“Normalizing” the Fed’s Balance Sheet

Implications and issues

Key Points

- The FOMC appears set to start letting its balance sheet roll off after its meeting in September.
- This “normalization” of the Federal Reserve’s balance sheet will generate a significant increase in the supply of long-term Treasuries and agency MBS in private hands. This supply shock is likely to generate higher term premia and higher mortgage spreads.
- Over the next several years, as we transition to full roll-off and the balance sheet passively shrinks, we think 10-year term premia will increase by about 35-50bp and MBS spreads should increase by 15-20bp.¹
  - However, the adjustment probably will not stop when, in a few years, the Federal Reserve’s balance sheet starts to expand again.
  - When the Federal Reserve balance sheet starts to grow again, it will still own about $1trn in agency MBS and a Treasury portfolio with a historically high average duration.
  - A full normalization of the Federal Reserve’s balance sheet – one that includes a much more substantial reduction of their agency MBS holdings and a return to a Treasury portfolio with a higher proportion of short-term Treasuries – implies larger increases in both term premia in the Treasury market and MBS spreads.
- While the FOMC has laid out its plans for how the balance sheet adjustment process will begin and how it will proceed in its initial stages, it has not defined the ultimate endpoint of “normalization.”
- The final size of the Federal Reserve’s portfolio remains uncertain:
  - Current Federal Reserve policymakers seem to be leaning toward maintaining a large balance sheet and the current operating procedures.
  - But the coming shift in Federal Reserve leadership could change that. The Trump Administration’s proposals for regulatory reform seem more consistent with going back to a smaller balance sheet.
- The ultimate composition of the Federal Reserve’s assets also remains uncertain.
  - At the moment the Federal Reserve holds only long-term securities (Treasury bonds and notes, and agency MBS). In contrast, for the four decades before the global financial crisis (GFC) the Fed’s assets were always at least one third bills.
  - The FOMC seems set on allowing its holdings of agency MBS to decline. Federal Reserve purchases of new agency MB securities should stop by the end of next year.
- Independent of the ultimate size of the Federal Reserve’s portfolio, there are two very different scenarios for the evolution of the duration of the Federal Reserve’s assets.

1) The aggregate duration of the Federal Reserve's assets may stop shrinking when the size of the balance sheet stops shrinking (in this case, the Fed would follow the current practice for asset purchases – i.e., buying bonds and notes across the curve – when they resume open market asset purchases).

2) The Fed may let the composition of its assets return to “normal” (in this case, the Fed would buy only bills once open market purchases resume). This implies a larger and more protracted adjustment in duration.

   - Scenario (2) implies a larger adjustment term premia.
   - The response of banks will be central. We do not think bank demand for long-term Treasuries and agency MBS will go up one-for-one with the decline in reserves. Some of the additional supply of Treasury and agency MB securities will have to be absorbed outside of the banking system. This would contribute to the upward pressure on term premia and mortgage spreads.

   - Short-term money markets will be affected by the decline in the supply of reserves.
     - Overnight bank funding rates should rise relative to the Federal Reserve policy rates (IOR and RRP).
     - The premium (for borrowers) for term funding should rise.

   - As the FOMC decides to let its balance sheet roll off, we do not expect there to be anything similar to a “taper tantrum.”
     - The balance sheet adjustment is likely to be gradual. The aggregate duration of the Federal Reserve’s assets has been declining since late 2014. The beginning of roll-off will not be a big change in that trend.
     - The FOMC’s plans have been well communicated.
     - Proposed changes in regulations could ease the adjustment by making it more attractive for banks to hold the high-quality securities that will be rolling off the Federal Reserve’s balance sheet.
     - US Treasury has said that its initial response to the change in the Federal Reserve’s balance sheet policy will likely be increased issuance of Treasury bills. This should reduce (or delay), to some degree, the upward pressure on term premia.
     - Rising term premia and mortgage spreads are likely to be offset, to a significant degree, by a lower trajectory of short-term interest rates. Model simulations (using the Fed staff’s FRB/US model) suggest that about half of the increase in term premia will be offset by a lower expected path for short-term interest rates.
     - Of course, bond markets rarely move in a continuous way.

   - In coming months, other factors here and abroad – such as resolution of near-term fiscal uncertainty, steady US growth, a pickup in US inflation, progress on tax reform and ECB “tapering” – could put upward pressure on term premia and US long-term interest rates. In this context, the Federal Reserve’s balance sheet policy will provide a tail wind for higher long-term interest rates.

**Brief road map**

While the FOMC has laid out how the normalization of its balance sheet will begin, many aspects of the ultimate objective remain unspecified. This report tries to address a range of issues related to that adjustment. We start by discussing roll-off and the factors that will determine the size of the Federal Reserve’ balance sheet. We then discuss how the composition and duration of the Federal Reserve’s assets may evolve. Banks will be particularly affected by the decline in the supply of reserves (the Federal Reserve liability that will be most directly affected by the roll-off of the Federal Reserve’s securities). We discuss how banks are likely to adjust their portfolios and how short-term money markets and the nexus of short-term interest rates will be affected by the contraction of the Federal Reserve’s balance sheet. We then discuss how a decline in the duration of Federal Reserve assets will affect term premia, and how these changes in term premia may affect the trajectory of short-term interest rates.
Roll-off

At this point it appears that only a major shock to financial markets can disrupt the FOMC’s intention to start its balance sheet roll-off process at its September meeting. A messy delay in raising the US debt limit could generate such a shock, but we do not view this as likely. Moreover, such a delay would likely be short. Thus, we expect the Federal Reserve’s balance to start shrinking within a few months.

The FOMC has laid out how balance sheet roll-off will go forward once it decides to proceed. Figure 1 shows the projected monthly pace of roll-off. The Federal Reserve currently holds $1.8tn in agency MB securities, which tend to amortize at a rate of about 1% per month, with some seasonal variation. The $20bn maximum cap for MBS roll-off should be enough to allow essentially unrestricted roll-off – unless interest rates fall and prepayments spike – by the end of next year.

