The Federal Reserve's Balance Sheet and Earnings: A Primer and Projections*

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Over the past few years, the Federal Reserve's use of unconventional monetary policy tools has received a vast amount of public attention, from discussing how these asset purchases have put downward pressure on longer-term interest rates and thus supported economic activity to evaluating the implications for Federal Reserve remittances to the Treasury and the effect on monetary and fiscal policy. As the economic recovery has gained some momentum of late, the focus has turned to issues associated with the normalization of monetary policy. In this paper, we begin by providing a primer for the Federal Reserve's balance sheet and income statement. With that foundation in place, we then consider a variety of scenarios consistent with statements by Federal Reserve officials about how the FOMC will normalize policy, including whether to sell mortgage-backed securities, whether to change the composition of Federal Reserve liabilities, and the timing of lifting the federal funds rate off from the zero lower bound. In each of these scenarios, we discuss the implications of these normalization policies on the size and composition of Federal Reserve asset and liability holdings and on remittances of earnings to the Treasury, which capture the interest rate risk of these normalization policies. We show that under a baseline

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normalization strategy described by policymakers, the balance sheet should slowly return to a more normal composition and size, while remittances should remain sizable. With some alternative normalization plans, especially if faced with high interest costs, remittances could drop to zero for some time.

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1. Introduction

In response to the financial crisis that began in 2007 and the subsequent recession, the Federal Reserve employed a variety of nontraditional monetary policy tools that garnered a vast amount of public discussion. Some discussion focused on the expanding size and changing composition of the Federal Reserve's balance sheet and, specifically, the Federal Reserve's holdings of securities in the System Open Market Account (SOMA) (Federal Reserve Bank of New York 2013). This expansion led to discussions about the effects of unconventional monetary policy on interest rates (Krishnamurthy and Vissing-Jorgensen 2011, Li and Wei 2013). In addition, other authors highlighted implications for Federal Reserve transfers to the Treasury ("remittances"), the effect on monetary and fiscal policy (Rudebusch 2011, Greenlaw et al. 2013), and the independence of the Federal Reserve from political pressure (Christensen, Lopez, and Rudebusch 2013).

More recently, as the economic recovery has gained some momentum, the discussion has turned to questions about the normalization of monetary policy. In various venues, Federal Open Market Committee (FOMC) participants have expressed their views about normalizing the stance of monetary policy. In particular, the June 2013 FOMC minutes provided some discussion on policy normalization and the long-run composition of the balance sheet, while FOMC statements clearly tie the rise in the federal funds rate to the outlook for unemployment and inflation. In this paper, we consider how the Federal Reserve's balance sheet, and the income that derives from the balance sheet, might evolve under a variety of assumptions about the path of monetary policy and approaches to the normalization of policy. For example, we consider the June 2011 exit principles that included sales of mortgage-backed securities (MBS) as part of the

normalization process, as well as the more recent information laid out in the June 2013 minutes that suggests that such sales would not be a prominent part of the early stages of policy normalization. In addition, given the evolving views in markets about the likely timing of the first increase in the federal funds rate, we consider a scenario where the date of liftoff is pushed out, consistent with some variant of quantitative forward guidance related to an unemployment rate or inflation threshold, and analyze the effect of that timing for the path of the balance sheet. Finally, we discuss some of the possible implications for Federal Reserve expenses from choosing different mixes of Federal Reserve liabilities (known as "reserve-draining tools") during the normalization process.

The scenarios presented here do not provide an exhaustive range of options that the FOMC could use to remove monetary policy accommodation. They do, however, show how many tools, in isolation, can aid the Committee in reducing the size of the balance sheet and boost short-term interest rates.[1] With these scenarios in mind, one can then see the impact of any convex combination of tools that the Committee may choose during the normalization process.

In analyzing each normalization scenario, we report the length of time until the Federal Reserve's balance sheet returns to a normal size. We also project how MBS holdings will evolve, given that holdings of MBS are a particularly novel development for the Federal Reserve and minutes from FOMC meetings suggest that their acquisition has been a source of some debate. In addition, we look at the interest rate risk of different exit strategies that appear to be under consideration. Such considerations may be important if, as Greenlaw et al. (2013) suggest, a period of zero remittances results in negative political pressures.

The remainder of the paper is organized as follows. Section 2 provides a primer on the Federal Reserve's balance sheet and income statement. Section 3 outlines the scenario assumptions used as inputs to the projections of the balance sheet. The baseline balance sheet and income projections are discussed in section 4. Section 5 considers the alternative normalization policies. Section 6 provides the sensitivity analysis. Section 7 concludes.

[1] See Ihrig et al. (2012) for how to link the size of the balance sheet to monetary policy accommodation.

2. The Federal Reserve's Balance Sheet, Income Statement, and Valuation of the SOMA Portfolio

In this section, we review key balance sheet components in our projections, as well as the income generated from the balance sheet. We also provide some historical context for the evolution of these items.

2.1 The Federal Reserve's Balance Sheet

Our discussion of the Federal Reserve's balance sheet will refer to the consolidated balance sheets of the twelve individual Reserve Bank balance sheets.[2] In reality, the accounting that will be discussed below is done at the Reserve Bank level; however, for simplicity, we focus on the Federal Reserve System's aggregate balance sheet.

Like any balance sheet, the Federal Reserve has assets on one side of the balance sheet, which must equal liabilities plus capital on the other side. As shown in table 1, at the end of 2006, total assets of the Federal Reserve were $874 billion, with the single largest asset item being the SOMA portfolio, at about $780 billion. Prior to the financial crisis, the domestic SOMA portfolio comprised only Treasury securities, of which roughly one-third were Treasury bills and two-thirds were Treasury coupon securities. On the other side of the balance sheet, the largest liability item was paper currency, or Federal Reserve notes (FR notes), at about $785 billion.

With the lending that took place during the financial crisis, for a time, the amount outstanding in the credit and liquidity facilities surpassed the size of the SOMA portfolio. As of December 25, 2013, however, the SOMA portfolio was again the largest asset item, and it had grown to $3.8 trillion because of the asset purchase programs. On the liability side of the balance sheet, FR notes, at about $1.2 trillion, were no longer the largest liability item. Instead, as the FOMC increased its asset purchases, reserve balances increased correspondingly to a level of about $2.5 trillion.

[2]The Board of Governors does not hold assets and liabilities in the same way that the Reserve Banks do. Section 10 of the Federal Reserve Act authorizes the Board to levy semi-annually upon the Reserve Banks, in proportion to their capital stock and surplus, an assessment sufficient to pay its estimated expenses for the half of the year succeeding the levying of such assessment, together with any deficit carried forward from the preceding half-year.

Table 1. Federal Reserve's Balance Sheet

Balance Sheet End-2006 $Billion				**Balance Sheet End-2013 $Billion**			
Assets		**Liabilities**		**Assets**		**Liabilities**	
SOMA	779	Deposits of Dep. Inst.	13	SOMA	3,763	Deposits of Dep. Inst.	2,451
Other Assets	95	Federal Reserve Notes	783	Other Assets	270	Federal Reserve Notes	1,195
		Other Liabilities	48			Other Liabilities	332
		Total Capital	31			Total Capital	55
Source: H.4.1. statistical release.							

The next few sub-sections review the key components of the Federal Reserve's balance sheet and how they have changed.[3]

2.1.1 The SOMA Portfolio: Composition, Size, and Maturity Structure

Over most of the post-war period, the SOMA portfolio was the largest asset item on the Federal Reserve's balance sheet.[4] During that time, the SOMA portfolio essentially held Treasury securities; however, the portfolio has held other types of securities over the course of its history.[5] For example, from 1971 to 1981, the Federal Reserve purchased limited quantities of agency securities; the last of these securities matured in the early 2000s, and none was purchased until 2008.[6]

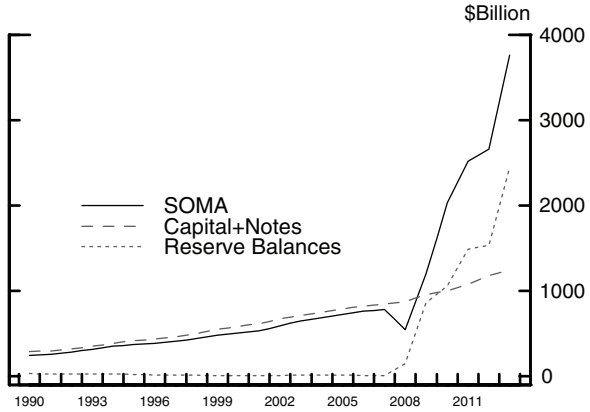
[3]For a description of additional components of the balance sheet, see the interactive guides to the H.4.1 tables at http://www.federalreserve.gov/monetarypolicy/bst_fedsbalancesheet.htm or the *Financial Accounting Manual for Reserve Banks* at http://www.federalreserve.gov/monetarypolicy/files/bstfinaccountingmanual.pdf.

[4]For a description of the Federal Reserve's balance sheet prior to World War II, see *Banking and Monetary Statistics, 1914–1941*, at http://fraser.stlouisfed.org/title/?id=38.

[5]Refer to Edwards (1997).

[6]Refer to Meltzer (2010).

Figure 1. SOMA, Capital + FR Notes, and Reserve Balances



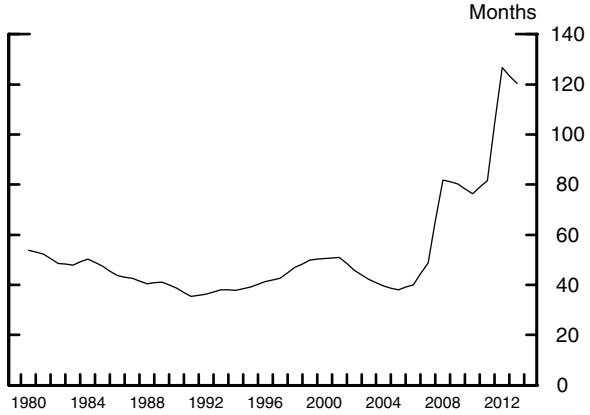
Source: H.4.1 statistical release.

Historically, the size of the SOMA portfolio—and the balance sheet, more generally—reflected growth in FR notes and Reserve Bank capital. When currency is put into circulation, it is shipped to a depository institution, and that institution's account at the Federal Reserve is debited by an equivalent amount. Because currency outstanding tends to trend upward, over time currency growth would tend to reduce the amount of reserve balances in the banking system. The Federal Reserve would purchase securities in open-market operations to offset this drain of reserves. On net, therefore, the growth rate of currency tended to drive the size of the balance sheet. Similarly, when a depository institution is required to subscribe to a larger amount of Federal Reserve capital or the Federal Reserve adds to its surplus account, the result would be, all else equal, a reduction in reserve balances.[7] As a result, the SOMA portfolio must increase to offset these increases as well, creating a larger balance sheet overall.

