

July 14, 2017

## **Recent Movements in Longer-Term Treasury Yields: Causes and Potential Policy Implications<sup>1</sup>**

### **I. Introduction**

Since December 2015, the FOMC has raised the target range for the federal funds rate by a cumulative 100 basis points. We would normally expect longer-term yields to also rise during a tightening cycle, albeit by a smaller amount. However, the 10-year Treasury yield is almost unchanged on net, as declines in longer-term forward rates have offset increases in shorter-term yields (Table 1). The 5-to-10-year forward rate also appears to be about 90 basis points below where investors expected it to be in December 2015. Meanwhile, prices of domestic risky assets have risen notably and credit spreads have tightened.

This memo discusses potential explanations for, and policy implications of, these movements in asset prices since December 2015. In summary:

- We consider four potential explanations for why longer-term forward rates have risen by less than expected since December 2015.
  - We find evidence suggesting that continued monetary policy easing abroad has likely put downward pressure on U.S. term premiums.
  - We also find some evidence that the long-term neutral real interest rate ( $r^*$ ) has fallen.
  - We find only limited support for two other potential drivers—lower longer-run inflation expectations, or a further reduction in term premiums due to concerns about the domestic economic outlook as investors seek hedges against potential economic downturns.
- These explanations have different implications for U.S. monetary policy:
  - Our interpretation of the evidence suggests that the smaller-than-expected rise in term premiums likely reflects a loosening in financial conditions (relative to what was expected) due to foreign monetary policy easing, which may argue for a faster removal of monetary accommodation, all else equal.

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<sup>1</sup> This memo draws on contributions from staff at the Board's divisions of MA (Anthony Diercks, George Eckerd, Andrew Meldrum, Marcelo Ochoa, Sean Savage, and Min Wei), IF (Carol Bertaut, Alain Chaboud, and Canlin Li), and R&S (Travis Berge and Nitish Sinha), and at FRBNY (James Egelhof and David Lucca).

- By contrast, declines in  $r^*$  or longer-term inflation expectations, or reduced term premiums associated with concerns about future economic outlook, would argue for a slower removal of monetary accommodation, all else equal.

## **II. A Detailed Look at Movements in Treasury Yields since December 2015**

### Longer-horizon forward term premiums declined since December 2015

We can shed further light on changes in the 10-year yield by looking at its various components. First, Figure 1 decomposes the 10-year zero-coupon yield into a 2-year yield, a 2-to-5-year forward rate, and a 5-to-10-year forward rate. The 2-year yield is about 35 basis points above its level in December 2015, as a 2-year period now spans a period of higher rates. However, long-term forward rates have declined modestly on net, with the 5-to-10-year forward rate 12 basis points lower. We therefore mainly focus on the 5-to-10-year forward rate in the remainder of this memo.

The decline in long-term forward rates is even more notable when compared with what investors expected in December 2015. For example, responses to the December 2015 Blue Chip Financial Forecasts survey suggest that investors expected the 5-to-10-year forward rate to rise by about 80 basis points by mid-2017 (row I of Table 2), i.e. 90 basis points higher than its level today. Part of this forecast error reflects the fact that the federal funds rate is expected to increase to a lower longer-run value than investors anticipated in late 2015. Figure 2 shows the expected paths for short-term interest rates over the next ten years from the December 2015 (the black dashed line) and June 2017 (the black solid line) Blue Chip surveys. While the expected short rate path rotated up in the near term, consistent with the rise in the federal funds rate, it rotated down beyond 2 years. More importantly, the expected short rate path lies well below the path that was expected to prevail in mid-2017 by respondents to the December 2015 survey (the red line), partly reflecting the fact that the funds rate has risen less than investors expected.

Apart from lower-than-expected short rates far in the future, the large forecast error for the longer-term forward rate also likely reflects a contribution from lower-than-expected term premiums. Rows II and V of Table 2 decompose the forecast error for the 5-to-10-year forward rate into surprise changes in expected future short-term interest rates and term premiums. The surveys imply that in December 2015, investors anticipated that the expectations component of the 5-to-10-year forward rate would remain unchanged, and that the term premium would rise by

about 80 basis points. In practice, however, short rate expectations have fallen by about 30 basis points, while the term premium has risen by only about 25 basis points.

We can further decompose the forecast errors in 5-to-10-year ahead expected short rates and term premiums into their real and inflation components (rows III, IV, VI and VII). The surprise fall in the short rate component was almost entirely accounted for by lower expected short-term real rates. And the smaller-than-expected rise in the term premium was largely accounted for by the inflation risk premium rising by less than expected, which more than offset a small surprise increase in the real term premium.

We caution that these decompositions are subject to considerable uncertainty. For example, the staff's term structure model suggests a much smaller forecast error in the 5-to-10-year forward rate than the survey does. In addition, market participants may have different views from survey respondents. Finally, the far forward rate has risen about 10 basis points since the June 2017 survey. If part of this increase reflects higher expected short rates, the decomposition will overstate both the fall in expected rates and the rise in term premiums.

#### Net moves over the period since December 2015 mask differences across sub-periods

The small net decline in long-term forward rates since December 2015 masks some substantial fluctuations during the period, as can be seen from Columns II through IV in Table 1. The 5-to-10-year-ahead forward rate fell by about 85 basis points on net between the December 2015 FOMC meeting and the Brexit referendum in June 2016, reflecting a deterioration in the global growth outlook. It then rose by more than 100 basis points on net ahead of the December 2016 FOMC meeting, reflecting an improved domestic growth outlook and business confidence, and expectations of changes to fiscal and regulatory policies following the U.S. election. Over both periods, longer-term forward rates moved in the same direction as near-term policy expectations. By contrast, the period since the day before the December 2016 meeting appears to be more puzzling, as long-term forward rates fell notably even as the FOMC raised the federal funds rate by a cumulative 75 basis points. Those declines in long-term forward rates partially reversed the sharp post-election rises and likely reflect in large part waning expectations of forthcoming fiscal and regulatory policy changes.

### A comparison to the 2004-06 “conundrum” period

Movements in interest rates over this period bear some resemblance to the 2004-06 “conundrum” period, when the FOMC raised the federal funds rate by a total of 425 basis points but long-term forward rates fell, leaving the 10-year yield only about 25 basis points higher (Figure 3 and Table 1).<sup>2</sup> Studies of that period have mostly attributed the decline in long-term forward rates to a fall in term premiums, with flows into U.S. Treasuries caused by the “global savings glut” cited as one of the primary drivers.<sup>3</sup> The contrast between a rising federal funds rate and a decline in longer-term forward rates is less stark in the current episode than during 2004-06, as the magnitudes of these recent moves are smaller. However, as we discuss in Section III, it still appears that international spillovers are playing a role in depressing long-maturity forward rates—in this case, associated with foreign policy easing rather than with large purchase of U.S. Treasuries by foreign central banks.