The pace of roll-off of the Federal Reserve’s Treasury holdings depends on the particular securities in the SOMA portfolio. Treasury amortizations are uneven month to month. This reflects the pattern of Treasury issuance, which, historically, has been higher in the middle month of each quarter. The $30bn maximum monthly cap on roll-off will be binding, and therefore the Federal Reserve will be purchasing new Treasury securities, in some months for the foreseeable future. This will facilitate the Federal Reserve’s ongoing securities lending operations, which promote the efficient functioning of the Treasury market. Nonetheless, under the FOMC’s plan for Treasury roll-off, the Federal Reserve’s holdings of Treasury securities should decline at a rate of about 11% per year over the next five years.

**Fig. 1: Projected roll-off of the Federal Reserve’s long-term securities**

![Graph showing projected roll-off of the Federal Reserve’s long-term securities.](source: Federal Reserve, Nomura)

**Fig. 2: Alternative scenarios for the size of Federal Reserve’s SOMA portfolio**

![Graph showing alternative scenarios for the size of Federal Reserve’s SOMA portfolio.](source: Federal Reserve, Nomura)

Normalization: The size of the Federal Reserve’s portfolio

Figure 2 shows alternative projections of the size of the SOMA portfolio assuming roll-off begins after the September FOMC meeting. Between now and end of next year, the Federal Reserve will reduce, step by step, the pace of its Treasury and agency MBS reinvestment. After that, the Federal Reserve’s holdings of Treasuries and agency MBS will shrink passively for a number of years. At some point, probably after three to five years, the Federal Reserve will have to start buying assets again in order to accommodate required increases to its liabilities.

In broad terms, the ultimate size of the Federal Reserve’s balance sheet will depend on structural factors and policy choices. Figures 3 and 4 provide details of the composition of the Federal Reserve’s liabilities and assets, respectively, under the alternative scenarios (see also Figures 17 and 18 in the Appendix for more detail).
Figures 3 and 4 also show three possible endpoints for the Federal Reserve’s balance sheet adjustment, which are broadly consistent with scenarios presented by Federal Reserve officials. Note that, even in the scenario with the smallest balance sheet endpoint, the “terminal” level is still much larger, in absolute terms and relative to GDP, than it was before the global financial crisis (GFC) in 2008-2009.

On the structural side, demand for currency and demand for liquidity from the US Treasury and foreign official institutions have gone up substantially since the GFC. This elevated demand for Federal Reserve liabilities is likely to persist.

The policy debate on the size of the Federal Reserve balance sheet

The primary difference between the three scenarios is the combined size of reserves and domestic RRPs (i.e., claims on the Federal Reserve held by domestic financial institutions; Figure 2). In the three scenarios, reserves plus domestic RRP range from 0.5% of GDP to 4.2% of GDP.

The scale of reserves and RRP transactions that the FOMC will ultimately choose to maintain depends on trade-offs between competing concerns.

A large Federal Reserve balance sheet means that the Fed has a “big footprint” in money markets. This has pros and cons. A “big footprint” may enhance the efficiency and effectiveness of the Federal Reserve’s control over short-term interest rates. It may also enhance financial stability by reducing complexity and reducing the incentive for private maturity transformation.

However, a “big footprint” also means that the Federal Reserve is effectively displacing private financial intermediation in short-term funding markets. It also means that the Federal Reserve interacts with a wider range of counterparties and has a direct impact on a wider range of short-term interest rates. A direct, obvious, and controversial aspect of this displacement of private financial activity is the interest that the Federal Reserve pays on reserves and its RRP transactions.

At the moment, the Federal Reserve appears more inclined to maintain a relatively large balance sheet and the “big footprint” in money markets that comes with it. However, a new set of policymakers will have to revisit these decisions. In the scenarios outlined above, the earliest that the Federal Reserve would have to start expanding its balance sheet again is July 2020. By that time, the Federal Reserve is likely to have a new Chair, a new Vice Chair, its first Vice Chair for Regulation, and a new President of the Federal Reserve Bank of New York.

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2 Under the three scenarios the “terminal” size of the balance ranges from $3.5tn (reached in July 2020) to $2.6tn (reached in June 2023).

3 See Powell (2017) and FRBNY (2017).

4 In mid-2007, currency outstanding was equivalent to 5.6% of GDP and accounted for 90% of the Federal Reserve’s liabilities. Currently, currency outstanding is about 8% of GDP, the highest it has been since the early 1950s. Precautionary demand for US dollar liquidity from official institutions with access deposits at the Federal Reserve has increased since the GFC. Over the last two years, foreign official claims on the Federal Reserve have averaged $238bn (ranging from $162bn to $292bn). Similarly, the US Treasury has increased its steady-state level of deposits in the wake of the brinkmanship regarding the debt limit since 2011. Over the last two years, the Treasury’s deposits at the Federal Reserve have averaged $245bn (ranging from $30bn to $429bn).

5 Before the GFC, the Federal Reserve controlled interest rates by managing the relative scarcity of Fed reserves. This only required a very low level of reserves. In 2007, reserves were about $15bn. Since late 2008, however, Federal Reserve asset purchases have generated a very substantial oversupply of reserves. Under these circumstances, the Federal Reserve has controlled short-term interest rates in a completely different way. Banks holding reserves now earn a fixed rate of interest, the so-called IOR rate. In addition, the Federal Reserve has given a range of non-bank financial institutions access to its balance sheet through its reverse repurchase (RRP) program, earning the RRP rate. Arbitrage relative to these two rates – IOR and RRP – provides anchors for the whole nexus of short-term interest rates. Controlling short-term interest rates through arbitrage to policy rates probably requires a larger balance sheet than the alternative. For more discussion see: The Clearing House (2016); Ihrig, Meade and Weinbach (2015); Logan (2017); and Potter (2017).

