

## The Puzzle of Low U.S. Treasury Yields

Long-term bond yields in advanced economies are at historically low levels. In Europe and Japan, this reflects persistent economic weakness and ongoing monetary stimulus. In the United States, the low level of yields is more surprising. Long-term Treasury yields have declined substantially since early 2014, despite a strengthening U.S. economy, the conclusion of Federal Reserve purchases of Treasuries, and broad-based expectations for the Federal Reserve to begin raising interest rates this year. Several explanatory factors appear to be at work: the increasing relative value of Treasuries amid expanded monetary easing abroad; reduced inflation expectations; a decline in the expected steady-state target rate of the Federal Reserve; and new U.S. bank demand for Treasuries. While financial stability risks currently appear moderate, a persistence of low long-term Treasury yields could lead to a buildup of such risks if it encourages excessive borrowing or investor risk-taking.

### Developments during the last month

- The U.S. dollar rally paused and U.S. interest rates declined modestly amid weaker U.S. economic data
- U.S. equity indexes made further gains, setting new price records
- Oil prices traded at the high end of their year-to-date range, still roughly 40 percent below 2014 highs
- Uncertainty over Greek government financing began to impact other euro area markets
- Chinese authorities made several important policy moves, including their largest rate cut since 2008 and measures to temper the rapid rise of equity prices

**Feature:** *A Closer Look at Trends in Cross-Asset Volatility* (p. 6)

### U.S. Treasury yields remain in a historically low range.

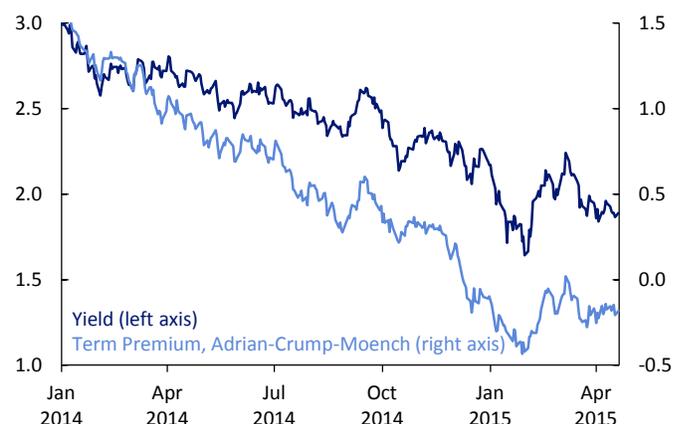
**Market attention remains focused on the very low level of long-term U.S. Treasury yields.** Since January 2014, 10-year yields have declined by more than 100 basis points (Figure 1). That sizable decline surprised market contacts, as it occurred in spite of developments widely expected to push yields higher: the wind-down of Federal Reserve purchases of U.S. Treasuries, a strengthening of the U.S. economy, and broad-based market expectations that the Federal Reserve will begin raising interest rates this year.

Market participants point to several key factors to explain the unexpected fall in yields:

- **Increased relative value of Treasuries.** Government bond yields in Europe have fallen

**Figure 1. The decline in long-term Treasury yields**

Ten-year U.S. Treasury Yield and Term Premium (percent)



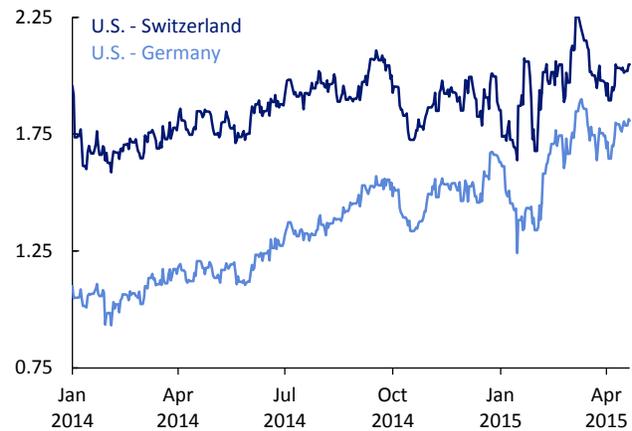
Source: Federal Reserve Bank of New York, Bloomberg L.P.

to much lower levels than in the United States (Figure 2), pushed by weaker economic growth, negative monetary policy rates, and the expanded bond purchase program of the European Central Bank (ECB). These developments have reportedly drawn investment out of European government bonds into U.S. Treasuries.

