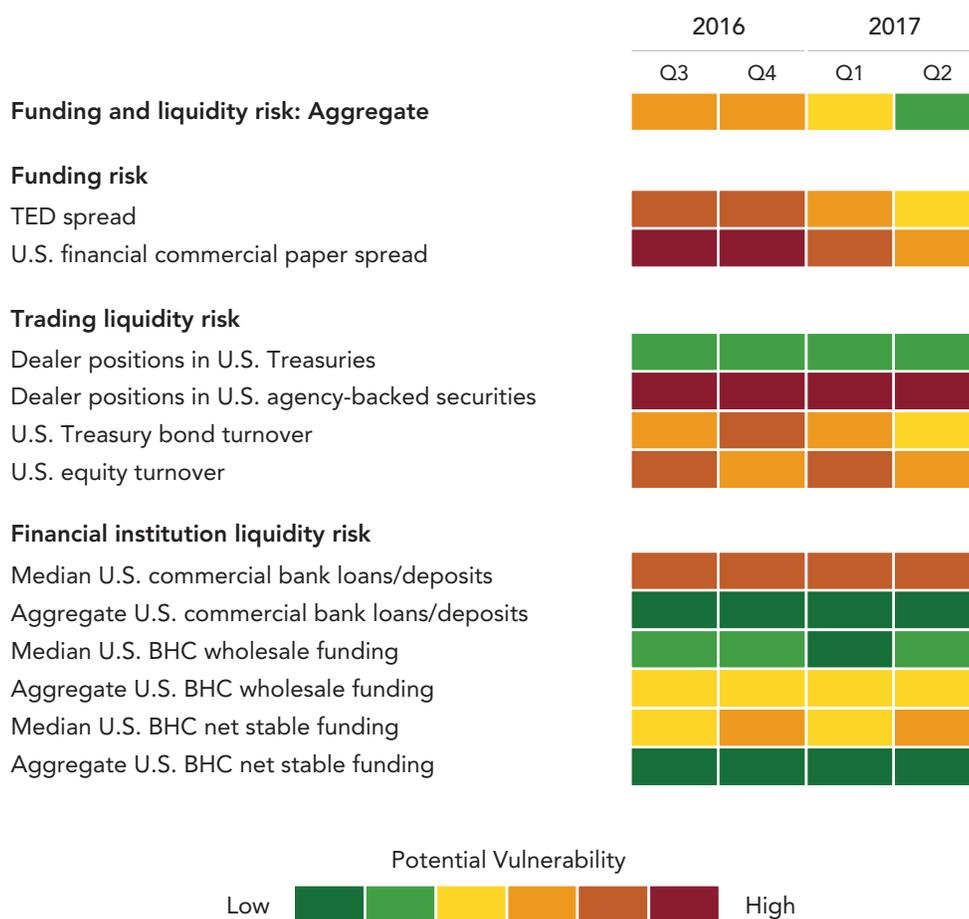
Large non-bank-affiliated broker-dealers still have significantly more leverage than bank-affiliated peers



Note: As of Dec. 31, 2016. Leverage is calculated as assets divided by assets minus liabilities.

Sources: SNL Financial LC, OFR analysis

Figure 28. Financial System Vulnerabilities Monitor: Funding and Liquidity Risk



Note: The TED spread is the difference between the London Interbank Offered Rate and the three-month Treasury bill rate. BHC stands for bank holding company. Figure is excerpted from the OFR Financial System Vulnerabilities Monitor. Technical information about the monitor is available at <https://www.financialresearch.gov>.

Sources: Bloomberg Finance L.P., Federal Financial Institutions Examination Council Call Reports, Federal Reserve Form Y-9C, Haver Analytics, OFR analysis

liquidity focus on aggregate turnover. They suggest that market liquidity conditions are moderate or worse. However, these indicators provide only one dimension to market liquidity, given that they focus only on quantities rather than prices.