6 See Greenwood, Hanson and Stein (2016).

7 This was reflected in the minutes of a discussion of these issues in the November 2016 FOMC meeting. Recent speeches by senior Federal Reserve officials have echoed and expanded on the points made in the November 2016 minutes. See Logan (2017) and Potter (2017).
In this context, it is important to note a key connection between the debate over financial regulation and the policy issues related to the size of the Federal Reserve’s balance sheet. This connection relates to short-term funding of long-term assets. Such “maturity transformation” was a major accelerant in the GFC, and important aspects of the regulatory response – notably the expanded use of simple leverage ratios and money market reform – were designed to limit that activity.

The Trump Administration said it makes sense to ease restrictions that have made it costly for banks to raise short-term liabilities to fund high-quality long-term assets. The administration seems much more supportive of facilitating such activity in the banking system. Given these attitudes, the Trump Administration and their potential appointees to the Federal Reserve Board may be less inclined to support the Federal Reserve maintaining a large balance sheet and a “big footprint” in money markets.

In this context, the positions put forward by The Clearing House (TCH), whose members are large banks, are noteworthy. Research from TCH has been very critical of the leverage ratio and other regulations that made it expensive for banks to expand the size of their balance sheets. In addition, other research from TCH advocated that the Federal Reserve should return to a small balance sheet, arguing that a small Federal Reserve “footprint” in money markets is less distortionary and that a lower level of interest on reserves would be less politically controversial.\(^8\)

On the key regulatory issues, the Trump Administration seems closer to the positions of TCH than those of current Federal Reserve officials, notably those expressed by Chair Yellen in her recent speech at Jackson Hole. It is not clear whether the incoming leadership of the Federal Reserve is going to be as supportive of maintaining a large balance sheet, and a “big footprint” in money markets as current Federal Reserve officials. Key decisions on the Federal Reserve’s balance sheet are years away, but attitudes of Trump’s Federal Reserve appointments on regulatory issues are worth monitoring.

What about a recession?
The marginal probability of a recession in any given year is substantial.\(^9\) Stochastic simulation of the Federal Reserve staff’s FRB/US model suggest that the cumulative probabilities of having a recession over the next 5 years is about 60%, and the cumulative probability of returning to the effective lower bound for interest rates roughly one in three. The FOMC’s Addendum says that the Committee will be willing to resume

\(^{8}\) See The Clearing House (2017); Nelson (2017); and Baer, G. and J. Newell (2017). The Clearing House was founded in 1853 to facilitate payments between New York banks. In the second half of the 19th century it performed some of the functions of a central bank. The Clearing House carried out a form of oversight on its members and at times of stress it could pool reserves. This function probably helped, on a number of occasions, to prevent pressures on vulnerable institutions from spreading into full-blown banking panic. But it could not create reserves. The failure of the Clearing House to contain the financial panic of 1907 led, more or less directly, to the founding of the Federal Reserve System in 1913.

\(^{9}\) That probability is elevated by the fact that potential growth is low and the neutral rate of interest remains depressed (see “Special Report: US: Estimating the Probability of Recession”, Special Report, 14 January 2016).
reinvestment if "a material deterioration in the economic outlook were to warrant a sizable reduction in the Committee’s target for the federal funds rate." Thus, it is far from certain that roll-off will proceed uninterrupted to its ultimate goal.

Normalization: The composition of the Federal Reserve’s balance sheet

Once the Federal Reserve gets to the point where it has to start buying assets again, it will face a choice of what to buy. At that point, there will be two notable characteristics of Federal Reserve assets. First, the Federal Reserve will still hold a substantial volume of agency MBS. Second, it will own no short-term securities (i.e., it will hold no Treasury bills). At that point, the average duration of the Federal Reserve’s Treasury securities will be more than twice what it was before the GFC.

In the past, the FOMC has indicated that, ultimately, it wants to eliminate its holdings of MB securities. This question is not addressed in the FOMC’s current balance sheet plans. It is another aspect of normalization that is to be determined.

Historically, the Federal Reserve has held a substantial amount of short-term securities. Figure 5 shows the share of short-term securities in the Federal Reserve’s balance sheet over its entire history. Between the Fed-Treasury Accord in 1951 and the eve of the GFC, short-term securities comprised 42% of the Federal Reserve’s assets.

During most of its existence the Federal Reserve has not tried to use the composition of its assets as an instrument of monetary policy. 10 Decisions regarding the composition of the Federal Reserve’s assets were driven by other considerations 11 (e.g., maintaining a large proportion of short-term securities made it easier to shrink the balance sheet when needed).

This all changed in the wake of the GFC. 12 The FOMC initiated large-scale asset purchases to ease extreme financial stress at the height of the GFC but, in response to a disappointing recovery, it continued its asset purchases to provide more support for aggregate demand. The FOMC also used asset purchase programs to signal that it would not raise short-term interest rates anytime soon, while its large scale asset purchase (LSAP) programs also significantly reduced the aggregate duration held by private investors. This tended to lower long-term interest rates and more generally support accommodative financial conditions.

Looking at balance sheet normalization through the prism of duration highlights another way in which the FOMC’s stated plans are incomplete. Figure 6 shows the aggregate duration of the Federal Reserve’s assets expressed in 10-year equivalents as a share of GDP. 13 The Federal Reserve’s aggregate duration has been declining since balance sheet expansion stopped in late 2014. Under the FOMC’s roll-off plan, the aggregate duration of the FOMC’s assets will fall steadily as the size of the balance sheet shrinks.

However, when the size of the FOMC’s balance sheet stops falling, the aggregate duration of the Federal Reserve’s assets will be substantially higher that it was before the GFC. Even under the “small” balance sheet scenario described above, the aggregate duration held by the Federal Reserve when the balance sheet starts to increase will be more than four times what it was, relative to GDP, before the GFC.

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10 This reflected two basic judgments. First, Federal Reserve officials generally believed that controlling the level of short-term interest rates and affecting expectations about the future path were all it needed to do to achieve its macroeconomic objectives. Second, Federal Reserve policy makers generally did not believe that the composition of its assets affected the price of long-term securities. The predominant academic theories of the term structure of interest rates focused on the expected path of short-term interest rates and attitudes towards risk. There were two notable exceptions to this pattern before the GFC: the Federal Reserve’s support for the government finance during and immediately following World War II and a brief period in the early 1960s when the Federal Reserve supported the Treasury’s “operation twist” initiative. See d’Amico, et al (2012).