- **Reduced market expectations for U.S. inflation and inflation risk.** Disinflation and the sharp reduction in oil prices have reduced market-implied inflation expectations and the premium that compensates for the risk of higher-than-expected inflation (Figure 3).
- **A decline in the expected long-run Federal Reserve target rate.** Long-term Treasury yields also reflect the expected path of short-term interest rates, which are strongly influenced by the Federal Reserve’s target rate. From January 2014 to March 2015, primary dealers surveyed by the Federal Reserve lowered their median forecast of the long-run target rate by 50 basis points to 3.5 percent.
- **Regulatory requirements have increased demand for U.S. Treasuries.** U.S. banks have sharply increased their holdings of Treasury securities since late-2013, when the U.S. liquidity coverage ratio (LCR) rule was proposed. The LCR incentivizes large banks to increase their holdings of “high-quality liquid assets,” including U.S. Treasuries. Since January 2014, commercial banks have increased their holdings of U.S. Treasuries by \$185 billion (45 percent).

**A medium-term persistence of low U.S. Treasury yields could lead to financial stability risks.** Persistently low yields can encourage excessive investor risk-taking and excessive leverage. There has already been material evidence of excessive risk-taking during the extended post-crisis period of low interest rates and low volatility (see [2014 OFR Annual Report](#)). Some of the factors noted above may continue for some time, particularly the divergence in economic and monetary policy that has increased the relative value of U.S. Treasuries. If so, an even longer period of low yields could increase the associated risks. Further, diminished market liquidity, mispricing in risk assets, and possible contagion could increase the risk of a disorderly adjustment in financial markets when long-term interest rates do rise.

**Figure 2. Increasing relative value of U.S. Treasuries**  
Ten-year Government Bond Yield Differential (percent)



Source: Bloomberg L.P.

**Figure 3. The decline in yields partly reflects disinflation**  
Market-Implied U.S. Inflation Expectations (percent)



Source: Bloomberg L.P.

**Figure 4. U.S. banks major buyers of Treasuries since LCR proposal**  
Commercial Bank Holdings of U.S. Government Securities (\$ bil)



Note: U.S. government securities includes Treasuries and agency debentures.

Source: Haver Analytics

**Expectations for “lift off” shifted to later in 2015...**

During the last month, markets have priced in a somewhat later start to the Federal Reserve’s tightening cycle. Market-implied expectations and dealer forecasts for a first policy rate hike are now split between September and December of this year. The adjustment in expectations reflected weaker U.S. economic data in Q1 2015 and the accommodative tone struck at the March meeting of the Federal Open Market Committee (FOMC) (see last month’s [Financial Markets Monitor](#)). The downward shift in interest rate futures markets increased the gap between market expectations and FOMC forecasts for 2016-17 (Figure 5).

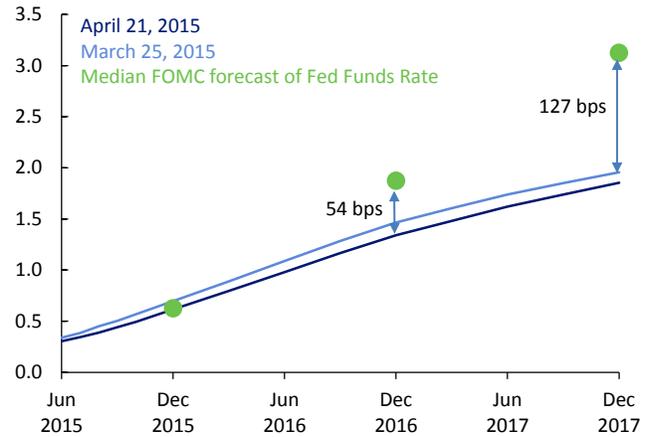
**...amid challenges of forward policy rate guidance.**

Policymakers continue to discuss the strategy for implementing monetary policy normalization (see [FOMC March 2015 Meeting Minutes](#) and [Money Markets and Monetary Policy Normalization](#)). The March spike in the overnight Treasury General Collateral (GC) repo rate, a benchmark for the cost of short-term secured funding, reinforced concerns about the challenge of the Federal Reserve providing guidance on policy rates. Before the financial crisis, the Treasury GC repo rate traded below the federal funds effective rate, reflecting the lower cost of collateralized funding. Since the financial crisis, reduced dealer repo provision and other market changes have pushed repo rates higher above the federal funds effective rate (Figure 6). The inversion of the spread between collateralized and uncollateralized rates is expected to persist, given the higher cost of dealer intermediation and increasing demand for Treasury collateral.

