OFR MARKETS MONITOR
OFFICE OF FINANCIAL RESEARCH

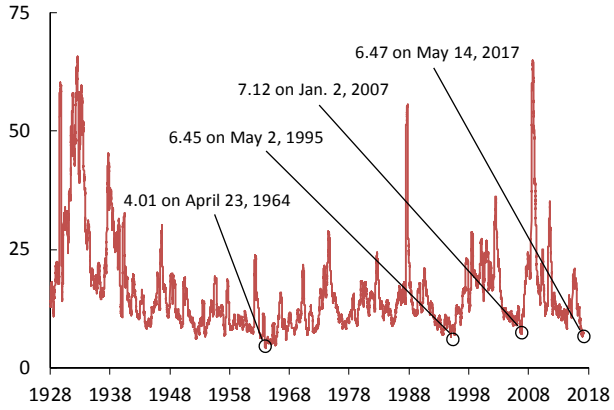
Second Quarter 2017
(data as of June 30)

A review of financial market themes and developments

The Volatility Paradox: Tranquil Markets May Harbor Hidden Risks

Financial markets were exceptionally calm in the second quarter by most measures. Only three times in the past 90 years has volatility been so low: twice during bull markets in the 1960s and 1990s, and once in the lead-up to the financial crisis of 2007-09 (see Figure 1). Is today's low volatility a sign of calm or a threat to financial stability — or both? This edition of the OFR's Financial Markets Monitor investigates the volatility paradox: the possibility that low volatility leads investors to behave in ways that make the financial system more fragile and prone to crisis. We analyze three channels through which a prolonged period of low market volatility may introduce financial stability risks: increased leverage, reduced hedging, and institutional investors' use of risk-management models. We find some supportive evidence of these channels at work, but better data are needed to make definitive conclusions. Volatility alone is not a good indicator of impending financial stress.

Figure 1: S&P 500 Index 90-day Realized Volatility (percent)
Volatility in U.S. equity markets is the lowest in decades



Note: Volatility is the standard deviation of daily returns over 90 days expressed as annualized percent change.
Source: Bloomberg Finance L.P.

Key findings

- Volatility for most asset classes across the world fell below historical averages during the second quarter. In some cases, volatility is near all-time lows. Drivers of low volatility may include expectations that the long U.S. economic expansion and still-easy funding conditions will persist.
- Some institutional investors have adapted by increasing leverage and the use of yield-enhancing strategies.
- Shocks could produce procyclical responses if market participants use measures of realized volatility to manage the risk of their portfolios.

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Volatility alone is a weak risk indicator.

Volatility measures for most asset classes across global financial markets fell below their historical averages during the second quarter (see Figure 2). Some measures approached all-time lows (for example, see Figures 1 and 3), which may have been driven by expectations that the long U.S. economic expansion and still-easy funding conditions will persist.

There are two types of volatility: realized and implied. Realized volatility reflects the historical price fluctuations of an asset. Implied volatility is forward-looking. It captures the market's expectation of future price fluctuations of an asset, derived from the options markets.

When implied volatility exceeds realized volatility, the difference reflects the extra return investors demand to hold a security solely because it is volatile. This difference is known as the volatility risk premium.

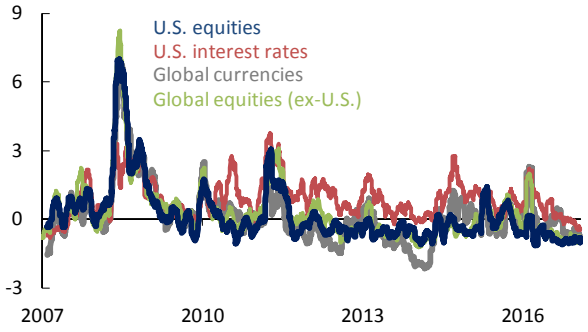
One of the most widely cited measures of implied volatility is the Chicago Board Options Exchange Volatility Index (VIX). The VIX is the 30-day implied volatility of options on the benchmark S&P 500 equity index. A low VIX doesn't necessarily signal that severe financial stress is unlikely. For instance, the VIX provided no advance warning of extreme volatility in the months leading up to the financial crisis. Realized volatility of the S&P 500 index was often substantially higher than the VIX had predicted 30 days earlier (represented by the blue dots over the 45-degree line in Figure 4). The relationship between realized and implied volatility for other asset classes followed a similar pattern during the crisis.

Market risks may seem low when volatility is low. However, low volatility may also serve as a catalyst for market participants to take more risk, thereby making the financial system more fragile. This phenomenon is known as the volatility paradox.

Low volatility directly incentivizes risk-taking.

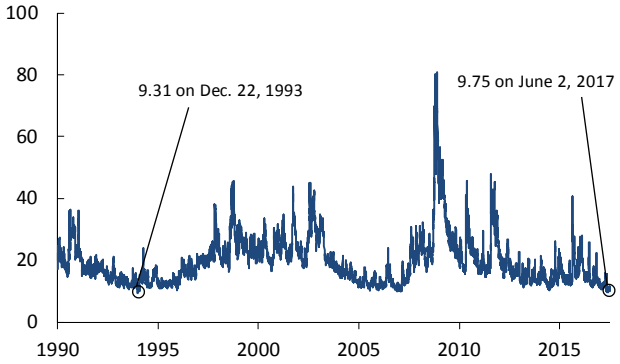
Lower volatility may contribute to greater leveraging and risk-taking through at least three channels. The first channel is through changing asset-return correlations, which tend to increase when markets are volatile. Low correlations could entice investors to

Figure 2: Realized Volatility by Asset Class (z-score)
Volatility has declined across major asset classes and markets



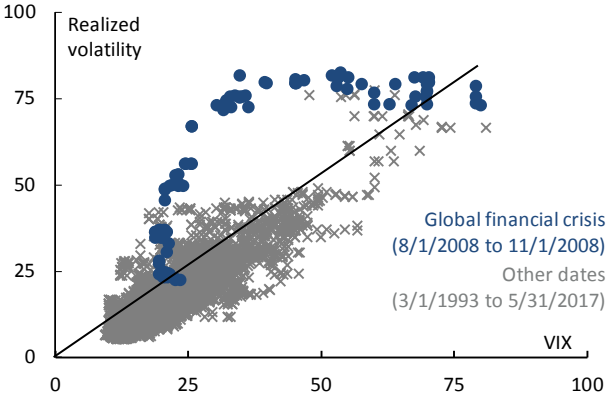
Note: Realized volatility is the standard deviation of daily returns over 30 days, expressed as annualized percent change. U.S. equities are represented by the S&P 500 index. U.S. interest rates are the weighted average of the Treasury yield curve. Global currencies are based on weights from JPMVXY index. Global equities are MSCI All Countries World Excluding U.S. Index. Standardization uses data since Jan. 1, 1993.
Sources: Bloomberg Finance L.P., OFR analysis

Figure 3: Chicago Board Options Exchange Volatility Index (VIX) (percent)
Implied volatility on equities has fallen to near all-time lows



Note: Implied volatility is derived from options markets and is the expected standard deviation of daily returns over the next 30 days, expressed as annualized percent change.
Source: Bloomberg Finance L.P.

Figure 4: VIX and Realized Volatility of S&P 500 Index (percent)
The VIX did not predict the global financial crisis



Note: Realized volatility is the standard deviation of daily returns over 30 days, expressed as annualized percent change.
Sources: Bloomberg Finance L.P., OFR analysis

accumulate risky exposures, believing they are diversified. Prolonged periods of low volatility may further decrease correlations, encouraging further risk-taking. This procyclical behavior increases investors' risk of loss from a systematic shock, when volatility spikes and asset-return correlations revert to historical levels.

Some evidence exists that this channel may be at work in equity markets. Sector correlations have declined significantly during the past two years, while volatility has remained low (see Figure 5).

Second, low volatility could encourage the use of other yield-enhancing strategies, such as selling deep out-of-the-money put options (those with a strike price substantially below current prices). Investors collect a premium from selling these options, but can be obligated to purchase the underlying assets if the price drops below the strike price. Investors who accumulate these risky exposures could be more likely to experience financial stress if prices sharply decline. Available data on investor portfolios are not sufficient to assess this channel adequately.

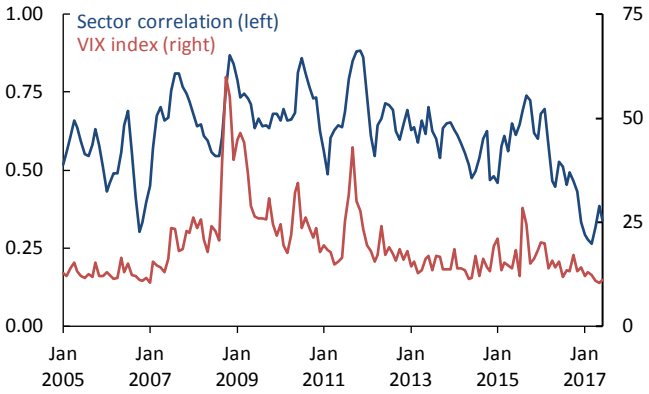
Third, low volatility can directly incentivize leveraging by lulling investors into underestimating the odds of a volatility spike. One measure of marketwide leverage is the ratio of margin debt to market capitalization. This measure is imperfect because it doesn't account for other positions on investor balance sheets, including derivatives positions. Figure 6 uses margin debt balances and market capitalization data from the New York Stock Exchange. The ratio increased from 2002 to 2007 amid low volatility, declined after the crisis, and has been climbing since as volatility again reached long-term lows.

Evidence also exists that some large investors are highly leveraged and, for that reason, may be susceptible to volatility events. For example, the top decile of macro and relative-value hedge funds has been leveraged about 15 times in recent quarters. These funds combined account for more than $800 billion in gross assets, about one-sixth of all hedge fund assets.

Low volatility could also disincentivize investor hedging.