### **III. What Factors Have Affected Longer-Term Forward Rates in the Recent Period?**

As discussed in the previous section, long-term forward rates have declined slightly on net since December 2015, and are currently about 90 basis points below where survey respondents expected them to be at the start of the period. This could reflect a number of factors:

- (1) Perceptions of a lower  $r^*$ .
- (2) Lower long-term inflation expectations.
- (3) A reduction in term premiums, which in turn could reflect a variety of factors, including:<sup>4</sup>
  - a. Changing views about the near-term outlook for the domestic economy; and
  - b. Continued monetary policy easing abroad, through spillovers of foreign central bank purchases of their own domestic securities on the term premiums of U.S. securities.

In this section we consider the evidence for declines in each of these components in turn.

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<sup>2</sup> More generally, recent evidence suggests that bond market “conundrums,” defined as short- and long-term yields moving in opposite directions, have become more frequent since 2000 (See Samuel G. Hanson, David Lucca, and Jonathan H. Wright (2017) “Interest Rate Conundrums in the Twenty-First Century,” *Federal Reserve Bank of New York Staff Reports* 810).

<sup>3</sup> See, for example, “The Global Savings Glut and the U.S. Current Account Deficit,” speech by Ben Bernanke on March 10, 2005.

<sup>4</sup> Another factor that could have led to increased investor demand for Treasury securities is the Liquidity Coverage Ratio (LCR), which requires banks to hold high quality, liquid assets such as central bank reserves and government debt. However, LCR-related demand is unlikely to be a major driver behind low long-term yields, as bank holdings of Treasury securities have risen only modestly since 2013, when the U.S. version of the LCR was proposed, and those holdings are reportedly concentrated in short and intermediate maturities. Moreover, banks’ holdings make up only 4 percent of the overall Treasury market.

(1) A lower neutral real rate

The net decline in longer-term forward rates since December 2015 might reflect perceptions of a lower  $r^*$ , perhaps due to expectations of continued slow productivity growth and demographic changes.

The evidence for a decline in  $r^*$  since December 2015 is somewhat mixed. On the one hand, *survey-based* measures suggest that investors may indeed have revised down their views about  $r^*$  over this period: As discussed in Section II, a measure based on the difference between Blue Chip Financial Forecasts of the three-month Treasury bill rate and CPI inflation 5-to-10 years ahead (the blue circles in Figure 4) fell by about 30 basis points on net between the December 2015 and June 2017 surveys; over the same period FOMC participants revised down their projections of the longer-run real federal funds rate slightly more.<sup>5,6</sup> In addition, expectations about longer-run real GDP growth implied by responses to the Desk’s survey of primary dealers (the red circles in Figure 4) have fallen gradually since the survey taken ahead of the December 2015 FOMC.<sup>7</sup>

On the other hand, a number of *model-based* estimates do not tend to point to substantial changes in  $r^*$  over this period. The staff term structure model discussed in Section II—which takes into account information from surveys—suggests that expected 5-to-10-year ahead real rates are little changed on net over this period (the black line in Figure 4). Estimates based on macroeconomic variables—including those of Holston, Laubach, and Williams (2016); Kiley (2015); Johannsen and Mertens (2016); and Lubik and Matthes (2015)—are significantly lower compared with the pre-crisis period.<sup>8</sup> Point estimates from these models have remained relatively stable over the past few years but, due to the wide confidence intervals on their estimates, are not inconsistent

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<sup>5</sup> Since the December 2015 FOMC meeting, the median FOMC participant’s projection of the long-run (nominal) federal funds rate in the Summary of Economic Projections has fallen from 3.5 to 3 percent, continuing a longer-running trend. The median long-run inflation projections have remained unchanged at 2 percent over that period.

<sup>6</sup> The average responses to the Desk surveys also suggest that longer-run expectations of the nominal federal funds rate have fallen by 30 basis points on net, with 5-to-10-year-ahead inflation expectations little changed. Looking at the median responses suggests a larger fall—about 50 basis points.

<sup>7</sup> In the Desk’s July 2016 surveys, respondents on average viewed changes in perceptions of the neutral real fed funds rate as a significant driver contributing to the declines in long-term forward rates between the start of 2016 and the Brexit referendum.

<sup>8</sup> Kathryn Holston, Thomas Laubach, John C. Williams (2016), “Measuring the Natural Rate of Interest: International Trends and Determinants,” *FRB San Francisco Working Paper* 2016-11; Michael T. Kiley (2015), “What Can the Data Tell Us About the Equilibrium Real Interest Rate?,” *FRB Finance and Economics Discussion Series* 2015-077; Benjamin K. Johannsen and Elmar Mertens (2016), “The Expected Real Interest Rate in the Long Run: Time Series Evidence with the Effective Lower Bound,” *FEDS Notes*; Thomas A. Lubik and Christian Matthes (2015), “Calculating the Natural Rate of Interest: A Comparison of Two Alternative Approaches,” *FRB Richmond Economic Brief*, October 2015.

with a further decline.<sup>9</sup> The continued low level of  $r^*$  estimates may also have led some market participants to revise down their own perceptions of  $r^*$ .

## (2) Lower long-term inflation expectations

As discussed in Section II, 5-to-10-year ahead inflation expectations as measured by the Blue Chip survey (the blue circles in Figure 5) have changed little on net since December 2015. This is consistent with responses to the Desk surveys (the red circles). Estimates of 5-to-10-year ahead inflation expectations from a staff model were also approximately flat over the period (the black line).<sup>10</sup>

If investors believe that recent weak inflation data provide a stronger signal about the longer-term prospects for inflation than was the case in the past, we might also expect to see signs of an increase in the sensitivity of inflation forwards to inflation surprises. But it is hard to find evidence that this is indeed the case, at least over the period since December 2015 as a whole: Regressions of changes in 5-to-10-year inflation compensation on surprises in core CPI suggest that the sensitivity has been slightly greater for the period since the December 2015 FOMC meeting than during the 2004-2015 period—about 1.4 basis points for a 0.1 percentage point core CPI surprise, compared with 1.0 basis points in the earlier period—but the difference is not statistically significant.<sup>11</sup>

## (3a) Lower term premiums due to changes in the domestic outlook

Even if longer-term  $r^*$  and inflation expectations remain stable, increased concerns about downside risks to the growth or inflation outlook could potentially hold down longer-term yields by reducing term premiums, as investors seek Treasury securities as good hedges against potential economic downturns—especially those associated with deflationary outcomes.<sup>12</sup> While this appeared to be an important driver of falling Treasury yields during a few episodes over the past year and a half, including early 2016 and immediately after the Brexit vote, there is less

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<sup>9</sup> A recent staff memo discusses model-based estimates of  $r^*$  in more detail (“Long-Run Value for the Equilibrium Rate of Interest” by Cristina Fuentes-Albero).