**Meanwhile, there has been a break in some key market trends.**

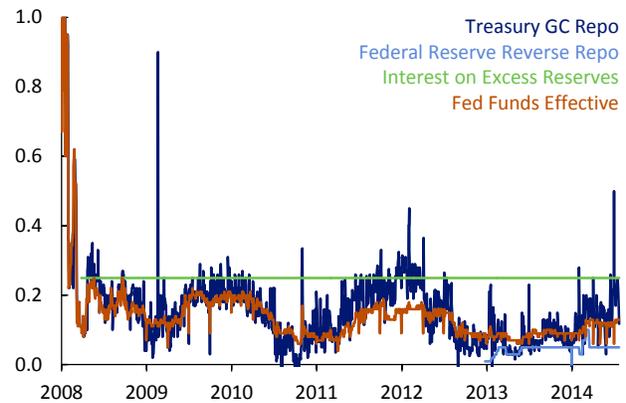
The U.S. dollar depreciated modestly from a mid-March peak, in what many market participants believe to be a pause in its sizable appreciation. After a nine-month, 26 percent rally, the U.S. dollar depreciated 2 percent from its March peak (Figure 7). Net speculative long positions unwound somewhat, but overall positioning implies further dollar appreciation is expected.

**Figure 5. Gap between market and Federal Reserve expectations**  
3m Eurodollar Futures and FOMC Member Target Rate Forecasts



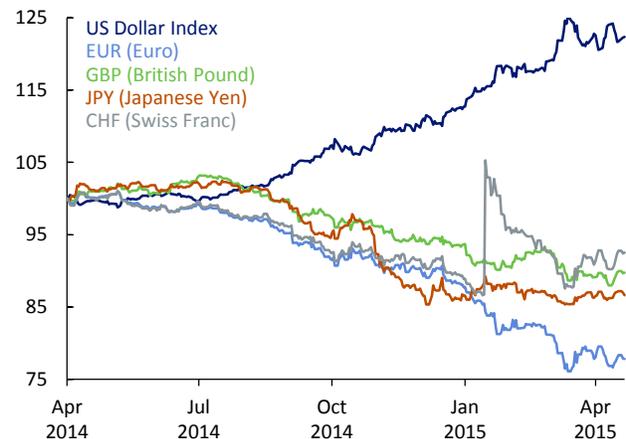
Source: Federal Reserve, Bloomberg L.P.

**Figure 6. Treasury GC Repo less anchored since the crisis**  
Money Market and Policy Interest Rates (percent)



Source: Bloomberg L.P.

**Figure 7. The U.S. dollar rally pauses**  
(FX unit per \$US, Index 100 = April 1, 2014)



Source: Bloomberg L.P.

**Crude oil prices have been range-bound since February, following a seven-month, 60 percent decline (Figure 8).** Speculative net long positions have increased since March, indicating that some market participants are anticipating a recovery in oil prices. U.S. shale production recorded its first monthly decline in more than four years, but U.S. inventories continue to build, reaching a 14-year high.

**U.S. equity prices and corporate mergers and acquisitions (M&A) remain elevated.**

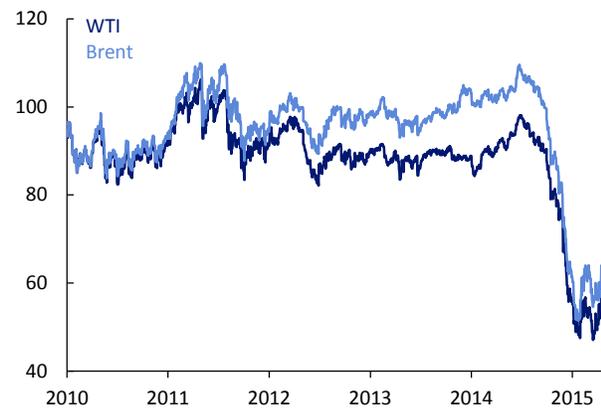
**U.S. equity analysts expect corporate earnings to decline in the first half of 2015, but U.S. equity valuations remain very high (Figure 9).** Analysts now forecast year-over-year declines in U.S. corporate earnings in Q1 and Q2 2015, largely reflecting weakness in the energy sector and the adverse effect of a stronger U.S. dollar on overseas profits and exports.

