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

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Abstract

Over the past few years, the Federal Reserve's use of unconventional monetary policy tools has led it to hold a large portfolio of securities. The securities holdings in excess of historical norms have been shown to be putting downward pressure on longer-term interest rates. One question asked is how long this unusual amount of monetary policy accommodation will be in place. Here we provide projections of the evolution of the Federal Reserve's balance sheet that are consistent with public economic forecasts and announced Federal Open Market Committee policy principles to help answer this question. We begin with a primer on the Federal Reserve's balance sheet. Then, with the foundational concepts in place, we present a framework for projecting Federal Reserve assets and liabilities through time. In the projections, the Federal Reserve's balance sheet remains large by historical standards for several years. Our baseline projection suggests that market participants likely do not expect the Federal Reserve's portfolio to return to a more normal size until August 2017, and its composition to return to normal until September 2018. Overall, this suggests that market participants believe that unconventional monetary policy will be in place for some time, likely depressing longer-term interest rates for a number of years.

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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. The use of these tools has had a significant effect on the Federal Reserve's balance sheet.[1] Both the size and the composition of the balance sheet have changed noticeably. As shown in Figure 1, through 2007, the assets of the Federal Reserve (reported above the horizontal axis) comprised mainly Treasury securities. The single largest liability item (reported below the horizontal axis) was Federal Reserve notes – that is, currency. Prior to the financial crisis, the Federal Reserve's balance sheet grew at a fairly moderate pace, with the Open Market Desk (Desk) at the Federal Reserve Bank of New York purchasing additional Treasury securities roughly on pace with the expansion of currency and Federal Reserve Bank capital.

At the start of the financial crisis, the Federal Reserve's balance sheet began to expand at a faster pace largely because of an increase of lending through the various liquidity and credit facilities that were established at that time.[2] These extensions of credit expanded the asset side of the balance sheet, while a substantial portion of the matching increase on the liability side of the balance sheet showed up in reserve balances.[3] As these liquidity facilities began to wind down, the Federal Reserve's large-scale asset purchase programs started to ramp up. The Federal Reserve's System Open Market Account (SOMA) portfolio—that is, its holdings of securities—more than tripled from 2008 to today, and in June 2012 exceeded $2.6 trillion.

The SOMA value of $2.6 trillion is nearly $1.5 trillion above the current value of currency and capital. The value of currency and capital, plus some level of reserve balances necessary for the conduct of monetary policy would essentially reflect the normal size of the balance sheet without the large amount of unconventional monetary policy accommodation currently in

[1] The Federal Reserve's balance sheet is published each Thursday in the H.4.1 statistical release, available at http://www.federalreserve.gov/releases/h41/.

[2] For a discussion of the Federal Reserve's credit and liquidity facilities, see http://www.federalreserve.gov/monetarypolicy/bst.htm.

[3] Throughout this paper the phrase "reserve balances" will be used to denote deposits of depository institutions that are not in term deposits. This measure is reported in tables 8 and 9 of the H.4.1 statistical release as "Deposits, Other deposits held by depository institutions." This concept is slightly distinct from the concept of reserve balances reported in table 1 of the release. That concept excludes, among other items, contractual clearing balances.

place. These excess holdings of securities by the Federal Reserve have reduced private sector holdings of these securities, and have put downward pressure on longer-term interest rates.[4] Having a projection of the balance sheet that is consistent with Federal Open Market Committee (FOMC) guidance and public economic forecasts provides some guidance on how market participants likely anticipate monetary policy accommodation to evolve. Studies that aim to quantify the contemporaneous and expected future interest rate effects of the Federal Reserve's unconventional monetary policy can use these projections as an input in their analysis.[5]

The Committee's recent statements about the outlook for monetary policy and its discussion in the minutes of the June 2011 FOMC meeting on "exit principles" suggest that the balance sheet could remain large by historical standards for some time. This paper describes a framework for constructing projections of the Federal Reserve's balance sheet. These projections are not forecasts. As will become clear, the projections depend critically on a whole host of assumptions about future monetary policy decisions, financial market developments, and other issues. Based on assumptions and projections of each of those factors, one can infer an implied path for the balance sheet. These projections illustrate how the various factors that affect the balance sheet of the Federal Reserve do so dynamically and allow for the analysis of alternative scenarios. In this paper, we base our modeling on three key inputs. First, we start with the Federal Reserve's balance sheet as of May 30, 2012. Second, we interpret the minutes of the June 2011 FOMC meeting to put some structure on a plausible exit strategy that removes monetary policy accommodation. Finally, we rely on the June 2012 Blue Chip Economic Indicators forecast for nominal GDP growth and interest rates. The Blue Chip Economic Indicators is a consensus forecast based on a survey of professional forecasters; we use the mean of the forecast for our selected economic variables. Importantly, we use the projection for the federal funds rate to identify the timing of the first expected increase in the federal

[4] See Yellen (2012) for more discussion of how the Federal Reserve's balance sheet operations have had substantial effects on longer-term Treasury yields, principally by reducing term premiums on longer-dated Treasury securities.

[5] See Ihrig et al. (2012) for a study that provides an estimate of the current and future expected path of the 10-year term premium associated with the Federal Reserve's unconventional monetary policy that is consistent with the balance sheet projections provided in this paper.

funds rate, and we assume that the various elements of the exit strategy are tied to that timing. All of these inputs are publicly available and in no way represent a forecast from the Federal Reserve or its staff. To illustrate the dependence of the projections to the assumptions, we perform a series of alternative simulations.

Key findings using the baseline assumptions noted above are the following. First, the projections yield a Federal Reserve balance sheet that remains large by historical standards for a number of years. In particular, the SOMA portfolio contracts at only a slow pace through the medium term, reflecting the fact that the FOMC has stated that it anticipates that conditions will warrant keeping the federal funds rate at exceptionally low levels at least through late 2014. Moreover the maturity extension program is reducing the holdings of shorter-dated Treasury securities in the portfolio to about zero, implying that there will be little passive shrinking in the holdings of Treasury securities when the reinvestment policy is ended. Under these projections, the SOMA portfolio does not return to a more normal size until mid- 2017, and its composition does not return to normal until 2018. If these projections underlie the beliefs of market participants, the implication is that the SOMA portfolio holdings should continue to put downward pressure on longer-term interest rates for a number of years.

The paper is organized as follows. Section 2 provides a primer on the Federal Reserve's balance sheet and accounting. Section 3 outlines the assumptions used as inputs to the projections of the balance sheet. The balance sheet projections are discussed in Section 4. Section 5 concludes. Two appendixes are also included. Appendix 1 provides more detail on the assumptions underlying the projections. Appendix 2 describes the method used to derive projections of coupons on future purchases of SOMA securities.

2 Background and historical perspective

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 12 individual Reserve Bank balance sheets.[6] 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 $875 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.[7] 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. Federal Reserve capital consists of two components, capital paid in and surplus.[8] By statute, member banks must subscribe to Federal Reserve Bank capital in an amount of 6 percent of each member bank's capital and surplus, half of which is paid in (this portion is referred to as capital paid in) and the other half is subject to call by the Board of Governors. When a member's capital or surplus changes, its holdings of Reserve Bank stock must be adjusted accordingly. Reserve Bank stock is quite different from stock in a private company and does not confer all of the controls in the way that equity in private firms does. Surplus capital is essentially retained earnings, and is equated to capital paid in.

[6] 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 semiannually 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.

[7] It is worth noting that there is a common misperception that the Federal Reserve only held Treasury bills prior to the large-scale asset purchases.

[8] See the *Financial Accounting Manual for Federal Reserve Banks*, which reports the accounting standards that should be followed by the Federal Reserve Banks at www.federalreserve.gov/monetarypolicy/files/bstfinaccountingmanual.pdf, page I-68.

With the lending that took place during the financial crisis, for a time, lending of various sorts surpassed the size of the SOMA portfolio. As of May 30, 2012, the SOMA portfolio was again the largest asset item, but it had grown to over $2.6 trillion because of the asset purchase programs. On the liability side of the balance sheet, FR Notes, at about $1.1 trillion, were no longer the largest liability item. Instead, as the FOMC increased its asset purchases, reserve balances increased correspondingly to a level about $1.5 trillion.

Table 1: Federal Reserve's Balance Sheet, end-2006 and present

Balance Sheet end-2006
billions of $

Assets		Liabilties	
SOMA	779	Deposits of DIs	13
other assets	95	FR Notes	783
		other liabilities	49
		memo: capital	31

Balance Sheet May 30, 2012
billions of $

Assets		Liabilties	
SOMA	2,602	Deposits of DIs	1,526
other assets	243	FR Notes	1,068
		other liabilities	197
		memo: capital	55

Source: H.4.1 Statistical Release

The next few subsections review the key components of the Federal Reserve's balance sheet and how they have changed.[9]

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.[10] During that time, the SOMA portfolio essentially held Treasury securities; however, the portfolio has held other types of securities in its portfolio over its history.[11] 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 no more were purchased until 2008.[12]

[9] 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 at http://www.federalreserve.gov/monetarypolicy/files/bstfinaccountingmanual.pdf.
[10] For a description of the Federal Reserve's balance sheet prior to World War II, see Banking and Monetary Statistics, 1914-1941 (1943).
[11] Refer to Edwards (1997).
[12] Refer to Meltzer (2010).