This historical pattern is illustrated in figure 1. As can be seen, through 2007, both the SOMA portfolio and currency and capital

[7]As will be more fully explained later in the paper, each member bank of a Reserve Bank is required to subscribe to the capital of its district Reserve Bank in an amount equal to 6 percent of its own capital stock.

Figure 2. Weighted Average Maturity of SOMA



Source: Federal Reserve Bank of New York.
Notes: Includes only nominal Treasury securities.

trended upward together. When the asset programs began in late 2008 and early 2009, and continuing through the second round of purchases in 2010 and 2011, the SOMA portfolio increased markedly and at a rate that far outpaced the growth of currency and capital. With the initiation of the maturity extension program in 2011, the size of the portfolio remained roughly constant; however, as depicted in figure 2, the weighted average maturity of Treasury securities in the SOMA portfolio increased markedly. From a longer perspective, over time, the SOMA portfolio has had a range of maturities of Treasury securities in its holdings.[8] Prior to the financial crisis, the Open Market Trading Desk (the Desk) tended to purchase securities across the entire yield curve to avoid distorting the yield curve. However, after the start of the financial crisis, the maturity of Treasury coupon securities in the SOMA portfolio lengthened notably, reflecting the runoff in bills to sterilize the credit and liquidity programs in 2008, and the purchase of longer-dated securities more recently.

[8]In the weekly H.4.1 statistical release, in addition to the Federal Reserve's balance sheet, the maturity distribution of asset holdings is also published.

2.1.2 Deposits of Depository Institutions

Deposits of depository institutions include all depository institutions' balances at the Federal Reserve that are used to satisfy reserve requirements and balances held in excess of balance requirements. Deposits of depository institutions grew dramatically through the crisis, and are currently quite elevated by historical standards. When we refer to "reserve balances," we are using the "deposits of depository institutions" concept. These deposits represent funds that depository institutions own; they are a liability of the Reserve Bank, but an asset of the depository institution. These funds are also used for payment system settlement; for example, a payment from one bank to another (or from one bank's customer to the customer of a different bank) typically results in a debit to the paying bank's account and a credit to the receiving bank's account. Lending of reserve balances and payment activity result only in a movement of reserve balances from one depository institution's account at the Federal Reserve to another institution's account; the aggregate quantity is unchanged.

2.1.3 Federal Reserve Notes

Federal Reserve notes, or currency, are a liability of the Federal Reserve. As a practical matter, the Federal Reserve does not determine the quantity of currency outstanding. Instead, when a depository institution wants to hold currency in its vault or automatic teller machines in order to meet customer needs, it requests a shipment from its Federal Reserve Bank. When that shipment is made, the depository institution's reserve account at the Reserve Bank is debited by the amount of the currency shipment. One important source of demand for U.S. currency is from overseas. Although it is impossible to know with certainty what portion of currency outstanding is outside of the United States, estimates suggest that the fraction is one-half or more.[9] Prior to the financial crisis, currency was the largest liability item on the Federal Reserve's balance sheet.

[9]Refer to Judson and Porter (1996).

2.1.4 Capital Paid In, Surplus, and Interest on Federal Reserve Notes Due to U.S. Treasury

The capital of the Reserve Banks is different from the capital of other institutions.[10] It does not represent controlling ownership as it would for a private-sector firm. Ownership of the stock is required by law, the Reserve Banks are not operated for profit, and the stock may not be sold, traded, or pledged as security for a loan. As stipulated in section 5 of the Federal Reserve Act, each member bank of a Reserve Bank is required to subscribe to the capital of its district Reserve Bank in an amount equal to 6 percent of its own capital stock. Of this amount, half must be paid to the Federal Reserve Banks (referred to as capital paid in) and half remains subject to call by the Board of Governors. This capital paid in is a required assessment on the member banks and its size changes directly with the capital of the member banks. Also stipulated by law is that dividends are paid at a rate of 6 percent per year. Over the past decade, reflecting increases in capital at member banks, Reserve Bank capital has grown at an average rate of almost 15 percent per year. In addition, Reserve Banks have surplus capital, which reflects withheld earnings, and Federal Reserve Bank accounting policies stipulate that the Reserve Banks withhold earnings sufficient to equate surplus capital to capital paid in. As a result, as capital of member banks grows through time, capital paid in grows in proportion. Because surplus is set equal to capital paid in, it likewise grows at the same rate as member bank capital.

2.1.5 Deferred Asset

One liability item is distinct from the others. Under the Federal Reserve's remittance policy, the Federal Reserve remits all net income to the U.S. Treasury, after expenses and dividends and allowing for surplus to be equated to capital paid in. As those earnings accrue, they are recorded on the Federal Reserve's balance sheet as

[10] See the *Financial Accounting Manual for Federal Reserve Banks*, which reports the accounting standards that should be followed by the Federal Reserve Banks, at http://www.federalreserve.gov/monetarypolicy/files/bstfinaccountingmanual.pdf, pages 1–68.

"Interest on Federal Reserve notes due to U.S. Treasury." In the event that earnings only equal the amount necessary to cover operating costs, pay dividends, and equate surplus to capital paid in, this liability item would fall to zero because there are no earnings to remit and payments to the Treasury would be suspended. If earnings are insufficient to cover these costs—that is, there is an operating loss in some period—then no remittance is made until earnings, through time, have been sufficient to cover that loss. The value of the earnings that need to be retained to cover this loss is called a "deferred asset" and is booked as a negative liability on the Federal Reserve's balance sheet under the line item "Interest on Federal Reserve notes due to U.S. Treasury." A deferred asset is an asset in the sense that it reflects a reduction of future liabilities to the U.S. Treasury.

One consequence of the current implementation of Federal Reserve Bank accounting policy is that the recording of a deferred asset implies that Reserve Bank capital does not decline in the event of an operating loss. From time to time, individual Reserve Banks have reported a deferred asset; for example, as shown on the H.4.1 statistical release from November 3, 2011, the Federal Reserve Bank of New York recorded a deferred asset that week and the subsequent week.[11] However, by the third week, remittances had cumulated to a sufficient level to be able to pay off the deferred asset. More generally, it has never been the case that the Federal Reserve System as a whole has suspended remittances to the Treasury for a meaningful period of time because of operating losses.

Because there has never been a deferred asset of any significant size, there is little guidance as to the whether or not there is a limit to the potential size of the asset. It may be plausible to assume that it would not be allowed to exceed the value of all future earnings, possibly in present discounted terms, given the fact that it is paid down through future earnings. As will be clear in the following projections, a scenario that would result in a deferred

[11]In November 2011, the Maiden Lane accounts, which are marked to market and consolidated onto the balance sheet of the Federal Reserve Bank of New York (FRBNY), were revalued and resulted in an unrealized loss that required the Federal Reserve Bank of New York to record a deferred asset. Over time, the FRBNY's loans to the Maiden Lane limited liability companies were repaid in full, with interest.

asset in excess of the present value of future earnings is difficult to contemplate.

Some foreign central banks do not record deferred assets and instead use different accounting policies. For example, many foreign central banks smooth remittances each year, by transferring an average amount of net income back to the government and saving the "excess" net income for times with negative shocks. Other foreign central banks allow for negative remittances—that is, transfers *from* rather than *to* the government—if the loss is too large. The infusion of funds from their governments in cases of large negative shocks avoids deferred assets for these institutions. One example of a central bank with a form of a deferred asset is the Czech National Bank. This institution has operated for a number of years with a negative equity position and zero remittances. We will return to this balance sheet line item in the projections, as we see what policy levers may induce a deferred asset.

2.2 The Federal Reserve's Income Statement

As the Federal Reserve's balance sheet has expanded in recent years, the income derived from the balance sheet has also grown, though the key line items from the balance sheet that generated this income are the same. As shown in table 2, net income in both 2006 and 2013 was driven by interest income from the SOMA portfolio. Despite the difference in magnitude, in both years, SOMA interest income was more than 95 percent of total income. That said, SOMA interest income grew substantially over this period as the SOMA portfolio expanded. Interest expense, on the other hand, was minimal in both years. In particular, FR notes are a large liability without an associated interest expense. And, although the Federal Reserve has paid interest on reserve balances since October 2008, this liability item has incurred little interest expense because the IOER (interest on excess reserves) rate has been at 25 basis points since December 2008. In both years, other items in the income statement were similar. In total, remittances to the Treasury were positive in both years, but much larger in 2013 because of the expanded SOMA portfolio.

The next few sub-sections review the key line items of the Federal Reserve's income statement in more detail.

Table 2. Federal Reserve's Income and Expense

Income and Expense, 2006 $Billion		Income and Expense, 2013 $Billion	
Income	**Expense**	**Income**	**Expense**
Interest Income 37	Interest Expense 1	Interest Income 90	Interest Expense 5
Other Income 2	Other Expense 4	Other Income 1	Other Expense 7
	Additions/ Deductions, Dividends, and Transfers 4		Additions/ Deductions, Dividends, and Transfers 2

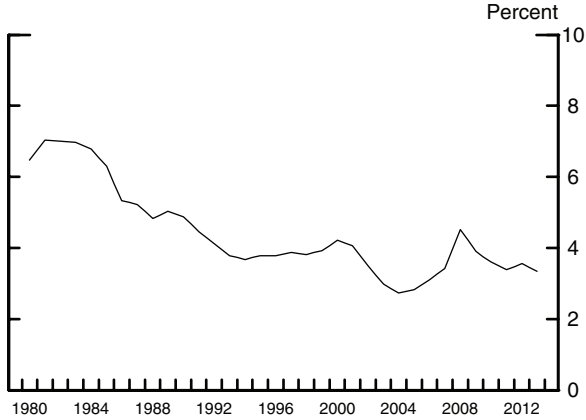
Source: Federal Reserve annual report and press release titled "Reserve Bank Income and Expense Data and Transfers to the Treasury for 2013" (January 10, 2014).

2.2.1 SOMA Interest Income

As noted above, income on the securities held in the SOMA portfolio constitutes the vast majority of interest income. SOMA interest income primarily reflects the size of the portfolio and the weighted average coupon (WAC) of the portfolio, less any amortized net premiums paid on securities.[12] Prior to the financial crisis, the size of the portfolio increased steadily at a moderate rate. With the adoption of the asset programs, the securities portfolio expanded rapidly and now stands at a level noticeably above its longer-run trend. The WAC, as shown in figure 3, fluctuated over time, rising and falling with the market rates and the SOMA portfolio's holdings. This pattern primarily reflects the fact that the Federal Reserve reinvests maturing Treasury securities at auction, and the coupon at auction tends to be in line with market rates. Although the asset purchase programs resulted in a significant accumulation of longer-term debt in recent years, much of it was issued in a low interest

[12]SOMA interest income is defined as the rate of return on the portfolio (the product of the size of the portfolio times the WAC) minus amortized net premiums. Net premiums, though important in deriving the precise value of interest income, will not be a primary driver of the contour of the projections of interest income.