**Among the forces buoying stock prices are the elevated levels of share buybacks and M&A activity, both at their highest levels since 2007.** Although buybacks are often viewed as a favorable use of capital, they may be detrimental to (remaining) shareholders when transacted at prices well above intrinsic value. M&A activity is being supported by low interest rates, rising equity values, low organic growth, large corporate cash balances, abundant debt capital, and profit margin pressure.

**Corporate bond issuance remains strong, while leveraged loan production is diminishing.**

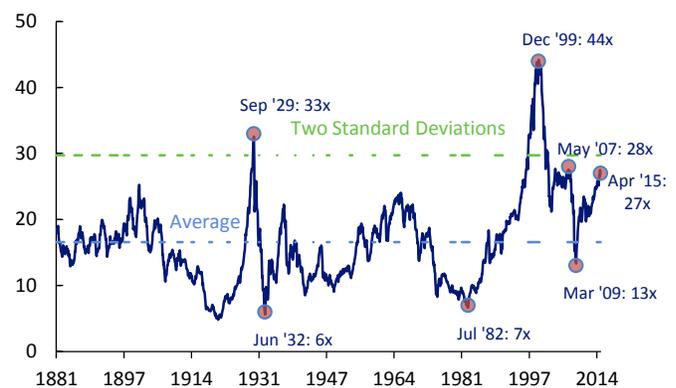
**Issuance of U.S. corporate bonds was elevated in Q1 (Figure 10).** Issuance was supported by the low level of interest rates, M&A activity, and a return of oil and gas companies to the issuance market as oil prices stabilized. In contrast to conditions in the bond market, leveraged loan production fell to its lowest first-quarter volume since 2010 in Q1. Market contacts attributed the slowdown to increased supervisory scrutiny of leveraged lending. On the demand side, loan fund outflows have slowed, with retail investors and managers of collateralized loan obligations (CLOs) expressing greater interest. As a result of the supply-demand imbalance, leveraged loan prices are up 3 percent year-to-date and yields fell to their lowest point since the first half of 2014.

**Figure 8. Oil prices range-bound since February**  
Crude Oil Prices (\$US per barrel)



Source: Bloomberg L.P.

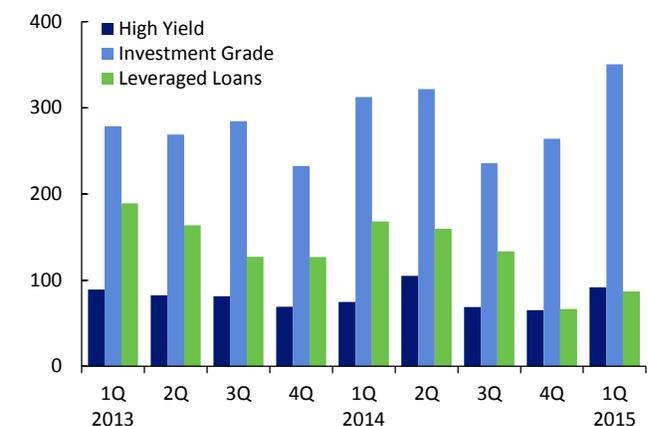
**Figure 9. U.S. equity valuations still highly elevated**  
Cyclically Adjusted Price-to-Earnings (CAPE) Ratio



Note: CAPE is the ratio of the monthly S&P 500 price level to trailing 10-year average earnings (inflation adjusted).