<sup>10</sup> Although the net change in inflation compensation since December 2015 has been small, 5-to-10-year ahead breakevens have fallen by about 15 basis points since the December 2016 FOMC, while an alternative measure based on inflation swaps has fallen by about 20 basis points. The accompanying memo from staff at the NY Fed (“Explaining the Current Level of U.S. Treasury Yields – Views from Market Outreach” by James Egelhof and Benedict Wensley) suggests that market contacts have attached some weight on lower inflation expectations as an important driver of falls in Treasury yields over the last few months.

<sup>11</sup> The sensitivity of longer-term inflation forward rates to *headline* CPI surprises is even smaller and is not significantly different from zero.

<sup>12</sup> It is possible that the hedging properties of Treasury securities have been improved further by the possibility that FOMC would expand its asset purchases in an economic downturn—thereby raising long-term bond prices.

evidence that such concerns are significantly higher today *on net* relative to December 2015. For example, the distribution of average inflation over the next 10 years implied by inflation caps (Figure 6) has shifted slightly to the right and now attaches lower odds to average inflation being below 2 percent.

(3b) Lower term premiums due to spillover from global monetary policy easing

One final factor that may be influencing the longer-end of the U.S. Treasury curve is accommodative monetary policy abroad. 5-to-10-year ahead forward rates are lower across the U.S. and advanced foreign economies on net since December 2015, which staff models largely attribute to declining term premiums (Table 3). More generally, movements in U.S. and European forward rates are highly correlated (Figure 7), and these correlations have risen in recent years. These high correlations could reflect a wide range of factors, such as common shocks to the world economy and global shifts in risk sentiment. But they could also reflect cross-border spillovers of monetary policy: monetary policy easing abroad may well have contributed to the recent stagnation of U.S. yields.

Indeed, Table 4 presents a few recent examples of foreign central bank communications that both affected foreign yields and spilled over onto U.S. yields. More systematically, a regression of changes in 10-year Treasury yields on changes in 10-year Bund yields in a 2-hour window around ECB policy announcements shows that Treasury yields move about 0.5 basis point for every 1-basis-point move in Bund yields (Figure 8).<sup>13</sup> Effects on U.S. yields of about the same magnitude are found in reaction to the policy actions of other major foreign central banks. We have long been aware that U.S. monetary policies affect foreign financial markets, but clearly the reverse is true as well.

One question that arises is: what are the specific channels through which foreign monetary policy affects U.S. yields? One possibility is that declines in actual and/or expected policy interest rates abroad are expected to push up the dollar, thereby depressing expectations of the path of the federal funds rate. We do not find much evidence to support this explanation for recent developments, however. As shown in Figure 9, correlations of weekly changes in expected short-term interest rates between the United States and Germany and the United States and the

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<sup>13</sup> The regression shown uses data from 2010 through the present. The estimated slope coefficient changes little when estimated using only data from the past 2 or 3 years.

United Kingdom have recently been low or negative.<sup>14</sup> By contrast, correlations between foreign and U.S. longer-term term premiums have risen to historically high levels in the past few years (Figure 10). Such correlations could reflect simultaneous shifts in risk sentiment around the world. However, in conjunction with the event studies of monetary policy spillovers described above, they suggest a role for foreign asset purchases in depressing term premiums in their home countries, which then spill over to term premiums in the United States.

Indeed, since the end of 2015, the ECB, the BoE, the SNB and the BoJ have, in total, increased their balance sheets by about \$3.1 trillion equivalent (Figures 11 and 12). These purchases of mainly high-quality assets have exerted downward pressure on foreign sovereign yields and, as evidence suggests, U.S. yields as well. But by how much? By way of a very rough calculation, existing estimates of the impact of quantitative easing (QE) suggest that QE purchases in the euro area since December 2015 in total would have lowered 10-year German yields by roughly 50 basis points.<sup>15</sup> Employing the pass-through estimate of 0.5, we calculate that ECB QE since that time would have pushed down the U.S. 10-year yield by about 25 basis points. If we do similar calculations for other major central banks and assume that the effects of all foreign monetary policy actions on Treasury yields are additive, we obtain a possible total downward impact of foreign QE on the U.S. 10-year yield of about 50 basis points since December 2015. Of course, this is likely a high-end estimate, since—among other things—markets had already priced in some of these purchases in December 2015 and it is doubtful that monetary policy actions of smaller economies would affect U.S. yields as much as ECB actions. Overall, we believe 25-50 basis points to be a plausible range of the effect of foreign monetary policy easing on the U.S. 10-year yield.

Before concluding our discussion of global factors, it bears mention that, as discussed in Section II, movements in U.S Treasury yields since December 2015 bear some resemblance to the 2004-06 “conundrum” period. There is, however, an important difference between the two periods. In

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<sup>14</sup> We also note that, despite continued policy easing abroad, the dollar has depreciated against the currencies of most advanced economies since December 15, 2015. In particular, the dollar is down on net about 4 percent against the euro and 7 percent versus the Japanese yen. The exception: the dollar has appreciated 17 percent against sterling, owing mostly to the Brexit vote. (As the dollar has appreciated against a number of emerging market currencies, including the Mexican peso and the Chinese renminbi, our broad dollar index is down only 1 percent since December 2015.)