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 subscribes 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. 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 2. As can be seen, through 2007, both the SOMA portfolio and currency and capital trended upward together. When the LSAPs began in late 2008 and early 2009, and continuing through the second round of purchases in 2010, the SOMA portfolio increased markedly and at a rate that far outpaced the growth of currency and capital. The expansion of the SOMA portfolio at that point was reflected in reserve balances.

The SOMA portfolio has a range of maturities of Treasury securities in its holdings.[13] Historically, the Desk tended to purchase securities across the entire yield curve to avoid distorting the yield curve. As shown in Figure 3, the weighted-average maturity of Treasury coupon securities in the SOMA portfolio stayed around three to four years. 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.

2.1.2 Premiums and discounts

Federal Reserve accounting records all domestic securities holdings at face value, rather than at market value. Except for the rollover of maturing Treasury securities, new purchases of

[13] 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.

securities are conducted in the open market at market prices. If a security is purchased for more than its face value, the difference between the purchase price and the face value—the premium on that security—is recorded separately as an asset on the balance sheet. Likewise, if a security is purchased for less than its face value, the difference between the purchase price and the face value—the discount on that security—is recorded as a liability on the balance sheet. Reserve balances increase by the purchase price of the security, that is, the face value plus the net premium (premiums net of discounts). At maturity of the security, the Federal Reserve will only receive the face value, so the premiums and discounts must be amortized over the remaining term of the security. U.S. Treasury securities and agency debt securities held by the Federal Reserve Banks are amortized linearly over the remaining term of the security. In the accounting treatment of agency MBS premiums, the amortization schedule for MBS is based on an effective yield calculation, which results in a constant rate of return during the term of the security. In the analysis that follows, however, we simplify this assumption and implement agency MBS amortization using the path of anticipated paydowns of agency MBS. As of year-end 2011, there were $88 billion in unamortized premiums and $1 billion in discounts associated with holdings of Treasury securities and $12 billion in unamortized premiums and $1 billion in discounts associated with holdings of agency MBS.[14]

2.1.3 Lending

Since its inception, the Federal Reserve has had the authority to lend to depository institutions. Prior to the financial crisis, however, borrowing from the Federal Reserve tended to be quite small, typically less than a couple hundred million dollars outstanding per day. During the financial crisis, lending by the Reserve Banks grew significantly, at one point exceeding $1 trillion outstanding.[15] Lending by the Federal Reserve increases reserve balances, all else equal, because in lending to a depository institution, the Reserve Bank directly credits that institution's reserve account. As a result, reserve balances rose as lending increased during the

[14] Refer to the Combined Financial Statement of the Federal Reserve System, available at http://www.federalreserve.gov/monetarypolicy/bst_fedfinancials.htm.

[15] Included in this number are primary, secondary and seasonal loans; term auction credit; the primary dealer and other broker-dealer credit, credit extended to AIG, net portfolio holdings of Commercial Paper Funding Facility, and the outstanding principal amount of loans extended by the Federal Reserve Bank of New York to Maiden Lane, Maiden Lane II, and Maiden Lane III.

financial crisis. The loan to the institution is the corresponding asset on the Federal Reserve's balance sheet.

2.1.4 Deposits of depository institutions and reverse repurchase agreements

Deposits of depository institutions include balances at the Federal Reserve of all depository institutions that are used to satisfy reserve requirements and balances held in excess of balance requirements, as well as service-related deposits. 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.

2.1.5 Reverse repurchase agreements

The Federal Reserve conducts reverse repurchase agreements (reverse repos, or RRPs) by selling securities to counterparties who sell the securities back to the Federal Reserve on a stated future date. Currently, the largest portion of outstanding reverse repos is with foreign central banks that hold dollars in their accounts at the Federal Reserve Bank of New York. Known as the "foreign RP pool," as of end-May 2012, there was a little less than $100 billion in foreign RP pool transactions outstanding on the Federal Reserve's balance sheet.

In addition to the foreign RP pool, before the financial crisis, the Federal Reserve occasionally engaged in reverse repos with primary dealers to drain reserve balances. These transactions are conceptually distinct from the service provided by the foreign repo pool; in particular, they are intended to be part of open market operations and therefore part of the conduct of monetary policy. Since late 2009, the Federal Reserve Bank of New York has taken steps to expand the types of counterparties for reverse repos to include entities other than primary

dealers, in order to prepare for the potential need to conduct large-scale reverse repurchase agreement transactions.

2.1.6 Federal Reserve Notes

Federal Reserve notes, or currency, are a liability of the Federal Reserve. As a practical matter, the quantity of currency outstanding is not determined by the Federal Reserve. 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.[16] Prior to the financial crisis, currency was the largest liability item on the Federal Reserve's balance sheet.

2.1.7 Capital paid-in, surplus, and interest on Federal Reserve notes due to U.S. Treasury

The capital of the Reserve Banks is different than the capital of other institutions. 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 and surplus. Of this amount, half must be paid to the Federal Reserve Banks 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 about 15 percent per year. In addition, Reserve Banks have surplus capital, which reflects withheld

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

earnings, and Federal Reserve accounting policies stipulate that the Reserve Banks withhold earnings sufficient to equate surplus 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.

One liability item is distinct from the others. As noted above, the Federal Reserve remits all net income, after expenses and dividends and allowing for surplus to be equated to capital paid in, to the U.S. Treasury. As those earnings accrue, they are recorded on the Federal Reserve's balance sheet as "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 the payment 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 would 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 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; however, these deferred assets were generally short-lived.[17] 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.

2.1.8 Other liabilities

The Federal Reserve acts as fiscal agent for the U.S. Treasury. The Treasury holds two accounts at the Federal Reserve, which are the Treasury's General Account (TGA) and the Supplemental

[17] For example, as shown on the H.4.1 Statistic Release from November 3, 2011, the Federal Reserve Bank of New York recorded a large enough deferred asset so that the Federal Reserve System also did.

Financing Account (SFA).[18] The TGA is the primary account through which the Treasury's transactions settle. Major outlays of the U.S. Treasury are generally made from this account and tax receipts are deposited in this account. The TGA is also used to collect funds from sales of Treasury debt. Prior to the financial crisis, the Treasury managed the balance in this account, which receives no interest, to a level of about $5 billion each day, and invested any additional funds in the banking system. The Treasury traditionally received the federal funds rate less a spread on funds it had invested in depository institutions. Since late 2008, the federal funds rate has been close to zero, and the Treasury has placed essentially all of its operating cash in the TGA.[19]

The SFA was established by the Treasury in September 2008 to hold the proceeds of the Supplementary Financing Program and to coordinate with the Federal Reserve in the management of the aggregate quantity of reserve balances. Under this program, the Treasury issues marketable debt and deposits the proceeds in an account at the Federal Reserve that is segregated from the TGA. On a number of occasions as the statutory debt limit appeared to be binding, the Treasury reduced the quantity of debt issued under the SFP, thereby reducing the balance in the SFA. The SFA fell to zero in late July 2011 and has stayed at that level subsequently.

There are a set of other liabilities that we do not discuss in detail because they are, in general, either small or not particularly relevant for the purposes of these projections. More discussion of the Federal Reserve's balance sheet is available on the Board of Governors' website.[20]

2.2 Valuation of the SOMA portfolio

There are a number of different ways to record the value of the SOMA portfolio. Reserve Bank accounting records the SOMA portfolio at par value. The par value of the portfolio, reported in line 1 of Table 2, gives the face value of the securities in the portfolio. This is the value of the

[18] Technically, the Treasury has a general account at each Reserve Bank, however in practice these accounts are consolidated each night into the general account at the Federal Reserve Bank of New York.
[19] See http://www.fms.treas.gov/tip/communication/special-communication-2008.pdf for the Treasury's announcement of the suspension of its Term Investment Option auctions.
[20] http://www.federalreserve.gov/monetarypolicy/bst_fedsbalancesheet.htm

portfolio reported in the weekly H.4.1 statistical release. The amortized cost of the portfolio, also called the book value of the portfolio and shown in line 3, is the par value of the portfolio plus any unamortized net premiums associated with the securities. A third valuation of the portfolio is the market value, line 4. The Monthly Report on Credit and Liquidity Programs and the Balance Sheet and the Annual Report also report the fair value of the portfolio.[21] As interest rates change, the market value of the securities in the portfolio changes. The difference between the market value and the book value is the unrealized net gain (or loss) position of the portfolio, line 5. As of the end of March 2012, the portfolio had an unrealized gain of $177 billion, reflecting a gain on each of the three types of securities holdings.[22] March 2012 is the last published information on the position of the portfolio as of the writing of this paper; however, a similar calculation is possible at roughly any time. In particular, the Federal Reserve Bank of New York publishes the CUSIP of every security held in the SOMA portfolio. Combining these CUSIPs with market prices for the securities allows for the calculation—on any day—of the market value of the Federal Reserve's portfolio.[23]

Table 2: Value of the SOMA portfolio as of March 31, 2012
($ billions)

	Treasuries	Agency Debt	Agency MBS	Total SOMA
1. Par value*	1,665	96	837	2,598
2. Net premiums	99	4	12	115
3. Amortized cost	1,764	100	849	2,713
4. Market value	1,892	106	892	2,890
5. Gain/Loss	128	6	43	177

[21] The quarter-end market value of the SOMA portfolio is published in the Monthly Report on Credit and Liquidity Programs and the Balance Sheet, available at http://www.federalreserve.gov/monetarypolicy/clbsreports.htm, with a lag. Alternatively, the Federal Reserve Bank of New York publishes the CUSIPs of all of the securities in the Federal Reserve's portfolio. Matching these CUSIPs with current market prices allows for an estimate of the current market value of the portfolio.