11 See Wallich and Keir (1979) and Meulendyke (1998).

12 The channels through which the FOMC’s large scale asset purchases provided that support were controversial at the time, and to some degree they remain so. Shortly before leaving the Federal Reserve, Ben Bernanke famously quipped that “the problem with QE is that it works in practice, but it doesn’t work in theory.” See James Saft, “You must be joking, Mr. Bernanke,” Reuters, 16 January 2014. d’Amico, et al, (2012) provides a survey of the evolution of the Federal Reserve’s thinking on these issues.

13 We add the stock of Agency MBS to the aggregate duration of US Treasuries on a weighted basis using the factor loadings from Table 3 in Li and Wei (2014). That is, we multiply Agency MBS holdings by (9.73/10.16) and add that to the stock of Treasury duration.
When it is time to start expanding the balance sheet again, the FOMC will have to decide how to do so. One option would be for the Federal Reserve to continue its current policy and just purchase a rising share of the issuance of Treasury bonds and notes. Under this approach, the aggregate duration held by the Federal Reserve will stabilize, relative to GDP, when the size of the portfolio stops falling. This seems more likely if the FOMC decides to maintain a balance sheet with a high level of reserves and RRP liabilities.

Another option would be for the Federal Reserve to expand its balance sheet, when the time comes, by purchasing Treasury bills. This would allow the FOMC’s holdings of long-term securities to continue to decline even as the size of the portfolio increases. The projection in Figure 6 assumes that this is how the FOMC responds, and this would seem more likely if the FOMC transitions back to a balance sheet with a low level of reserves.

It is worth noting that much of the Federal Reserve’s own analysis of the impact of LSAPs assumes the aggregate duration of the Federal Reserve’s assets, relative to GDP, ultimately goes back to pre-GFC norms. In a recent speech, Governor Powell highlighted work by the Federal Reserve staff that provides estimates of the impact of the Federal Reserve’s balance sheet policies. These staff projections assume that the Fed’s duration returns to pre-crisis norms.\(^\text{14}\)

The FOMC’s residual holdings of agency MBS are a separate issue. In the past, the FOMC has said that it expects to eliminate its holdings of MBS in the long run. At the point when the balance sheet stops shrinking, the Fed is likely to still hold a substantial volume ($1.0-1.3tn) of MBS. When the FOMC resumes asset purchases, it can continue to allow its agency MBS to amortize passively. At some point, when the stock of the Federal Reserve’s agency MBS becomes small enough, it may seek to remove them from the SOMA portfolio.

**Normalization and bank assets**

As shown in Figure 7, bank holdings of reserves and securities have increased since the GFC. Reserves, Treasuries and agency MBS now account for over 21% of bank assets, the highest level since the early 1960s. Over the same period, bank holdings of loans, which are predominantly to households and small businesses, and corporate bonds have declined substantially. This change in the composition of bank assets reflects regulatory changes, the Federal Reserve’s monetary policy and the nature of the post-GFC recovery.

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\(^\text{14}\) See Powell (2017) and Bonis, Ihrig, and Wei (2017).
Since the GFC, banks’ investment decisions have had to adjust three broad regulatory changes.\(^1\)

1. A substantial increase in risk-based capital requirements
2. The imposition of a new simple leverage ratio (this is essentially a capital requirement based on just the total, i.e., unweighted, size of assets)
3. New liquidity requirements

These changes alter banks’ incentives in different, and in some cases conflicting, ways. The increase in risk-based capital requirements makes it more costly for banks to hold lower-quality credit. On the other hand, the new leverage ratio, when it is binding, is an additional tax on relatively low-risk intermediation.\(^2\)

Liquidity requirements effectively link the composition of bank assets and liabilities. Bank holdings of low quality assets have to be matched with longer-term funding. Short-term funding has to be matched with high-quality liquid assets. In this context, banks essentially chose a mix of two strategies. First, they can attract medium-term funding to underwrite credit. Second, they can take in short-term deposits and use the funds to invest in high-quality liquid securities. Of course, these two strategies are not black and white categories, and banks are not the only financial institutions that perform these functions.

Into this complex mix of incentives, the Federal Reserve dramatically increased the supply of reserves. Reserves are an attractive asset for banks. They are risk-free, highly liquid and earn a reasonable rate of return. The super abundance of reserves makes it attractive for banks to warehouse cash (i.e., take in short-term deposits to fund high-quality liquid assets). The net result has been a shift in the composition of bank assets towards reserves and high-quality securities and away from loans and risky securities.

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\(^{15}\) See Committee on the Global Financial System (2015).

\(^{16}\) Whether risk-based capital requirements or the leverage ratio is binding depends on the mix of a bank’s assets. The largest banks tend to hold more securities, which tend to have lower risk weightings, so the largest banks are more likely to be constrained by the leverage ratio. See also: “Bank bids ‘carry on’ as support for bonds,” US Rate Insights, 15 May 2014; and “Optimizing Bank Buying of US BONDS,” US Rate Insights, 24 May 2016.

\(^{17}\) The role of reserves has changed over time. When banks were subject to high reserve requirements and reserves earned no interest (before 2008) the Federal Reserve could create pressure to either expand or contract the banking system by changing the stock of reserves. This “money multiplier” effect was considered central to the implementation of monetary policy for many decades. But starting in the early 1980s, the Federal Reserve lowered reserve requirements in a series of discrete steps. By the eve of the GFC, reserve requirements were so low that most banks met them with vault cash. At those diminimus levels, reserve requirements had ceased to be a meaningful constraint on the banking system. For more detail on the evolution of reserve requirements and their role in the Federal Reserve’s operating procedures see: Feinman (1993), Weiner (1992), and Federal Reserve System Staff (2008).
Other factors have contributed to this shift. Demand for credit has grown slowly in recent years. The economic recovery following the GFC has been lackluster, with business investment particularly weak.