Sources: Robert Shiller, OFR analysis

**Figure 10. Corporate bond issuance strong in Q1**  
Quarterly U.S. Corporate Debt Issuance by Type (\$ billions)



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

### Uncertainty in Greece has started to spill over to other euro area markets.

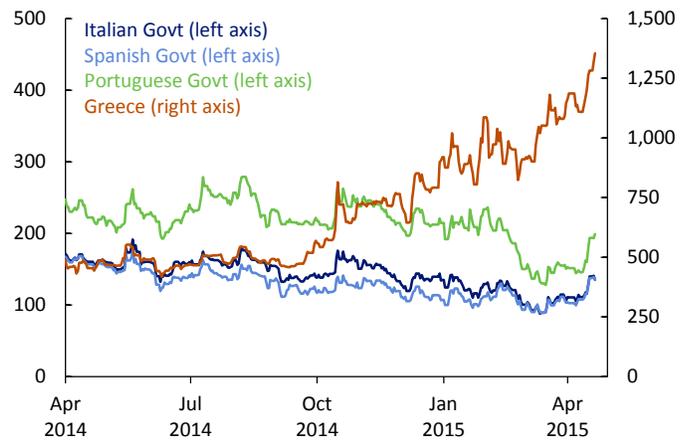
Greece's negotiations with official creditors deteriorated further over the last month, delaying an agreement to disburse needed government financing. Since January, a new Greek government has sought to renegotiate existing agreements, in turn renewing market fears of a Greek government default or even an exit from the euro area currency union.

Tensions between Greece and its official sector lenders severely disrupted other euro area markets in 2011-12, but have reverberated much less in recent years. Spillovers have been limited by greater confidence in euro area financial backstops and the willingness of the ECB to stabilize markets where governments comply with relevant policy conditions. However, euro periphery markets started to come under modest pressure in April (Figure 11), and warrant continued monitoring. The 2011-12 experience demonstrates that vulnerable euro area markets can remain stable for some time before a disruptive re-pricing.

### Chinese authorities took several important policy steps.

The Chinese central bank announced its largest single rate cut since 2008, in response to weaker economic data. The 100-basis-point cut in the reserve requirement ratio was the central bank's most significant step yet to support the decelerating economy, which in Q1 grew at the slowest rate since 2009 (7 percent year-on-year). Regulatory authorities also announced steps to restrain the surging equity market (Figure 12), which has been increasingly financed on margin. Authorities placed new restrictions on margin borrowing and liberalized rules to permit greater short-selling.

**Figure 11. Initial signs of spillover from Greece**  
10-year Bond Spreads over German Bunds (basis points)



Source: Bloomberg L.P.

**Figure 12. Chinese equities' extraordinary rally**  
Global Equity Indexes (Index 100 = April 1, 2014)



Source: Bloomberg L.P.

## FEATURE: Trends in Cross-Asset Volatility

(data as of April 17)

### Cross-asset volatility broke out of its low range during late 2014 and early 2015 (Figure 13).

- Low market volatility has been a theme of the post-financial-crisis period, raising concerns about the potential for excessive risk-taking (see [2014 OFR Annual Report](#)).
- Cross-asset implied volatility reached historically low levels in mid-2014, but has since risen materially. A simple measure of aggregate volatility is now near its long-term average.
- However, there are important differences across asset classes. Notably: (i) oil volatility surged in late-2014 and remains elevated; (ii) currency volatility has fluctuated around its long-term average; (iii) equity and interest rate volatility have receded to lower levels in recent months.

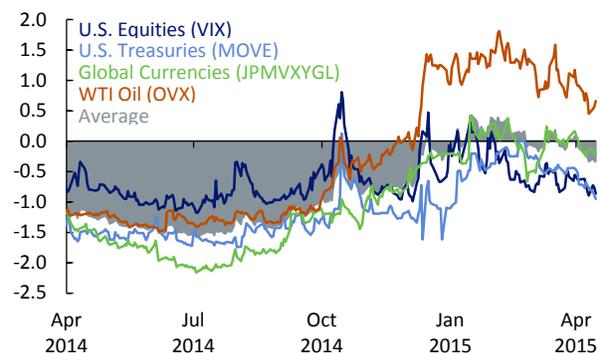
### No single factor appears to explain the rise in cross-asset volatility (Figure 14).

- Although volatility measures for different asset classes have been somewhat correlated, a principal components analysis of volatility indexes does not point to a single, dominant driver.
- In particular, the analysis shows that only about 30 percent of the total recent variation in volatility indexes can be explained by the first principal component, below the 10-year average.
- Market contacts point to a number of drivers, including the sharp decline in oil prices, major central bank surprises, and the unanticipated speed of moves in the U.S. dollar and euro.