[22] Importantly, even if the SOMA portfolio was in an unrealized net loss position, the ability of the Federal Reserve to implement monetary policy would not be hampered.

[23] In addition, the amortized cost of the portfolio is required. In real time, amortized cost can be easily approximated by the par value of the portfolio, which is published weekly, and the net unamortized premiums, which are included in the weekly publication of the balance sheet and are explicitly published quarterly.

*Par value as of March 28, 2012 from the H.4.1 Statistical Release.
Source: Monthly Report on Credit and Liquidity Programs and the Balance Sheet, June 2012.

3 Projections assumptions

In order to construct projections of the Federal Reserve's balance sheet, assumptions about many of the details of the balance sheet and its evolution must be made. The following subsections review assumptions made about key line items of the balance sheet. A detailed description of these and additional line items is found in Appendix 1.

3.1 Interest rate assumptions

To evaluate the current and future value of securities, and therefore the SOMA portfolio, assumptions must be made about the path of interest rates over the projection period. For this analysis, we rely on interest rate projections from the June 2012 Blue Chip forecast for the federal funds and 10-year Treasury interest rates. The results of the simulations presented in this paper would be different under alternative assumed paths for market interest rates. The assumed path for the federal funds rate and the yield on the 10-year Treasury note are shown in Figure 4. The federal funds rate remains in the 0 to ¼ percent range until the end of 2013. This forecast is the mean of the Blue Chip's professional forecasters' responses, and the forecast does not represent the views of the Federal Reserve or its staff.[24] After that point, interest rates are projected to rise and at the end of the projection period in 2020, the funds rate stands at 3.6 percent. The yield on the ten-year Treasury note also rises, from its current low level of 1.96 percent to 4.9 percent at the end of the projection period.

To perform the asset valuations that will be required, however, an entire yield curve is needed. As a result, we create a yield curve at each point in time over the projection period using historical relationships between the federal funds rate, the 10-year Treasury rate and selected intermediate tenors. Asset valuation is needed, for example, to project the effect on reserves of selling MBS as envisioned in the FOMC's exit principles. The higher the market value of the

[24] The January through August 2012 FOMC statements indicated that the federal funds rate would remain at exceptionally low levels "at least through late 2014." Later in the paper, we provide an alternative scenario where the federal funds rate does not rise above ¼ percent until October 2014.

security, the more reserves would be drained through the sale. The lower the market value, the reverse would be true. More details are provided in Appendix 2.

3.2 Near-term balance sheet assumptions

This subsection reviews our projection methodology for selected asset and liability items that are of particular interest. All elements of the balance sheet are projected, but we leave those of less interest to Appendix 1.

3.2.1 SOMA portfolio

The evolution of the SOMA portfolio is intended to be consistent with the FOMC statement on June 20, 2012. In particular, we assume

(1) The maturity extension program (MEP), which started in September 2011, is continued through the end of 2012. We assume that the Desk conducts sales of shorter-dated Treasury securities so that sales and redemptions total about $44 billion on average per month and purchases of longer-term Treasury securities of a similar amount in the secondary market through the end of 2012; and

(2) Reinvestment of principal payments from agency securities into agency MBS continues in the near term.

By "near-term," we mean the period of time between now and the beginning of an exit strategy from the current accommodative monetary policy stance.[25] Given the initial composition of the SOMA portfolio on May 30, 2012, the portfolio evolves over time. We adjust the maturity structure of holdings of Treasury securities and agency securities through time to reflect the sales and purchases of the MEP along with the reinvestment policy and the passage of time. Moreover, the forecast for future purchases imposes the constraint that SOMA holdings of any one CUSIP remain below 70 percent of the total amount outstanding in that CUSIP, as announced by the Federal Reserve Bank of New York.

Similar to the use of Blue Chip projections for interest rates, we turn to public projections for the Treasury's issuance of marketable debt. We use projections of both the amount and the

[25] The exit strategy and other timing issues will be discussed in further detail in Section 3.3.

maturity of Treasury issuance in order to project securities available for purchase by the Federal Reserve. We use Treasury issuance as of May 2012, and from that point forward, coupled with the Congressional Budget Office's January 2012 projections for total Treasury debt outstanding, we generate the level and maturity structure of marketable debt outstanding. In addition, we assume that the average maturity of Treasury debt outstanding extends from its current level of 62 months to 70 months by 2015, consistent with the Treasury's stated intentions as of November 2011.[26] Therefore, future Treasury purchases are associated with coupons that evolve over time reflecting projections in interest rates, Treasury issuance, and the 70 percent ownership rule.

As noted above, Federal Reserve accounting records the securities holdings at face value and records any unamortized premium or discount in the "other assets" category. Consequently, we must project both the face value of the portfolio and the associated premiums. To project premiums on future securities purchases we need to calculate the market value of securities in the future. We take the market value for securities as the present discounted cash flow of these securities using the coupon rate to generate cash flows and the yield curves described in Section 3.1 and Appendix 2 to discount these cash flows. The premium is the difference between the face value and the market value of the security. Treasury securities that are rolled over at auction are assumed to be purchased at par, and therefore have no premium.

For MBS reinvestment, we need to project the coupon of the securities that will be purchased. The model used for that is described in Appendix 2. Because reinvestments are assumed to continue only in the near term, we assume that purchases of MBS take place at a price 4 percent above face value, consistent with recent MBS reinvestment activity.

3.2.2 Liabilities and capital

In our modeling, two liability items are important exogenous drivers of the balance sheet contour – FR notes and the TGA. For simplicity, we assume that FR notes grow in line with the

[26] Refer to Minutes of the Meeting of the Treasury Borrowing Advisory Committee the Securities Industry and Financial Markets Association November 1, 2011, available at http://www.treasury.gov/press-center/press-releases/Pages/tg1349.aspx.

Blue Chip forecast for nominal GDP. Prior to 2008, the level of the TGA was fairly constant near $5 billion.[27] Since that time, however, the Treasury has maintained essentially its entire cash balance in the TGA and the TGA has been volatile, reflecting the ebbs and flows of the Treasury's cash management as borrowing and tax receipts increase the cash balance and various outflows reduce the cash balance.[28] For the projections, we assume that the TGA follows the recent historical pattern in the near term, and then drops to $5 billion after the lift off of the federal funds rate. Capital paid in is assumed to grow at its decade average of 15 percent per year, and surplus is equated to capital paid in. This growth rate plays a role in the long-run trend growth rate of the SOMA portfolio.

Reserve balances, an important liability item for the Federal Reserve, are in general calculated as the residual of assets less other liabilities less capital in the balance sheet projections. However, we assume a minimum level of $25 billion is set for reserve balances. That level is roughly consistent with the level of reserve balances observed prior to the financial crisis. Both FR Notes and capital are trending higher in these projections. 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 – as noted above, 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.

3.3 Exit strategy assumptions for the balance sheet

For the near-term projections, we assume that the FOMC completes the continuation of the MEP policy announced in June 2012. Further out in the projection period, we base our projections on the general principles for the exit strategy that the FOMC outlined in the

[27] For a discussion of Treasury cash management during this period, refer to Garbade, Partlan and Santoro (2004).
[28] Refer to FRBNY (2011), pages 28-29.

minutes of the June 2011 FOMC meeting.[29] The Committee stated that it intended to take the following steps in the following order:

(1) Cease reinvesting some or all payments of principal on the securities holdings in the SOMA;
(2) Modify forward guidance on the path of the federal funds rate and initiate temporary reserve-draining operations aimed at supporting the implementation of an increase in the federal funds rate when appropriate;
(3) Raise the target federal funds rate;
(4) Sell agency securities over a period of three to five years; and
(5) Once sales begin, normalize the size of the balance sheet over two to three years.

To complete the projections, however, we need to make additional assumptions. We tie changes in the SOMA portfolio to the date the federal funds rises from its effective lower bound, based on the Blue Chip forecasts. We assume that the reinvestment of securities ends six months before this date. We do not explicitly model the use of reserve-draining tools.[30] We assume that sales of agency securities begin six months after the federal funds rate begins to rise and that the balance sheet has returned to normal size over about three years. In interpreting "normal size" we rely on the $25 billion minimum level for reserve balances as "normal." We summarize the assumed exit strategy in Table 3.[31]

[29] Minutes of the Federal Open Market Committee, June 21-22, 2011, available at http://www.federalreserve.gov/monetarypolicy/files/fomcminutes20110622.pdf.
[30] If term deposits or reverse repurchase agreements were used to drain reserves prior to raising the federal funds rate, the composition of liabilities would change: Reserve balances would fall as term deposits and reverse repurchase agreements rose. Presumably, these draining tools would be wound down as the balance sheet returned to its steady state growth path, so that the projected path for SOMA holdings presented here remains valid.
[31] If the expected date of the federal funds lift off is later than in the June 2012 Blue Chip forecast, the start dates for the exit strategy principles will similarly be delayed but the contours of the projections presented here will be roughly unchanged.