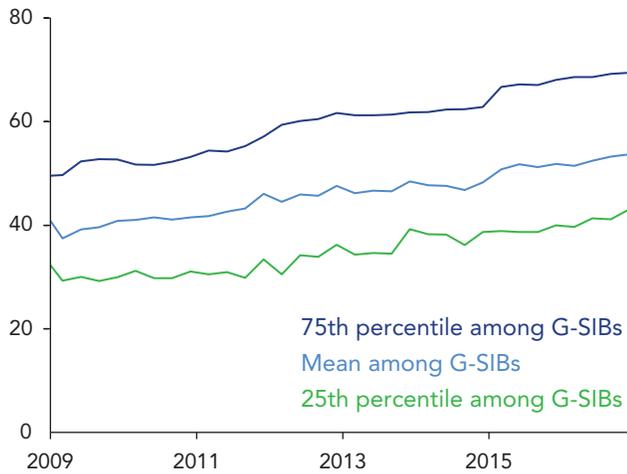
Two measures of market liquidity that signaled extraordinary stress during the crisis but have since eased are shown in [Figure 30](#). First, bid-ask spreads reflect the difference between the average price at which customers buy from dealers and the average price at which customers sell to dealers. Narrow spreads today suggest that

liquidity is available and that trading costs are relatively low. Second, price-impact measures reflect the price change after a large trade is completed — specifically the price change from the previous large trade divided by the trade size. Price impact measures today are lower than during the crisis. However, the measure is higher today for corporate bonds than before the crisis. These changes may reflect greater trade fragmentation and increased concentration of market participants.

The structure of markets may pose risks that impair aggregate liquidity across a number of asset classes.

Figure 29. Runnable Liabilities of G-SIBs (percent of total liabilities)

G-SIBs have increased their reliance on runnable sources of funding



Note: Data as of Dec. 31, 2016. Runnable liabilities are defined as the sum of borrowings under repurchase agreements and securities loans, commercial paper issued, money market accounts, and uninsured deposits. G-SIB stands for global systemically important bank.

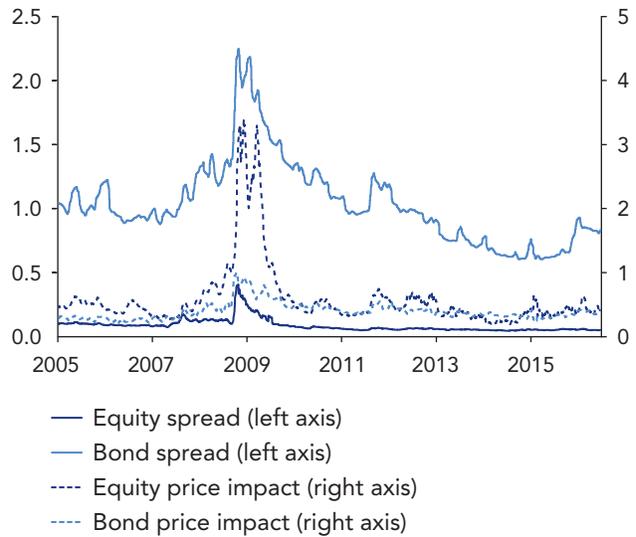
Sources: Federal Reserve Form Y-9C, OFR analysis

In particular, changes in market structure may affect liquidity by influencing trading behavior. These changes may have resulted from changes in the regulatory environment for some market participants, availability of trading venues, or innovation in tradable contracts that promote flexibility in investment opportunities.

Post-crisis regulatory reforms may have affected market liquidity. The Volcker rule, for example, restricts banks from making speculative investments in many asset classes. It does permit market-making and underwriting activities conducted for the benefit of customers. OFR research found evidence that the implementation of the Volcker rule coincided with a modest tightening in dealers' credit default swap inventories and a significant reduction in interbank derivatives trading (see [Figure 31](#)). These results are consistent with a view that bank-affiliated dealers' responses to the rule are driven by increased compliance costs associated with the Volcker rule. Interbank trading provides an important venue

Figure 30. Market Liquidity in Equity and Corporate Bond Markets

Bid-ask spreads (percent of par) and price impact (percent of par per million) both measure market liquidity

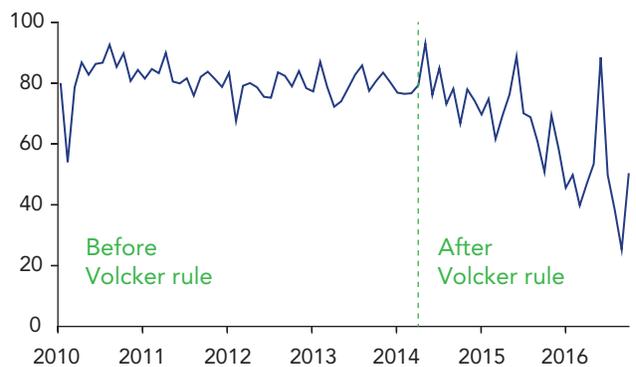


Note: Data as of June 30, 2016.