<sup>15</sup> This estimate of the ECB QE effect and the subsequent estimates of other foreign central bank QE effects are based on the following two ECB working papers: Carlo Altavilla, Giacomo Carboni, and Roberto Motto (2015), “Asset Purchase Programmes and Financial Markets: Lessons from the Euro Area,” *ECB Working Paper* 1864; and Philippe Andrade, Johannes Breckenfelder, Fiorella De Fiore, Peter Karadi, and Oreste Tristani (2016), “The ECB’s Asset Purchase Programme: An Early Assessment,” *ECB Working Paper* 1956.



the earlier period, foreign official purchases of U.S. Treasuries and other bonds were likely a significant factor in depressing U.S. Treasury yields: Foreign official investors purchased about \$525 billion in U.S. Treasury and U.S. government agency securities, amounting to about two-thirds of the net issuance of these securities (the blue bars in Figure 13). Staff analysis suggests that these purchases could have pushed down the 10-year Treasury yield by about 1 percentage point.<sup>16</sup> In addition, sizable foreign private inflows into U.S. bonds likely provided some additional effect depressing U.S. yields and credit spreads through portfolio balance channels.

In the more recent period, since December 2015, downward pressure on U.S. yields has come not through foreign official purchases of U.S. securities but rather through spillovers of foreign central bank purchases of their own domestic securities on the term premiums of U.S. securities. Although foreign private investors have bought Treasuries and agencies over 2016-2017Q1, foreign official investors on net have turned to foreign exchange rate intervention *sales* of U.S. assets over this period, leaving U.S. domestic investors to absorb essentially all of the recent net issuance in both Treasury and agency debt.<sup>17</sup> Foreign investors have made more significant purchases of U.S. corporate bonds, however, and thus it is possible that these purchases could be contributing to some downward pressure on U.S. Treasury yields and credit spreads.

#### **IV. Two Related Questions**

##### (1) Does the flattening of the yield curve indicate a forthcoming economic slowdown?

The Treasury yield curve has flattened notably over the current tightening cycle. This development has attracted significant investor attention and raises the question of whether the likelihood of an economic downturn has risen.

Building on a large academic literature, two staff memos from March 2016 found that the slope of the yield curve (or “term spread”) helps to predict recessions over the next 12 months.<sup>18</sup>

Indeed, Figure 14 shows that the spread between the 10- and 2-year Treasury yields turned

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<sup>16</sup> Daniel Beltran, Marcel Kretchmer, Jaime Marquez, and Charles P. Thomas (2013), “Foreign Holdings of U.S. Treasuries and U.S. Treasury Yields,” *Journal of International Money and Finance* 32(1), pp. 1120-1243.

<sup>17</sup> It is perhaps a bit of a “puzzle” that movements in foreign yields could influence movements in Treasury yields recently, even without substantial net foreign inflows. But it is not unusual or unexpected to see the price of an asset move without trading activity if market participants believe that information they have received, including movements in the prices of other financial assets, warrants a change in the valuation of that first asset.

<sup>18</sup> “Probabilities of the U.S. Economy Entering a Recession in the Coming Year” by Travis Berge, Nitish Sinha and Michael Smolyansky; and “Probability of Recession Implied by Credit Market Sentiment” by Giovanni Favara, Kurt Lewis and Gustavo Suarez. These memos build on a large literature on the slope of the yield curve as a predictor of economic growth and recessions.

negative before each of the last six NBER dated recessions. While that spread currently remains close to the sample average since 1972, a staff model discussed in those memos suggests that the probability of recession 12 months ahead rose from about 5 to 15 percent between December 2015 and June 2017.

It is worth bearing in mind that the term spread has also produced some false positives—periods when the yield curve has flattened substantially but no recession has occurred within the next 12 months: it was close to zero throughout most of the second half of the 1990s; and it fell sharply during the conundrum period of 2004 (and had actually started to rise by the time of the 2007-09 recession). And there is also evidence that the predictive power of the term spread for economic activity has become weaker over time (Chinn and Kucko (2015)).<sup>19</sup>

The signal that the term spread contains for activity ought to depend on *why* it is low. If forward-looking investors expect growth to slow down, they are likely to expect policy rates to be reduced in the future—or at least be raised more slowly. But if the slope is low because term premiums have fallen, this could potentially point to a loosening of financial conditions that might spur higher growth, and thus call for *higher* future short rates. Moreover, if term premiums are generally lower than in the past—as our term structure models suggest—we would expect a flatter average yield curve for a given growth outlook, meaning that models estimated on long sample periods are likely to overstate current recession probabilities.<sup>20</sup> If we re-estimate the model of recession probabilities mentioned above using yields adjusted for term premiums using the Kim and Wright (2005) term structure model, the probability of a recession 12 months ahead has remained below 5 percent throughout this period.

## (2) How to reconcile the flattening yield curve and rising equity prices

Some market observers noted that the flattening yield curve, on the one hand, and rising risky asset prices, on the other, appear to send conflicting signals about the future course of the economy. Indeed, equity prices have risen about 20 percent since the start of the current tightening cycle, amidst historically low equity market volatility, while corporate bond spreads narrowed markedly to near post-crisis lows. This combination of asset price movements also

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<sup>19</sup> Menzie Chinn and Kavan Kucko (2015), “The Predictive Power of the Yield Curve across Countries and Time,” *unpublished working paper*.

<sup>20</sup> This point has been noted previously by, for example, Joshua V. Rosenberg and Samuel Maurer (2008), “Signal or Noise? Implications of the Term Premium for Recession Forecasting,” *FRB New York Economic Policy Review*, July 2008.

appears to be at odds with the pattern that prevailed in recent decades, with bond yields and risky asset prices mostly moving in the same direction on an intraday or daily basis.

To reconcile these developments, we note that the co-movement between longer-term Treasury yields and risky asset prices depends on the types of shocks driving asset prices. Bond yields and stock prices typically move in the same direction when asset prices are mainly driven by news about the outlook for economic growth. However, bond yields and stock prices would be expected to move in opposite directions in response to a reduction in the discount rate—perhaps associated with continued expansionary monetary policy abroad—or negative surprises to inflation.

In addition, stock prices appear to be boosted by an improving investor outlook for corporate earnings in the near term and even further out. As shown in Figure 15, Wall Street analysts’—and presumably investors’—expectations of earnings per share 12 months ahead have climbed quite robustly since the first quarter of 2016. In addition, as shown in Figure 16, the average long-term growth forecast for S&P 500 firms—often thought of as a 5-year forecast—has climbed notably since December 2015, from about 9.5 percent to 12 percent. The increase in the long-term growth forecast is broad-based but is particularly striking for the financial sector which had not witnessed this level of optimism since onset of the financial crisis. These stronger long-term earnings growth forecasts may reflect some anticipation of potential benefits from deregulation or reductions in the corporate tax rate. That said, the forward price-to-earnings ratio rose fairly notably since December 2015, suggesting that the run-up in equity prices likely also reflects an increased appetite for risk.