Figure 5: 3-Month Moving Average of S&P 500 Sector Correlations, VIX Index (correlation, percent)

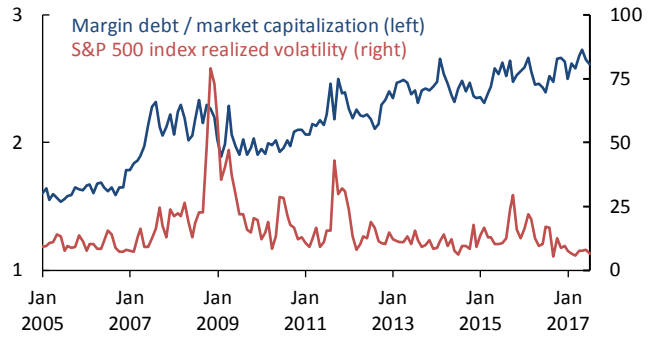
Correlations between sectors have fallen amid low volatility



Note: S&P 500 sector pairwise monthly correlation; 3-month moving average.
Sources: Bloomberg L.P., OFR analysis

Figure 6: 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



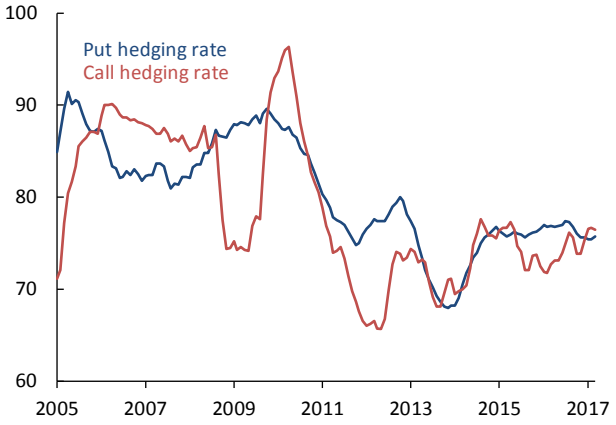
Note: Values are the New York Stock Exchange (NYSE) market capitalization and margin debt balances of its members. Dealer margin debt balances may reflect positions on securities not listed on the NYSE. Realized volatility is the standard deviation of daily returns over 30 days expressed as annualized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

Another way investors may adapt to low volatility is by reducing their hedging of risky positions. This behavior was particularly relevant in recent years, when historically low interest rates pressured investors to reach for yield by holding more lower-rated fixed-income securities and more equities (see the OFR's *2016 Financial Stability Report*). OFR analysis of options trading suggests that investors have reduced their hedging of market exposure. Investor hedging activity is difficult to measure, although it can be captured to some extent using contracts outstanding in current-month SPY options. SPY is an exchange-traded fund that mirrors the benchmark S&P 500 equity index. Traders commonly sell SPY options to hedge equity market exposure. Options give investors the right, but not the obligation, to buy or sell a specific security at a specific strike price and time. A call option is a right to buy; a put is a right to sell.

Options with a strike price near the current price of SPY are said to be "at the money." Contracts with a strike price far from the current price are "away from the money." These options are less likely to be held for hedging purposes and instead may represent yield-enhancing strategies. Investor hedging activity is captured through a hedging rate, calculated as the proportion of contracts on SPY options that is "at the money" versus "away from the money." Hedging rates are currently lower on average than in the years immediately preceding the financial crisis (see Figure 7), suggesting a structural change in hedging activities after the crisis. However, the evidence is somewhat mixed. Considerable variation has occurred since 2010, and current levels appear to be higher relative to 2014 for both call and put hedging ratios. The absence of sharper measures of aggregate hedging activities makes drawing definitive conclusions difficult, though these hedging ratios at least suggest significant differences before and after the crisis.

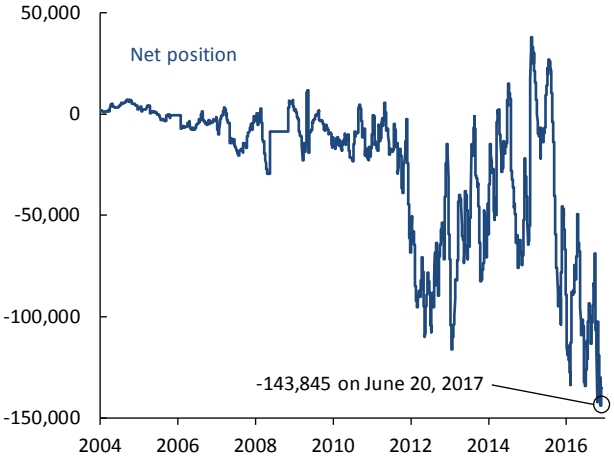
The Commodity Futures Trading Commission (CFTC) collects data on an alternative measure of hedging activity using positions of futures traders. CFTC data categorize hedge funds and other investors as "non-commercial," or speculative, traders. As of May 2017, the net short position on VIX futures of non-commercial traders sat at levels larger than even before the crisis (see Figure 8). Common volatility strategies involve taking short positions in longer-dated contracts and long positions in shorter-dated contracts. Reduced

Figure 7: SPY Options Held for Hedging Purposes (percent)
Investors are less hedged compared to the pre-crisis period



Sources: OptionsMetrics, OFR analysis

Figure 8: VIX Futures Noncommercial Net Total (contracts)
Speculators increased short bets on VIX to the most since 2004



Sources: Bloomberg Finance L.P., Commodity Futures Trading Commission

hedging in these strategies would imply shorting in the aggregate, consistent with Figure 8. However, establishing a direct link without more granular data is difficult.

Together, these data suggest that some investors may have adapted to the low-volatility environment by reducing risk hedges and increasing speculative bets. Data limitations temper the findings to some extent, and leave opportunities for further analysis. With less hedging, these investors' balance sheets may be less resilient to large volatility shocks when volatility returns to financial markets.

Value-at-Risk models may give faulty signals in low-volatility markets.

Low realized volatility can affect the behavior of banks, hedge funds, and other asset managers that use a risk management framework based on realized volatility, including some Value-at-Risk (VaR) measures. About 40 percent of large hedge funds, representing about 62 percent of gross hedge fund assets, regularly calculate VaR statistics for their funds, according to Form PF data collected by the Securities and Exchange Commission (SEC).

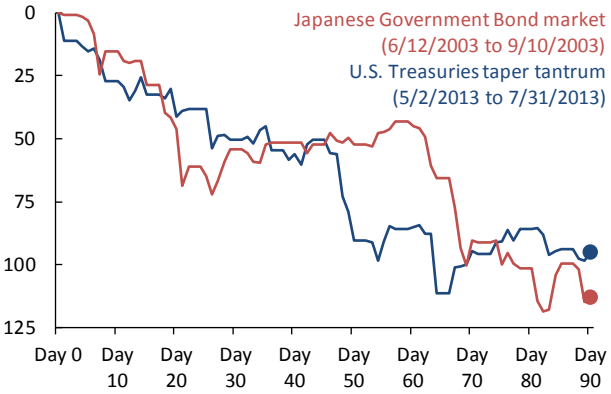
VaR measures the risk of investments. It captures how much value investments might lose over a set time. Although VaR can be a valuable risk-management tool, overreliance on VaR when volatility is low could result in procyclical behavior that makes investors more vulnerable to volatility shocks if market conditions change abruptly.

A decline in realized volatility can reduce a portfolio's VaR, allowing market participants to increase position sizes without exceeding predefined VaR risk limits. The reverse is true when volatility rises. In that case, VaR-sensitive investors may be forced to simultaneously sell assets to get their portfolios below risk limits.

A selloff induced by a VaR shock can become self-reinforcing as liquidity dries up and as deleveraging occurs. Some market observers believe VaR shocks contributed to selloffs in the Japanese government bond market in 2003 and in the U.S. Treasury market during the 2013 taper tantrum (see Figure 9). Long-term investors that are not sensitive to VaR, such as pension funds and insurance companies, may not step in and provide liquidity unless prices fall sharply.

Figure 9: Cumulative Yield Change in 10-year Government Bonds (basis points)

VaR shocks may have deepened past selloffs in bond markets



Note: The vertical axis is inverted to reflect lower bond prices as yields increase. Horizontal axis is the number of days since the beginning of the sell-off period.

Sources: Bloomberg Finance L.P., OFR analysis

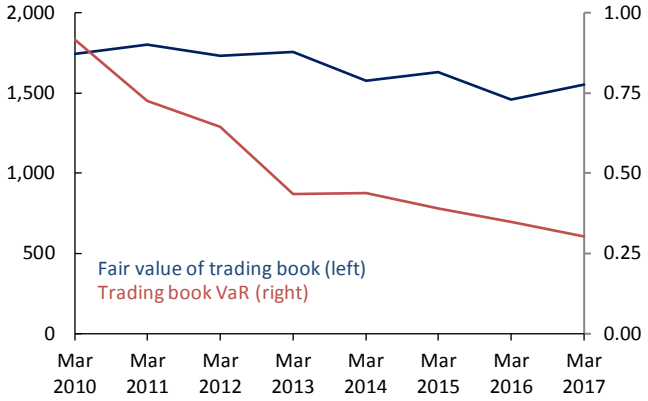
Most large U.S. banks report data on the VaR of their trading books in quarterly 10-Q filings to the SEC. These data show a dramatic decline since 2010 in the VaR of banks' trading books, without a commensurate decrease in the fair value of those trading books (see Figure 10). All else being equal, this change suggests that the reduction in VaR may reflect falling realized volatility rather than a decline in the size of banks' trading books during the period. If volatility rises and banks aim to keep their VaR stable, the banks would need to shrink their trading books. Another possibility is that the declining VaR is evidence that banks have reduced the overall market risk in their portfolios, in part responding to additional regulatory oversight. A definitive conclusion is difficult without detailed data on dealer positions.

Targeting a specific level of volatility has recently become an investment strategy. Many institutional investors now are holding so-called "volatility control funds" in their portfolios. Assets under management in variable annuity volatility control funds rose to $325 billion at the end of 2016 (see Figure 11). These funds make asset allocation decisions aimed at maintaining a stable level of volatility for their whole portfolios. If volatility were to rise suddenly in a previously stable asset class, these funds may be forced to rebalance and sell assets. These investors' activities could have a procyclical effect on asset prices and exaggerate volatility.

Conclusion

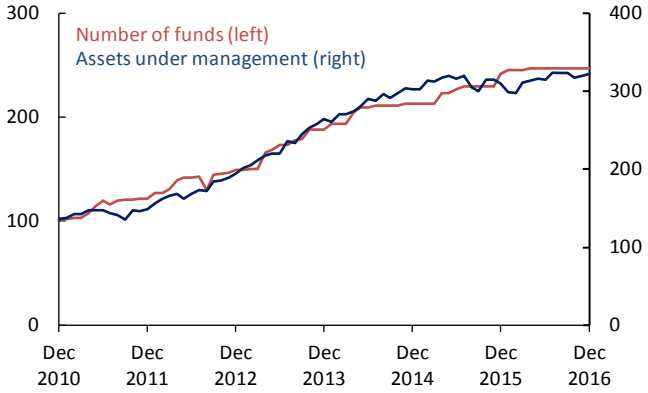
Prolonged low market volatility may introduce financial stability risks through at least three channels. First, investors could respond by directly taking on more leverage and risk. Second, investors could reduce hedging activities. Third, institutional investors' use of VaR or other risk-management models that have realized volatility as a key input could lead them to take more risk. A spike in volatility can result in outsized investor losses from sharp asset price changes. Data limitations hinder the ability to make definitive conclusions regarding the extent to which these channels are at work. However, the evidence is consistent with these channels operating and suggests the need for further analysis.