Figure 3. Weighted Average Coupon of SOMA



Source: Federal Reserve Bank of New York.
Notes: Includes only nominal Treasury securities.

rate environment and, therefore, the WAC of the portfolio decreased somewhat.

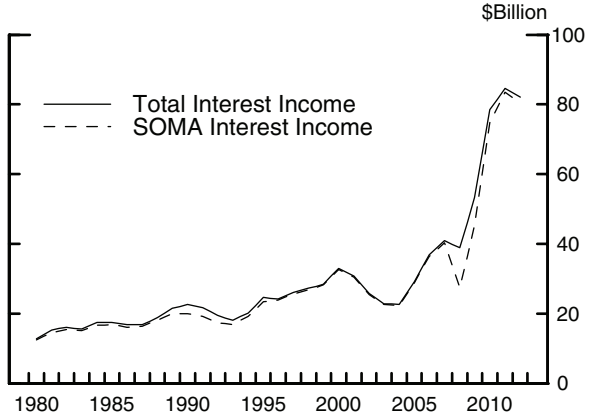
Putting the size of the portfolio and the WAC of the portfolio together, as shown in figure 4, interest income climbed at a moderate pace in the years prior to the financial crisis, primarily because of the steady increase in the size of SOMA, which rose in line with the growth of FR notes and capital. Beginning in 2009, interest income from the portfolio rose noticeably as large-scale asset purchases increased the size of the portfolio.

2.2.2 Interest Expense

With the introduction of interest on reserves in the fall of 2008 and the concurrent rise in the level of reserve balances, interest expense rose. As mentioned above, the IOER rate has been 25 basis points since December 2008, and as a result, even with a substantial volume of reserve balances, interest expense from reserve balances has been low compared with interest income and was roughly $5 billion in 2013.

In addition to interest expense from reserve balances, there is also interest expense from reverse repurchase agreements (RRPs), mostly

Figure 4. Interest Income



Source: Annual report of the Federal Reserve Board of Governors.

generated by the foreign repurchase agreement (RP) pool.[13,14] Interest rates paid on the foreign RP pool are generally in line with market rates, and when reserve balances are relatively low, interest expense on the foreign RP pool can represent a large share of total interest expense.

Reverse repurchase agreements with primary dealers and other institutions and the Term Deposit Facility (TDF) also have associated interest expense. In addition to the primary dealers, the Federal Reserve selected money-market mutual funds, the Federal Home Loan Mortgage Corporation (Freddie Mac), the Federal National Mortgage Association (Fannie Mae), and some banks as potential counterparties for RRPs (both overnight and term). In contrast

[13]Before December 13, 2002, repo transactions were conducted as matched sale-purchase transactions, where the Federal Reserve sold a security with an agreement to purchase it again at a later date. However, because matched sale-purchase transactions were accounted for as an outright sale rather than as a financing transaction the way reverse repurchase agreements are, the transactions did not result in interest expense.

[14]Every business day, the Federal Reserve conducts overnight reverse repos with foreign central banks that hold dollars in their accounts at the Federal Reserve Bank of New York. These transactions are one of the services that central banks provide one another to facilitate their international operations.

to the RRPs, only banks are counterparties in TDF transactions. Although the Federal Reserve has developed the capability of conducting large-scale operations in either RRPs or the TDF, these operations have been only in the testing phase to date, and as a result, interest expense associated with these operations has been minimal.

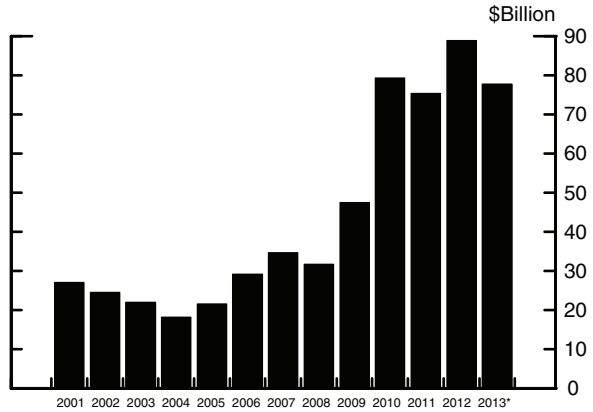
2.2.3 Capital Gain (Loss)

Under Federal Reserve accounting rules, a Federal Reserve Bank realizes gains or losses on a security only when the security is sold. At sale, the Federal Reserve's gain or loss is the market value minus the par value and unamortized net premiums on the security. Historically, the Federal Reserve did not generally sell securities, because the secular growth in currency resulted in a need for a long-term increase in securities holdings. In 2008, however, the Desk did sell some securities to offset the expansion of the balance sheet that resulted from the introduction of the liquidity facilities at the early stages of the financial crisis. In that year, the Federal Reserve realized a capital gain of roughly $3 billion because market rates had fallen, pushing up the market price of the securities sold. With the maturity extension program, the Federal Reserve also sold securities; in 2011, these sales realized a $2.3 billion capital gain.

2.2.4 Payment of Dividends, Transfers to Surplus, and Interest on Federal Reserve Notes Due to U.S. Treasury

As noted above, member banks are required to subscribe to the capital stock of the Reserve Banks, and the Federal Reserve Act stipulates that the Federal Reserve pay a 6 percent dividend on this capital. Under policy prescribed by the Board of Governors, excess earnings are retained as surplus capital in an amount equal to capital paid in. Before remittances to the Treasury are made, dividends are paid and earnings are retained to equate surplus to capital paid in. Dividends are paid even if remittances to the Treasury would be zero. As discussed earlier, in the event that earnings fall short of the amount necessary to cover operating costs, pay dividends, and equate surplus to capital paid in, the Federal Reserve books a liability of "Interest on Federal Reserve notes due to U.S. Treasury." This line item is recorded in lieu of reducing the Reserve Bank's surplus.

Figure 5. Federal Reserve Distributions to the U.S. Treasury



Source: Annual report of the Federal Reserve Board of Governors.
*Preliminary unaudited estimate; see http://www.federalreserve.gov/newsevents/press/other/20140110a.htm.

2.2.5 Remittances to the Treasury

Each week, the Federal Reserve remits any earnings in excess of operating expenses and dividends to the U.S. Treasury.[15] The use of these funds is stipulated in the Federal Reserve Act, which states:

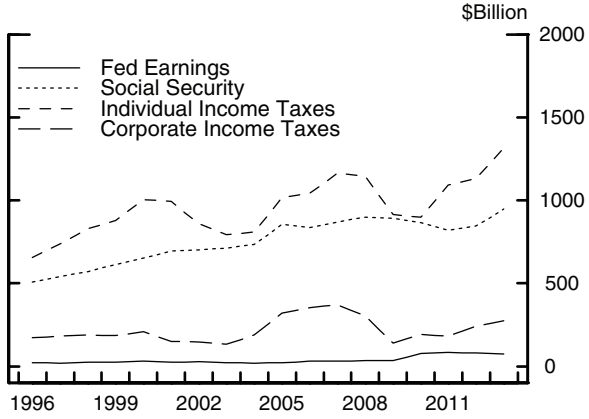
> The net earnings derived by the United States from Federal Reserve banks shall, in the discretion of the Secretary, be used to supplement the gold reserve held against outstanding United States notes, or shall be applied to the reduction of the outstanding bonded indebtedness of the United States under regulations to be prescribed by the Secretary of the Treasury.[16]

Over time, as shown in figure 5, annual remittances remained in a relatively small range, averaging about $25 billion in the years

[15]Occasionally, statutory transfers occur, which mandate that the Federal Reserve transfer a portion of its surplus to the Treasury. The last time this occurred was in 2000, when approximately $3.8 billion held in the surplus account was transferred to the Treasury.

[16]Federal Reserve Act, Section 7, Use of Earnings Transferred to the Treasury, 12 USC 290, sub-section (b).

Figure 6. Selected Treasury Receipts



Source: U.S. Treasury Bulletin.

immediately preceding the financial crisis. During the crisis, as Federal Reserve income increased notably, so did remittances to the Treasury. Still, remittances remained a relatively small share of government receipts—dwarfed by individual income and corporate income taxes, as shown in figure 6, and about in line with customs deposits (not shown).

3. Projections Assumptions

In order to construct projections of the Federal Reserve's balance sheet, assumptions about many of the details of the macroeconomy as well as the Federal Reserve's balance sheet and its evolution must be made. In addition, the projections in this paper are constructed to be consistent with the Federal Reserve accounting principles discussed in section 2.[17] The following sub-sections review key assumptions made to project the balance sheet and income.

[17]The Federal Reserve's accounting principles are published on the website of the Board of Governors of the Federal Reserve: http://www.federalreserve.gov/monetarypolicy/files/bstfinaccountmanual.pdf.

3.1 Scenario Assumptions and Results Overview

Our projections rely on the FOMC's guidance regarding monetary policy normalization principles, the forecasts in the February 2014 primary dealer survey conducted by the Federal Reserve Bank of New York, and the December 2013 and February 2014 Blue Chip forecasts. In the near term, we assume large-scale asset purchases that are in line with the median projection from the dealer survey, with purchases in 2013 and 2014 totaling about $1.5 trillion. Consistent with the June 2011 FOMC "exit principles," which were detailed in the June 2011 FOMC meeting minutes, we assume that the first step to normalize the stance of monetary policy involves the FOMC allowing SOMA holdings to mature or prepay without reinvestment. Beyond that first move, we analyze a variety of alternative normalization policies mentioned above. A summary of the key results is shown in table 3.

In the baseline projection, we assume no MBS sales. The size of the SOMA portfolio will normalize by June 2021. Despite the normalization of the size of the portfolio, the composition of the portfolio will still reflect the non-traditional policy choices; at the end of our projection period in 2025, over $500 billion of MBS will remain on the Federal Reserve's books. The amount of these MBS holdings even at this late date is still large, and residual sales would most likely take some careful consideration if sales were desired. Annual remittances to the Treasury are projected to remain sizable over the near term and cumulate from 2009 through 2005 to about $920 billion. Overall, this scenario suggests that large-scale asset purchases will have a net positive effect on income relative to a scenario with no purchases, but the Federal Reserve will continue to hold sizable MBS for some time.

The second scenario considers MBS sales. Under the June 2011 exit strategy principles, sales of MBS were included because of a desire to return to a Treasury-only portfolio.[18] Sales of MBS over four years accelerate the date of normalizing the size of the portfolio by about two years relative to the scenario with no MBS sales.