Finally, it is also possible that the growth in equity values and equity portfolios may itself create increased demand for long-term Treasuries—and thereby lower Treasury yields—as hedging demand from equity investors grows. In particular, Treasuries would provide a hedge against a decline in equity values should growth be disappointing, as this disappointment would tend to drive yields lower and thus cause long-term bond portfolios to appreciate.

## **V. Policy Implications of Lower Long-Term Forward Rates**

The policy implications of falling long-term forward rates depend on the underlying factors driving the declines. While it is difficult to conclusively demonstrate that neutral real rates have fallen since December 2015 based on term structure or macroeconomic models, there is some

evidence that survey expectations of long-horizon interest rates and growth expectations have drifted lower over this period. It is harder to find strong evidence of lower long-term inflation expectations from models and surveys over the period since December 2015 as a whole. All else equal, a decline in either neutral real rates or long-term inflation expectations could incline policy makers to follow a more gradual path in normalizing the stance of policy than they had previously anticipated.

We find stronger evidence that lower longer-term forward term premiums have placed downward pressure on forward rates over this period. The appropriate monetary policy response depends importantly on the reason that term premiums have fallen. If the drop in long-term Treasury yields is mainly driven by a decline in term premiums reflecting concerns about the economic outlook and deflationary forces, the FOMC may want to remove policy accommodation more gradually than originally anticipated.

By contrast, if the smaller-than-expected rise in longer-term forward term premiums was mainly associated with downward pressure due to monetary policy accommodation abroad, then there is a risk that U.S. long-term rates may stay lower than in our baseline forecast if foreign policy accommodation persists, although its effect on the economy could be partially offset if accompanied by a strengthening of the dollar. Such developments may call for a faster removal of monetary policy accommodation, all else equal, to bring financial conditions in line with the Committee's policy objectives.

**Table 1: Summary of Movements in Interest Rates since December 2015 and over the 2004-06 “Conundrum” Period**

	(I)	(II)	(III)	(IV)	(V)
	Sub-samples				
	Dec. 2015 FOMC – 7/12/2017	Dec. 2015 FOMC – Brexit ref.	Brexit ref. – Dec. 2016 FOMC	Dec. 2016 FOMC – 7/12/2017	June 2004 FOMC – June 2006 FOMC
Federal funds rate	100	25	0	75	425
10-year yield	1	-75	96	-21	27
2-year yield	33	-38	55	16	236
2-5-year forward	0	-83	107	-24	32
5-10-year forward	-12	-84	106	-34	-59

Note: All changes are in basis points. Yield and forward rate changes are based on zero-coupon Treasury yields. Each FOMC date refers to the day before the statement release, except the June 2006 meeting, which refers to the day of the statement release.

Source: FRBNY; Federal Reserve Board staff estimates.

**Table 2: Decomposition of 5-to-10-year forward forecast error**

		Expected change	Actual change	Forecast error
(I)	Nominal forward	82	-7	-89
(II)	Expected short rate	-2	-32	-30
(III)	Real	0	-30	-30
(IV)	Inflation	-2	-2	0
(V)	Term premium	84	25	-59
(VI)	Real	17	24	7
(VII)	Inflation	67	1	-66

Source: FRBNY; Blue Chip; Federal Reserve Board staff estimates.

**Table 3: Domestic and Foreign Yields**

	<i>Current Levels (percent)</i>					<i>Change Since Dec. 15, 2015 (basis points)</i>				
	<u>United States</u>	<u>Germany</u>	<u>United Kingdom</u>	<u>Canada</u>	<u>Japan</u>	<u>United States</u>	<u>Germany</u>	<u>United Kingdom</u>	<u>Canada</u>	<u>Japan</u>
<b>Nominal Yields</b>										
2-Year	1.37	-0.64	0.30	1.24	-0.10	33	-30	-41	73	-8
5-Year	1.89	-0.18	0.65	1.55	-0.04	14	-13	-70	67	-7
10-Year	2.35	0.57	1.28	1.92	0.11	2	-10	-71	28	-19
5-to-10 Year Forward	2.81	1.32	1.92	2.28	0.26	-10	-7	-72	-11	-31
<b>Real Yields</b>										
5-Year	0.21	-1.06	-2.20	0.31	-0.42	-30	-36	-132	61	56
10-Year	0.66	-0.61	-1.75	0.50	-0.32	-25	-19	-96	35	18
5-to-10 Year Forward	1.10	-0.15	-1.29	0.69	-0.22	-19	-2	-59	8	-20
<b>Inflation Compensation</b>										
5-Year	1.67	0.89	2.85	1.25	0.38	44	22	63	6	-62
10-Year	1.70	1.18	3.03	1.42	0.43	27	8	25	-7	-37
5-to-10 Year Forward	1.72	1.47	3.21	1.59	0.47	9	-6	-13	-19	-12

Note: Current levels and changes as of July 12, 2017. Yield and forward rate changes are based on par yields.  
Source: Staff calculation; Thomson Reuters; BrokerTec.

**Table 4: Reaction to Foreign Central Bank Communications**

		<i>One-day Sovereign Yield Moves (basis points)</i>			
<u>Event</u>		<u>Foreign 10-year</u>	<u>U.S. 10-year</u>	<u>Foreign 2-year</u>	<u>U.S. 2-year</u>
Aug. 4, 2016	BOE cuts rates & expands QE	-16	-4	-8	-2
Oct. 4, 2016	Bloomberg article on ECB tapering	4	6	1	3
Mar. 9, 2017	ECB meeting - risks 'less pronounced'	6	5	-1	2
Apr. 19, 2017	Hansson (ECB) discusses normalization	5	5	6	2
June 27, 2017	Draghi (ECB) speech in Sintra	13	7	6	4
June 28, 2017	Carney (BOE) speech in Sintra	6	2	3	-2

Source: Bloomberg.