The normalization of the Federal Reserve’s balance sheet will change the opportunities available to banks. It means a reduction in the supply of one high-quality liquid asset – i.e., central bank reserves – combined with an increase in the supply of other types of high-quality liquid assets – i.e. Treasuries and agency MBS.

Banks may choose to offset the decline in reserves by holding more Treasuries and agency MBS. This is consistent with the basic liquidity rules but would require banks to take on substantially more interest rate risk. Presumably, banks would only be willing to take on that additional risk if expected returns on Treasuries and agency MBS increase. It is also worth noting that a one-for-one substitution of Treasuries and agency MBS for the decline in reserves would push banks’ holding of securities to historically high levels. This seems unlikely.

These factors suggest that a substantial portion of the additional supply of Treasuries and agency MBS will need to be absorbed outside of the banking system. This also implies a shift in short-term funding (i.e., the warehousing of cash) away from banks. That said, other regulatory changes, notably new restrictions on money-market mutual funds, have created additional headwinds to warehousing cash outside of the banking system.

Regardless of whether the additional supply of Treasuries and MBS are absorbed inside or outside the banking system, higher expected returns on these assets – reflected in higher term premia and MBS spreads – will probably be needed.

**Normalization and short term money markets**

Over the last several years, the Federal Reserve’s IOR and RRP rates have provided an effective anchor for short-term interest rates. Most short-term rates have risen contemporaneously with these rates since the FOMC started hiking in December 2015 (Figure 8). Looking ahead, normalization is likely to affect short-term money markets in a number of ways. First, and perhaps most directly, the decline in reserves should increase demand in the overnight bank funding market. This should push up the overnight bank funding (OBF) rate relative to other short-term rates. If the FOMC transitions to a small balance sheet, and it uses reserve scarcity to control the level of short-term rates, the OBF rate would likely be above the IOR rate. The FOMC also said that it plans to eliminate the RRP program as soon as it is no longer need to control short-term interest rates.

Second, if banks hold fewer high-quality liquid assets, then we should expect some combination of increased demand for term funding and/or reduced demand from banks for short-term funding. This should increase the cost (for borrowers) of extending maturity. For example, the 3-month LIBOR-OIS spread should increase.

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18 There is no mechanical relationship between the roll-off of the Federal Reserve’s securities and deposit funding available to banks. When a Treasury security held by the Federal Reserve matures, there is a one-for-one decline in Treasury’s deposits held at the Federal Reserve. If a bank chooses to buy a new security issued by the Treasury then their bank reserves go down and the funds are transferred to the Treasury’s account at the Federal Reserve. In this case, the Federal Reserve’s assets have declined and so have reserves. At the same time, banks’ holdings of reserves have declined and their holdings of Treasuries have gone up. None of this implies any change in bank deposits.

Now consider the roll-off of Agency MBS. When a borrower pays off a mortgage, and that ultimately generates an amortization in an Agency MBS held by the Federal Reserve, there is a decline in bank deposits and a decline in reserves held by banks. But why should we assume that the Federal Reserve’s balance sheet policy will affect the aggregate outstanding stock of mortgages? Surely the right assumption is that, when one consumer mortgage is paid off another consumer mortgage is issued. The new mortgage will create a new deposit. If that happens, the net effect will be that the Federal Reserve’s holding of Agency MBS will go down, and the level of reserves will go down. For the banking system, their holding of reserves at the Federal Reserve will fall, their holdings of mortgages will go up, and their deposits will be unchanged. See: Ihrig, Meade, Weinbach (2015); Leonard, et al (2017a) and Leonard, et al (2017b).

19 In 2013, the Federal Reserve introduced its Reverse Repo Program (RRP). This gave an expanded set of counterparties – including MFs and GSEs – access to interest from the Federal Reserve through reverse repo transactions. Over the last several years, the IOR and RRP programs have generally provided an anchor for the nexus of short-term interest rates. See Duffie and Krishnamurthy (2016); Klee, Seryuz, and Yoldas (2016); and Potter (2017).

Third, the decline in Fed reserves should increase demand for close substitutes. The primary effect should be on Treasury bills. For example, among level 1 HQL assets, Treasury bills are probably the closest to Fed reserves in terms of risk and liquidity.

**Fig. 8: Short-term interest rates**

![Graph showing short-term interest rates](image)

Source: US Treasury, Federal Reserve, Nomura

**The impact of regulatory changes**

As noted above, the Trump administration has indicated that it plans to ease some regulatory restrictions on banks that were put in place in response to the GFC. For example, a recent report from the Treasury Department proposes excluding bank holdings of Fed reserves and Treasuries from leverage ratio calculations, which would encourage banks to hold more Treasuries and eliminate one of the obstacles keeping the Fed funds rate below the IOR rate. The Treasury report also proposed expanding the set of securities that qualify as HQL assets for calculating the LCR, which would also increase the incentive for banks to hold the affected securities. It would also tend to increase bank demand for short-term funding. It is unclear whether, or when, these changes will become effective. Federal Reserve Chair Yellen in her recent speech at Jackson Hole offered a strong defense for maintaining the bulk of the regulatory changes that have been put in place since the GFC, although she did acknowledge that reviewing the interaction of risk-based capital requirements and the leverage ratio may be warranted.

**Normalization and term premia**

When considering the impact of balance sheet normalization, we can apply the now extensive literature on the impact of central bank “quantitative easing” policies. Gagnon (2016) reviews 24 studies covering the US, euro area, UK, Japan and Sweden. These studies differ, but the empirical techniques used generally fall into three categories: event studies, time series models and term structure models with supply effects. Figure 9 shows the distribution of the estimates from the 24 models reported by Gagnon (2016) on the impact of asset purchases equal to 10% of GDP on 10-year interest rates. These alternative techniques generate a range of estimates that are, in a broad sense, consistent.