Sources: Calculated based on data from the Center for Research in Security Prices ©2017 Center for Research in Security Prices (CRSP®), the University of Chicago Booth School of Business; Financial Industry Regulatory Authority; OFR analysis

Figure 31. Single-Name CDS Trading Behavior (percent of interdealer trade)

Trading dropped notably after the Volcker rule took effect



Note: Data as of October 2016. CDS stands for credit default swap.

Source: OFR analysis, which uses data provided to the OFR by the Depository Trust & Clearing Corp.

for bank-affiliated dealers to offset positions and reduce market risk. The OFR’s research focused on the credit default swap market. While narrower in scope, liquidity dynamics in the derivatives markets are informative given that these markets are more susceptible to liquidity shocks, as demonstrated during the financial crisis.

2.6 Contagion Risk Signals Are Mixed

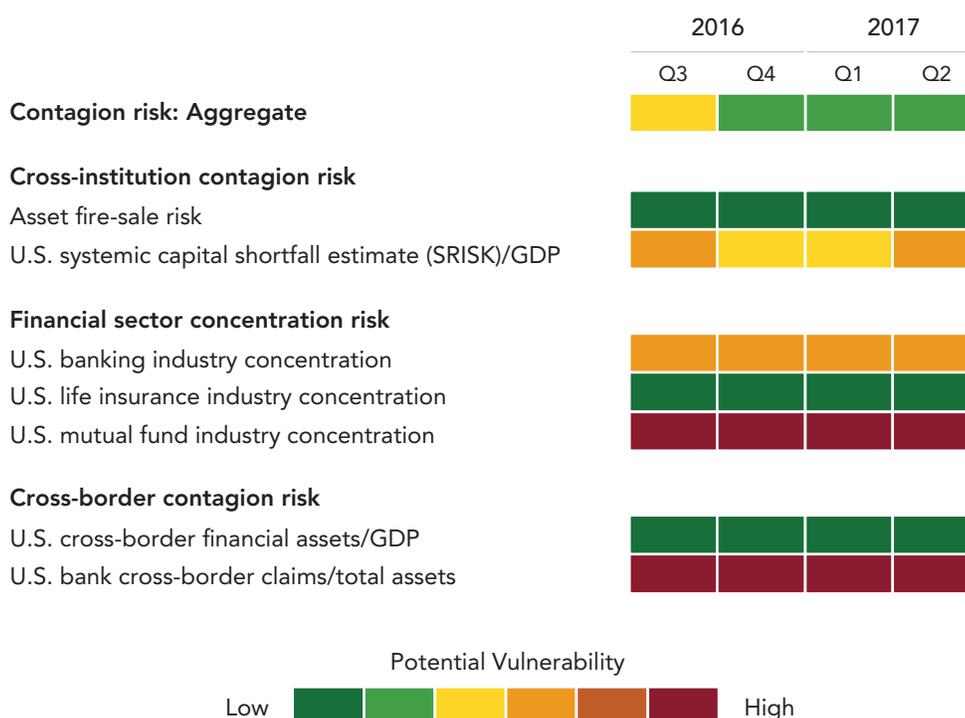
Contagion risk is the danger that financial stress spreads across markets, institutions, or other entities. Of the many factors contributing to the crisis of 2007-09, contagion is among the most difficult to measure. A key focus of OFR monitoring and research has been to help stakeholders and the public at large better measure this risk. The OFR’s heat map contains available metrics of

cross-institution contagion risk, financial sector concentration, and cross-border contagion risk (see Figure 32).

In the category of cross-institution contagion, the heat map now includes an index of fire-sale risk, which measures the likely feedback effect as bank asset liquidations depress prices in a falling market. Fire-sale risk has been very low in recent years, having been quite high before the financial crisis (see Duarte and Eisenbach, 2015).