Table 3 – Key assumptions used in balance sheet projections

Assumption	Baseline	Later liftoff	Faster sales
MEP Treasury Purchases			
Amount	$667 billion	$667 billion	$667 billion
Length	15 months	15 months	15 months
First month	Oct-11	Oct-11	Oct-11
Last month	Dec-12	Dec-12	Dec-12
MEP Treasury Sales or Redemptions			
Amount	$667 billion	$667 billion	$667 billion
Length	15 months	15 months	15 months
First month	Oct-11	Oct-11	Oct-11
Last month	Dec-12	Dec-12	Dec-12
Current Portfolio Strategy			
Agency reinvestments	Agency MBS	Agency MBS	Agency MBS
Exit Strategy			
Fed Funds liftoff	Dec-13	Oct-14	Dec-13
Redemptions start	Jun-13	Jun-14	Jun-13
Agency sales			
Sales start	Jun-14	Jun-15	Jun-14
Sales end	May-18	May-19	May-17

Other line items on the balance sheet continue on their projected path as noted above.

4 Projections

In this section, we begin with the baseline projection of the Federal Reserve's balance sheet. The baseline scenario provides a useful guide to how the Federal Reserve's balance sheet might evolve under reasonable assumptions. Next, we examine two other scenarios that vary some key assumptions of the projections. In the first, the liftoff of the federal funds rate is delayed until late 2014, the date referenced in the January 2012 FOMC statement. In the second, the Committee chooses a more aggressive pace for normalizing the size of the SOMA portfolio and sells MBS securities over three years. We stress again that these projections are the result of the underlying assumptions made about interest rates and policy decisions and, as a result, are not forecasts themselves. The point of the analysis here is to establish a framework for such projections, and different assumption would, in general, result in different projections.

4.1 Baseline

Figures 5 and 6 present the projections of key balance sheet line items under our baseline scenario. As shown in the top left panel of Figure 5, SOMA holdings (the solid line) remain roughly at their current level of $2.6 trillion through mid 2013; the MEP and the agency securities reinvestment policy imply that the size of the SOMA portfolio does not change over that time period. After that time, 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, whose timing is implied by the interest rate projections, SOMA holdings begin to decline. Notice that SOMA Treasury holdings, the top right panel, remain constant even when roll off begins. This fact is a result of the MEP reducing holdings of shorter-dated Treasury securities to near zero. MBS holdings, the bottom left panel, on the other hand, begin to contract. Beginning in June 2014, again consistent with our assumptions about the exit strategy, MBS sales begin, and these holdings fall to zero by May 2018. On balance, these actions normalize the size of the balance sheet in 2017, four years after MBS sales begin.

The reduction in the size of the SOMA portfolio, along with the projected growth of Reserve Bank capital and FR notes, results in declines in the level of reserve balances, shown in the bottom right panel of Figure 6. As described above, we assume that reserve balances are not allowed to fall below $25 billion. Therefore, in 2017, these projections assume that the Desk again starts to reinvest maturing Treasury securities and begins purchases of Treasury securities. After this point in time, the SOMA portfolio expands in line with FR notes and capital and reserve balances remain constant.

It is in 2017, when the balance sheet is normalized, that the Federal Reserve's excess securities holdings drop to zero. That is, private holdings of securities are back to normal and indicate that market participants believe it is about four years from now when unconventional monetary policy has essentially unwound.

4.2 Later liftoff

As shown in Figure 4, under the later liftoff scenario (the long dashed line), the federal funds rate rises above the effective lower bound in October 2014 – one of many possible

interpretations of the date referenced in the January through August 2012 FOMC statements that stated economic conditions are likely to warrant exceptionally low levels for the federal funds rate at least through late 2014. We stress, however, that this assumption, like all others, is to some degree arbitrary and could be adjusted. We leave the path of the yield of the 10-year Treasury note unchanged for simplicity.

The change in the timing of liftoff in this scenario affects the timing of the exit strategy, and as a result, the contours of the balance sheet and income. The portfolio stays roughly constant until mid-2014, and, as seen in Figures 5 and 6, total SOMA holdings and reserve balances remain in line with the baseline in the near term. As the assumed date of liftoff approaches and securities are allowed to mature or are sold, the SOMA portfolio normalizes in size a little less than one half year later than in the baseline, in early 2018. Sales of MBS continue through early 2019, and the composition of the balance sheet normalizes around that time as well.

This scenario highlights that this later lift off delays the exit of accommodative policy by 11 months relative to the baseline. Hence if market participants shift their view of exit toward the guidance provided in the January 2012 statement that "economic conditions … are likely to warrant exceptionally low levels for the federal funds rate at least through late 2014", such a shift would imply that the portfolio is expected to remain large for a longer period, and as a result keep longer-term interest rates depressed a touch longer than what is expected in the baseline case.

4.3 Faster sales

The Committee has stated that it ultimately intends to return the SOMA portfolio to holding only Treasury securities. We assume in the baseline that the sale of MBS takes place over four years, but the pace could be faster. For this scenario, we assume that the federal funds rate rises above the effective lower bound at the same time as under the baseline, but that sales of MBS take place over three years instead of four years. All other assumptions are unchanged

from the baseline.[32] As shown in Figure 5, the faster sales imply that the size of the SOMA portfolio returns to normal five months earlier than the baseline scenario, in March 2017. In addition, as shown in Figure 6, the level of reserve balances contracts somewhat faster than under the baseline during the sales of MBS.

Compared to the baseline, accommodation will be removed faster in the medium term. So, longer-term interest rates will move up a bit faster than in the baseline as well.

5 Conclusion

In this paper we have outlined the mechanics of the Federal Reserve's balance sheet and how assumptions about monetary policy affect the outlook for the balance sheet through time.

Under the baseline projections, derived from publicly available forecasts about the economy and public statements by the FOMC, the balance sheet remains constant for a couple of years before contracting gradually, and only returning to its long-run growth path in mid- 2017. This result, if it is expected by market participants and were to be realized in practice, would imply that unconventional monetary policy actions would be holding interest rates down, to some degree, for a number of years.

To demonstrate the sensitivity of such projections to alternative assumptions, and to underscore the fact that these projections are not forecasts per se, but rather, the result of a set of assumptions, we provided alternative scenarios. These projections provide some guidance into how alternative assumptions about the removal of unconventional monetary policy would affect the Federal Reserve's balance sheet and, hence, longer-term interest rates.

[32] Presumably, selling MBS at a faster rate would tend to increase interest rates relative to the baseline, as the private sector would need to be compensated for holding additional interest rate risk. We do not model this effect in our projections, but it would likely cause realized losses on sales to be slightly higher than modeled here.

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Appendix 1: Overview of assumptions underlying the Balance Sheet projections

This appendix provides details about the forecasting procedure for each balance sheet item. Those not specifically discussed are held at their level as of May 31, 2012.

6.1 Treasury securities

SOMA Treasury holdings are assumed to evolve through a combination of outright purchases and outright sales in the secondary market, reinvestment at auction, and maturities.

- Outright purchases for the $667 billion Maturity Extension Program (MEP) are simulated according to the maturity buckets and targets as announced by the Federal Reserve Bank of New York:

Maturity Extension Program purchase distribution (percent)				
Nominal coupon securities				TIPS
6-8 years	8-10 years	10-20 years	20-30 years	
32	32	4	29	3

- Securities assumed to be available for purchase reflect those outstanding on the Monthly Statement of the Public Debt as of May 31, 2012 as well as forecasts for future issuance. Holdings of any particular CUSIP are limited to 70 percent of the CUSIP outstanding, consistent with the Desk's current practice.
- Sales and maturities associated with the MEP will take place in Treasury securities with remaining maturities of up to three years.
- The total par value of Treasury securities outstanding reflects the Congressional Budget Office's (CBO) projections for total debt held by the public.
- The average maturity of Treasury debt extends from its current value of 60 months to 70 months, consistent with observations made by the Treasury Borrowing Advisory Committee in November 2011.[33]
- The proceeds from maturing securities are reinvested at auction at rates consistent with the Blue Chip forecast for interest rates, as discussed in Appendix 2. Auction sizes are determined by the amount of total debt necessary to match CBO projections and follow

[33] Refer to http://www.treasury.gov/press-center/press-releases/Pages/tg1349.aspx.

a distribution determined by actual auctions through May 2012. This distribution is then altered as necessary to extend the average maturity of Treasury debt. The CBOs debt projections along with the maturity distribution of securities auctioned in November 2011 are summarized in the tables below.

Year	CBO debt held by the public ($ Billion)
2010	9,019
2011	10,128
2012	11,242
2013	11,945
2014	12,401
2015	12,783
2016	13,188
2017	13,509
2018	13,801
2019	14,148
2020	14,512
2021	14,872

Source: CBO, Jan. 2012 "The Budget and Economic Outlook: Fiscal Years 2012 to 2022"

Buckets	May 2012 Issuance by bucket ($ Billion)	Initial shares of issuance
1 month	120	0.22
3 month	120	0.22
6 month	108	0.2
1 year	25	0.05
2 year	35	0.07
3 year	32	0.06
5 year	35	0.07
7 year	29	0.05
10 year	21	0.04
30 year	13	0.02

Source: Wrightson, Auction Calendar

The agency securities portfolio is assumed to evolve due to a combination of purchases, sales, and prepayments.