Figure 10: U.S. G-SIBs' Combined Trading Books ($ billions)
Big banks' VaR has collapsed but portfolio size is little changed



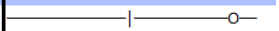
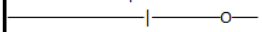
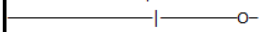
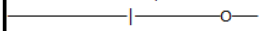
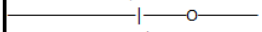
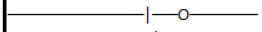
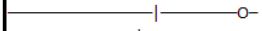
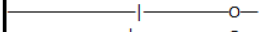
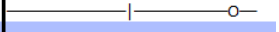
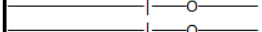
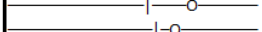
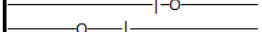
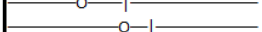
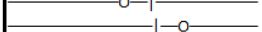
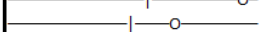
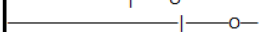
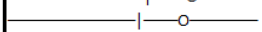
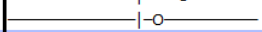
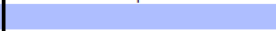
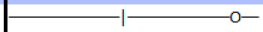
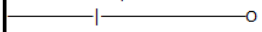
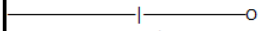
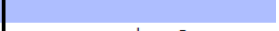
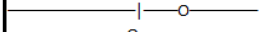
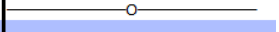
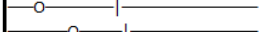
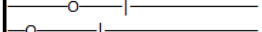
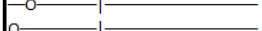
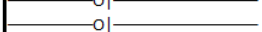
Note: G-SIB = Global systemically important bank
Sources: Bank 10-Q forms filed with Securities and Exchange Commission, OFR analysis

Figure 11: Variable Annuity Volatility Control Funds ($ billions, count)
Variable annuity volatility control funds have more than doubled in size



Source: Milliman Financial Risk Management LLC

Selected Global Asset Price Developments

	LEVEL (6/30/2017)	1Q CHANGE (bps or %)	1Q CHANGE (standard deviations)*	YTD CHANGE (bps or %)	12-MONTH RANGE**
EQUITIES					
S&P 500	2423	2.6%	0.1	8	
U.S. KBW Bank Index	96	3.9%	0.1	4	
Russell 2000	1415	2.1%	0.0	4	
Nasdaq	6140	3.9%	0.1	14	
Euro Stoxx 50	3442	-1.7%	-0.3	5	
Shanghai Composite	3192	-0.9%	-0.2	3	
Nikkei 225	20033	6.0%	0.5	5	
Hang Seng	25765	6.9%	0.4	17	
FTSE All World	307	3.6%	0.2	10	
RATES					
U.S. 2-Year Yield	1.38%	13	0.3	19	
U.S. 2-Year Swap Rate	1.62%	0	0.1	17	
U.S. 10-Year Yield	2.30%	-8	-0.1	-14	
U.S. 10-Year Swap Rate	2.28%	-10	-0.1	-6	
U.S. 30-Year Yield	2.83%	-17	-0.3	-23	
U.S. 2y10y Spread	92	-21	-0.6	-33	
U.S. 5Y5Y Inflation Breakeven	1.86%	-26	-0.9	-18	
U.S. 5Y5Y Forward Rate	2.80%	-14	-0.2	-25	
Germany 10-Year Yield	0.47%	14	0.5	26	
France 10-Year Yield	0.82%	-15	-0.3	13	
Japan 10-Year Yield	0.09%	2	0.2	4	
U.K. 10-Year Yield	1.26%	12	0.4	2	
JPM EMU Periphery Yield	1.87%	-9	-0.1	19	
Euro area 5Y5Y Inflation Breakeven	1.58%	2	0.2	-16	
FUNDING					
1M T-Bill Yield	0.84%	11	0.3	42	
DTCC GCF Treasury Repo	1.37%	34	1.2	90	
3M Libor	1.30%	15	0.3	30	
Libor-OIS Spread	14	-8	-0.3	-20	
EURUSD 3M CCY Basis Swap	-27	-1.0	0.0	28	
U.S. MBS					
FNMA Current Coupon	3.03%	-10	-0.1	-10	
FHLMC Primary Rate	3.88%	-26	-0.5	-44	
CREDIT					
CDX Investment Grade 5-Year CDS Spread	61	-5	-0.3	-6	
CDX High Yield 5-Year CDS Spread	340	3	0.0	-15	
Barclays US Corp. High-Yield OAS	3.64%	-19	-0.1	-45	
Barclays US Corp. Investment Grade OAS	1.15%	-11	-0.3	-11	
IMPLIED VOLATILITY					
VIX Index	11.2	-10%	-0.4	-20	
V2X Index	17	4%	0.0	-5	
VDAX Index	16	10%	0.2	-8	
MOVE Index	55	-9%	-0.5	-23	
3M2Y Swaption Volatility	43	-9%	-0.4	-22	
3M10Y Swaption Volatility	65	-7%	-0.5	-23	
DB G10 FX Volatility Index	8	-15%	-0.9	-31	
JPM EMFX Volatility Index	8	-14%	-0.7	-31	
FOREIGN EXCHANGE & COMMODITIES					
U.S. Dollar Index***	96	-4.7%	-1.2	-6	
EUR per USD	1.14	7.3%	1.4	9	
JPY per USD	112	0.9%	0.1	-4	
GBP/USD	1.30	3.8%	0.9	6	
USD/CNY	6.78	-1.5%	-0.3	-2	
USD/CHF	0.96	-4.5%	-0.8	-6	
WTI Crude	46	-9.0%	-0.7	-14	
Gold	1242	-0.6%	-0.3	8	
S&P GSCI Commodities Index	372	-4.1%	-0.5	-6	
EMERGING MARKETS					
JPM EMFX Index	69	0.8%	0.3	4	
MSCI Emerging Market Equity Index	1011	5.5%	0.3	17	
CDX EM 5-Year CDS Spread	202	-12.0	-0.2	-40	

* Standard deviations based on quarterly data from January 1994 or earliest available thereafter.

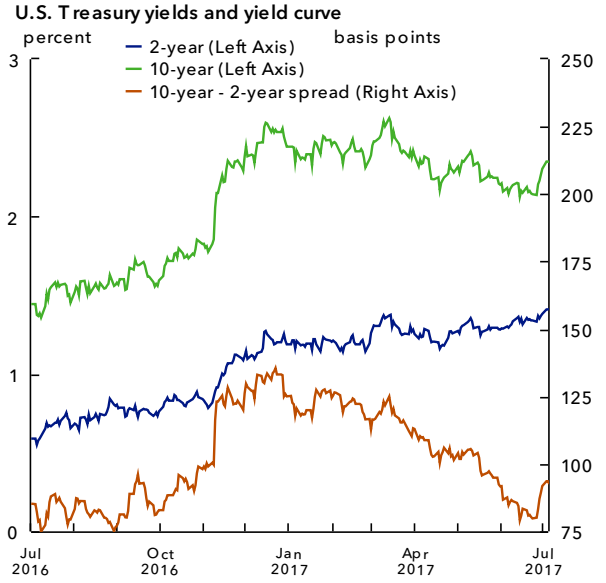
** Trailing 12-month range. Latest (O); Mean (|).

*** Dollar index from Bloomberg (ticker: DXY); averages the exchange rates between the U.S. dollar and major world currencies.

Sources: Bloomberg Finance L.P., OFR analysis

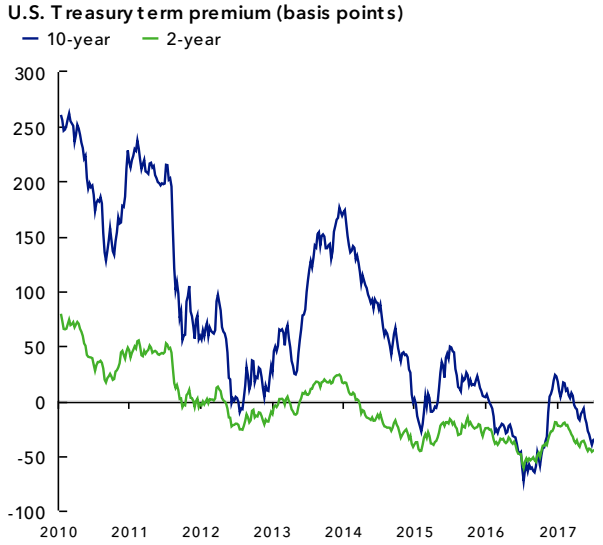
Select U.S. Interest Rates

U.S. Treasury yields and yield curve



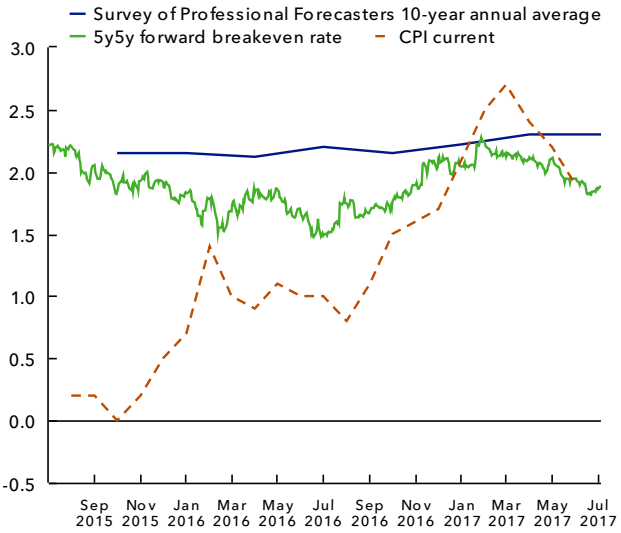
Source: Bloomberg Finance L.P.