Figure 1: Cumulative Change in Nominal Treasury Yields

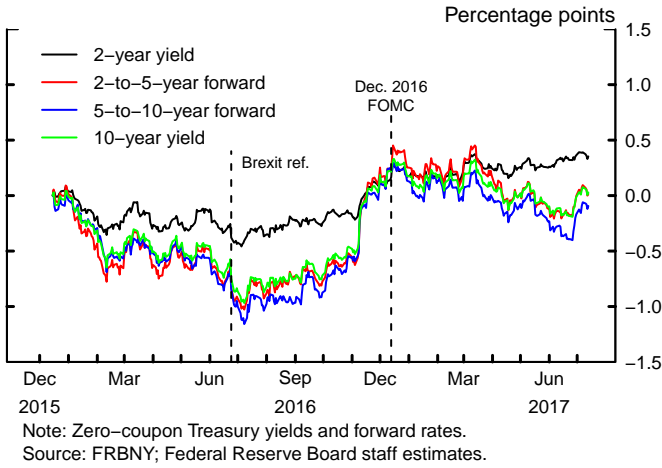


Figure 2: Expected Paths of Short-Term Rates

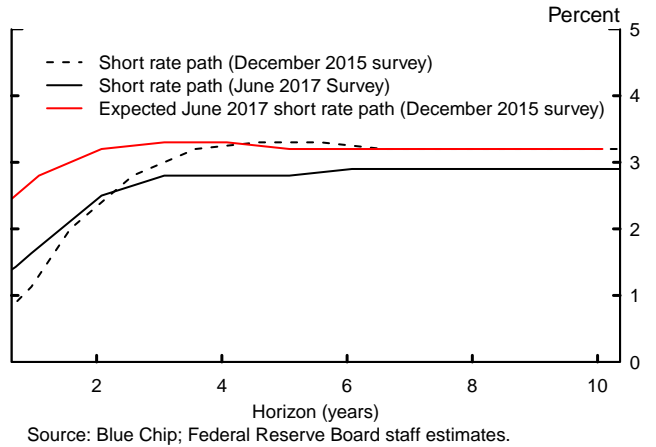


Figure 3: Effective Federal Funds Rate and 10-year Treasury Yield

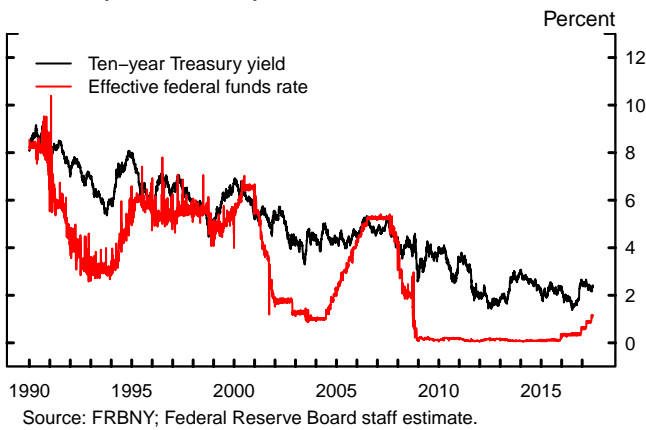


Figure 4: Long-Horizon Real Rate Expectations

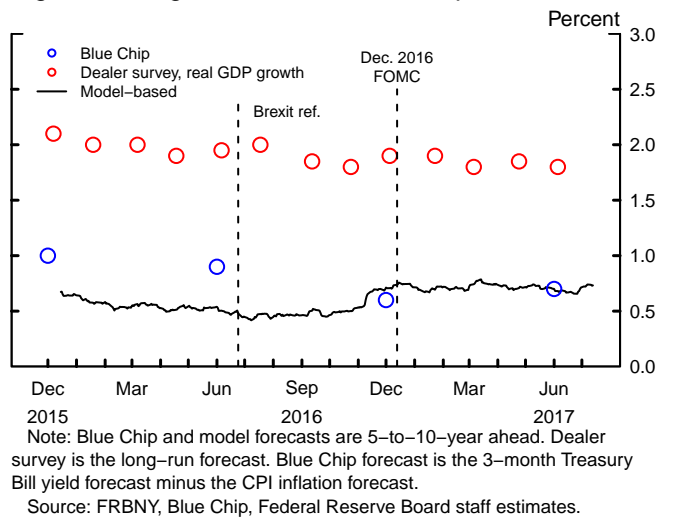


Figure 5: Long-Horizon CPI Inflation Expectations

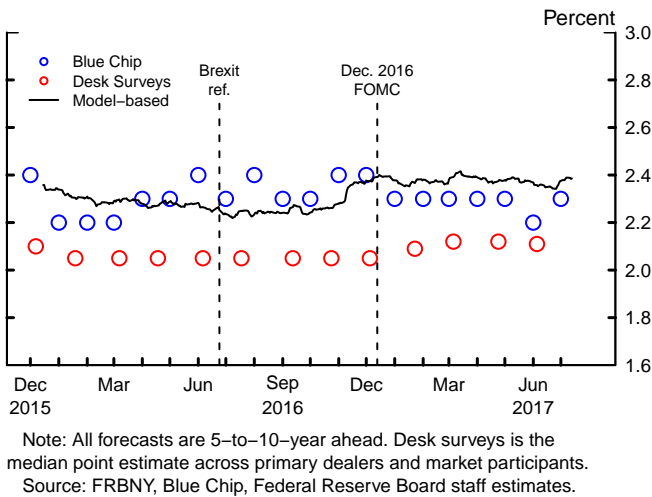


Figure 6: Probability Distributions of Annualized CPI Inflation Over the Next 10 Years

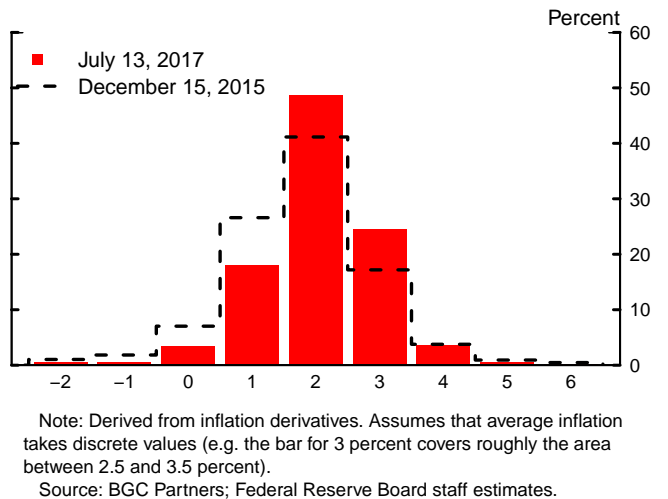


Figure 7: Rolling Correlation of 5-to-10 Year Forward Yields

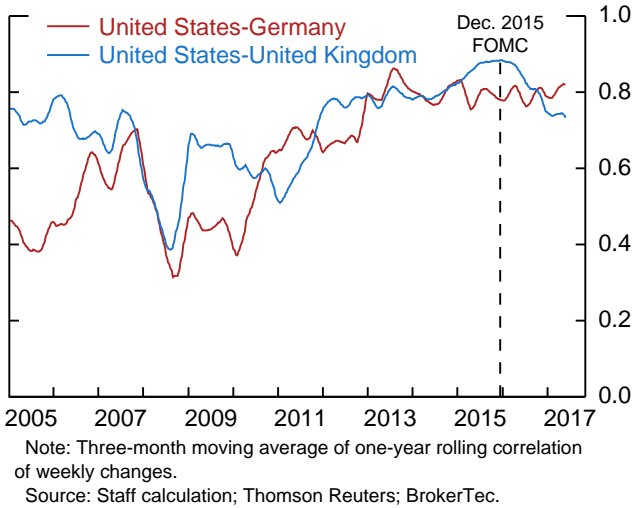


Figure 8: U.S. Yield Changes Around ECB Announcements (2010 - 2017)