[18]In the minutes of the April 2011 FOMC meeting, the reason for selling MBS was to "minimize the extent to which the SOMA portfolio might affect the allocation of credit across sectors of the economy."

Table 3. Summary of Alternative Normalization Policies

	SOMA Size Normalizes	SOMA Composition Normalizes	2025 MBS Holdings	2009–2025 Cumulative Remittances	Trough Remittances (Date)
	Date		$Billion		
Baseline	Jun. 2021	Aug. 2022	$538	$918	$18 (2018)
MBS Sales	May 2019	Aug. 2020	$0	$820	$0 (2017–2020)
Later Liftoff	Nov. 2021	Nov. 2022	$612	$989	$24 (2019)
Reserve-Draining Tools +50bp	Jun. 2021	Aug. 2022	$538	$875	$11 (2018)
Higher Interest Rates +200bp	—	—	—	—	—
Baseline	Sep. 2021	Aug. 2022	$615	$791	$0 (2017–2020)
MBS Sales	Aug. 2019	Jan. 2021	$0	$634	$0 (2016–2023)

However, sales of MBS would also likely result in realized capital losses on the MBS, an outcome that would most likely reduce annual remittances to zero for a few years. In pursuing this normalization strategy, the FOMC presumably would need to evaluate, among other considerations, the trade-off of quickly reducing MBS holdings to zero with the possibility that remittances could be halted. In addition, seasoned MBS may have a coupon that is very different from prevailing market interest rates, suggesting that these MBS would need to be sold in a less liquid market than the one in which they were purchased, which might also be seen as risking unnecessary volatility in these fixed-income markets at the critical point when the FOMC is trying to firm the stance of policy.[19]

The third scenario explores a policy option that was discussed in early 2014. As the unemployment rate began to decline toward 6.5 percent, the Committee adjusted the quantitative thresholds that dictated the forward guidance on the liftoff of the federal funds rate to language that would signal an extended period of time before raising short-term interest rates.[20] If this guidance implied a later liftoff than what is in the baseline scenario, this would delay the date of normalization of the size of the balance sheet somewhat. Moreover, this alternative path for the balance sheet combined with a different path for interest rates would have implications for Federal Reserve income and, as a result, remittances to the Treasury. In our analysis, a delay in liftoff would boost remittances but result in more MBS holdings at the end of the projection period, implying holding these non-traditional assets on the balance sheet for longer, or having to sell more residual MBS at some date in the future.

Finally, we examine the use of term reserve-draining tools. The baseline analysis does not explicitly model reserve-draining tools. One interpretation of this assumption is that no such tools are

[19] "Seasoned" MBS, or MBS that have been issued sometime prior, would need to be sold in the specified pool MBS market. As discussed in Vickrey and Wright (2013), and detailed in Friewald, Jankowitsch, and Subrahmanyam (2014), the transaction costs of selling these securities far exceed those in the TBA market, where the securities were purchased. Executing a high volume of trades in any market with high transaction costs could potentially present difficulties for market functioning.

[20] See the January and March 2014 FOMC minutes for a summary of the Committee's discussion.

needed, or that the use of RRPs or term deposits by the Federal Reserve would be at the same cost as IOER.[21] FOMC communications suggest that policymakers are considering the use of these reserve-draining tools during normalization. And, it is possible that some of the operations will involve transactions with terms longer than overnight, which would most likely be at a rate that is above the federal funds rate. A priori, we have little information to gauge the likely cost of these tools. The cost will depend on the rate as well as the quantity of reserves that shift to these alternative tools. To provide a rough gauge as to how costly these tools could be, we assess the effects on Federal Reserve net income if the interest expense is 50 basis points higher than the projected level of the federal funds rate and apply this to all reserve balances. Fifty basis points is roughly one standard deviation of the historical spread between the federal funds rate and the yield on the three-month Treasury bill; assuming all reserve balances are drained to the higher expense tools provides an upper bound on this expense. Although interest expenses rise, there is only a modest effect on the Federal Reserve's cumulative remittances.

The analysis assumes that interest rates follow the median paths forecasted by the primary dealers and Blue Chip respondents. To explore the interest rate sensitivity of our results, we also consider a case where interest rates are 200 basis points higher after liftoff, for both the baseline and MBS sales scenarios. These results provide a rough notion of the interest rate risk embedded in the SOMA portfolio. Compared with the baseline, the higher interest rate path implies greater interest expense on reserve balances, lower net income, and consequently lower remittances to the Treasury. With no MBS sales, we find remittances to the Treasury are halted for three years. In the case of MBS sales, remittances are halted for eight years. Of course, if sales were being implemented and rates rose dramatically as suggested here, policymakers could slow the pace of sales or stop them entirely. In fact, if rates rose, sales, which would put upward pressure on rates, might not be the preferred policy. In addition, the FOMC has said sales are not part of the normalization plan. Finally,

[21] The Federal Reserve has been testing overnight RRP operations since late 2013. Since this tool is overnight, it most likely has a similar expense to IOER and is not discussed here.

in thinking about this scenario, it is important to put the shock in some perspective. Christensen, Lopez, and Rudebusch (2013) report that this interest rate shock scenario is very unlikely.

The sections that follow explore these conclusions in more detail.

3.2 Interest Rate Assumptions

To evaluate the current and future value of the SOMA portfolio, to project the future interest expense of reserve balances, and to project the future interest income from the portfolio, assumptions must be made about the path of interest rates over the projection period. For this analysis, we rely on the consensus near-term interest rate forecasts from the February 2014 Blue Chip survey combined with the consensus long-term Blue Chip forecasts from the December 2013 Blue Chip survey. The assumed path for the federal funds rate and the yield on the ten-year Treasury note are shown in figure 7. The federal funds rate remains in the 0 to 1/4 percent range through the first quarter of 2015, then lifts off during the second quarter. We combine the Blue Chip forecast for the federal funds rate with their forecasts for the five-year, ten-year, and thirty-year Treasuries to construct an entire yield curve.[22]

3.3 Near-Term Balance Sheet Assumptions

This sub-section reviews our projection methodology for selected asset and liability items that are of particular interest.

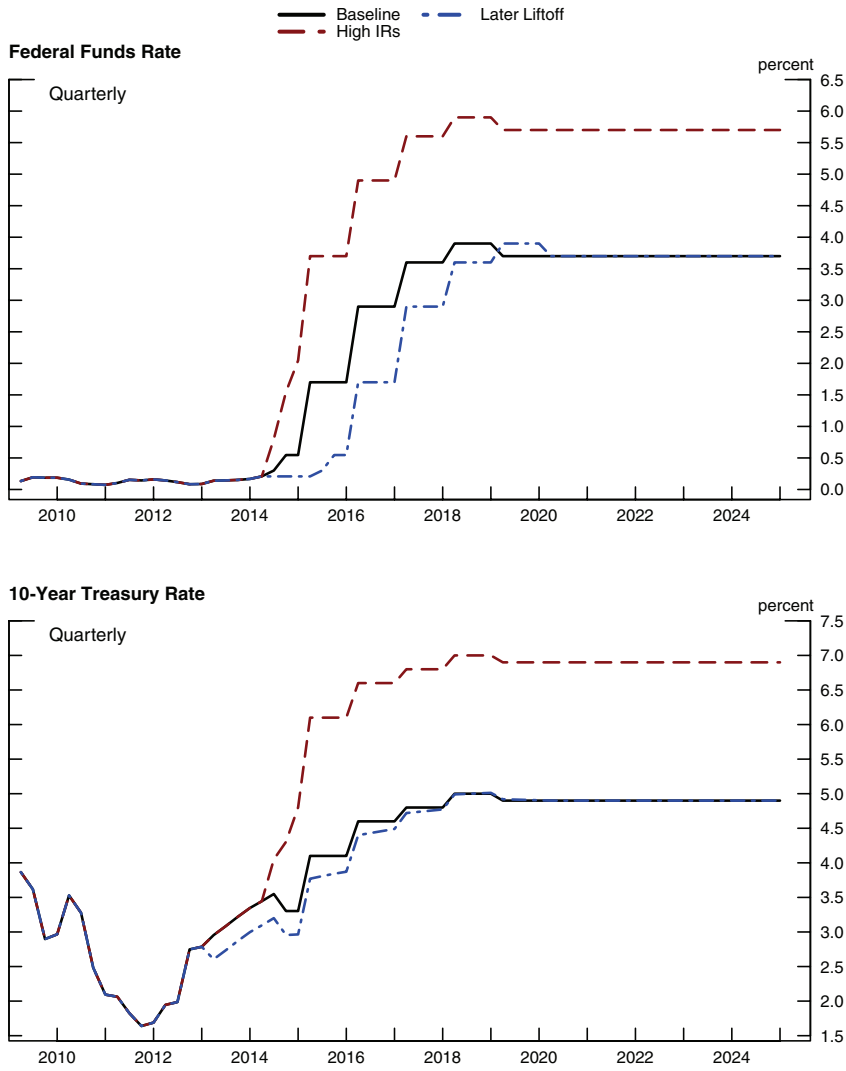
3.3.1 SOMA Portfolio

The evolution of the SOMA portfolio is intended to be consistent with FOMC communications through April 2014. In particular, we assume the following:

(i) Holdings of securities are increased at a declining pace consistent with the February 2014 primary dealer survey, until purchases stop in October 2014. The total expansion in holdings of Treasury securities and MBS over 2013 and 2014 is about $1.5 trillion.

[22]Refer to Carpenter et al. (2013).

Figure 7. Interest Rates



(ii) Reinvestment of principal payments from agency securities into agency MBS continues until the FOMC begins to unwind the current accommodative monetary policy stance.

Specifically, maturing or prepaying securities are assumed to be reinvested until six months prior to the first projected increase in the federal funds rate.