U.S. Treasury term premium (basis points)



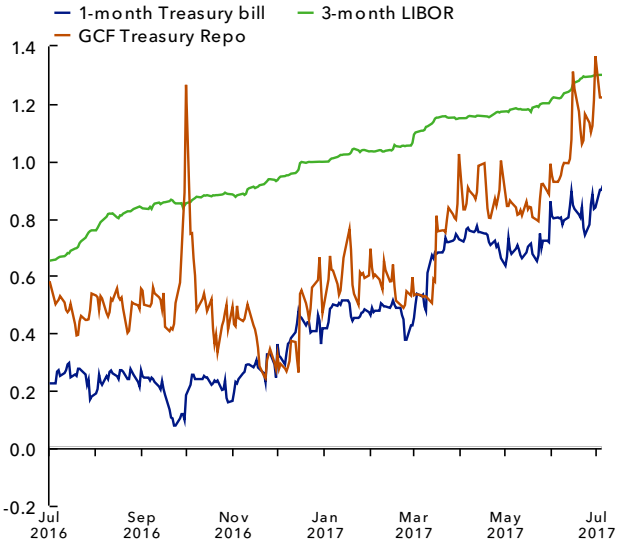
Note: Adrian, Crump, & Moench model
Source: Bloomberg Finance L.P.

Professional vs. market-implied U.S. inflation expectations (percent)



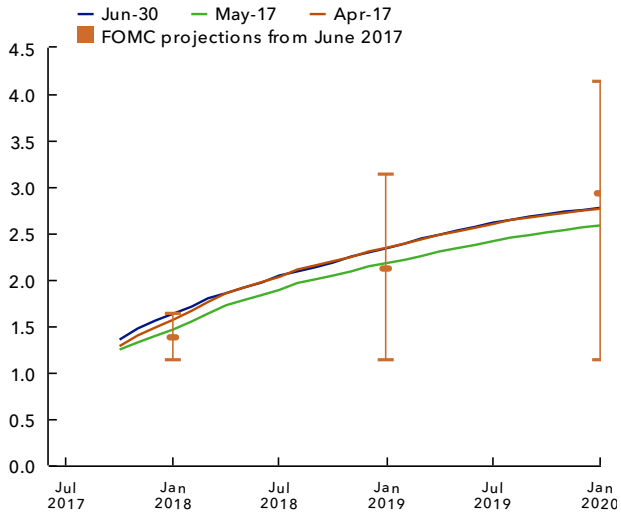
Source: Bloomberg Finance L.P.

Short-term market rates (percent)



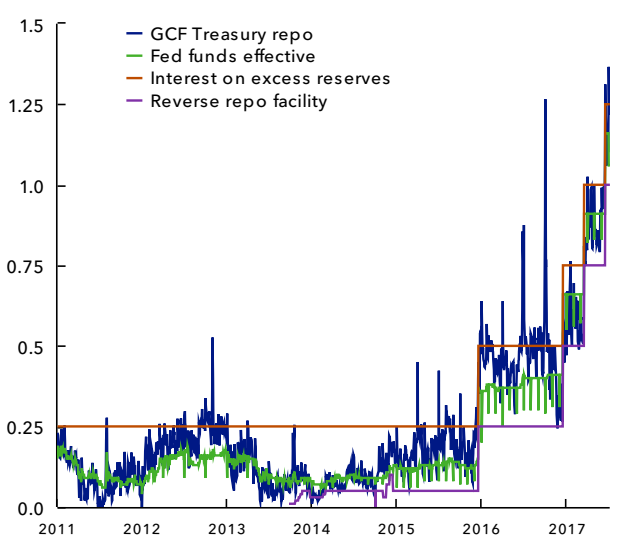
Source: Bloomberg Finance L.P.

Three-month Eurodollar futures (percent)



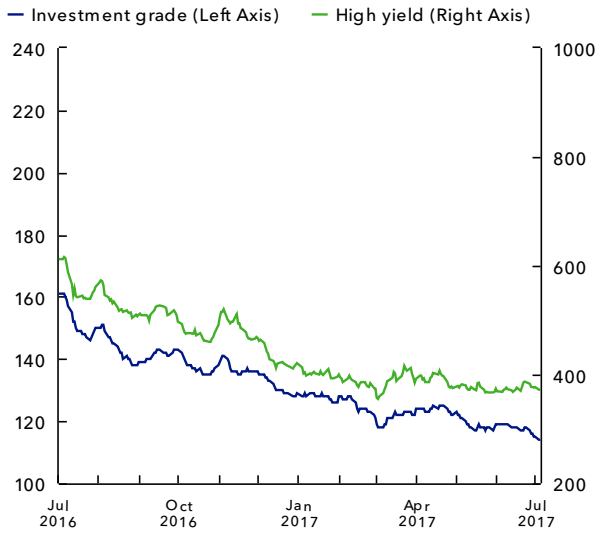
Notes: The high and low points of the Dec FOMC projections are the maximum and minimum forecasts. The rectangle represents the median.
Source: Bloomberg Finance L.P.

Money market and policy interest rates (percent)



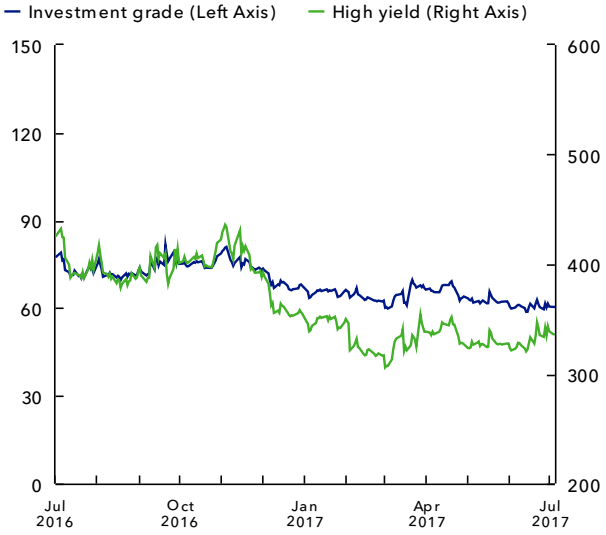
Source: Bloomberg Finance L.P.

U.S. corporate bond option-adjusted spreads
(basis points)



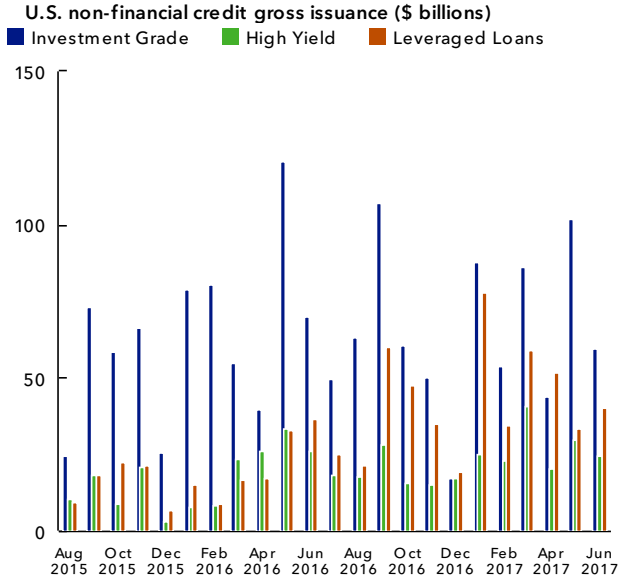
Source: Haver Analytics

U.S. corporate CDS indexes (basis points)



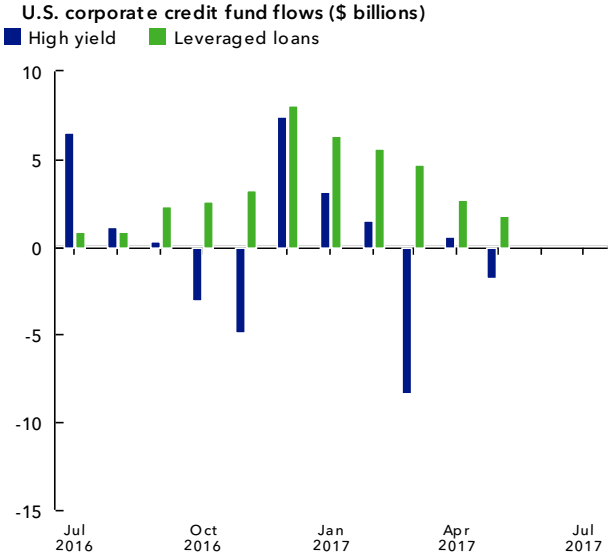
Note: Five-year maturity CDS Index
Source: Bloomberg Finance L.P.

U.S. non-financial credit gross issuance ($ billions)



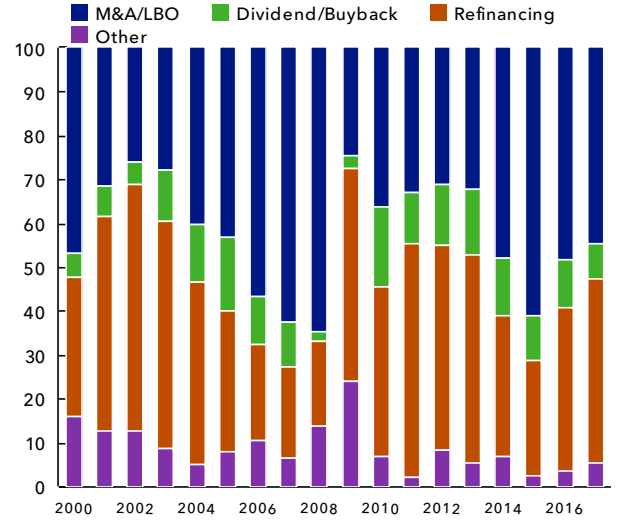
Sources: Dealogic, Standard & Poor's Leveraged Commentary & Data

U.S. corporate credit fund flows ($ billions)



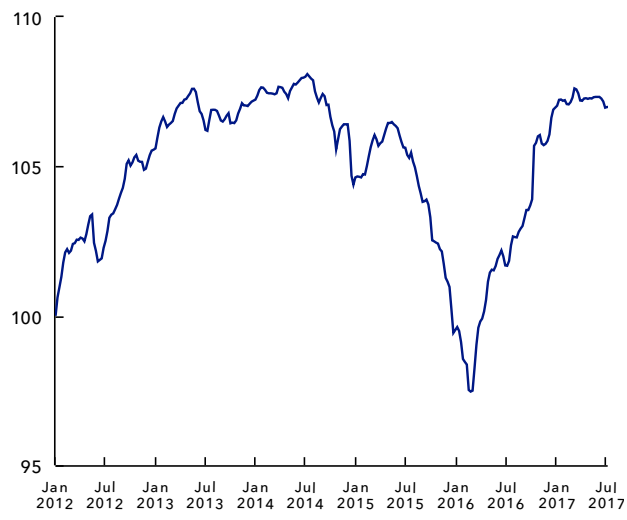
Note: Flows data are released with one-month lag.
Source: Haver Analytics

Leveraged loan issuance by use of proceeds (percent)