- Consistent with the FOMC's statement after the September 2011 FOMC meeting, principal payments from SOMA agency MBS and debt and are reinvested in agency MBS. We use a current coupon model to estimate the coupon on newly purchased MBS securities based on the consensus long-run Blue Chip forecast for the 10-year Treasury rate, reviewed in Appendix 2.
- Prepayments on settled agency MBS holdings as of May 31, 2012 are generated by applying the realized prepayment rate on the SOMA holdings of MBS from June 2010 to July 2011 (the period when there were no new holdings of MBS settling in the SOMA portfolio) on monthly holdings from June 2012 to the federal funds liftoff, in December 2013. This prepayment rate is notably faster than what would be predicted using the standard PSA prepayment model, likely a result of the historically low level of mortgage

rates. After the federal funds rate lifts off, we gradually smooth the prepayment rate back to the long-run PSA model over a five year period.

- Prepayments on anticipated future purchases of agency MBS follow the long-run PSA model for the life of the security.
- Sales of agency securities begin six months after the first increase in the federal funds rate and last for four years. This timing is consistent with that laid out in the June 2011 FOMC Minutes; however, the exact timing is merely illustrative and chosen so as to be easily implementable in our projections.
- Under these assumptions, and given the maturity schedule for agency debt securities, the volume of sales necessary to reduce holdings of these securities to zero over the four year period only requires a six month period of minimal sales near the end of those four years.

6.1.1 Premiums and discounts

A premium (discount) is the amount paid above (below) the par value of a security. As of March 31, 2012, the Federal Reserve had $99 billion in net unamortized premiums on Treasury securities, $4 billion on agency debt securities, and $12 billion on agency MBS. We use straight-line amortization of these premiums and discounts over the expected life of current SOMA holdings. We derive new premiums and discounts from outright Treasury purchases by using the difference between the assumed coupon of the security being purchased and the corresponding market interest rate, as given by the yield curve estimates reviewed in Appendix 2. We assume that agency MBS are purchased at a price 4 percent above par value, and therefore book some premiums on these asset purchases. Based on the calculations for the purchase prices of Treasury securities, we estimate that there are approximately $60 billion in premiums associated with Treasury securities purchases over the course of the Maturity Extension Program.

6.1.2 Discount window lending

We make the simplifying assumption that all discount window lending over the projection period is zero.

6.1.3 TALF LLC

Assets held by TALF LLC consist of investments of commitment fees collected by the LLC and the U.S. Treasury's initial funding. In this projection, the LLC does not purchase any asset-backed securities received by the Federal Reserve Bank of New York in connection with a decision of a borrower not to repay a TALF loan. The assets held by TALF LLC remain at their current level of about $1.0 billion through 2014 before declining to zero the following year.

6.1.4 Maiden Lane, Maiden Lane II, and Maiden Lane III

The assets held by Maiden Lane LLC, Maiden Lane II LLC and Maiden Lane III LLC decline gradually over time reflecting known sales in the near term and a slow drop to zero thereafter. Holdings for all three LLCs fall to zero by early 2015.

6.1.5 Reserve balances

Reserve balances are the residual of assets less other liabilities less capital in the balance sheet projection. That said, a minimum level of $25 billion is set for reserve balances, roughly equivalent to the level of reserve balances before the start of the financial crisis. To maintain reserve balances at this level, first Treasury bills are purchased. Purchases of bills continue until these securities comprise one-third of the Federal Reserve's total Treasury security holdings– about the average level prior to the crisis. Once this level is reached, the Federal Reserve buys notes and bonds in addition to bills to maintain an approximate composition of the portfolio of one-third bills and two-thirds coupon securities. In general, increases in the level of Federal Reserve assets add reserve balances. By contrast, increases in the levels of liability items, such as Federal Reserve notes in circulation or other liabilities, or increases in the level of Reserve Bank capital, drain reserve balances.

6.1.6 Currency

Federal Reserve notes in circulation are assumed to grow at the same rate as nominal GDP. We use the consensus Blue Chip forecasts for real GDP growth and the price level to form the forecast for nominal GDP through September 2013. Because this is an annual forecast, we use

the annual growth rate as the annualized quarterly growth rate for the 2nd and 3rd quarters of each year, and then interpolate growth rates for the 1st and 4th quarters of the year. The table below summarizes the Blue Chip projections for nominal GDP growth.

Year	Blue Chip nominal GDP growth forecast
2012	4.4%
2013	4.8%
2014	5.0%
2015	5.2%
2016	5.1%
2017	5.0%
2018	4.9%
2019	4.6%
2020	4.6%

Source: Blue Chip, June 2012

6.1.7 Reverse Repurchase Agreements (RRPs)

The Federal Reserve conducts RRPs with foreign official accounts, international accounts, and other counterparties. The volume of RRPs that is conducted with foreign official and international accounts is assumed to stay constant at its most recent level of approximately $98 billion in May 2012. The portion that is conducted with others is assumed to stay at zero over the projection period.

6.1.8 U.S. Treasury's General Account (TGA)

The TGA cash balance is projected to follow the recent historical pattern in the near term, and then drops to $5 billion after the lift off of the federal funds rate.

6.1.9 Supplementary Financing Account (SFA)

We maintain the SFA balance at its current level of zero throughout the forecast, consistent with the Treasury Borrowing Advisory Committee's recommendation not to resume the program at this time.[34]

6.1.10 Capital

Federal Reserve capital grows 15 percent per year, in line with the average rate of the past ten years.

6.1.11 Deferred Asset

In the event that a Federal Reserve Bank's earnings fall short of the amount necessary to cover operating costs, pay dividends, and equate surplus to capital paid-in, a deferred asset will be recorded. This deferred asset is recorded in lieu of reducing the Reserve Bank's capital and is found on the liability side of the balance sheet as "Interest on Federal Reserve notes due to U.S. Treasury." This liability takes on a positive value when weekly cumulative earnings have not yet been distributed to the Treasury, while this liability takes on a negative value when earnings fall short of the expenses listed above.

[34] Refer to "Minutes of the Meeting of the Treasury Borrowing Advisory Committee, the Securities Industry and Financial Markets Association, November 1, 2011," available for download at http://www.treasury.gov/press-center/press-releases/Pages/tg1349.aspx.

Appendix 2: Constructing yield curves and coupons on purchased securities and valuation of the SOMA portfolio[35]

The projections for the coupon rates on Treasury securities depend on forecasts for the yield curve. We construct a zero-coupon yield curve using projections for the federal funds rate and the forecast for the 10-year Treasury yield, where these independent variables are taken from the June 2012 Blue Chip forecast for future interest rates.

We specify the relationship between a yield at tenor *i* and these rates using a regression:

$$y_{it} = \alpha_i + \beta_{1i}\, ff_t + \beta_{2i}(10year)_t + \varepsilon_{it},$$

where y_{it} is the zero-coupon yield for maturity *i* at time *t*, α is a constant term, β_{1i} is the yield-specific coefficient on the federal funds rate, β_{2i} is the yield-specific coefficient on the 10-year rate, and ε_{it} is an error term. We evaluate this specification on historical data at the 2, 3, 4, 5, 10, 15, 20, and 30 year tenors. The historical data are yields constructed from an off-the-run Svensson-Nelson-Siegel zero-coupon yield curve, the Treasury yield curve used in production work at the Board.[36] The sample is daily data from January 3, 1994 to April 10, 2010. Standard errors are calculated using a robust sandwich procedure.

The estimated coefficients and associated R-squared statistics are displayed in the appendix table A2-1. In general, the results are in line with intuition and these two rates can explain almost all the variation in the other rates. In addition, we performed a series of robustness checks. Specifically, longer-term rates tended to exhibit cointegration with the 10 year rate, but shorter-term rates did not. Overall, the estimated coefficients and resulting yield curves presented here are broadly similar to those using a cointegrated or other type of specification.

With these estimates in hand, we then construct "initial" yield curves for each point in time in our forecast, interpolating values for tenors for which we do not explicitly estimate a model. We use these for our projected coupons on Treasury securities we purchase over the forecast period.

[35] Much of the methodology described in this section is attributable to Viktors Stebunovs and Ari Morse.
[36] For details, refer to Gurkaynak, Sack and Wright (2007).

An additional estimate is needed to forecast the coupon rate on future MBS purchases. This is done by estimating the statistical relationship between the Fannie Mae MBS current coupon rate and the 10-year Treasury rate. We use quarterly averages of daily data from 1984Q4 to 2011Q3 to generate our parameter estimates. We use an ARIMA(1,1,0) model to account for the autocorrelation in the error terms and the cointegration in the two series. As is evident from table A2-2, changes in the 10-year rate are matched almost one-to-one with those in the MBS current coupon rate, and the autocorrelation in the differenced series, while not strong, is still persistent enough to be relevant in tests for autocorrelation of the residuals.