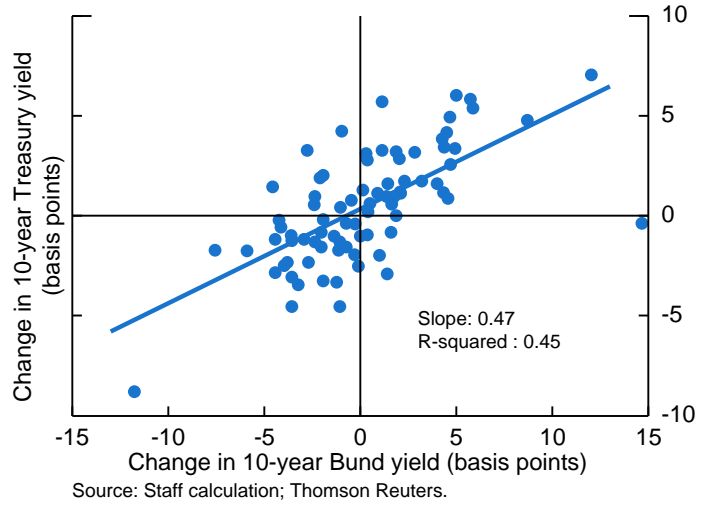


Figure 9: Rolling Correlation of 5-to-10 Year Forward Expected Short Rates

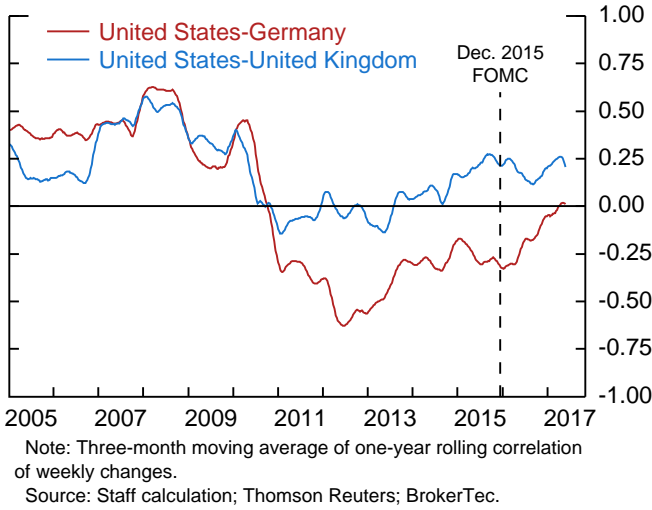


Figure 10: Rolling Correlation of 5-to-10 Year Forward Term Premiums

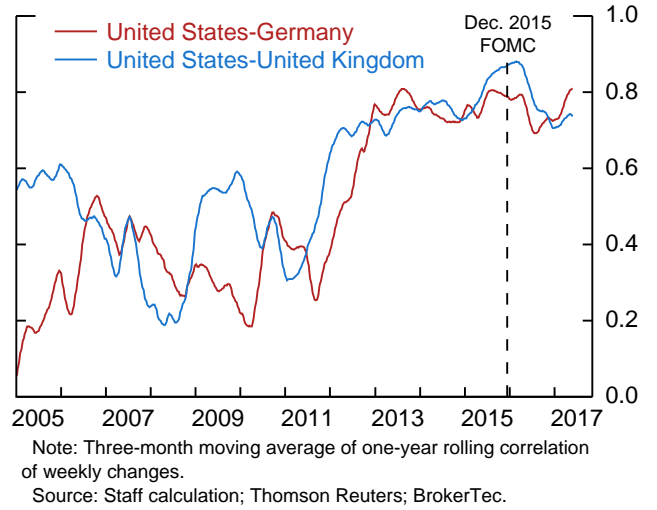


Figure 11: Central Bank Balance Sheets as a Percent of GDP (FRB, ECB, and BOE)

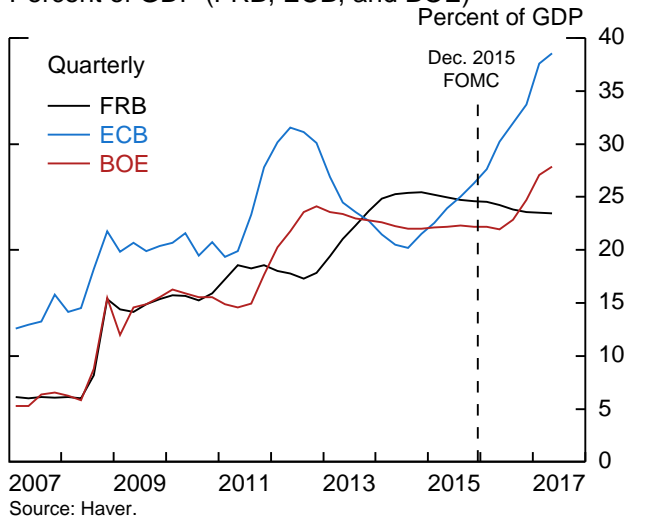


Figure 12: Central Bank Balance Sheets as a Percent of GDP (BOJ and SNB)