In this note, we focus on the Li-Wei model, which is one of the models discussed in Gagnon (2016). This is an empirical implementation of a “preferred habitat” model of

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22 See Yellen (2017).
23 There are some outliers. The largest estimate comes from a study that focuses on the impact on the particular securities that the Federal Reserve purchased. Studies that focus on the first phase of asset purchases also tend to generate higher estimates.
24 See Li and Wei (2014). Canlin Li and Min Wei are members of the staff of the Federal Reserve Board, and much of the Federal Reserve Board staff’s analysis of the Federal Reserve’s balance sheet policies relies on their model. For example see: Ihrig, et al (2012); Engen, Laubach, and Reifschneider (2015); and Bonis, Ihrig, and Wei (2017).
term structure and has a number of advantages in analyzing the impact of balance sheet normalization.

- The Li-Wei model focuses on the question most relevant for “normalization” (i.e., the impact of changes in the supply of duration on term premia).
- It is based on duration, rather than just the nominal size of Federal Reserve assets. This means that the Li-Wei model can be used to assess the impact of changes in the composition of Federal Reserve assets.
- In the model, the expected path of duration matters, not just its current level. The current level of term premia reflects the Fed’s current holdings of duration and the discounted sum of expected future changes in those holdings. This means that the model can be used to assess how the trajectory of duration, and changes in that trajectory, affect term premia.
- It takes account of the supply of agency MBS explicitly.

The magnitude of the impacts generated by the Li-Wei model is in line with those from other models. Gagnon (2016) reports that the Li-Wei model implies asset purchases equal to 10% of GDP will move 10-year term premia by 57bp. This falls between the median and the mean of the 24 estimates reported in Gagnon (2016).

Figure 10 shows estimates of the impact of the Federal Reserve’s asset purchases on 10 term premia for 10-year Treasuries, based on the Li-Wei model under three different assumptions for the evolution of the Federal Reserve’s balance sheet. The peak effect on term premia comes when the aggregate duration of the Federal Reserve’s assets relative to GDP (see Figure 6) is at its peak (i.e., late 2014).

All three scenarios assume that the FOMC starts its balance sheet adjustment after its meeting in September and that the Federal Reserve’s portfolio follows the median trajectory shown in Figures 2, 4 and 18. That is, the Federal Reserve’s balance sheet is assumed to decline until September 2021 before growing roughly in line with nominal GDP thereafter.

In the “full normalization” scenario in Figure 10, the Federal Reserve’s long-term securities are assumed to continue to roll off after the portfolio starts to grow again in Q4 2021; this assumes the FOMC will then purchase only Treasury bills until the aggregate

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25 Our estimates may differ somewhat from the Federal Reserve staff’s estimates for a number of reasons. First, we do not have full coefficient estimates from the Li-Wei model. We used equation 33 and estimated factor loading for term premia presented in Table 3 in Li and Wei (2014) as the basis for our estimates. We assume the baseline for comparison is the duration that the Federal Reserve held at the end of the Li-Wei sample period. That may not match the assumptions that the Federal Reserve staff use in their simulations. In addition, we do not take account of the fiscal impact of Federal Reserve asset purchases.
duration, relative to GDP, in the Federal Reserve's portfolio returns to its pre-GFC level. These assumptions are consistent with the standard assumptions made by the Federal Reserve staff in its own analysis. These analyses tend to assume that, regardless of the size of the Federal Reserve's portfolio, aggregate duration returns to its pre-GFC level.

In the base case, the Federal Reserve's long-term securities are assumed to roll off until the average duration of its portfolio returns to pre-GFC levels.

In the other scenario, the FOMC maintains an elevated level of duration. That is, it is assumed the FOMC will follow current practice and purchase Treasury bonds and notes across the curve once the balance sheet stops shrinking. Here, the aggregate duration of the Federal Reserve's portfolio stops falling, relative to GDP, once the size of the balance sheet starts to increase again.

In the near term, there is little difference between these three scenarios. The portfolio's elevated duration is currently depressing term premia by about 100bp. How far term premia will adjust depends largely on how far the duration of the Federal Reserve's portfolio declines. The ultimate adjustment of term premia is much more modest if the FOMC decides to maintain the current composition (average duration) of its balance sheet. This highlights the importance of FOMC decisions on the composition of its assets, not just the size of the portfolio.

Figure 11 shows the same three scenarios relative to the recent performance of term premia. In this case, we assume that the adjustment of term premia is relative to average term premia during the period over which the Li-Wei model was estimated (i.e., March 1994 to July 2007). Implicitly we are assuming that, if the aggregate duration of the Fed’s portfolio returns to its pre-GFC level, relative to GDP, then term premia will return to their pre-GFC levels as well.

**Fig. 11: 10-year term premia and Nomura’s projection**

There is considerable uncertainty over the trajectory of the Federal Reserve’s Treasury holdings. In contrast, it seems quite likely that, once the Federal Reserve starts to allow its balance sheet to shrink, the Federal Reserve will allow its agency MBS holdings to roll off for the foreseeable future. Currently, the Federal Reserve is absorbing about a quarter of new agency MBS issuance, but this will decline over the next year. By the fourth quarter of next year, we think Federal Reserve purchases will have ceased.

Recently, MBS spreads have been remarkably stable. Since the beginning 2014, they have moved in a narrow 20bp range and are now near the low end of that range. Over the next several years, as reinvestments decline and then its agency MBS portfolio shrinks passively via amortizations, our Structured Products research team believes that mortgage spreads will increase by about 15-20bp. This reflects a comparison of where spreads are now to where they were during the period from July 2010 to June 2011.
which is the last time the Federal Reserve was not buying a substantial portion of agency MBS issuance.\textsuperscript{26}

For our long-term simulations, we assume that a full normalization would reduce agency MBS spreads by 30bp.\textsuperscript{27}

**Other factors affecting term premia**

Term premia remain very low by historic standards and the Federal Reserve’s asset purchases have no doubt played an important role in that. However, a lot has happened over the last decade to affect term premia.

First, the supply of duration has increased substantially over the last decade. The Federal Reserve has only absorbed a portion of that increase. The US government has run large fiscal deficits over the last decade. Federal government debt outstanding, including Treasury debt held by the Federal Reserve, has increased from $5.7trn (40% of GDP) a decade ago to $16.8trn (87% of GDP) now.