Table A2-1: Yield curve regressions

	Effective rate			10-year rate			Constant			R-squared
Year	Coefficient	Standard error	T-stat	Coefficient	Standard error	T-stat	Coefficient	Standard error	T-stat	
2	0.536***	0.003	155.438	0.746***	0.007	109.305	-0.018***	0	-62.483	0.971
3	0.392***	0.003	131.062	0.877***	0.006	154.592	-0.018***	0	-72.969	0.975
4	0.282***	0.002	116.573	0.945***	0.004	211.367	-0.015***	0	-80.671	0.982
5	0.196***	0.002	107.059	0.980***	0.003	293.544	-0.012***	0	-87.013	0.988
7	0.071***	0.001	87.829	1.003***	0.001	678.057	-0.006***	0	-95.999	0.997
10	-0.039***	0	-119.39	1.000***	0.001	1420.984	0.002***	0	59.475	0.999
15	-0.121***	0.001	-88.754	0.995***	0.003	397.277	0.008***	0	76.072	0.983
20	-0.149***	0.002	-64.611	1.013***	0.004	269.745	0.010***	0	54.576	0.953
30	-0.168***	0.004	-46.25	1.083***	0.006	196.249	0.005***	0	19.391	0.9
N	4067									
Sample:	1/3/1994-4/10/2010									

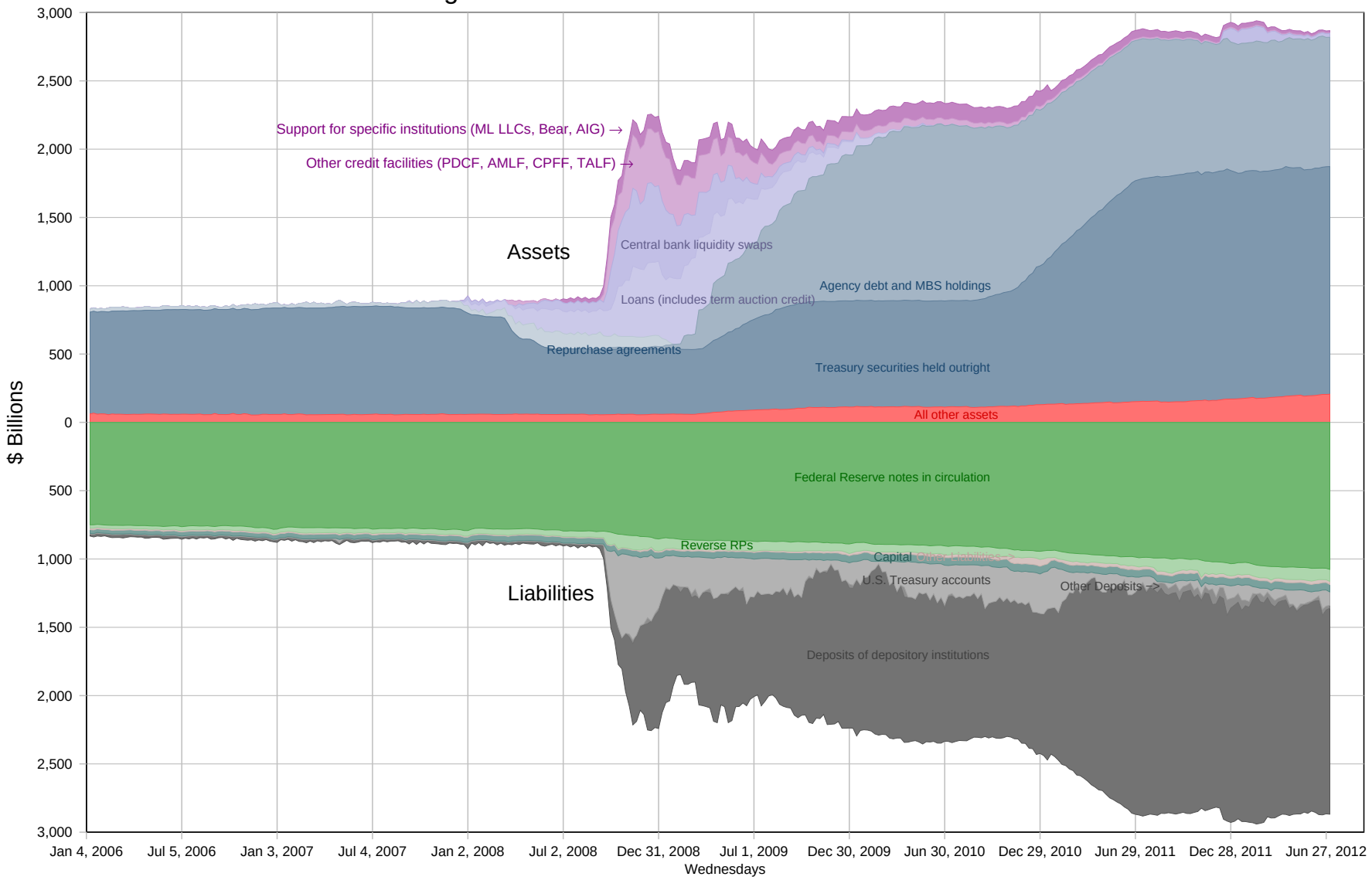
Table A2-2: MBS coupon forecasting regression

Forecasting MBS current coupon

Dependent variable: Δ(Fannie Mae 30-year current coupon)

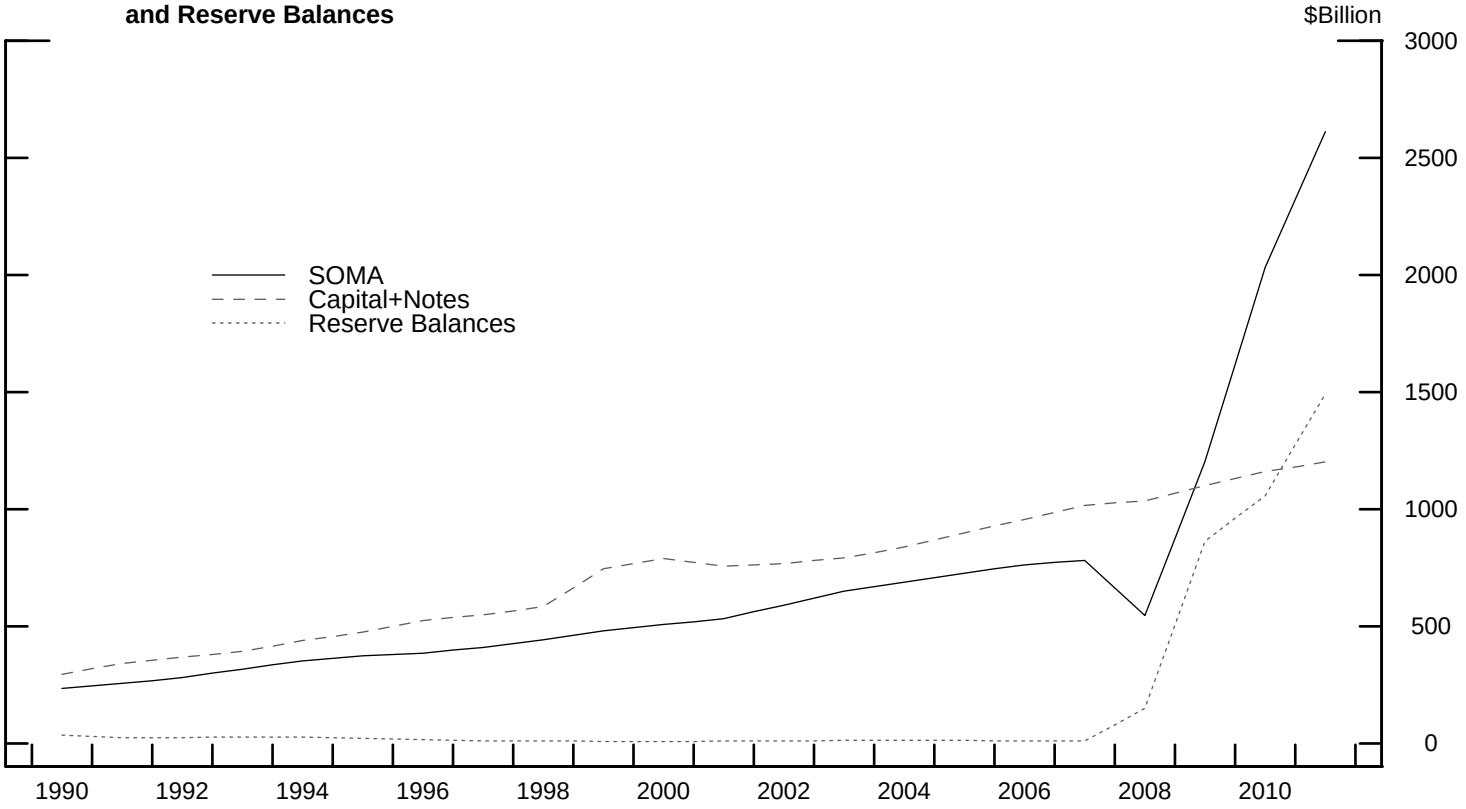
	Coefficient	Standard error	Z
Δ(10-year rate)	0.981	0.031	32.12
AR(1)	0.095	0.069	1.37
Constant	-0.004	0.017	-0.26
N	107		