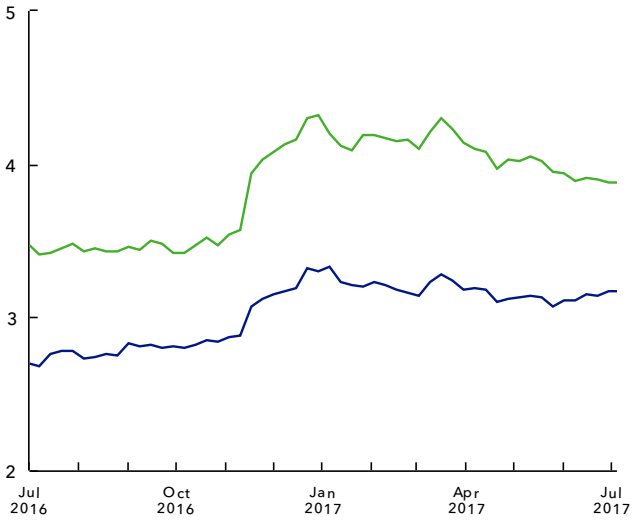
Note: Data for 2017 are year-to-date as of January.
Sources: Standard & Poor's Leveraged Commentary & Data, OFR analysis

Leveraged loan price activity



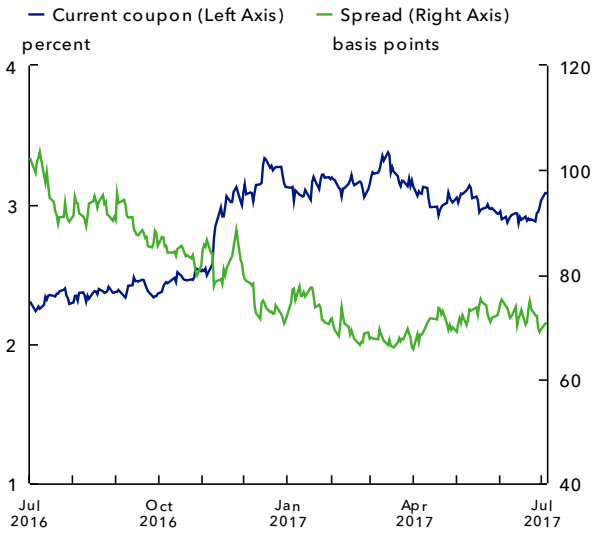
Notes: S&P Leveraged Loan Index. Index 100=January 01, 2012.
Source: Bloomberg Finance L.P.

Primary mortgage rates (percent)



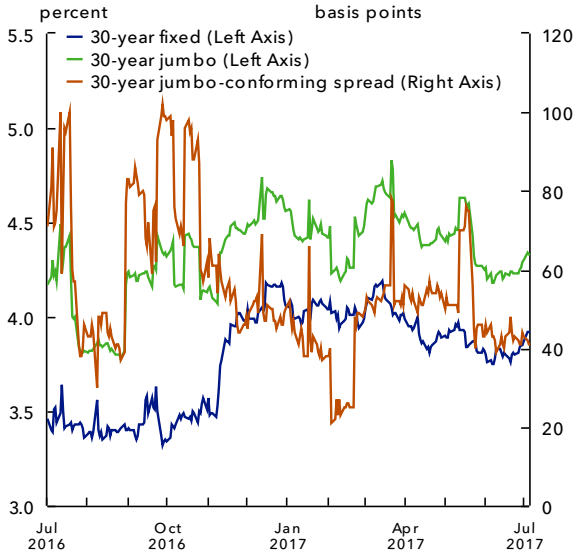
Source: Bloomberg Finance L.P.

MBS yield and option-adjusted spread to U.S. Treasury securities



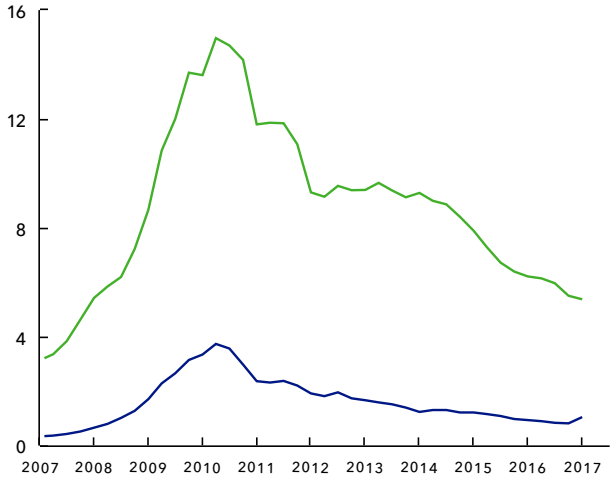
Source: Bloomberg Finance L.P.

30-year home mortgage fixed and jumbo rates and spread



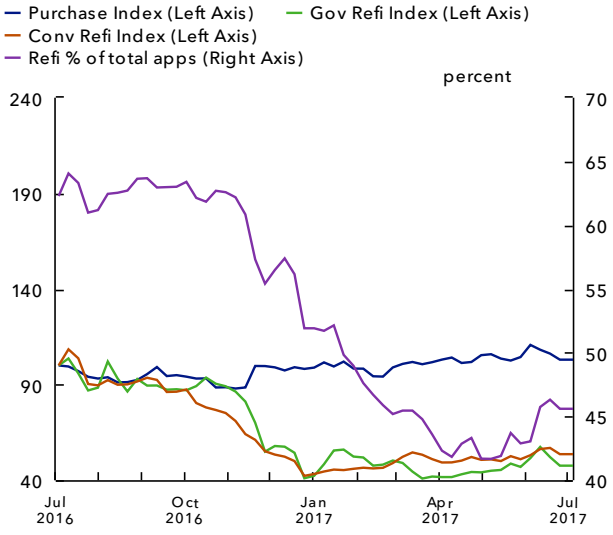
Source: Bloomberg Finance L.P.

Conventional mortgage severe delinquencies (percent, 90+ days late, seasonally adjusted)



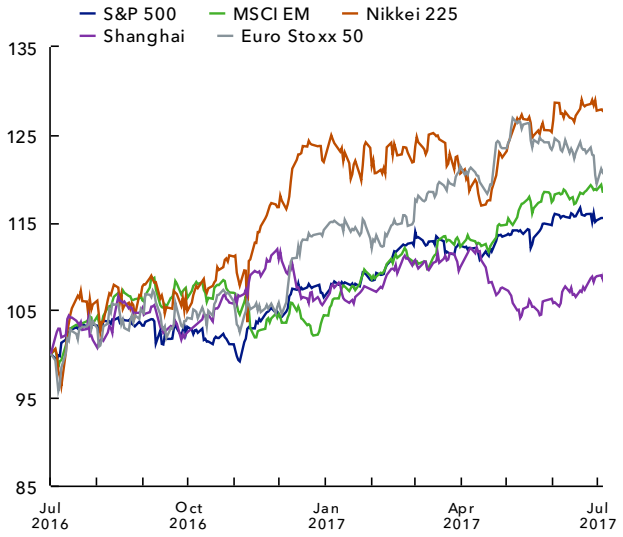
Source Haver Analytics

Refinance and purchase loan applications



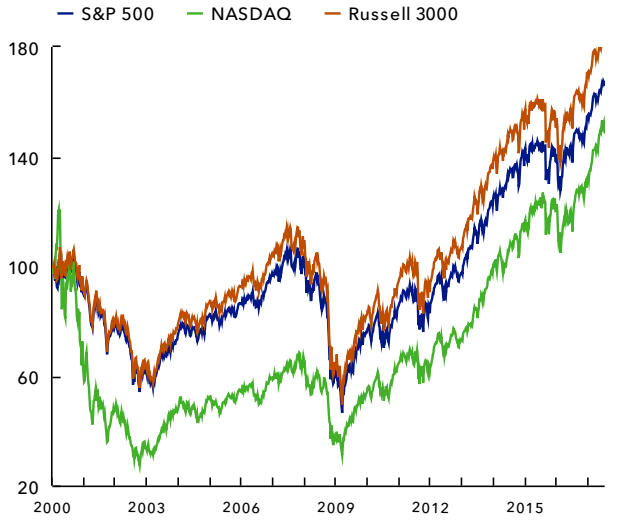
Note: Index 100 = July 01, 2016.
Source: Bloomberg Finance L.P.

Global equity indices



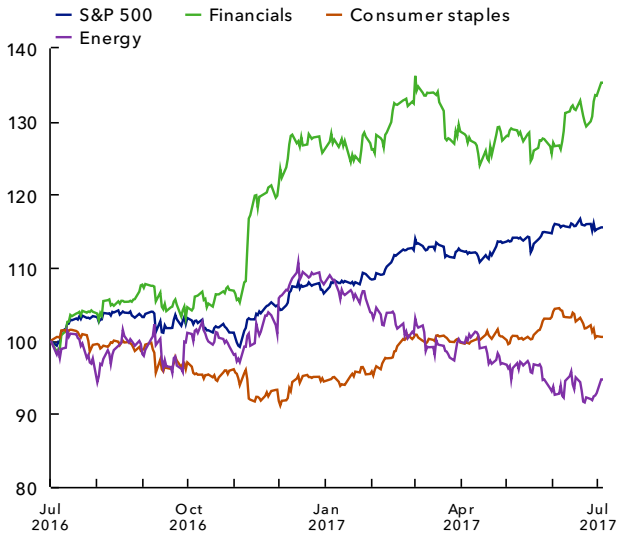
Note: Index = July 01, 2016.
Source: Bloomberg Finance L.P.

U.S. equity indexes



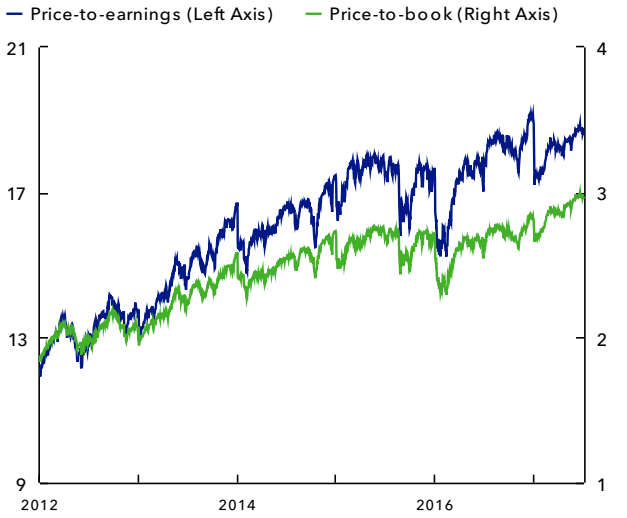
Note: Index 100 = Jan 01, 2000.
Source: Bloomberg Finance L.P.