Figure 12 shows aggregate duration outstanding – Federal government debt plus agency MBS – expressed in 10-year equivalents relative to GDP, and the Federal Reserve’s aggregate duration on the same basis. Total Treasury and agency aggregate duration, in 10-year equivalents, has increased from 43% of GDP to 76% of GDP. Aggregate duration, on the same basis, held by the Federal Reserve has increased from 1.8% of GDP to a peak of 21.1% of GDP in late 2014 before moderating to 17.7% of GDP now. In other words, the increase in duration held by the Federal Reserve, substantial though it is, accounts for only about half of the increase in the overall supply of duration.

The response in issuance by the Treasury will be important. In its latest Quarterly Refunding Statement, the Treasury stated that its first response to a reduction in Federal Reserve reinvestment would likely be increased Treasury bill issuance. This would both mitigate any premium for T-bills and reduce, somewhat, the upward pressure on term premia. That said, the medium-term outlook for US fiscal policy suggests overall issuance will rise steadily. Moreover, Treasury Secretary Mnuchin suggested that it may be desirable, eventually, to lengthen the overall maturity of Treasury issuance. In other words the supply of duration is likely to increase substantially over the period when the Federal Reserve’s balance sheet is normalizing.

Three factors other than the Federal Reserve’s asset purchases help to explain the depressed level of term premia despite the increase in the overall supply of duration. First, foreign official institutions have increased their holdings of US assets. Foreign official holdings of long-term Treasuries increased from $1.2trn at end-2006 to $3.8trn at the end of last year.

As a consequence of the global financial crisis in 2007-2009 and the subsequent euro-area crisis, there has been deterioration in the perceived quality of a range of assets that were previously considered “safe”. Caballero, Farhi, and Gourinchas (2017) argue that we have lost $6.3trn in safe assets since 2007 just through the change in the perceived quality of private asset-backed securities and peripheral euro-area sovereign debt.

Finally, other major central banks have implemented their own asset purchase programs. The Bank of Japan (BoJ), the European Central Bank (ECB) and the Bank of England (BoE) have all sought to use their balance sheets to lower long-term interest rates and boost their economies. These policies have had a notable impact on US long-term interest rates. For example, in the second half of 2014, the Federal Reserve was reaching the end of its balance sheet expansion while the ECB was preparing to launch a new round of asset purchases. During this period, the spillovers from declines in long-term euro rates appeared to dominate the widening down of the Federal Reserve’s balance sheet expansion. Since the end of 2014, asset purchases by the ECB and BoJ have more than offset the slowdown in purchases by the Federal Reserve.

Another factor that probably contributed to the low level of term premia is the inversely correlated relationship between the price of US Treasuries and the price of equities. Figure 13 shows the 2-year rolling correlation between the daily changes in 10-year Treasury bond prices and the S&P 500 equity price index. In the second half of the


\textsuperscript{27} This estimate is also consistent with other model-based estimates. See Hancock and Passmore (2014).
1990s, that correlation moved from positive to negative. Treasuries are attractive now, in part, because they can be a hedge for equities.

While all of these arguments help to explain why term premia are currently so low, they do not suggest balance sheet normalization will not push term premia higher.

**Normalization’s impact on interest rates and the broader economy**

After financial stress eased in the first half of 2009, the Federal Reserve’s asset purchases did two things: 1) they “signaled” the FOMC’s intention to keep interest rates at their effective lower bound for an extended period of time and 2) they removed duration and interest rate risk from private portfolios thereby depressing term premia and other risk premia. From 2010 through mid-2013, these two channels – signaling and duration – both worked to pull long-term interest rates down.

Figure 14 shows 10-year term premia and the one-month OIS rate, three years forward since 2009. Between mid-2010 and the end of 2012 the FOMC launched a range of LSAP programs designed to support the recovery. Over this period, term premia and expectations for short-term interest rates moved together, trending lower.

These factors worked in reverse during the so-called “taper tantrum” in 2013. In May and June of 2013, Chairman Bernanke indicated that the FOMC was likely to begin scaling back the FOMC’s asset purchase by the end of the year. Bernanke’s announcement changed market participants’ expectations for the path of duration that the Federal Reserve was ultimately going to acquire and hold. That had an immediate effect on term premia (Figure 14). The basic logic of the Li-Wei model captures this well; Chairman Bernanke’s announcement lowered the expected path of the Federal Reserve’s holdings of duration and that had an immediate impact on term premia.

Chairman Bernanke’s announcement also affected market participant expectations for the path of short-term interest rates. That is, the prospect of the beginning of the end of the FOMC’s large scale asset purchases meant that increases in short-term interest rates were likely to come sooner (Figure 14).

An important aspect of balance sheet normalization is that the two drivers of long-term interest rates – term premia and the expected path of short-term interest rates – are likely to move in opposite directions. Higher term premia will tighten financial conditions. The first order effect on the economy would be a reduction of aggregate demand. With inflation still notably below the FOMC’s target, the FOMC will want to offset the economic impact of higher term premia. In other words, the FOMC will probably moderate the trajectory of its short-term interest rate hikes in order to counteract the economic impact of higher term premia. That means declines in the expected path of short-term interest rates will offset some portion of the rise in term premia on long-term interest rates.
We can use the Federal Reserve Staff’s FRB/US model to assess how rising term premia will affect the US economy, the trajectory of short-term interest rates and other financial assets. Even with the Federal Reserve’s well-communicated intention to move very gradually, there may be a discrete reaction in term premia and mortgage spreads. Figure 15 shows the impact of a sustained 50bp increase in term premia, combined with a sustained 25bp increase in the spread between retail mortgage rates and comparable Treasury yields (Figure 15 shows deviations from the baseline).

The direct effect of the rise in term premia and mortgage spreads is a reduction of aggregate demand, increasing the unemployment rate and lowering inflation. The FOMC is assumed to follow an inertial Taylor rule, so it can lower the path of short-term interest rates. Asset markets are assumed to be forward looking. Consequently, the expected short rate component of ten-year yields falls when term premia and mortgage spreads rise. This immediate response offsets a significant part of the rise in term premia on long-term interest rates.