Given the initial composition of the SOMA portfolio on February 28, 2014, the portfolio evolves reflecting these two primary assumptions and the fact that, over time, securities held in the portfolio age, mature, or prepay. The interest earned on securities already in the portfolio is known. The interest rates on securities purchased in the future are based on a projection of all outstanding securities available to purchase including future issuance. Moreover, the composition of future purchases imposes the assumed constraint announced by the Federal Reserve Bank of New York that SOMA holdings in any one CUSIP will remain below 70 percent of the total amount outstanding in that CUSIP.[23]

In contrast to the Treasury securities held in the SOMA, the maturities of the MBS securities held in the portfolio are a function of prevailing interest rates given the embedded optionality of the mortgages underlying these securities. To capture the effect of interest rates on the paydown path of the MBS portfolio, we implement a stripped-down version of the MBS prepayment model proposed in Richard and Roll (1989). We abstract from the seasonality of prepayments, since our primary focus is not on the month-to-month variation of prepayments but rather the long-term prepayment behavior of the portfolio. We also abstract from the "burnout" of prepayments; "burnout" refers to the exhaustion of mortgage refinancings in the MBS, as the loans that remain in the security after a sustained period of refinancing opportunities are unlikely to prepay. Since the rates in our set of scenarios are never decreasing, the underlying mortgages will always be at or moving away from the "money" and will therefore never experience burnout. The remaining terms of the model are a seasoning factor and a refinancing incentive factor. Seasoning captures the observed "ramp" in prepayment behavior. The "ramp" captures the fact that individuals are unlikely to prepay mortgages that were recently issued regardless of the mortgages' "moneyness." The refinancing incentive factor captures the optionality component of the underlying mortgages and is defined as a

[23]Refer to http://www.newyorkfed.org/markets/lttreas_faq.html.

function of the ratio of the coupon rate on the MBS to the prevailing mortgage rate. The refinance incentive factor takes the following form:

$$\textit{Refinancing Incentive} = .2406 - .1389 * \arctan\left(5.952 * \left(1.089 - \frac{CouponRate}{MortgageRate}\right)\right).$$

The parameters of this equation are taken from the Office of Thrift Supervision (2000). Using the combined seasoning and refinancing incentive factors, along with our interest rate paths, we can project the cash flows on both current and future MBS holdings, and use these cash flows to obtain the level and approximate value of the MBS portfolio in any given period.[24]

It is important to note that Federal Reserve accounting records the securities holdings at face value and records any unamortized premium as a separate asset or unamortized discount as a separate negative asset. Consequently, we project both the face value of the portfolio and the associated premiums. To project premiums on securities purchased in the future, we calculate the market value of the securities at the time of the purchase, which we assume is the present discounted cash flow of these securities. To discount the cash flows from Treasury securities, we use the yield curves constructed from the Blue Chip forecasts for the federal funds rate, five-year rate, ten-year rate, and thirty-year rate. To discount the cash flows from the MBS securities, we apply an additional add factor to all points along the Treasury yield curve. To calibrate this add factor, we match the realized market value of the MBS held in the portfolio at the end of February to the value of projected cash flows discounted by the Treasury yield curve plus the add factor. For the projection, we take this add factor and phase it into the long-run historical spread of approximately 40 basis points over the next six months.

[24] Given that this methodology only incorporates a single path of interest rates and therefore a single path of cash flows for a given scenario, the valuation neglects the probability of future "moneyness" of the underlying mortgage and is therefore a simplification of a true MBS valuation.

3.3.2 Liabilities and Capital

In our modeling, projections of Reserve Bank liabilities and capital are also critical. In the near term, the size of the balance sheet is driven primarily by securities purchases boosting the asset side of the balance sheet and reserve balances increasing on the liabilities side as the primary offsetting accounting entry. Later in the projection, normalization of the size of the balance sheet occurs, which is the point when the liabilities side begins to determine the size of the balance sheet. That is, like historical times, reserve balances become fairly small, so increases in currency are the main determinant of changes in the size of the balance sheet. For simplicity, we assume that Federal Reserve notes grow in line with the Blue Chip forecast for nominal GDP.[25] Capital paid in is assumed to grow at its decade average of 15 percent per year, and surplus is equated to capital paid in.[26] This growth rate plays a role in the long-run trend growth rate of the SOMA portfolio.

Until the size of the balance sheet is normalized, we allow reserve balances to be endogenous, calculated as the residual of assets less other liabilities less capital. When reserve balances fall to the nominal level of $25 billion as the portfolio shrinks, however, we assume that the Federal Reserve does not allow them to fall further. As currency and Reserve Bank capital are still expanding at that point, purchases of Treasury securities are assumed to restart. Holdings of Treasury securities expand at the same rate as currency and Reserve Bank capital, keeping reserve balances at the assumed $25 billion

[25]In a classic money demand model with no change in velocity, one can proxy money growth with nominal GDP growth. That said, there are a number of factors that influence demand for currency beyond nominal GDP, including demand for currency from abroad, demand for currency during financial crises, and technological change in payment systems.

[26]In the years prior to the financial crisis, capital paid in grew rapidly. Each member bank of the Federal Reserve System is required, by law, to subscribe to shares of its local Reserve Bank in an amount equal to 6 percent of its own capital and surplus. Of this 6 percent, half is held at the Federal Reserve and the other half is on call at the bank. Consolidation in the banking industry, which resulted in rapid growth of member bank assets, and regulatory pressures led to higher key performance indicators from member banks. Member bank asset growth declined during the financial crisis; however, capital-paid-in growth may increase going forward because of, for instance, systemically important financial institution surcharges or Basel III requirements.

level. To maintain reserve balances at $25 billion, we assume that the Desk begins to purchase Treasury bills. Purchases of bills continue until these securities comprise one-third of the Federal Reserve's total Treasury security holdings—about the average proportion of Treasury holdings prior to the crisis. Once this proportion of bills is reached, we assume that the Desk buys coupon securities in addition to bills to maintain an approximate composition of the portfolio of one-third bills and two-thirds coupon securities.

3.4 Exit Strategy Assumptions for the Balance Sheet

We tie our modeling of the normalization of policy to the forecasted initial increase in the federal funds rate. We rely on the general principles for the exit strategy that the FOMC outlined in the minutes of the June 2011 FOMC meeting, updated for discussion in the June 2013 minutes. Specifically, we assume that the reinvestment of securities ends six months before the federal funds lifts off from the zero lower bound. Although the FOMC guidelines note that reserve-draining tools will be used prior to raising the funds rate, to support the implementation of an increase in the federal funds rate when appropriate, we abstract from this detail in the baseline projection. The key assumptions used in the baseline and alternative normalization projections are summarized in table 6 in the appendix.

4. Baseline

With the assumptions in place, this section presents the baseline balance sheet and income projections, assuming no MBS sales. This scenario illustrates one path for monetary policy normalization that is generally consistent with current FOMC communications. Critical assumptions for this scenario, as well as all other scenarios, are found in table 6 in the appendix.

4.1 Balance Sheet

Figure 8 presents the projections of key balance sheet line items (the solid lines). As shown in the top-left panel, SOMA holdings move

Figure 8. Selected Assets and Liabilities of the Balance Sheet

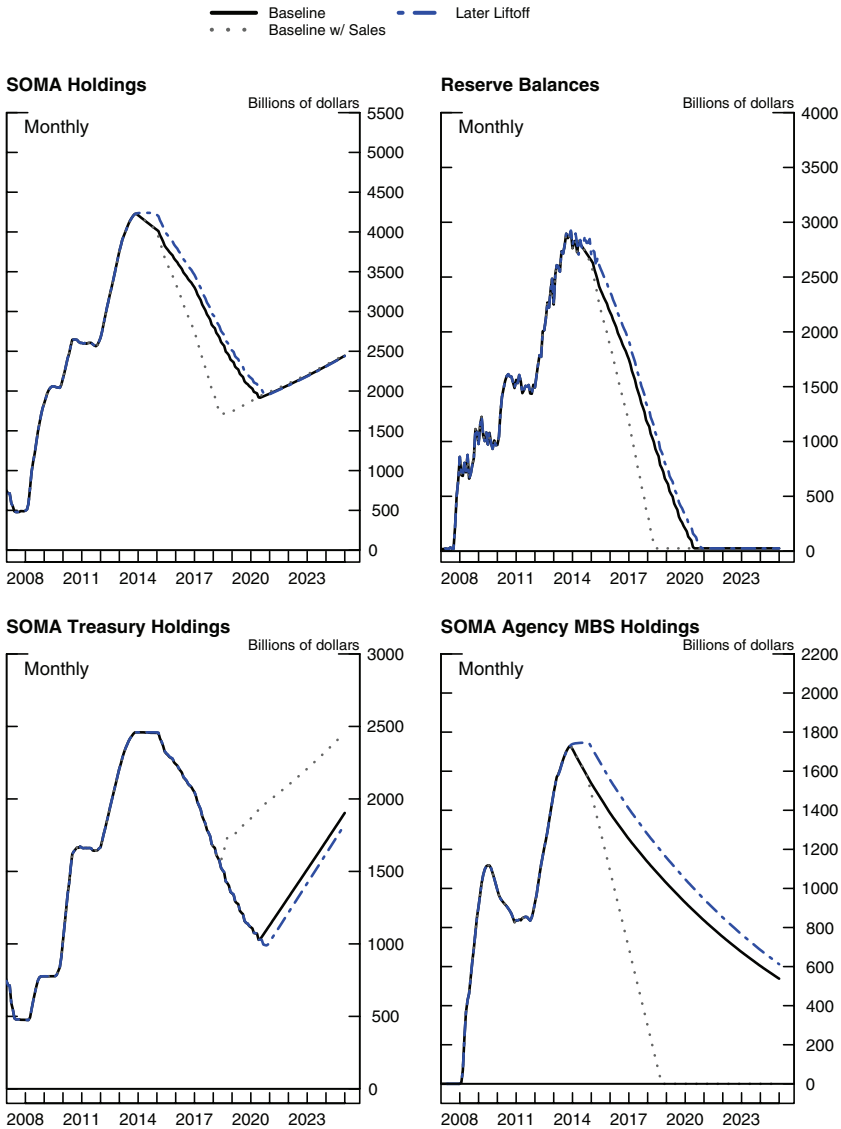


Table 4. Projected Maturing Treasury Securities, $Billion

2015	$3.5
2016	$215.5
2017	$194.2
2018	$374.0

up slightly through the middle of 2014, reflecting the continuation of the asset purchase program. After the conclusion of purchases in October 2014, the baseline portfolio begins to decline from its peak level of $4.2 trillion as securities are allowed to redeem without reinvestment. The peak size of the portfolio is much larger than the size of SOMA immediately prior to the financial crisis, which was roughly $800 billion, and roughly $3 trillion above Federal Reserve notes.

After purchases end, under the assumption that the FOMC begins to allow all asset holdings to roll off the portfolio as the first step in the exit strategy, SOMA holdings begin to decline. However, because the Federal Reserve sold or redeemed almost all of the Treasury securities with less than three years of remaining maturity during the maturity extension program in 2011–12, the portfolio holds very few shorter-dated Treasury securities at the time redemptions begin. Therefore, as shown in the bottom-left panel, when rolloff begins in November 2014, only a minimal amount of securities are maturing, and Treasury securities do not immediately decline. As shown in table 4, the amount of Treasury securities that are maturing becomes sizable in 2016. In particular, between 2016 and 2018, nearly $750 billion in Treasury securities are expected to mature and roll off the portfolio.