The revised heat map also includes SRISK, shorthand for “systemic risk.” It is a market-based metric that captures the additional capital that a financial institution would need to remain solvent in a crisis. The estimate is based on the firm’s current capital positions and the historical relationship between its stock price and the broader market (see Brownlees and Engle, 2017). The heat map measure of SRISK aggregates 97 major financial firms, measuring the joint distress of those firms in

Figure 32. Financial System Vulnerabilities Monitor: Contagion Risk



Note: SRISK is short for systemic risk. GDP stands for gross domestic product. Figure is excerpted from the OFR Financial System Vulnerabilities Monitor. Technical information about the monitor is available at <https://www.financialresearch.gov>.

Sources: Federal Financial Institutions Examination Council Call Reports, Federal Reserve Form Y-9C, Morningstar, SNL Financial LC, the Volatility Laboratory of the NYU Stern Volatility Institute (<https://vlab.stern.nyu.edu>), OFR analysis

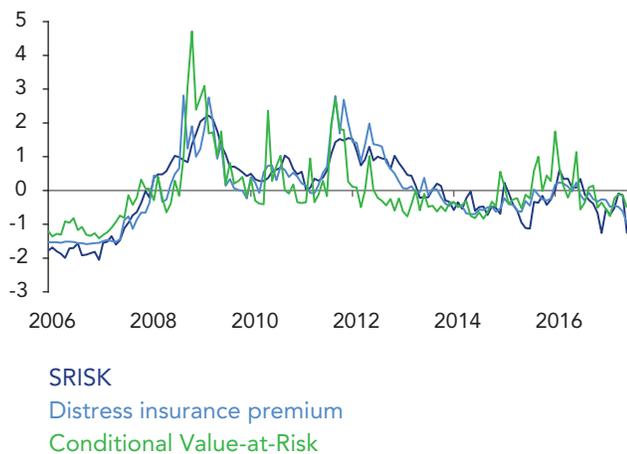
a crisis, and indexes the total estimated capital to U.S. gross domestic product. Currently, the estimated cost to recapitalize the U.S. financial sector in a crisis is just above the median of its range since 2000.

SRISK and two other metrics that provide insights on the contribution that the six largest U.S. bank holding companies make to market risk are shown in **Figure 33**. The distress insurance premium is the hypothetical contribution a bank would make to an insurance premium that would protect the whole financial system from distress. The conditional Value-at-Risk is the difference between the Value-at-Risk (VaR) of the financial system when the firm is under stress and the VaR of the system when the firm is not under stress.

In the category of financial concentration, the heat map includes measures of industry concentration, known as Herfindahl indexes, in banking, life insurance, and mutual fund markets. A concentrated industry is more vulnerable to disruptions from distress

Figure 33. Measures of Joint Distress for the Six Largest U.S. Bank Holding Companies (z-scores)

Joint distress metrics declined over the past year



Note: Equal-weighted average. The six bank holding companies are Bank of America, Citigroup, Goldman Sachs, JPMorgan Chase, Morgan Stanley, and Wells Fargo. Z-score represents the distance from the average, expressed in standard deviations. SRISK, distress insurance premium, and conditional Value-at-Risk are measures of systemic risk.

Sources: Bloomberg Finance L.P., the Volatility Laboratory of the NYU Stern Volatility Institute (<https://vlab.stern.nyu.edu>), OFR analysis

at individual firms. U.S. mutual fund industry concentration is at the high end of its range since 2000. Banking industry concentration is moderately elevated, as the high post-crisis concentration has dissipated. Concentration in the life insurance industry is low.

The heat map also captures a third category of contagion risk, cross-border connections. The United States remains highly financially connected to other countries, leaving the system more exposed to shocks from abroad. Cross-border financial assets are historically high relative to GDP, as are banks' foreign claims relative to their total assets. However, the trend of increasing interconnectivity has slowed since the financial crisis, and cross-border financial exposures are relatively low when indexed to a 10-year moving average, as shown in the heat map.