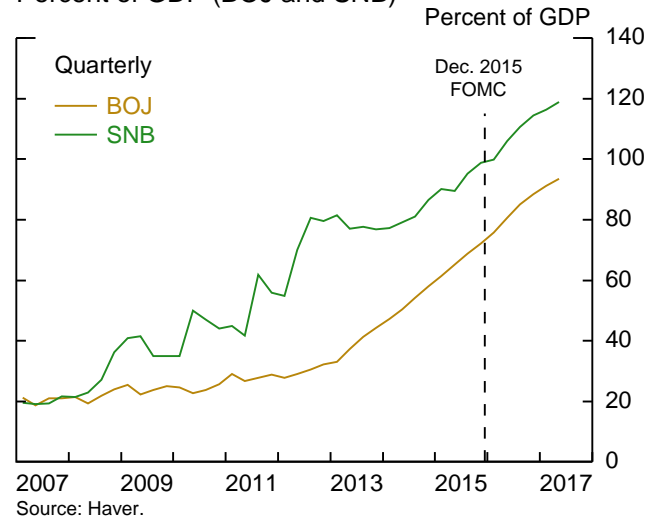
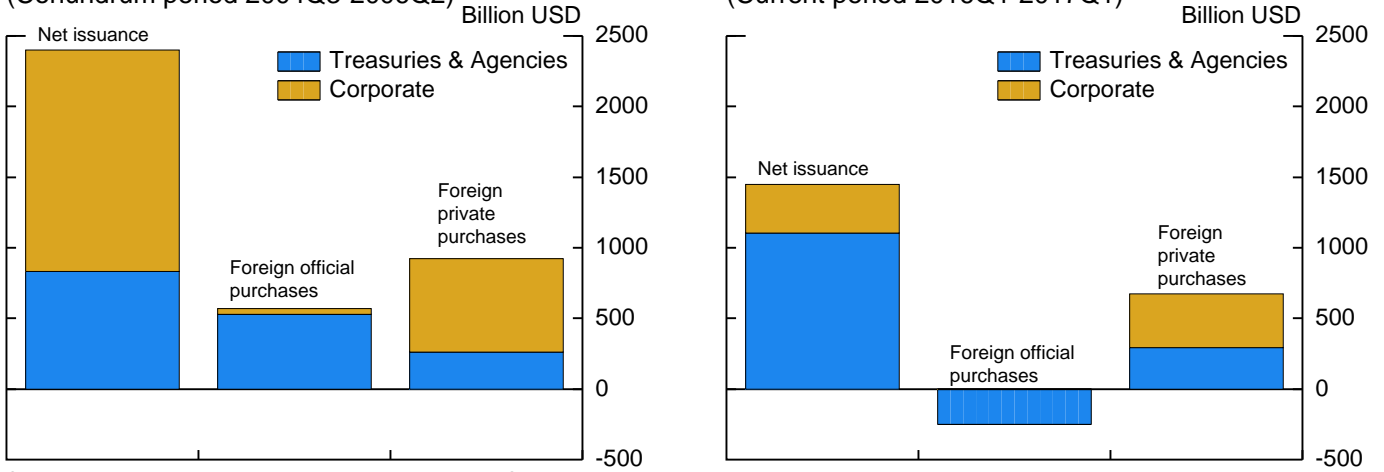


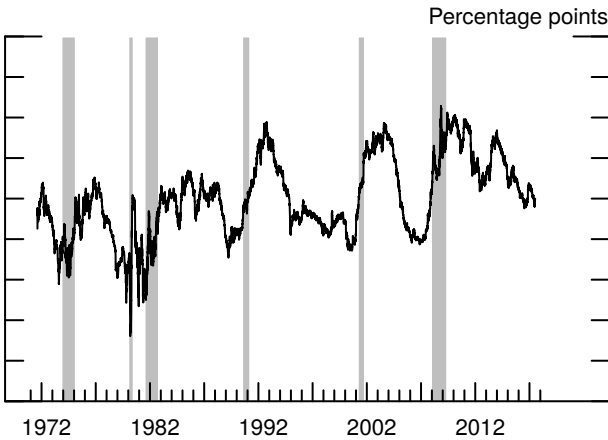


Figure 13: Net Issuance of U.S. Bonds and Purchases by Foreign Official and Foreign Private Investors (Conundrum period 2004Q3-2006Q2) (Current period 2016Q1-2017Q1)



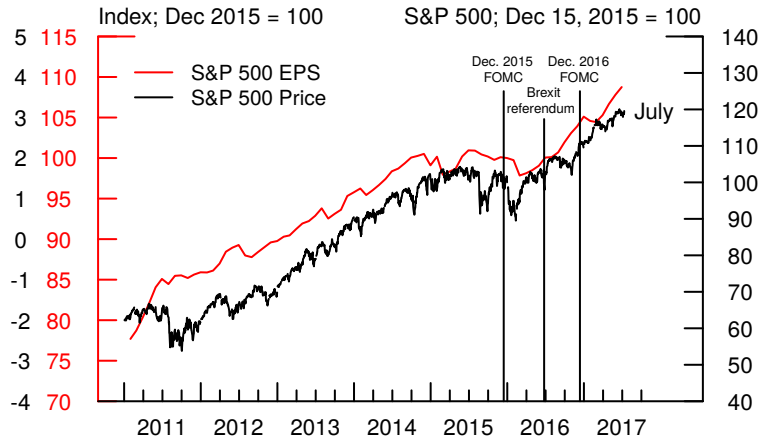
Source: Federal Reserve Financial Accounts of the United States and Bureau of Economic Analysis Balance of Payments Accounts.

Figure 14: Treasury Yield Curve Slope



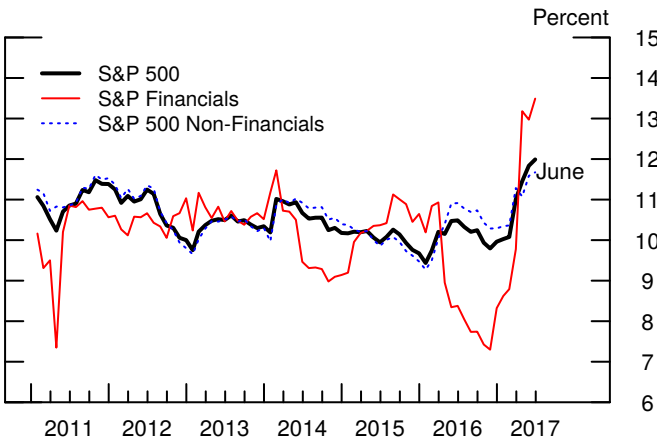
Note: 10-year minus 2-year zero-coupon yields. Gray shading shows NBER-dated recessions.  
Source: FRBNY; NBER; Federal Reserve Board staff estimates.

Figure 15: 12-Month Forward Earnings Per Share



Source: Thomson Reuters Financial; Bloomberg.

Figure 16: Long Run Earnings Growth Expectation



Source: Thomson Reuters Financial.