While Treasury securities do not decline until sometime after liftoff, MBS holdings, the bottom-right panel, begin to contract immediately. These holdings decline modestly, as prepayments are projected to be about $45 billion per quarter around the time of liftoff, and then slow further as rates rise. By the end of 2025, MBS holdings are roughly $540 billion. Recall that in former Chairman Bernanke's press conference he noted, "in the longer run, limited sales could be used to reduce or eliminate residual MBS holdings."

This projection suggests that residual holdings are still a sizable amount.

The decline in Treasury and MBS securities implies that the size of the balance sheet is normalized in May 2021 with $1 trillion in Treasury securities holdings and $890 billion in MBS holdings. Afterwards, SOMA begins to expand in line with the growth of currency and capital. Purchases of Treasury securities can be strategic to move the portfolio toward the composition that the FOMC desires in the longer run.

The level of reserve balances throughout the projection roughly reflects the asset program minus currency in circulation. As shown in the top-right panel, reserve balances top out at $2.9 trillion in November 2014, as the SOMA portfolio peaks with the end of asset purchases. Further out in the projection, the reduction in the size of the SOMA portfolio, along with the projected growth of Reserve Bank capital and Federal Reserve notes, results in declines in the level of reserve balances. Since we assume that reserve balances do not fall below $25 billion, by mid-2021 the Desk again starts to reinvest maturing Treasury securities and begins purchases of Treasury securities. If one were to consider a higher level of steady-state reserve balances, then normalization would occur slightly earlier.

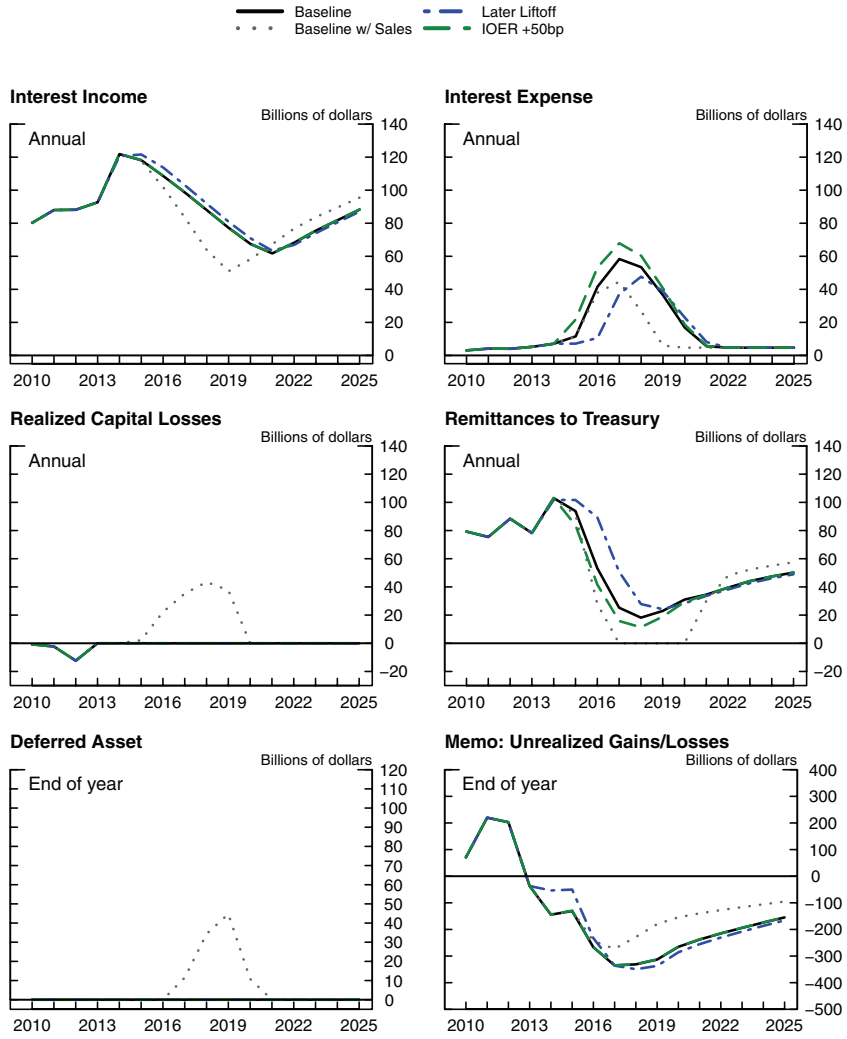
4.2 Income

Figure 9 shows the path of Reserve Bank net income. Because of the large size of the SOMA portfolio, combined with the (relatively high) coupons on the securities, interest income is elevated for some time.[27] As the SOMA portfolio begins to contract with the assumed steps in the exit strategy, interest income declines through mid-2021. After reserve balances reach $25 billion, Treasury purchases resume, expanding the portfolio, causing interest income to rise.

Interest expense reflects both the level of the federal funds rate and the level of reserve balances. The federal funds rate in the dealer

[27]The current weighted average coupon on the SOMA portfolio is 3.4 percent. This weighted average coupon evolves over the projection period as securities are purchased or are removed from the portfolio.

Figure 9. Income Projections



survey begins to rise in 2015, and interest expense rises with it. However, in 2018, interest expense begins to moderate, as the decline in reserve balances more than offsets the rise in the federal funds rate.

On net, annual remittances to the Treasury remain elevated by historical standards in the near term, but then decline. The trough

in remittances is $18 billion in 2018, a level that is not much lower than the $25 billion average remittances in the decade prior to the financial crisis. There is no deferred asset in this baseline projection. Cumulative remittances from 2009 through 2025 are $918 billion, above the level predicted by a trend growth in remittances. Of course, the overall effect on the federal government's finances is more complicated than just the impact from Federal Reserve remittances. For example, if asset purchases provide meaningful economic stimulus, the increase in government revenues from faster economic growth could more than offset any lull in remittances. Further, if the asset purchases lower interest rates, the interest expense of the federal government is lower.

Although only realized gains or losses affect the Federal Reserve's income, we project the unrealized gain or loss on the portfolio. The unrealized loss on the portfolio at a point in time is defined as the difference between the projected market value of the portfolio, less the amortized cost of the portfolio (par value of the securities plus net premiums). Given the large SOMA portfolio and the projected rise in interest rates, under the baseline projections, the portfolio is in an unrealized loss position at the end of 2014. This unrealized loss position continues to grow through the beginning of 2018, but subsequently diminishes as the portfolio shrinks through redemptions and sales.

5. Alternative Normalization Strategies

The baseline assumption of how the FOMC may choose to unwind unconventional monetary policy is one of many alternatives available to the Committee. Here we consider a few alternative normalization strategies: MBS sales, alternative forward guidance, and term-draining tools. We compare the effects of these alternative strategies on the balance sheet and income relative to the baseline projection.

5.1 MBS Sales

The June 2011 FOMC minutes laid out exit strategy principles that included selling MBS over a period of three to five years at some date after the funds rate moved above the zero lower bound.

Selling securities is one way of raising interest rates; see, for example, Ihrig et al. (2012). In addition, FOMC members have expressed a desire to remove MBS from the portfolio, in part reflecting their view that the Federal Reserve should minimize the extent to which the Federal Reserve portfolio might affect the allocation of credit across sectors of the economy.[28] In this projection, we consider selling MBS holdings over four years, commencing six months after liftoff. Selling MBS after the funds rate starts to rise is not only a way to remove MBS from the portfolio but also a way to reduce the amount of unconventional monetary policy in place at a time when the FOMC wants to firm monetary policy. A consequence of selling MBS is that the Federal Reserve will realize capital loses, reflecting selling relatively low-coupon MBS in an environment with rising interest rates. This type of strategy will reduce remittances to the Treasury.

The implications of MBS sales on the balance sheet are shown in figure 8. With MBS sales (the dashed lines), MBS holdings drop much faster than in the baseline. Consequently, the balance sheet with MBS sales normalizes in size around May 2019, implying that unconventional monetary policy is unwound one year earlier than in the baseline.

The income projection is a bit different from the baseline. Because of MBS sales, as shown in figure 9, there are fewer securities in SOMA and so interest income is lower in the medium term. Interest expense is also lower, because of the reduction in reserve balances. Under this path of interest rates, with sales come realized capital losses.[29] Over the four-year sales period, September 2015 to August 2019, these losses average roughly $35 billion per year. Putting the pieces together, remittances fall to zero from 2017 through 2020.

The projection has a deferred asset that peaks at about $45 billion. This illustrates that if policymakers choose to sell MBS, there is a chance that remittances will be zero for a period of time. Moreover, as Greenlaw et al. (2013) have suggested, this could involve

[28] Refer to the minutes of the April 2011 FOMC meeting, available at http://www.federalreserve.gov/monetarypolicy/fomcminutes20110427.htm.

[29] Treasury securities sales conducted under the maturity extension program resulted in small gains because of the low level of market interest rates in 2012 and the relatively higher coupon on the securities sold.

negative political pressure. However, zero remittances do not mean the Federal Reserve cannot conduct monetary policy. Other central banks have operated with losses. For example, the Swiss National Bank experienced an operating loss in 2008 and 2010, as a result of their currency interventions in support of the Swiss franc.[30] Despite these losses, the ability of the Swiss National Bank to influence monetary conditions was relatively unaffected. Moreover, policymakers have suggested this is not their preferred normalization strategy and would have the choice to slow or stop sales if this policy was found to be inconsistent with their dual mandate.

Despite the limited period of zero remittances, the level of remittances plus capital remains positive for most of that time, suggesting that the Federal Reserve could see only brief periods of negative equity. In addition, from an operational point of view, zero remittances do not preclude the FOMC from conducting monetary policy. As noted by Cukierman (2011) and others, a central bank differs from a private corporation in that its objective is not profit maximization—for example, in the United States, the Federal Reserve's objective is promoting maximum employment, stable prices, and moderate long-term interest rates—and it can therefore operate with negative equity.

For simplicity, this scenario is modeled assuming the same underlying macroeconomy as in the baseline. Of course, the underlying economy could differ, and most likely would be part of the reason that the FOMC chose to deviate from its current plans not to sell MBS in its normalization strategy. For example, it might be the case that the economy starts to expand at a faster rate than desired or inflation rises above the Committee's 2 percent objective. If so, MBS sales could put upward pressure on interest rates and return the economy to the baseline path. So, assuming that the monetary policy actions are effective, the medium- to longer-run projection for the economy should be similar to what is assumed in the baseline.

[30]Refer to "Annual Result of the Swiss National Bank" for 2008 and 2010, available for download at http://www.snb.ch/en/mmr/reference/pre_20090304/source/pre_20090304.en.pdf and http://www.snb.ch/en/mmr/reference/pre_20110303/source/pre_20110303.en.pdf.