Much of our research focuses on modeling contagion risk, monitoring its changes over time, and asking how regulation might help or hinder. OFR researchers have proposed a contagion index that seeks to measure the potential spillovers to the rest of the financial system if a bank defaults. The index has been decreasing in recent years for most G-SIBs (see **Figure 34**). The measure is not included in the monitor because it can only be calculated since 2013. The index combines measures of a bank's leverage, size, and connectivity. It is calculated as:

$$\text{Contagion Index} = \text{Financial Connectivity} \times \text{Net Worth} \times (\text{Outside Leverage} - 1)$$

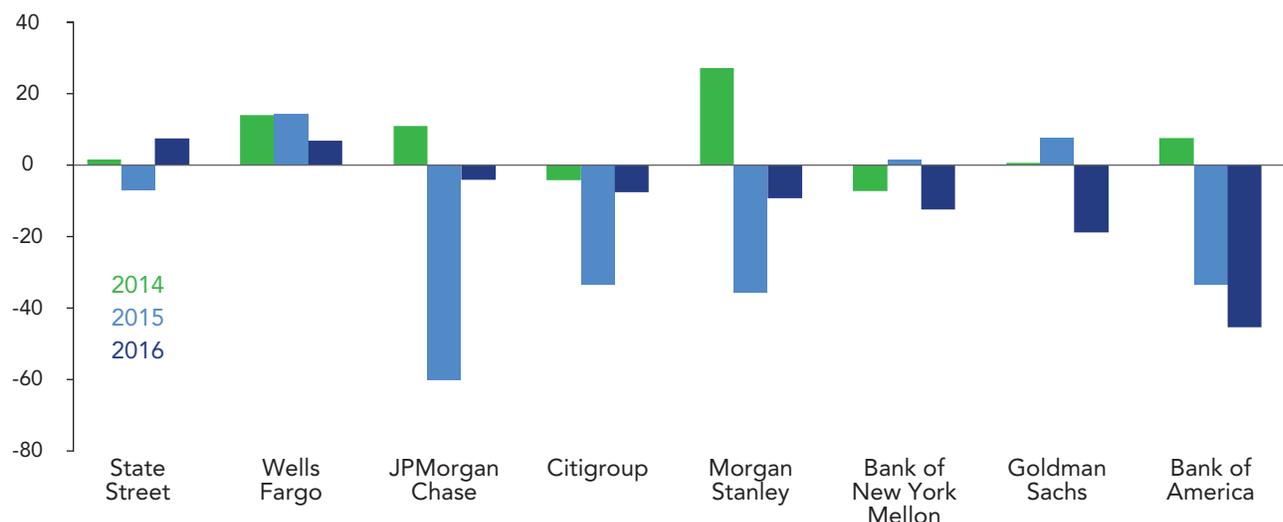
Connectivity is measured as the portion of a bank's liabilities held by other financial institutions.

OFR researchers have also examined the Federal Reserve's Comprehensive Capital Analysis and Review (CCAR) supervisory stress scenarios, which consider the impact of the default of a bank's largest counterparty. The indirect contagion effects of this default, through the bank's other counterparties, may be larger than the direct impact of a large counterparty default on the bank (see Cetina, Paddrik, and Rajan, 2016).

Some of our other work uses agent-based models to analyze how risks can spread across firms in a crisis. Agent-based models seek to model the behavior of

Figure 34. Contagion Index (change in index from prior year)

The contagion index declined for most G-SIBs in 2015 and 2016



Note: The contagion index is a measure of financial connectivity, which together with size and leverage measures a financial institution's potential contribution to financial contagion. G-SIB stands for global systemically important bank.

Sources: Federal Reserve Form Y-15, OFR analysis

different types of financial firms by specifying possible rules of firms' behavior to simulate the effects of shocks or regulatory policies on the financial system. Potential behavioral rules could include regulatory requirements or profit maximization. The OFR cosponsored a conference on the topic with the Bank of England and Brandeis University in September 2017.

A recent OFR working paper used an agent-based model to analyze contagion in the interbank funding market (see Liu and others, 2016). The authors used balance sheet data from more than 6,600 U.S. banks. They reproduced dynamics similar to those of the 2007-09 financial crisis and showed how bank losses and failures arise from network contagion and lending market illiquidity. Tests of the model against actual bank failures before, during, and after the crisis suggest that the market has become more resilient to asset write-downs and liquidity shocks.