S&P 500 sector performance



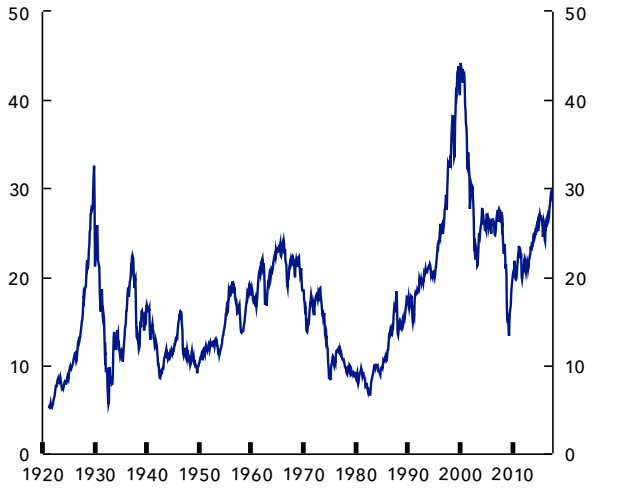
Note: Index 100 = July 01, 2016.
Source: Bloomberg Finance L.P.

S&P 500 price-to-earnings and price-to-book ratios (multiple)



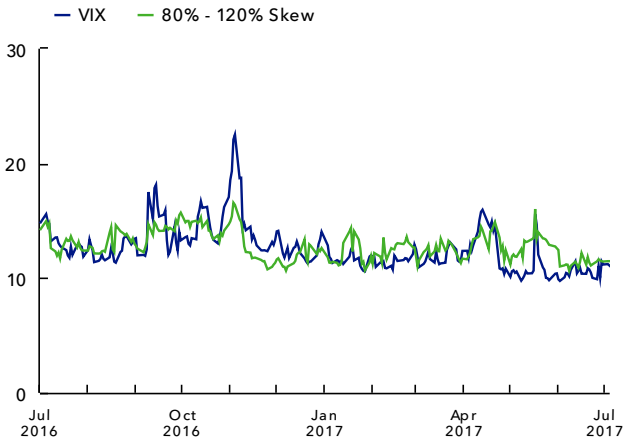
Source: Bloomberg Finance L.P.

U.S. equity valuations: Shiller CAPE (ratio)



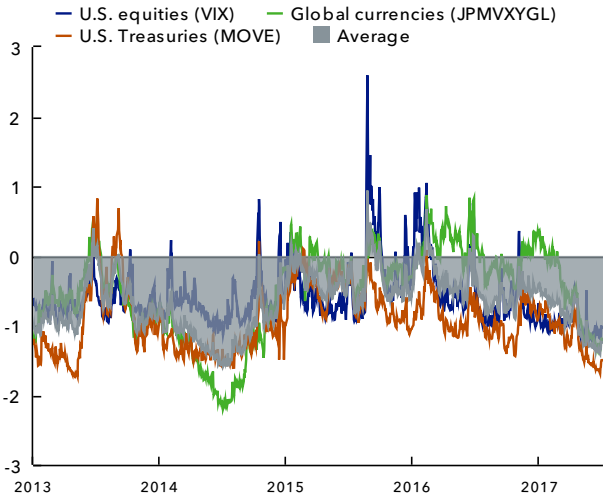
Notes: CAPE is the ratio of the monthly S&P 500 price level to trailing ten-year average earnings (inflation adjusted).
Sources: Haver Analytics, Robert Shiller

S&P 500 implied volatility and option skew (percent)



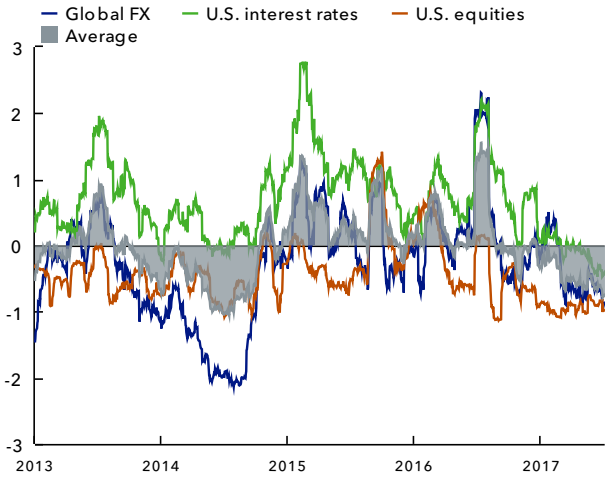
Notes: Option skew is the difference between three-month implied volatility of out of the money puts and calls with strikes equal distance from the spot price (+/- 20 percent). Higher values reflect greater demand for downside risk protection.
Source: Bloomberg Finance L.P.

Implied volatility by asset class (Z-score)



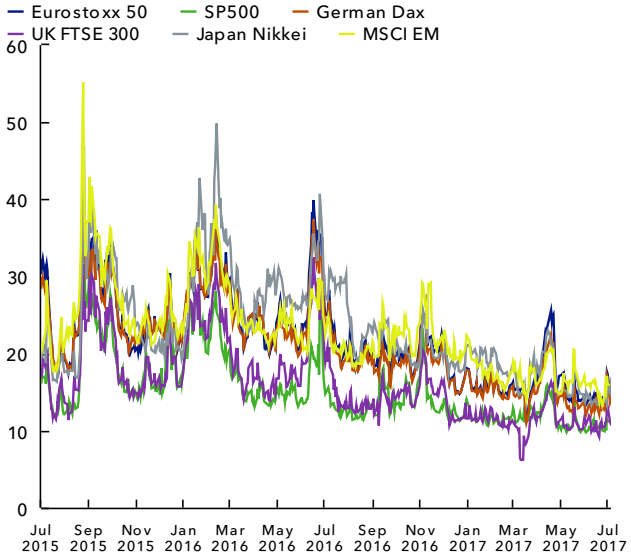
Notes: Z-score represents the distance from the average, expressed in standard deviations. Standardization uses data going back to January 01, 1993.
Sources: Bloomberg Finance L.P., OFR analysis

Realized volatility by asset class (Z-score)



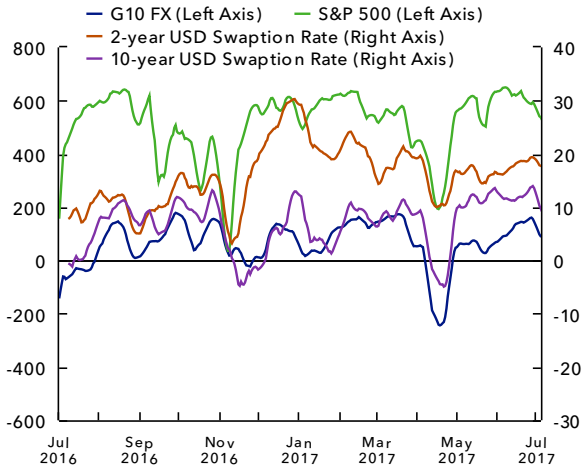
Notes: Thirty-day realized volatility. Equities based on S&P 500 index, interest rates based on weighted average of Treasury yield curve, FX based on weights from JPMVXY index. Standardization uses data going back to January 01, 1993.
Sources: Bloomberg Finance L.P., OFR analysis

Global equity indexes 1-month implied volatility (percent)



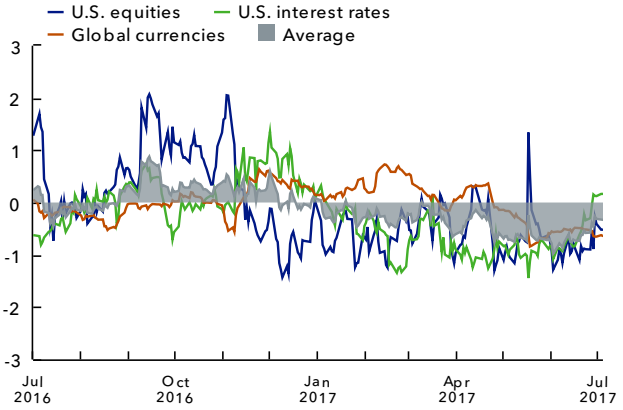
Source: Bloomberg Finance L.P.

Slopes of implied volatility curves (basis points)



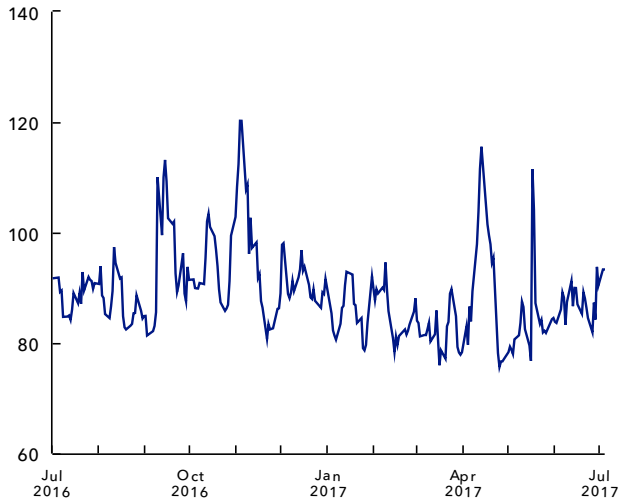
Notes: Seven-day moving average. Slope represents difference between one-year and one-month maturities. G10 FX based on weights from Deutsche Bank's CVIX index.
Sources: Bloomberg Finance L.P., OFR analysis

Option skew by asset class (z-score)



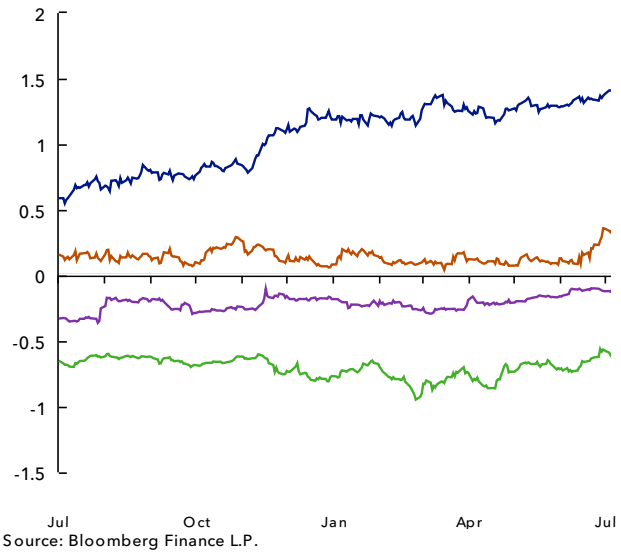
Notes: Option skew is the difference between three-month implied volatility of out of the money puts and calls with strikes equal distance from the spot price (+/- 10 percent). Higher values reflect greater demand for downside risk protection. Equities represents S&P500 index. Interest rates represent weighted average skew of Treasury futures curve. Currencies represent dollar skew against major currencies based on JPMVXY index weights. Z-score standardization uses data going back to January 01, 2006.
Sources: Bloomberg Finance L.P., OFR analysis