5.2 Alternative Forward Guidance Thresholds

From December 2012 to March 2014, the FOMC provided forward guidance about the federal funds rate in terms of a threshold for the unemployment rate. The FOMC statement explicitly noted that the funds rate would remain in "this exceptionally low range . . . at least as long as the unemployment rate remains above 6-1/2 percent." In the January 2014 FOMC minutes, the Committee contemplated alternative quantitative forward guidance.[31] In March, the minutes noted that a "participant favored introducing new quantitative thresholds of 5¼ percent for the unemployment rate and 2¼ percent for projected inflation." Here, we consider the impact of implementing a threshold that would push out liftoff from the date assumed in the baseline.

Lowering the threshold implies shifting market participants' beliefs to a later liftoff of the federal funds rate. For illustrative purposes, we assume the liftoff occurs four quarters later than the baseline, which is when the Blue Chip forecast has the unemployment rate reach 5.6 percent and CPI inflation one year out is 2.3 percent. This later liftoff implies that the contour of the balance sheet will change, delaying the decline in the portfolio and therefore the normalization of the size of the balance sheet. In addition, the delay in liftoff affects income. Of course, a critical question is how fast rates will rise after liftoff. We assume the funds rate moves up at the same pace as the baseline scenario, as illustrated in figure 7. We also assume that rolloff begins six months before liftoff, delaying the start to rolloff by six quarters from the baseline. The ten-year yield is adjusted by a simple approximation of the expected change in the rate as implied by the expectations hypothesis. That is, we lower the ten-year yield by the average decrease in the path of the federal funds rate over the next forty quarters.

Figure 8 illustrates the evolution of the balance sheet (the dashed-dotted lines). The delayed start to stopping reinvestment implies larger MBS holdings throughout the projection period, with about $600 billion in holdings at end-2025.[32] For Treasury securities, however, the delayed start to allowing the securities to roll off the

[31] FOMC minutes are found here: http://www.federalreserve.gov/monetarypolicy/fomccalend

[32] Chairman Bernanke mentioned in his press conference statement that residual agency MBS holdings could be sold at some point in the future.

portfolio when they mature is not as dramatic. This is in part a result of the maturity extension program, in which the Federal Reserve sold or allowed to redeem all securities with remaining maturity of less than three years and purchased the same amount of securities with remaining maturity of six years or greater over the course of 2011 and 2013. Consequently, there are few securities maturing in 2015 (see table 4). Hence, projected Treasury holdings in the medium term are not that different from the baseline. Of course, later in the period, Treasury holdings are less than the baseline since there are more MBS holdings in this scenario. Taken together, the evolution of the securities holdings implies that normalization of the size of the balance sheet is delayed by six months relative to the baseline, implying a longer period for unconventional monetary policy to be in place.

Figure 9 shows that this policy would boost remittances to the Treasury by a sizable amount. Interest income is boosted through the medium run by the higher securities holdings. Interest expense is generally lower than the baseline, reflecting the fact that delayed start to the rise in the federal funds rate allows more Treasury securities to roll off the books and reduce reserve balances faster once the federal funds rate rises. These two factors imply that remittances are much higher through the medium term, with a trough of roughly $25 billion. Cumulative remittances are $989 billion, $71 billion more than the baseline. This scenario shows that if the FOMC chose to lower the threshold, for whatever reason, unconventional monetary policy would be unwound a bit more slowly, while remittances would be boosted relative to the baseline scenario. Again, MBS holdings would be sizable at the end of 2025.

Of note, our analysis abstracts from possible macroeconomic effects of delaying the rise in rates. For example, while there could be beneficial effects on output if rates were held "low for long," inflation could rise substantially. In particular, evidence from DSGE models suggests a particularly outsized response from forward guidance, and some authors suggest methodologies for damping this response (Del Negro, Giannoni, and Patterson 2013). Moreover, there could be evidence of excess risk taking in financial markets, leading to financial instabilities, discussed in Feroli et al. (2014). The conditionality of forward guidance should mitigate these risks; however, as with any

policy decision, there exists some uncertainty and therefore some risk of an unfavorable outcome.

5.3 Term Reserve-Draining Tools

So far, our analysis has assumed that the Federal Reserve has not engaged in any active liability management and, as a result, reserve balances passively decline as securities mature and roll off the portfolio. As noted in the June 2011 exit principles, the Committee may elect to incorporate liability management tools to reduce or "drain" reserve balances into its exit strategy in order to support conditions in which the federal funds rate trades near the intended target policy rate. Tools that could be used to drain reserve balances include reverse repurchase agreements and term deposits. RRPs can be conducted at an overnight or term frequency. Overnight RRPs would result in the balance sheet composition shifting from reserve balances to RRPs, but with the overnight rate likely being near IOER, there would likely be only a minimal effect on income. For term-draining tools, however, the income effect could be more noticeable.

If the Federal Reserve were to use term-draining operations where counterparties demanded a relatively high rate of return since these term operations have a longer maturity and would be less liquid than reserve balances, interest expense would rise. To illustrate this point, we assume that *all* reserve balances pay 50 basis points above IOER. This scenario is calibrated to one standard deviation of the historical spread between the federal funds rate and selected one- and three-month money-market rates.

The size of the balance sheet is unchanged in this scenario, though there would be a shift in the composition of liabilities: reserve balances would fall 1:1 with the use of term deposits and term RRPs. Interest expense would rise, with an increase of 50 basis points per each dollar drained. Given we assume all reserve balances are drained, an extreme example, as shown in table 5 and figure 9, even in this case, annual remittances are only marginally affected. This result is because the balance sheet is shrinking at the time interest expense is rising. The impact of higher costs reduces cumulative remittances by about $40 billion. Given the magnitude of the other

Table 5. Projected Remittances, $Billion

	2015	2016	2017	2018	2019	2020	Cumulative 2009–2025
Baseline	93.8	53.3	25.2	18.2	22.9	31.0	918.4
Costly Draining*	83.8	41.7	15.8	11.4	18.9	29.3	875.1

*Term-draining tools implemented on all reserve balances from liftoff to when reserve balances are normalized.

costs and revenues, the expense associated with draining tools does not seem too large.

6. Interest Rate Sensitivity—Deferred Asset

Above we found that with baseline assumptions the Federal Reserve will normalize monetary policy and its balance sheet without any deferred asset. The only way that remittances could fall to zero in this case would be if interest expense rose sustainably while reserve balances were elevated. In the MBS sales scenario, remittances could be halted for a longer period than projected above if realized losses were larger. To illustrate these points, we allow interest rates to rise 200 basis points higher after liftoff than in the baseline projection. The results will highlight the point discussed in the December 2012 minutes: "Depending on the path for the balance sheet and interest rates, the Federal Reserve's net income and its remittances to the Treasury could be significantly affected during the period of policy normalization." In particular, it could be necessary to raise rates faster than in the baseline if the economy was overheating or if inflation was consistently well above the Committee's 2 percent objective. This shock to interest rates has two effects on the size of the balance sheet. First, higher interest rates reduce the incentive for mortgage holders to refinance, causing MBS prepayments to slow. Second, higher interest rates increase interest expense on reserve balances in both scenarios and realized losses in the scenario with sales. All these factors increase the likelihood of a deferred asset, which also delays the date of normalization.

Figure 7 shows the projected rates for the higher interest rate scenarios. The federal funds rate and ten-year Treasury yield rise at a faster pace at liftoff, and after one year are 200 basis points higher than the baseline rates over the remainder of the projection. In the baseline interest rate projection, the ten-year Treasury yield rises by approximately 1 percentage point between end-2014 and end-2016. By contrast, the 200-basis-point shock implies that the ten-year Treasury yield is increasing by 3 percentage points over those two years.

There are a couple of ways to put the size of this shock in perspective. To start, this size shock is 1.3 percentage points above the average forecast of the top 10 highest respondents in the December 2013 Blue Chip survey (roughly 20 percent of the sample), and thus is probably comfortably above most market participants' interest rate projections. In addition, for a historical comparison, from 1978 to present, the standard deviation of the two-year change in the ten-year Treasury yield is 1.6 percentage points. As a result, this higher interest rate scenario should be seen as a somewhat unlikely scenario, but not an implausible one. Of course, to the extent that inflation expectations have become better anchored through time, this increase in interest rates may be even less probable than the historical record may suggest.

Focusing on the baseline, no-MBS-sales scenario, shown in figure 10, the interest rate shock does not substantially change the Federal Reserve's balance sheet projections.[33] The income projection, as shown in figure 11, does change, however. The higher federal funds rate implies greater interest expense. Once combined with non-interest income and expenses, remittances to the Treasury fall to zero for several years and a deferred asset is booked for 2017 through 2020.

How should we interpret this shock? Cumulative remittances from 2009 to 2025 are $791 billion, about $125 billion less than in the baseline. To put some perspective on this value, it remains greater than what would be suggested by a pre-crisis 1990–2007 trend level of remittances. This projection is also similar to what Christensen, Lopez, and Rudebusch (2013) report as their

[33] A deferred asset will have a small impact on the size of the SOMA portfolio, but not enough to see in the figures.