Figure 1 − Federal Reserve's Assets and Liabilities



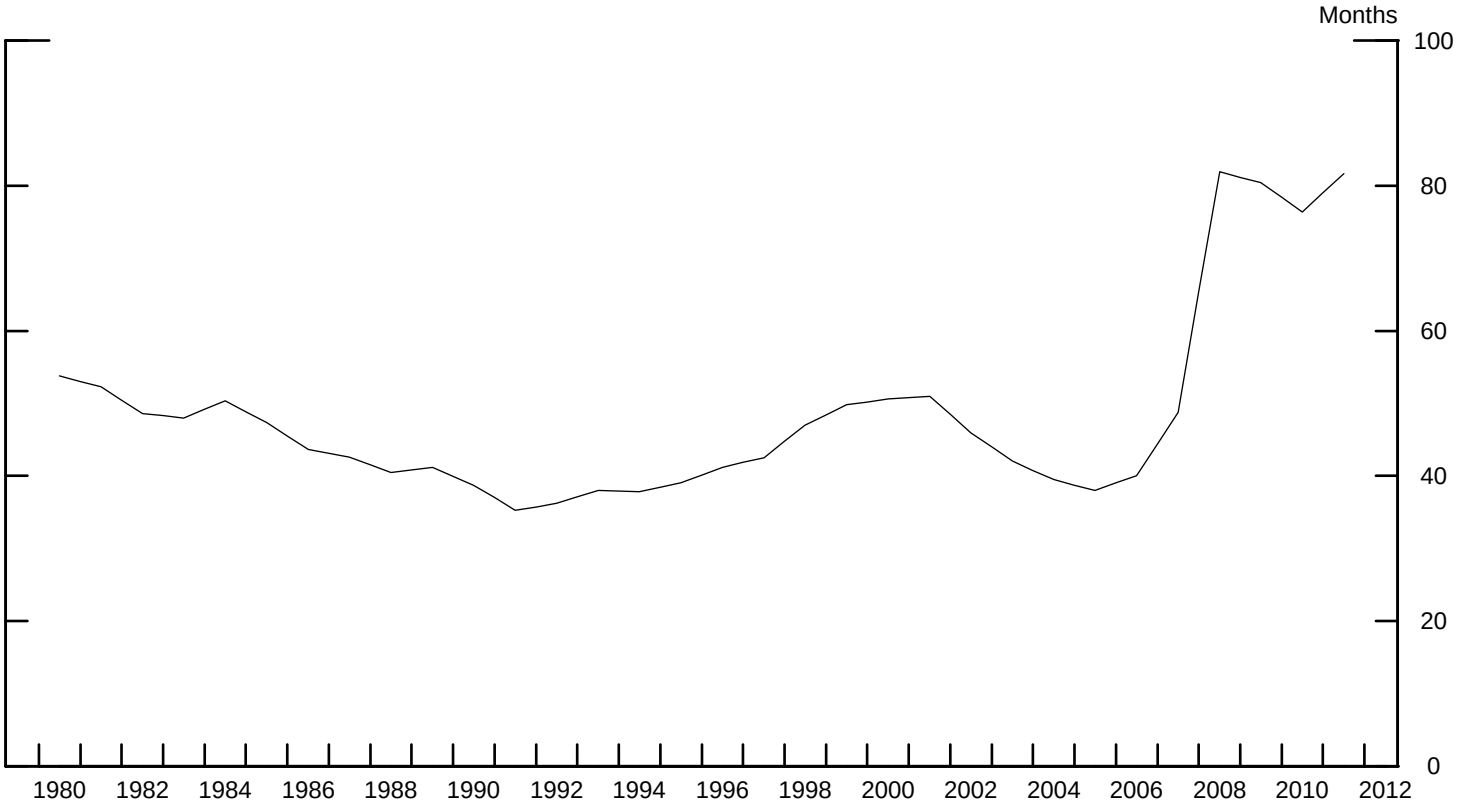
Last updated July 7, 2012.

Figure 2 - SOMA, Capital + FR Notes, and Reserve Balances



Source: H.4.1 Statistical Release

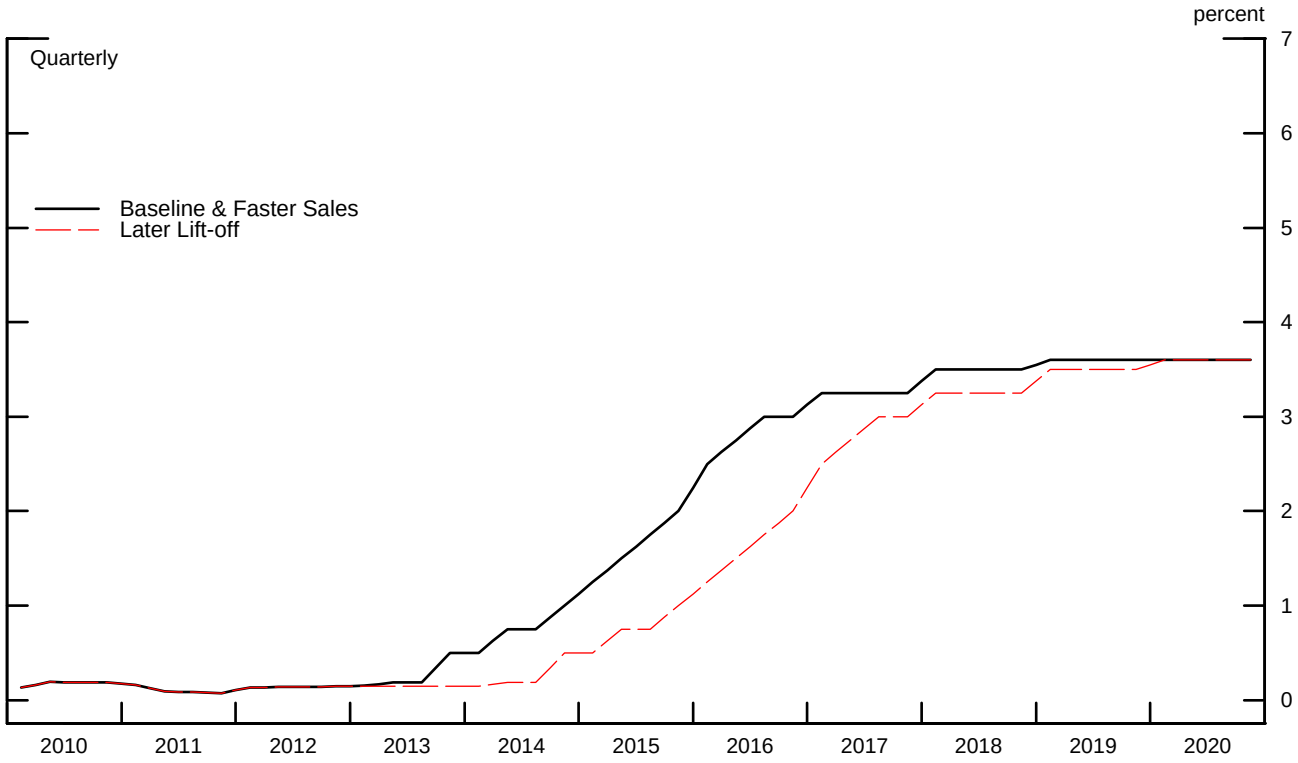
Figure 3 - Weighted Average Maturity of SOMA



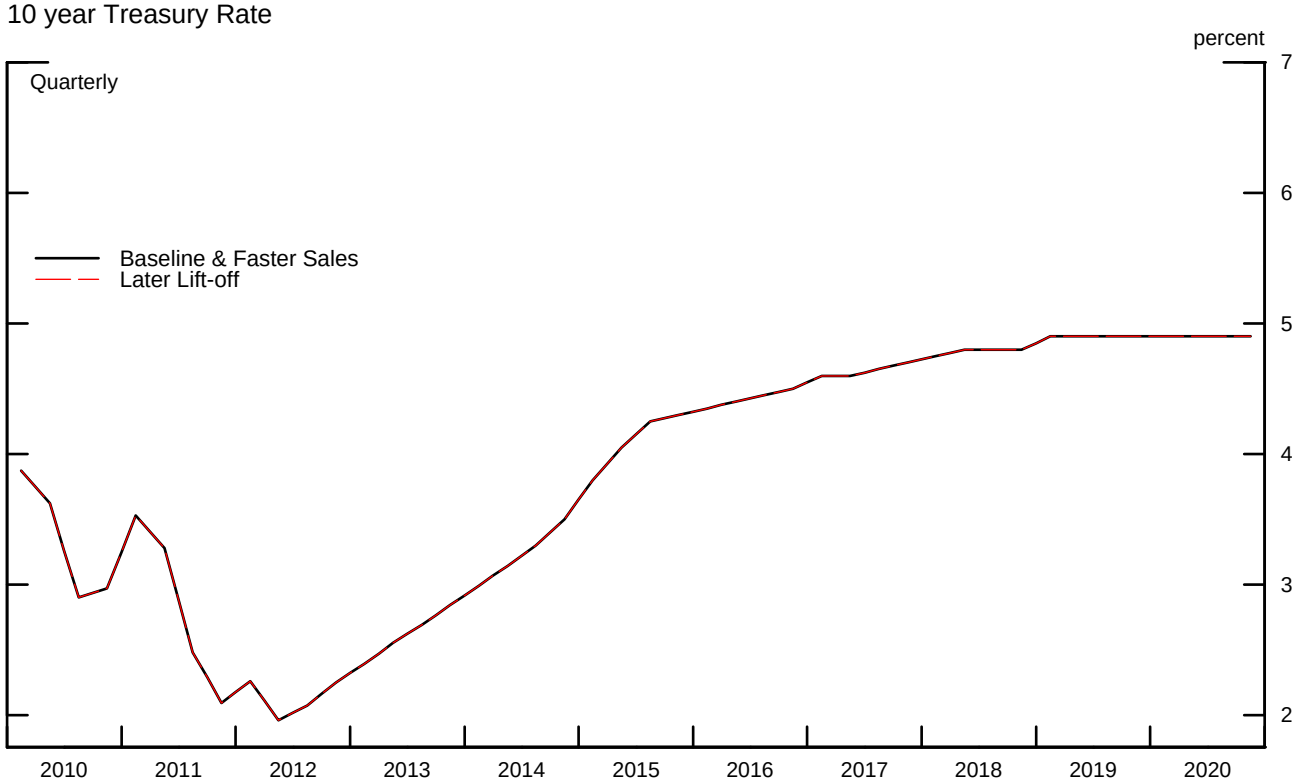
Note. Includes only nominal Treasury securities
Source: Federal Reserve Bank of New York and Center for Research in Security Prices