Volatility of equity volatility



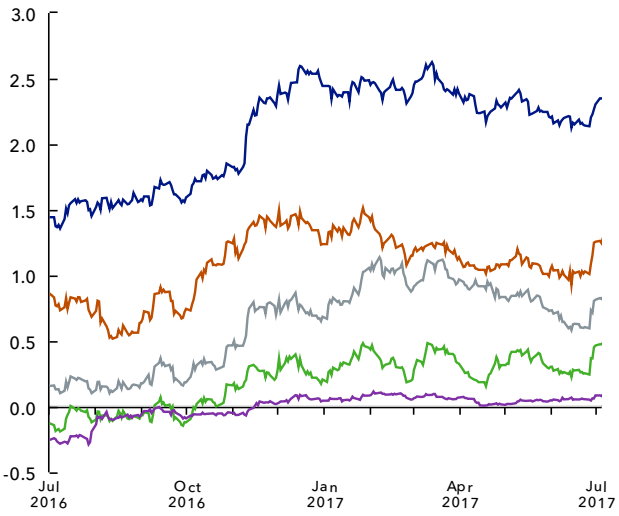
Note: VVIX Index measures the expected volatility of the 30-day forward price of the CBOE VIX Index.
Source: Bloomberg Finance L.P.

2-year sovereign bond yields (percent)



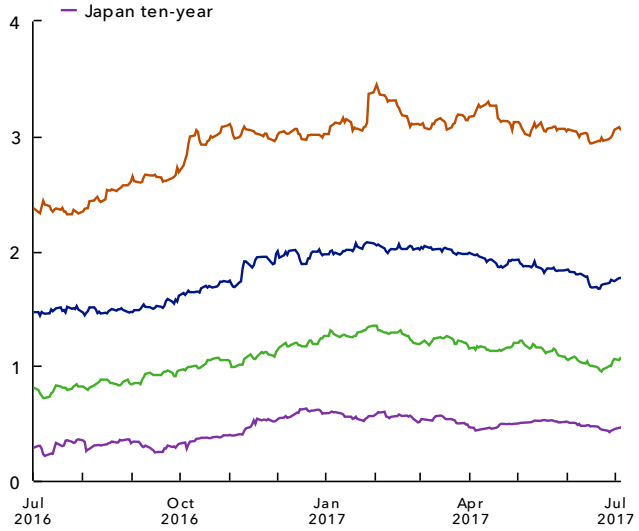
Source: Bloomberg Finance L.P.

10-year sovereign bond yields (percent)



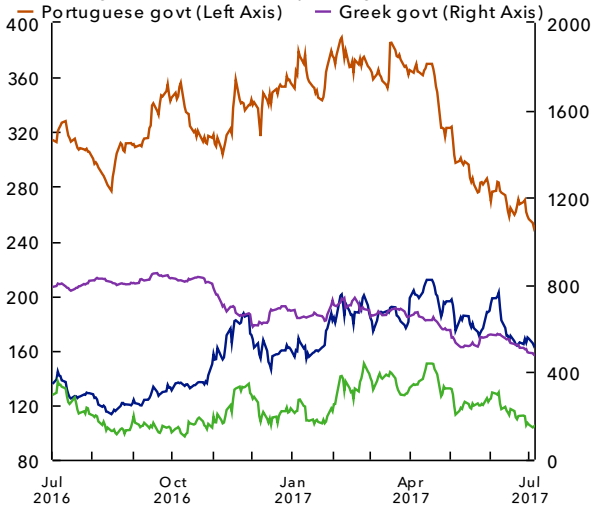
Source: Bloomberg Finance L.P.

Breakeven inflation (percent)



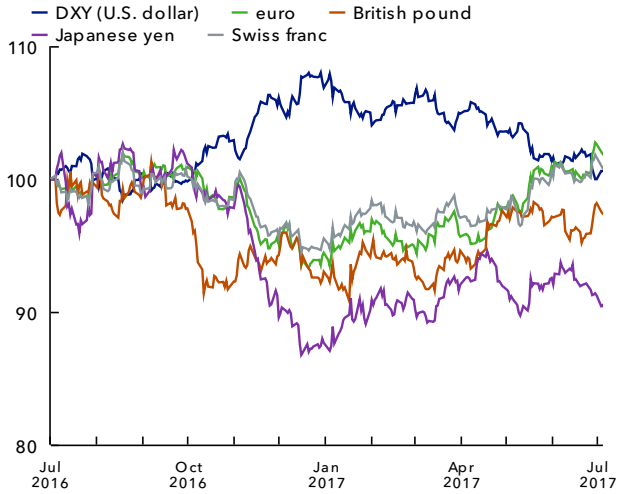
Source: Bloomberg Finance L.P.

10-year euro area periphery government bond spreads over German bunds (basis points)



Source: Bloomberg Finance L.P.

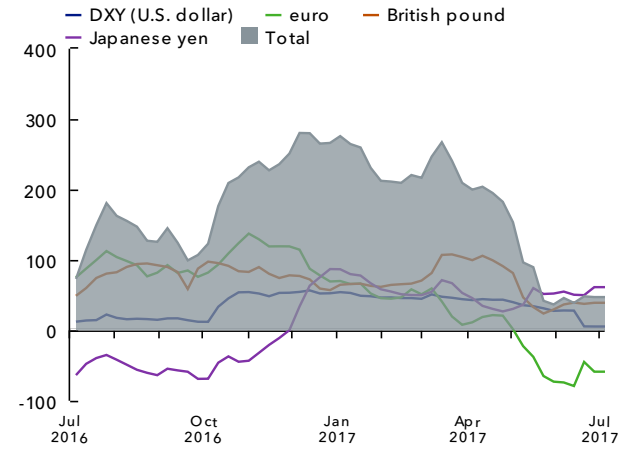
Major currency indexes



Notes: Foreign currency increases represent greater strength versus the U.S. dollar. DXY increases represent greater strength of the U.S. dollar versus a basket of major world currencies. Index 100 = July 01, 2016.

Source: Bloomberg Finance L.P.

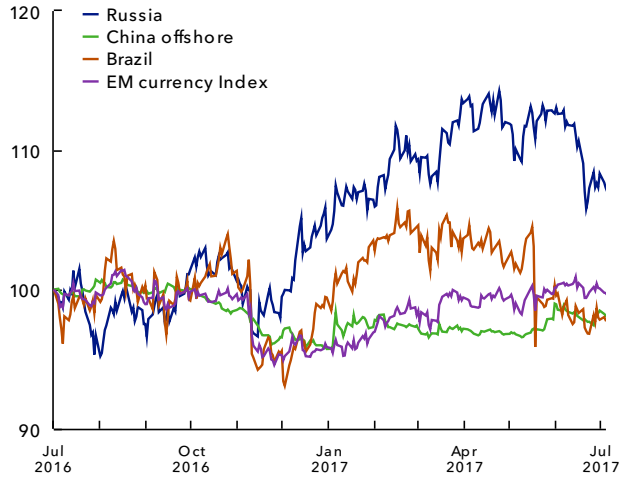
U.S. dollar long positioning vs. major currencies (net speculative positions, thousands of contracts)



Notes: Positive values represent net U.S. dollar long positions. The Dollar Index (DXY) is a futures contract based on the U.S. dollar's value against a basket of major world currencies. To express a U.S. dollar long position in a non-U.S. dollar contract, the contract must be shorted.

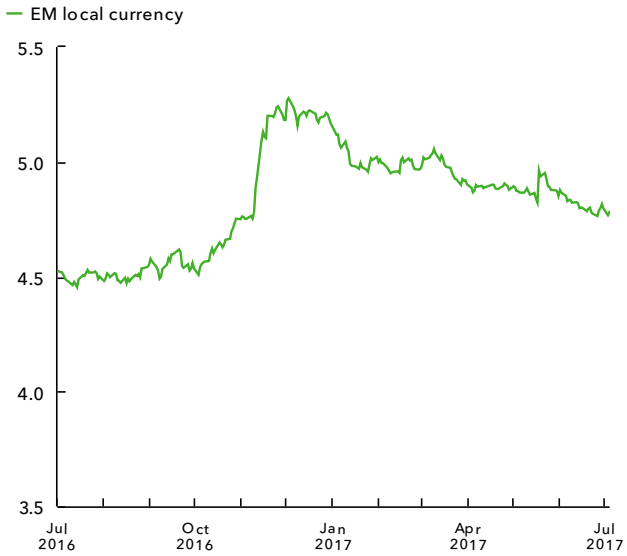
Source: Bloomberg Finance L.P.

Emerging market currencies
(U.S. dollars per foreign currency unit)



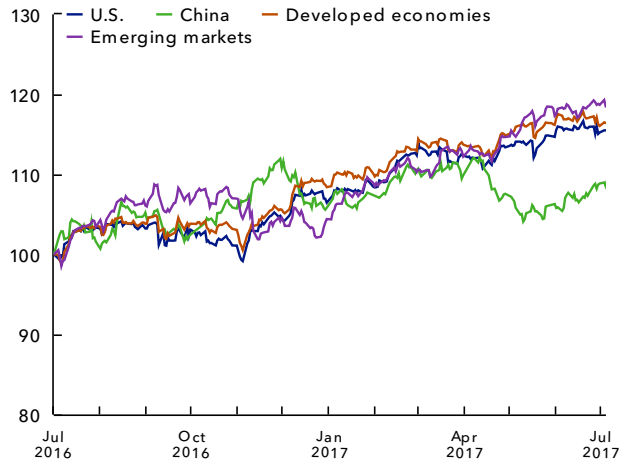
Notes: Increasing values indicate strengthening versus the U.S. dollar. Index 100=July 01, 2016.
Source: Bloomberg Finance L.P.

Emerging market sovereign debt yield



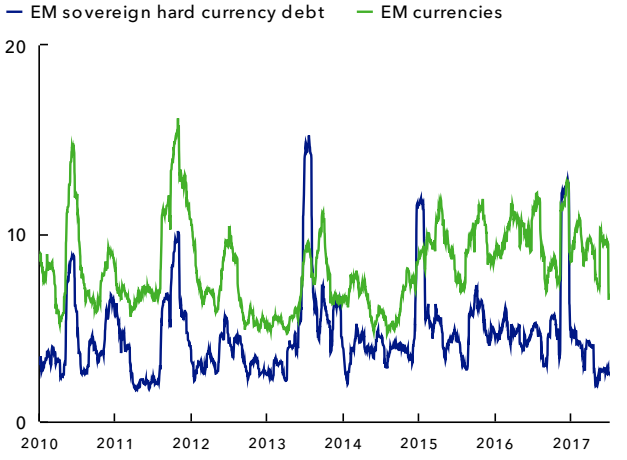
Source: Bloomberg Finance L.P.