Figure 10. Selected Assets and Liabilities of the Balance Sheet

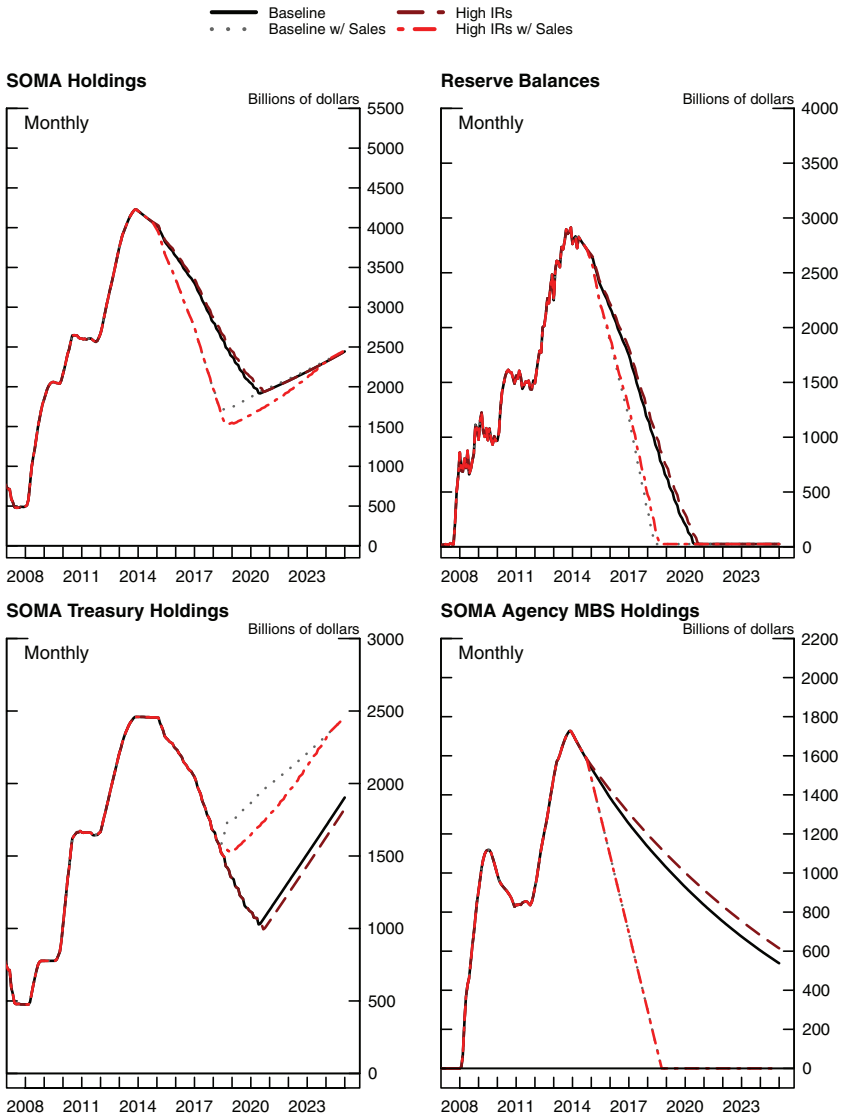
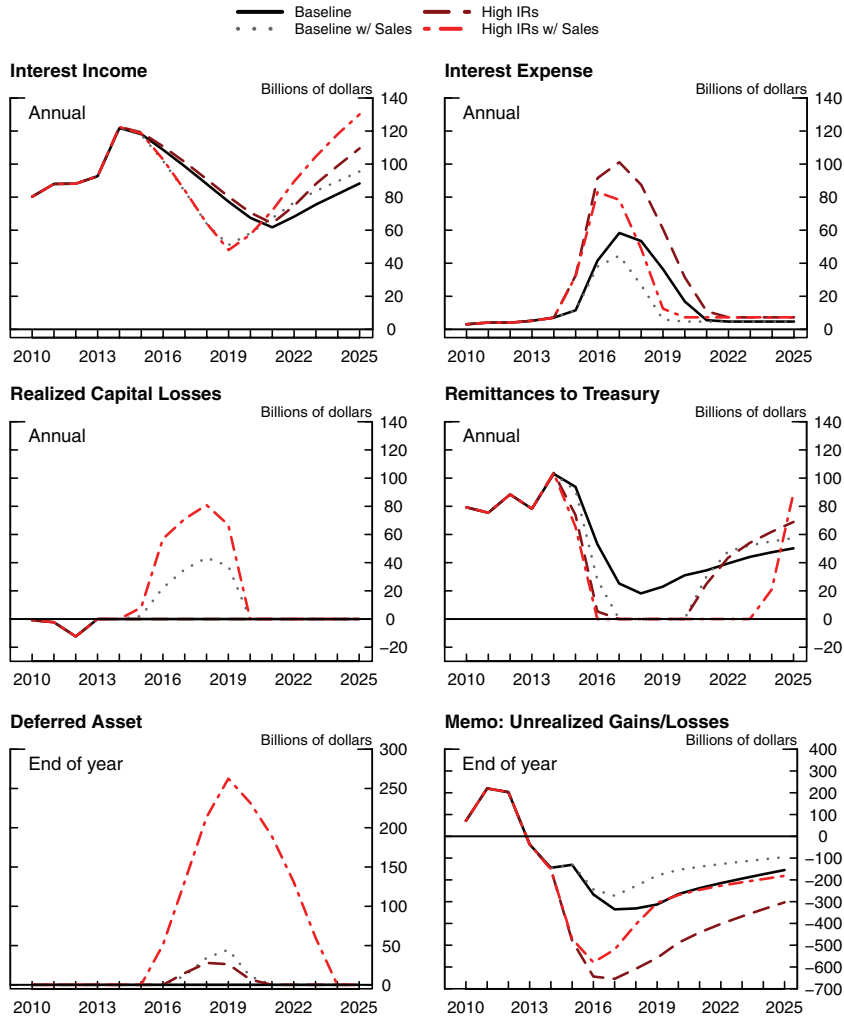


Figure 11. Income Projections



lower-bound "probability-based" stress scenario.[34] Further, they note that the chance that cumulative remittances would be below an underlying trend value is less than 0.1 percent.

[34] Christensen, Lopez, and Rudebusch (2013) suggest that the probability of this shock is less than 5 percent.

Turning to a scenario where MBS are sold, the higher interest rate path does not change the balance sheet by much, but with higher interest expense and larger capital losses, a deferred asset peaks at nearly $263 billion. Moreover, remittances to the Treasury are halted for 8¾ years. Cumulative remittances from 2009 to 2025 are $635 billion, about $283 billion less than in the baseline. Of course, the June 2013 minutes stated that policymakers do not expect to sell agency mortgage-backed securities during the process of normalizing monetary policy. Therefore, this scenario is very unlikely to play out. In addition, policymakers could change their exit strategy, slowing or stopping these asset sales.

These sensitivity scenarios illustrate that in some circumstances the Federal Reserve could have years with no remittances to the Treasury and a deferred asset on its books. It is important, however, that these scenarios be viewed within a macroeconomic framework. As noted above, to the extent that asset purchases are effective in stimulating the economy, overall government revenues would be boosted on net, despite the capital losses at the Federal Reserve. In addition, one should consider the Federal Reserve's remittances over the entire period of unconventional monetary policy. Overall, average annual remittances to the Treasury even in these shock scenarios remain well above the average annual remittances of $25 billion recorded prior to the crisis.

More broadly, as mentioned above, zero remittances would not affect the conduct or stance of monetary policy. This assertion is based on a number of points that have been raised previously in the academic literature. First, monetary policy in the United States has historically been conducted by adjusting short-term interest rates, and there is no direct, causal link between the remittances to the Treasury and short-term interest rates.

Second, Cukierman (2011) and others cite that the main drivers of central bank insolvency include assumptions of problem assets by the central bank, fiscal abuse, and a buildup of large stocks of foreign reserves, sometimes to support an exchange rate peg. These drivers are absent from the U.S. case. Other drivers that could be more applicable to the United States are a need to absorb banking-sector excess liquidity and central bank purchases of relatively low-yielding instruments. That said, in most scenarios, we find that any deferred

asset would most likely be for a handful of years and would not present an ongoing concern.

And third, one possible (though in our view, unlikely) channel through which losses could impair monetary policy is if, for some reason, economic agents believed that the central bank's earnings affected inflation. If beliefs were formed in that way, perhaps because of a misunderstanding of the mechanics of the economy, inflation expectations could rise and thereby become embedded in actual inflation. Relatedly, a model by Hall and Reis (2013) provides a theoretical model that explores the potential for a central bank to pursue an inflationary policy in order to erode capital losses. They state that the realization of this outcome in the United States is unlikely and find the potential for the Federal Reserve to become insolvent to be "remote." By contrast, empirical evidence provided by Klueh and Stella (2008) shows that in some countries, there can be a negative relationship between inflation and central bank capital. Their results were based on a set of countries where central bank losses as a percent of nominal GDP approached 2 percent, well below any levels projected here.

Such a process of a feedback loop of inflation and losses seems unlikely for the case of the United States. In particular, authors such as Del Negro and Sims (2014) point to the importance of the present value of net worth, rather than of equity, as the key measure of central bank solvency, and perhaps by extension, central bank independence. Because the Federal Reserve has an expected (positive) stream of seigniorage revenue from its currency franchise, the potential impact of a short-lived deferred asset on inflation expectations or on the necessity of the central bank to be recapitalized by the Treasury should be non-existent, or negligible. That said, Del Negro and Sims do highlight extraordinary circumstances of alternative equilibria under which the presented discounted value of seigniorage revenue is not sufficient to cover the gap between the interest earned on assets less the interest paid on liabilities. This could be a result of inflation expectations becoming embedded in asset values, thereby eroding their present worth. In their model, a central bank would have to resort to fulfilling those expectations by allowing inflation to drift above its target. However, in order for this to occur, the balance sheet would likely have to be multiples of the size of the current balance sheet, an unlikely outcome.

Moreover, given this apparatus to produce income projections for any monetary policy scenario, policymakers could evaluate alternative ways to remove monetary policy accommodation with the idea of choosing the path that most likely reduces the possibility of zero remittances and, hence, political scrutiny of their actions. Two additional strategies not presented here, for example, but that could reduce the probability of zero remittances are security sales in the near term when remittances are robust and committing to a more gradual pace of tightening after liftoff. Looking across all possible strategies, there would be trade-offs between alternative monetary policy actions, their effect on economic activity, and remittances. When considering these alternative actions, the FOMC would need to keep in mind its dual mandate of full employment and price stability.

7. Conclusion

In this paper, we have outlined a variety of ways the FOMC may unwind the unconventional monetary policy that it has instituted over the past several years. The different policies have implications for the length of time unconventional policy is in place, the composition of the Federal Reserve's balance sheet, and remittances to the Treasury. How fast unconventional monetary policy unwinds and the tools used depends on FOMC actions, and we discussed the impact of a few of these possibilities.

Appendix

Table 6. Key Assumptions of the Projections

Assumption	Baseline	Baseline with Sales	Later Liftoff
Current Portfolio Strategy			
Agency Reinvestments	Agency MBS	Agency MBS	Agency MBS
Treasury Purchases			
Total Amount (2013–14)	$790 billion	$790 billion	$790 billion
Jan. 2013 to Dec. 2013	45	45	45
Jan. 2014	40	40	40
Feb. 2014 to Mar. 2014	35	35	35
Apr. 2014	30	30	30
May 2014 to Jun. 2014	25	25	25
Jul. 2014	20	20	20
Aug. 2014 to Sep. 2014	15	15	15
Oct. 2014	10	10	10
MBS Purchases			
Total Amount (2013–14)	$680 billion	$680 billion	$680 billion
Jan. 2013 to Dec. 2013	40	40	40
Jan. 2014	35	35	35
Feb. 2014 to Mar. 2014	30	30	30
Apr. 2014	25	25	25
May 2014 to Jun. 2014	20	20	20
Jul. 2014	15	15	15
Aug. 2014 to Sep. 2014	10	10	10
Oct. 2014	5	5	5
Exit Strategy			
Fed. Funds Liftoff	2015:Q2	2015:Q2	2016:Q2
Redemptions Start	Nov. 2014	Nov. 2014	Nov. 2015
Sales Start	N/A	Oct. 2015	N/A
Sales End	N/A	Sep. 2019	N/A

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