### The volatility risk premium has been negative for oil and U.S. interest rates (Figure 15).

- The volatility risk premium is measured as the difference between option-implied volatility and expected volatility (see Figure 15 footnote). A negative risk premium is a sign that markets may be underpricing the risk of future volatility.
- A negative premium also makes selling options less attractive, as the income received fails to compensate the option seller for the expected volatility.

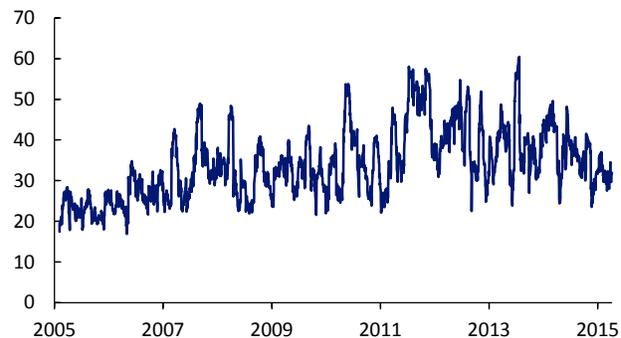
**Figure 13. Implied volatility by asset class (z-score)**



Note: Z-score represents the distance from the average, expressed in standard deviations. Averages for equity and interest rate volatility are based on data from 1991, currencies from 1992, and oil from 2007.

Source: Bloomberg L.P., OFR analysis

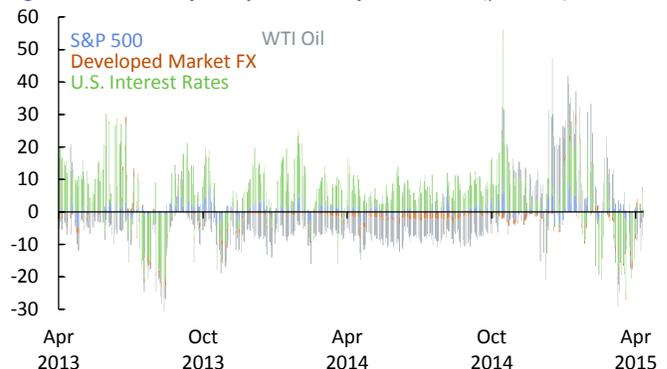
**Figure 14. Co-movement of volatility indexes (percent of variation explained by first principal component)**



Note: Volatility indexes include 12 measures across equities, U.S. and EU interest rates, commodities, and FX markets. Principal components are based on a 22-day rolling window of daily returns.

Source: Bloomberg L.P., OFR analysis

**Figure 15. Volatility risk premium by asset class (percent)**



Note: 1-month option-implied volatility minus 1-month model-predicted volatility. The latter is computed based on realized volatility, using a hetero-autoregressive model with 1, 5, and 22 day lags. U.S. Interest Rates represents the average volatility risk premium of 2- and 10-year swap rates.

Source: Bloomberg L.P., OFR analysis

**Demand for protection against a U.S. dollar depreciation is limited (Figure 16).**

- Despite the rapid appreciation in the U.S. dollar since late 2014, risk reversals remain positive, and are near a three-year high. A positive risk reversal means the implied volatility of out-of-the-money calls is greater than for similar puts. In other words, market participants are anticipating further gains in the dollar.
- Reflecting these expectations, speculative investors' net long dollar positions have grown, and are currently 2.5 standard deviations above their five-year average.

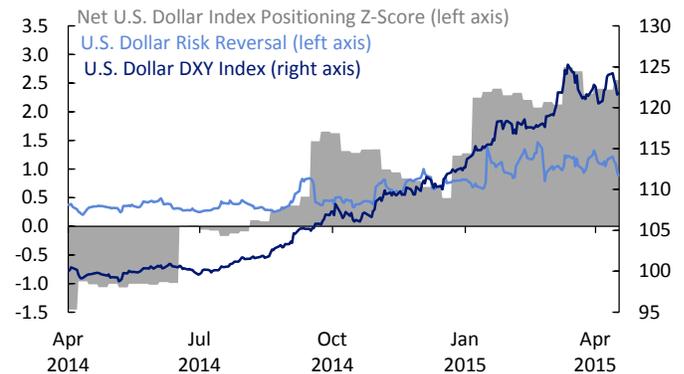
**U.S. interest rate swaption skew is negative for long-term rates (Figure 17).**