Equity price indexes



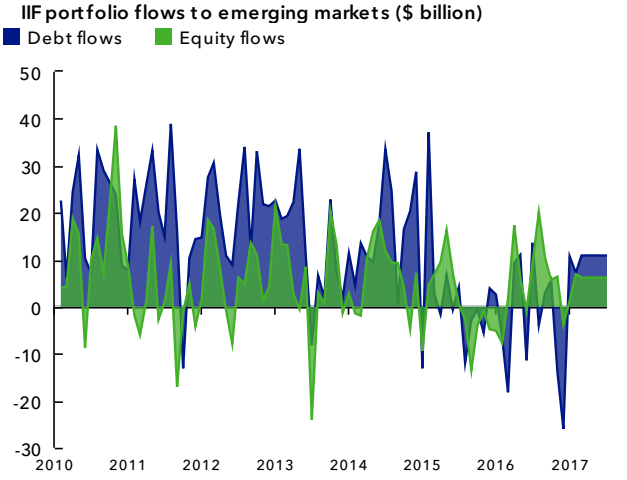
Notes: The US equity index is the S&P 500 Index. The Chinese equity index is the Shanghai Composite Index. The Developed Economies index is the MSCI World Index and the Emerging Markets index is the MSCI EM Index (both are in local terms). Index 100 = July 01, 2016.
Source: Bloomberg L.P.

1-month realized emerging markets volatility (percent)



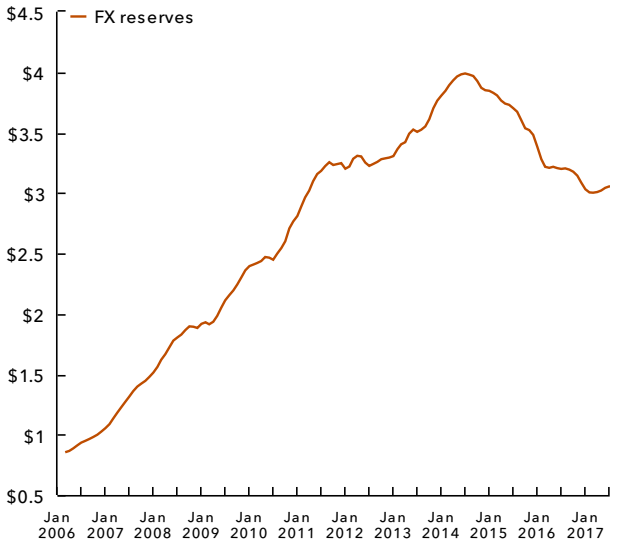
Notes: Realized volatility is the annualized standard deviation. Hard currency sovereign debt based on the J.P. Morgan Emerging Bonds - Global Price Index and currencies based on a weighted average of EM currency returns against the dollar using weights from J.P. Morgan VXY-EM currency volatility index.
Sources: Bloomberg L.P., OFR analysis

IIF portfolio flows to emerging markets ($ billion)



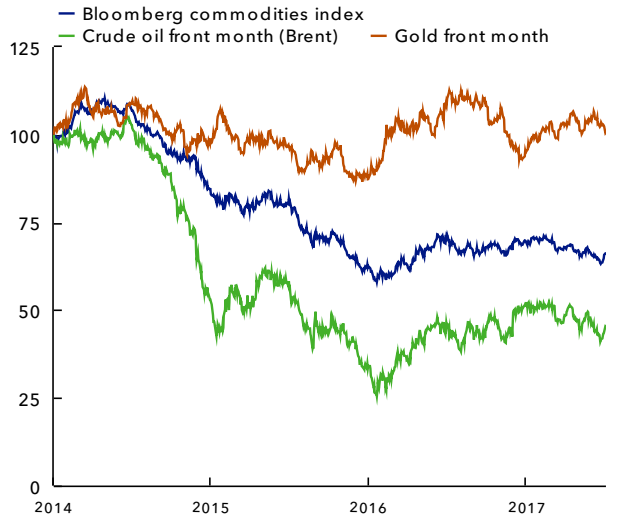
Notes: Data represent the Institute of International Finance's monthly estimates of non-resident flows into thirty EM countries. Data for latest observations are derived from IIF's empirical estimates using data from a smaller subset of countries, net issuance, and other financial market indicators.
Source: Bloomberg

China's Foreign Exchange Reserves ($ trillion)



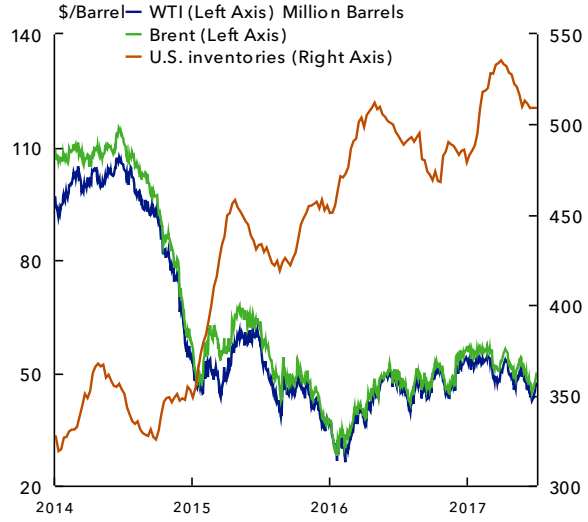
Source: Bloomberg

Major commodities prices



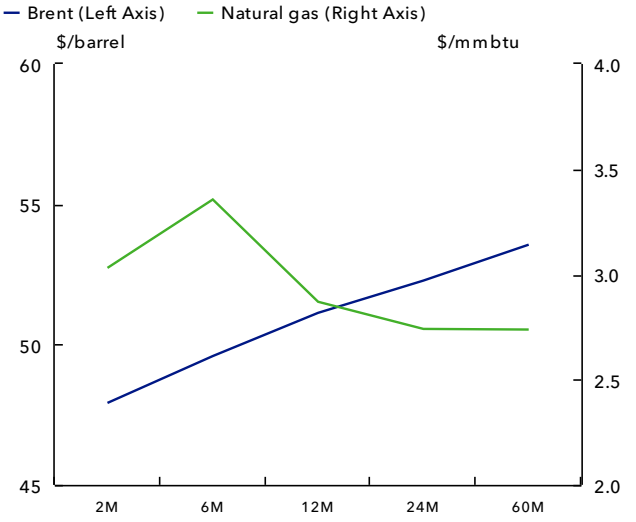
Notes: Index 100 = January 01, 2010
Source: Bloomberg Finance L.P.

Crude oil



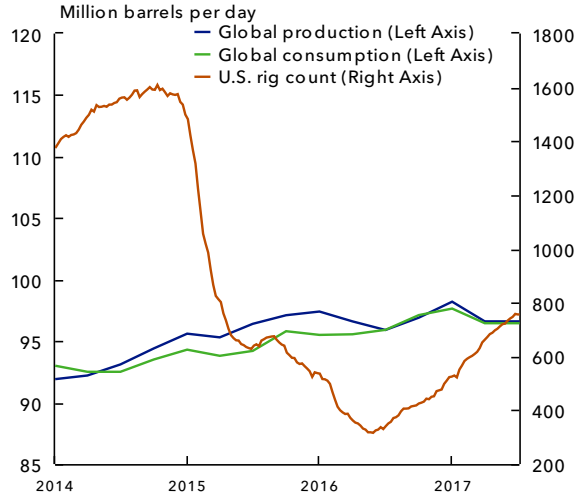
Note: WTI and Brent are front-month contracts.
Source: Bloomberg Finance L.P.

Oil and natural gas futures curves



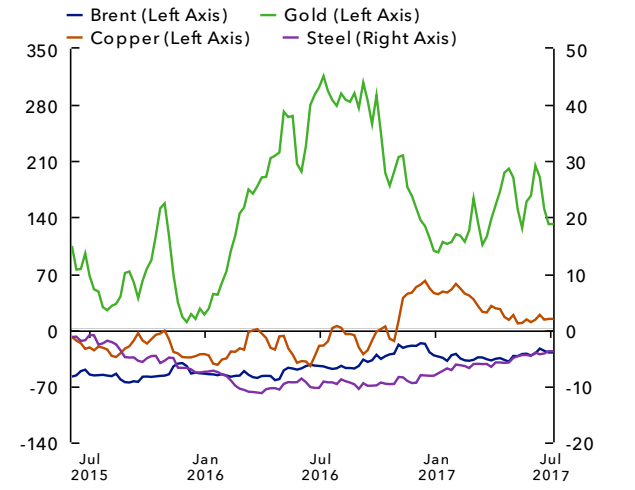
Note: Data as of July 05, 2017.
Sources: Bloomberg Finance L.P., OFR analysis

Oil supply and demand factors



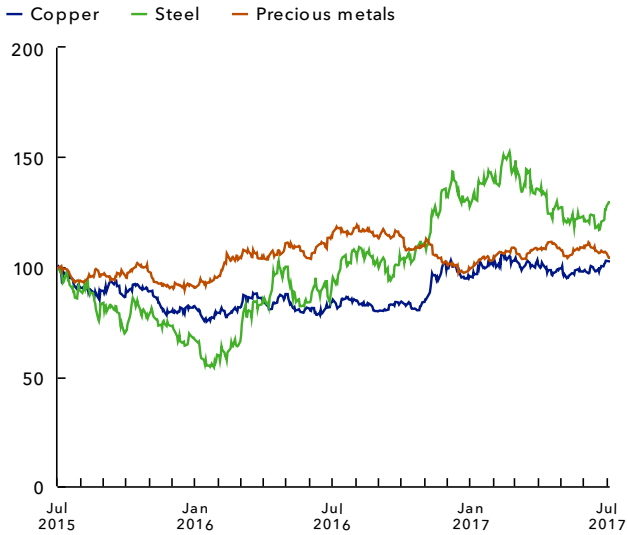
Note: Global production and consumption are estimates by the International Energy Agency.
Source: Bloomberg Finance L.P.

Speculative futures positioning (thousands of contracts)



Notes: Positive values represent net long positions. Negative values represent net short positions.
Source: Bloomberg Finance L.P.

Metals spot price indexes



Note: Index 100 = January 01, 2010.
Source: Bloomberg Finance L.P.