Figure 4 - Interest Rates*

Federal Funds Rate

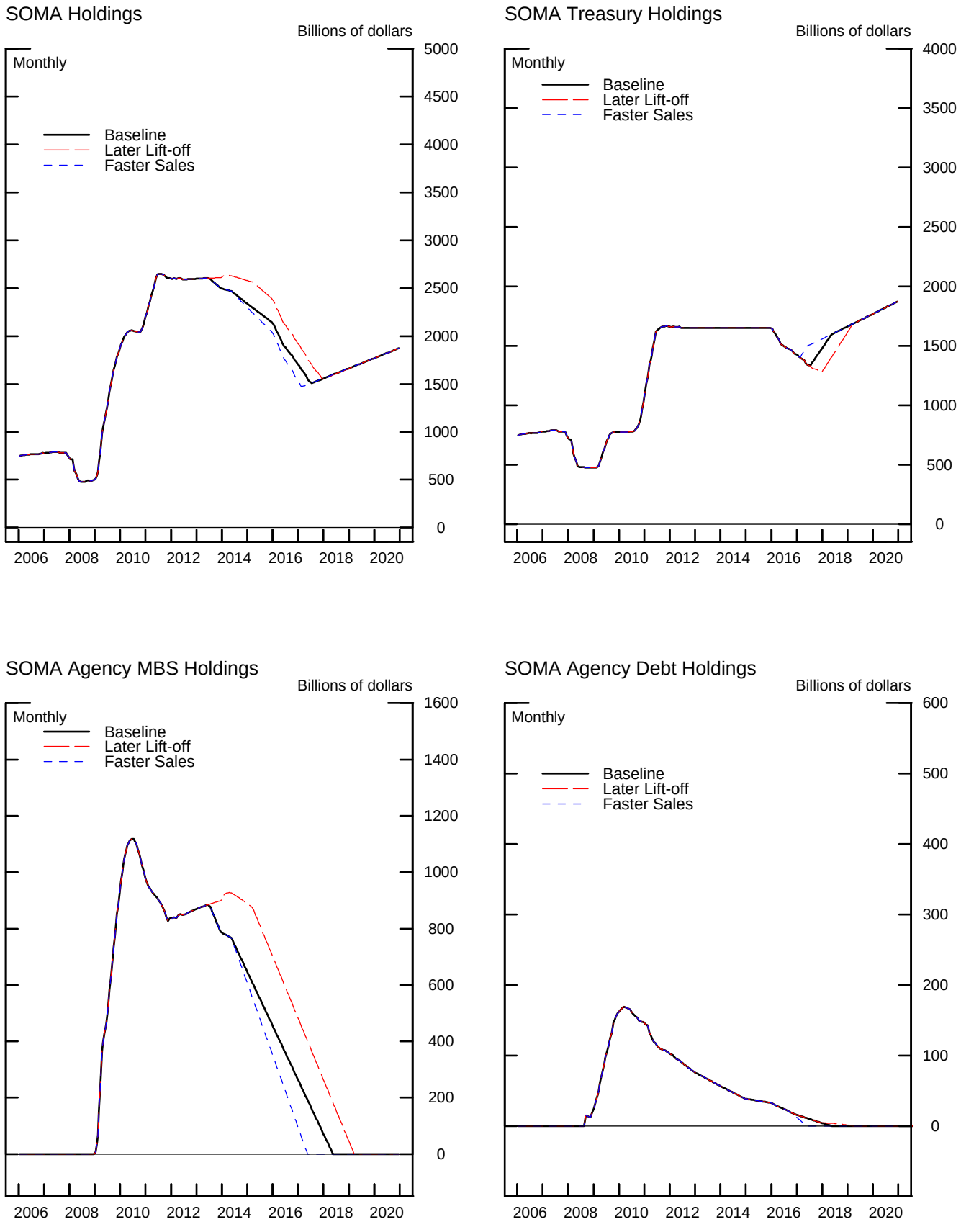


10 year Treasury Rate



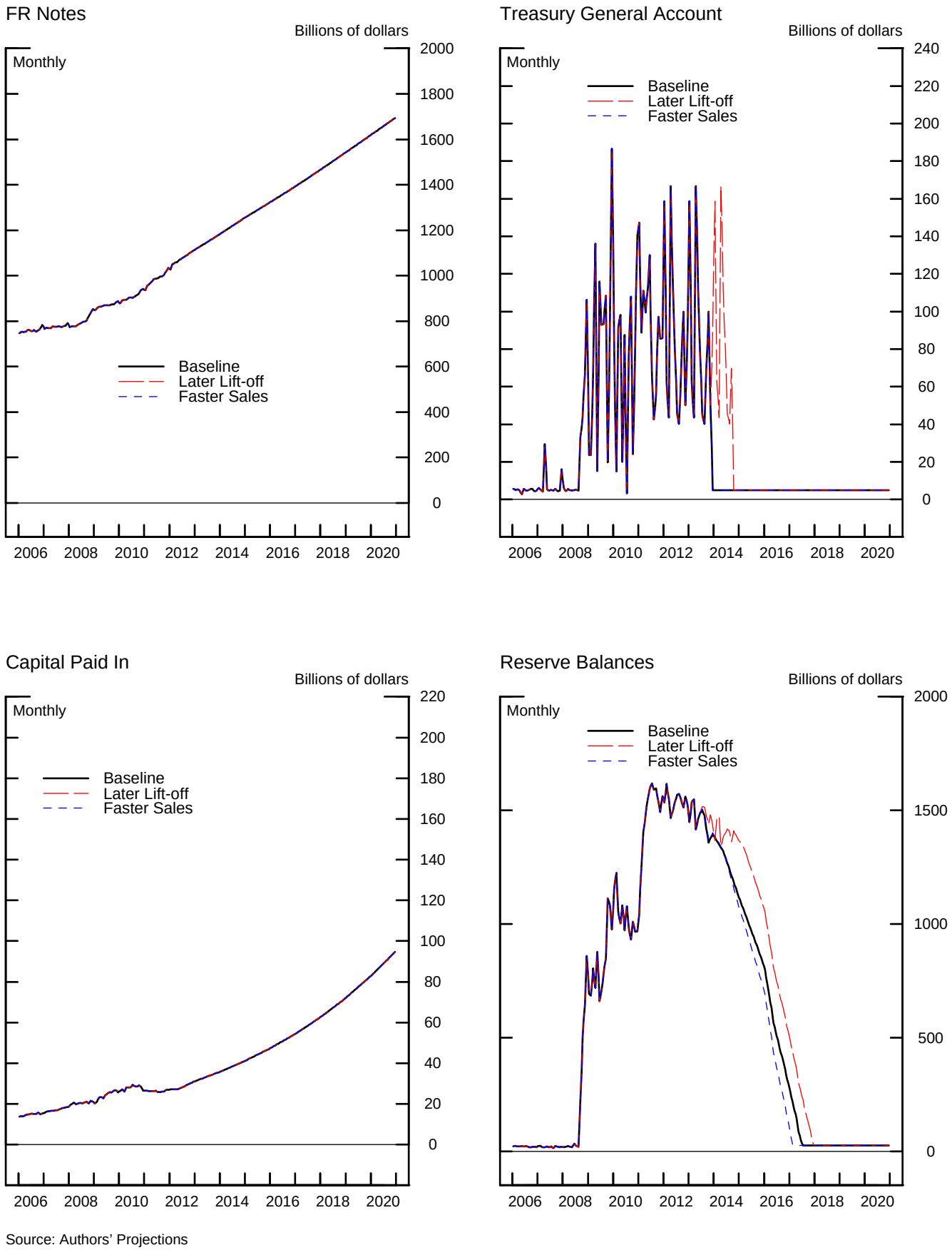
* Baseline interest rate paths are the consensus June 2012 Blue Chip forecast; later lift off path are authors' calculations

Figure 5 - Selected Assets Projections



Source: Authors' Projections

Figure 6 - Selected Liabilities Projections



Source: Authors' Projections