- As a Federal Reserve tightening cycle approaches, swaption skew – a measure of the cost of protection against future changes in interest rates – would be expected to be positive and increasing; in other words, markets would be expected to demand a higher price for protection against interest rate increases.
- However, swaption skew is now negative for long-term rates, indicating that investors are willing to pay a premium for protection against a *decline* in those rates. The desire for such protection reflects the same factors behind the surprising decline in long-term U.S. yields since early 2014, including the increased relative value of Treasuries and U.S. disinflation (see pages 1-2).

**U.S. equity volatility skew has declined from earlier peaks, but is still above average (Figure 18).**

- The positive skew in equities – which measures the difference in implied volatility of equally out-of-the-money puts and calls – indicates that investors are willing to pay a premium to buy protection against a fall in equities.
- Despite very high equity valuations, equity skew has edged lower since the start of this year, suggesting that investors are somewhat less willing to pay a premium for protection against a large market decline – defined here as a 20 percent drop in equity prices.

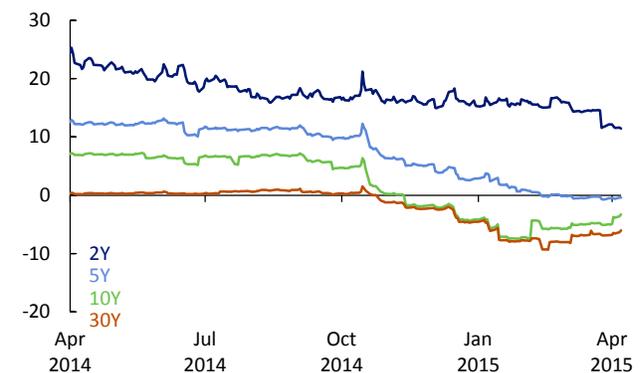
**Figure 16. U.S. dollar positioning, skew, and performance**



Note: Z score is based on data since 2010. U.S. dollar risk reversals based on weights from DXY index. DXY indexed to 100 at April 1 2014.

Source: Bloomberg L.P., OFR analysis

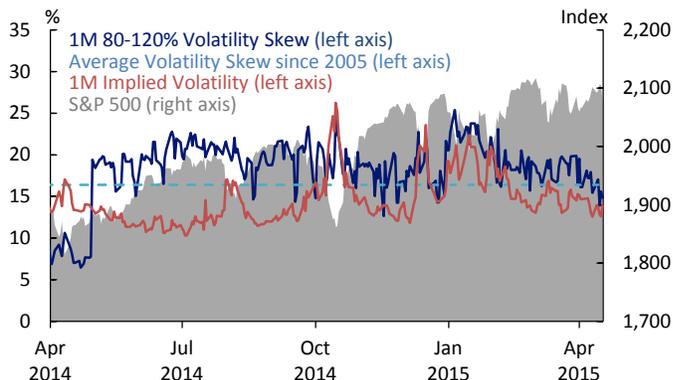
**Figure 17. 1-month U.S. interest rate swaption skew (percent)**



Note: Positive skew indicates greater demand for protection against a rise in interest rates (here measured as 25 basis points).

Source: Barclay's, OFR analysis

**Figure 18. U.S. equity prices, volatility, and skew**



Note: Higher skews reflect greater demand for protection against a sharp decline in prices (here measured as 20 percent).