Of course, a gradual adjustment of the Federal Reserve’s balance sheet should (may) generate a gradual adjustment of term premia and mortgage spreads. Figure 16 shows the impact of a gradual adjustment of term premia and mortgage spreads that is comparable to the base case shown in Figures 10 and 11. The total adjustment of term premia is about 80bp, but it takes place over many years. The rise in term premia eventually depresses the path of short-term interest rates. Investors anticipate the lower path of short-term rates, which holds down the expected rate component of long-term interest rates now. Thus, the prospect of balance sheet adjustment in the future holds long-term rates below where they would otherwise be right now because short-term rates will be lower in the future. Long-term interest rates would still rise from current levels, but by only about half of the adjustment in term premia.

The adjustment in term premia does imply a steeper yield curve over time. The logic of these simulations is that adjustments of the Federal Reserve’s trajectory for short-term interest rates keep the overall stance of monetary policy near the baseline path. However, with the adjustment in term premia, the mix of short- and long-term interest rate is quite different. That is, with balance sheet adjustment, the effective tightening through higher long-term rates is offset by a more accommodative path of short-term rates.
Normalized and near-term outlook for interest rates

As the Federal Reserve scales back its reinvestments and lets its holdings of Treasuries and agency MBS decline passively, we expect a material adjustment of term premia, long-term interest rates and mortgage spreads. The models suggest that, since the Federal Reserve’s assets will adjust gradually and the FOMC has effectively communicated its immediate plans, asset prices should adjust in a continuous way.

Of course, bond markets rarely respond to fundamentals in a continuous way. We think that the coming change in the Federal Reserve’s balance sheet policy will be a tail wind for a variety of factors that could push long-term interest rates higher in coming months and quarters. The market may react to the announcement of the beginning of roll-off, which we expect to come at the next FOMC meeting. But other factors in coming months may actually be more important.

As we have discussed above, the change in Federal Reserve leadership may increase the likelihood of the Federal Reserve returning to a small balance sheet. If this becomes clear in the process of determining who will lead the Federal Reserve after Yellen’s current term ends, markets may push term premia higher.

Other factors could trigger higher interest as well. In the near term, a relatively smooth effort to raise the Federal government’s debt limit and extend spending authority beyond the end of September, which seems somewhat more likely in the wake of hurricane Harvey, could take some of the “safe haven” pressure out of the Treasury market. Real progress in Congress on passing a material tax cut might also push long-term rates somewhat higher, as would a big spending bill to help with recovery after the hurricane. We do not expect to learn much about whether a tax cut is really coming until after the debt limit, spending authorization and any immediate fiscal response to Harvey are passed, presumably next month.

A rebound in inflation would likely reset expectations for the trajectory of short-term interest rates over the next 18 months. While we do expect inflation to move higher over the next several quarters, we think we are still several months away from clear signs of a recovery in inflation.

Perhaps most importantly, developments abroad could also be a trigger for higher US long-term rates. A decision by the ECB to begin to reduce its assets purchases, which is expected to come soon, could be another source of upward pressure on US interest rates.

We still expect the adjustment of short-term interest rates to be very moderate over the next few years. We forecast only three more hikes from the Fed in this cycle. That is, we forecast a terminal fed funds rate of 1.75 to 2%. This trajectory incorporates the path to higher term premia discussed above.
Final Comment

When the Federal Reserve began its large scale asset purchases in late 2008 they set a course without knowing where it would take them. They did not know that emergency asset purchases in the midst of a historic financial crisis would extend into a means of providing monetary stimulus once the financial stress had dissipated. They did not know that it would take almost nine years just to start the process of unwinding those policies. They did not know that paying interest on an elevated level of reserves would not be able to provide a floor for short-term interest rates. They did not know how financial regulations would change and how those changes would affect how monetary policy works. Most importantly, they did not know how their policies would affect financial markets and ultimately the economy, particularly beyond the immediate future.28

In many ways, the FOMC is about to do this again. The FOMC has laid out its plans for how the process of balance sheet adjustment will begin, and how it will proceed in its initial stages. However, after the FOMC meeting in June, Chair Yellen said quite explicitly that they expect to begin the process of reducing their balance sheet without knowing where the process will end. Given the breadth of issues at stake and the inherent uncertainties, that may be all the FOMC can do. After all, the policymakers that complete the process of normalizing the Federal Reserve’s balance sheet will not be the ones who started the process.

References


28 The FOMC was not totally unprepared. When the FOMC lowered its target for the Fed funds rate to 1% in 2003 it considered what it might have to do if it reached the limit of what could be achieved with short-term interest rates alone. Analysis of the impact of Treasury buy-backs early in the decade provided timely evidence of the potential effectiveness of asset purchases. In addition, Congress in 2006 gave the Federal Reserve the authority to pay interest in reserves. All of this proved useful when the GFC hit. See Bernanke, Reinhart and Sack (2004); and Carlson, Eggertsson, and Mertens (2008).


# Appendix: Balance projection details

## Fig. 17: SOMA actual values and projections: liabilities

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<td>Jul-17</td>
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<tr>
<td>Total</td>
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<tr>
<td>Reserves + Domestic RRP</td>
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<tr>
<td>Reserves</td>
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<td>RRP, domestic</td>
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<td>Treasury deposits</td>
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<tr>
<td></td>
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</tr>
<tr>
<td>RRP, foreign</td>
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<td></td>
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<tr>
<td>Other</td>
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</tr>
<tr>
<td></td>
<td>% of GDP</td>
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</table>

Source: Federal Reserve, Nomura

---

## Fig. 18: SOMA actual values and projections: assets

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<td>Jun-07</td>
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<td>Total</td>
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<td>Average duration</td>
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<td>Aggregate duration</td>
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<td>% of GDP</td>
<td>0.7</td>
</tr>
</tbody>
</table>

*Note: Duration aggregation based on the parameters of the Li-Wei model, as presented in Li and Wei (2014).
Source: Federal Reserve, Nomura
Appendix A-1

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