Source: Bloomberg L.P., OFR analysis

## Selected Global Asset Price Developments

	LATEST LEVEL (4/21/2015)	1M CHANGE (bps or %)	1M CHANGE (standard deviations) <sup>a</sup>	YTD CHANGE (bps or %)	12-MONTH RANGE <sup>b</sup>
<b>EQUITIES</b>					
S&P 500	2097	-0.5%	-0.3	1.9%	
U.S. KBW Bank Index	73	-1.6%	-0.3	-2.0%	
Russel 2000	1264	-0.2%	-0.2	4.9%	
Nasdaq	5014	-0.2%	-0.2	5.9%	
Euro Stoxx 50	3719	-0.2%	-0.1	18.2%	
Shanghai Composite	4294	18.7%	1.4	32.7%	
Nikkei 225	19909	1.8%	0.3	14.1%	
Hang Seng	27850	14.3%	1.9	18.0%	
FTSE All World	288	1.2%	0.1	4.8%	
<b>RATES</b>					
U.S. 2-Year Yield	0.52%	-7	-0.2	-15	
U.S. 2-Year Swap Rate	0.79%	-5	-0.1	-11	
U.S. 10-Year Yield	1.91%	-2	0.0	-26	
U.S. 10-Year Swap Rate	1.99%	-4	-0.1	-39	
U.S. 30-Year Yield	2.58%	7	0.4	-17	
U.S. 2y10y Spread	139	4	0.2	-11	
U.S. 5Y5Y Inflation Breakeven	1.97%	5	0.2	-17	
U.S. 5Y5Y Forward Rate	2.55%	4	0.2	-21	
Germany 10-Year Yield	0.10%	-8	-0.3	-44	
Japan 10-Year Yield	0.32%	-1	0.0	-1	
U.K. 10-Year Yield	1.57%	5	0.3	-19	
Germany 5Y5Y Inflation Breakeven	1.83%	-8	-0.3	-3	
<b>FUNDING</b>					
1M T-Bill Yield	0.01%	1	0.1	-1	
DTCC GCF Treasury Repo	0.12%	-1	-0.1	-13	
3M Libor	0.28%	1	0.1	2	
Libor-OIS Spread	14	0	0.0	1	
3M Eurodollar Sep 2016 Mid Yield	0.44%	-10	-0.2	-21	
EURUSD 3M CCY Basis Swap	-22	1	0.0	-8	
<b>U.S. MBS</b>					
FNMA Current Coupon	2.62%	-6	-0.2	-21	
FHLMC Primary Rate	3.67%	-11	-0.4	-16	
<b>CREDIT</b>					
CDX Investment Grade 5-Year CDS Spread	62	-1	-0.1	-4	
CDX High Yield 5-Year CDS Spread	336	16	0.1	-21	
CDX Itraxx Euro 5-Year CDS Spread	63	7	0.5	0	
U.S. 5-Year Sovereign CDS Spread	18	0	0.0	0	
<b>IMPLIED VOLATILITY</b>					
VIX Index	13	1.8%	0.0	-31.0%	
V2X Index	22	28.2%	1.4	-14.5%	
VDAX Index	21	13.3%	0.6	7.2%	
MOVE Index	73	-15.7%	-1.0	5.8%	
3M2Y Swaption Volatility	55	-15.9%	-0.9	-19.7%	
3M10Y Swaption Volatility	78	-10.4%	-0.9	5.6%	
DB G10 FX Volatility Index	11	-2.6%	-0.3	14.8%	
JPM EMFX Volatility Index	10	-3.8%	-0.3	-7.7%	
<b>FOREIGN EXCHANGE &amp; COMMODITIES</b>					
U.S. Dollar Index <sup>c</sup>	98	0.1%	0.0	8.6%	
EUR/USD	1.07	-0.8%	-0.3	-11.3%	
USD/JPY	120	-0.3%	-0.1	-0.1%	
GBP/USD	1.49	-0.2%	-0.1	-4.2%	
USD/CHF	0.96	-2.1%	-0.6	-4.0%	
Brent Crude	62	10.0%	1.4	1.4%	
Gold	1202	1.7%	0.2	1.5%	
S&P GSCI Commodities Index	426	7.0%	1.0	1.9%	
<b>EMERGING MARKETS</b>					
JPM EMFX Index	75	2.2%	1.1	-3%	
MSCI Emerging Market Equity Index	1042	7.5%	1.0	9.0%	
CDX EM 5-Year CDS Spread	301	-31	-0.6	-34	

<sup>a</sup> One month Change standard deviations based on monthly data from January 1994 or earliest available thereafter.

<sup>b</sup> Trailing 12-month range. Latest (O); Mean ( | ).

<sup>c</sup> Dollar index from Bloomberg (ticker: DXY); averages the exchange rates between the U.S. dollar and major world currencies.

Sources: Bloomberg L.P., OFR analysis