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Balance Sheet Considerations for the Federal Reserve's Long-Run Framework

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1. Executive Summary

The long-run size and composition of the Federal Reserve's balance sheet will depend on policymakers' decisions about the role the balance sheet will play in a long-run framework, including their choice of an operating regime to control short-term interest rates. In this memo, we first briefly consider the balance sheet's role in supporting control of short-term interest rates. We then focus on how the balance sheet can be used as an active tool to achieve macroeconomic or financial stability objectives.

Next, we analyze the implications of these possible balance sheet objectives for the System Open Market Account (SOMA) portfolio. We first consider a case in which the balance sheet is used passively to support short-term interest rate control and growth in currency in circulation and deployed actively only at the effective lower bound (ELB) or during times of financial stress, and then consider cases in which the balance sheet has a more permanent active role. These scenarios have different consequences for the optimal size and composition of the SOMA portfolio.

Finally, we discuss the fiscal implications of using the balance sheet as an active policy tool. We analyze this issue both from the perspective of the consolidated government budget and from the perspective of the Federal Reserve alone. We also briefly explore

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additional political economy considerations resulting from various balance sheet policies.²

The main takeaways are the following:

- A conventional role for a central bank's balance sheet is to support interest rate control; the size and composition of a central bank's balance sheet will reflect, in part, the details of the operating regime it uses to control short-term interest rates. However, policymakers' preferences for the size of the balance sheet—reflecting their views about its use as a tool to achieve macroeconomic or financial stability objectives and their assessment of the associated efficacy and costs—may have implications for the operating regime chosen and the tools employed.
- Research generally supports the proposition that the balance sheet actions taken by the Federal Reserve during the financial crisis and the subsequent ELB episode provided additional policy accommodation that eased financial conditions and helped improve macroeconomic outcomes. Accordingly, policymakers might conclude that balance sheet policies should remain in the policy toolkit for potential use in similar situations in the future. In principle, policymakers might also consider the use of balance sheet policies when the policy rate is well above the ELB. However, because there is only limited experience with the use of balance sheet policies away from the ELB, any assessment of the macroeconomic benefits and costs of such a strategy is necessarily tentative.
- Balance sheet actions could potentially be used to achieve a number of financial stability objectives, each with distinct implications regarding the size and composition of the balance sheet. These actions might include asset purchases to support liquidity and market functioning in times of stress (similar to some policy actions taken during the recent financial crisis) as well as preemptive actions such as providing safe and liquid assets to crowd out private money-like assets,

² Note that throughout this memo, discussion of balance sheet policies could include either asset purchases and sales, or maintaining the balance sheet through reinvestments.

flattening the shape of the yield curve with the intent of reducing excessive maturity transformation, expanding the stock of available high-quality liquid assets (HQLAs), and affecting financial conditions in the housing market by selling or buying agency MBS. Importantly, although there is a growing literature on such possibilities, our understanding of these topics is still limited and very little evidence is available at this point.

- Use of the balance sheet as an active tool only at the ELB or in periods of market stress suggests holding a relatively small balance sheet and relatively short- to medium-term assets in the SOMA portfolio in normal times to preserve the capacity to expand its size and change its composition when needed. In contrast, use of the balance sheet to further macroeconomic objectives away from the ELB or to promote financial stability may entail maintaining a relatively large balance sheet, although the composition of SOMA assets would depend on the desired objectives. The extent to which the starting point for the portfolio is a choice variable depends on economic developments.
- Maintaining a persistently large balance sheet and using it as an active policy tool would raise important fiscal and political economy issues. These include: The division of responsibility for debt management decisions between the central bank and the fiscal authority; the impact on central bank income and remittances to the Treasury; central bank independence; and balance sheet funding costs.

2. Support Interest Rate Control

In a conventional monetary policy implementation framework, the central bank sets a target for some short-term interest rate to influence monetary and financial conditions, and the size and composition of its balance sheet reflects the tools that make up the

central bank's normal operating regime, such as ceilings, floors, reserve requirements, open market operations, and liquidity backstops.³

Interest rate control can be achieved with either a "small" or a "large" balance sheet. The size of the balance sheet will be determined primarily by currency in circulation (CIC) and the aggregate level of reserve balances associated with the central bank's operating regime.⁴ All else equal, a regime that operates on the steep portion of the reserve demand curve has a small amount of excess reserves and is typically associated with relatively few assets in excess of CIC (a common measure of balance sheet "leanness"), and thus a relatively small balance sheet, while a regime that operates on the flat portion of the reserve demand curve has a more abundant supply of excess reserves and is typically associated with a relatively large balance sheet. However, there is no unique relationship between the size of the balance sheet and whether or not operations are occurring on the steep or flat part of the demand curve.

Under the Federal Reserve's pre-crisis framework, the Desk managed the supply of reserves, primarily through temporary and outright purchases and sales of Treasury securities, to make the supply schedule intersect the steep portion of the demand curve at a federal funds rate equal to the target set by the FOMC. Reserve requirements were low, and because reserves were unremunerated, banks demanded only a very small amount of excess reserves. The necessary supply of reserve balances was thus quite small, leading to a balance sheet that was only marginally in excess of CIC. Without the ability to pay interest on reserves (IOR), temporary adjustments in the SOMA portfolio were the main tool for hitting the interest rate target.⁵ The current framework is the polar opposite.

³ Issues for consideration in designing the Federal Reserve's long-run framework for controlling interest rates and providing liquidity in times of distress are discussed in the October 14, 2016, memo "Interest Rate Targets and Operating Regimes."

⁴The size of the balance sheet is also affected by autonomous factors such as government deposits and, in the Federal Reserve's case, the foreign repo pool. The aggregate level of reserves is affected by reserves supplied to meet reserve requirements and any additional balances supplied to achieve interest rate control or meet demand in the chosen operating regime. It could conceivably also be influenced by payment system efficiency goals, although tools other than high reserve balances are also available to support earlier settlement or other aspects of a safe and efficient payment system (see the September 30, 2016, memo "Monetary Policy Implementation Frameworks and the Payment System").

⁵ The July 8, 2016, memo "Lessons from the Crisis for a Future Monetary Policy Operating Framework" points to shortcomings of this framework, including the tension that arose between objectives of

Supply intersects demand on a flat portion of the demand curve, with abundant reserves (a byproduct of asset purchases). Interest rate control is achieved by paying IOR, with supplementary support from an overnight reverse repo (ON RRP) facility. These arrangements are consistent with traditional assumptions about the relationship between the type of operating regime and balance sheet size. However, other arrangements are theoretically possible. For example, in a voluntary reserves targeting regime, it might be possible to operate on the steep part of the demand curve even with a large amount of total reserves. Alternatively, if reserve requirements were reduced to zero and IOR was paid at the policy rate, the supply of reserves could intersect the flat portion of the demand curve even if the supply of reserves is not especially abundant.

Just as the choice of operating regime can influence the size of the balance sheet, policymakers' preferences for the size of the balance sheet—which may reflect decisions to use the balance sheet as an active policy tool to achieve macroeconomic goals or to promote financial stability—may have implications for the operating regime and the tools employed. The next sections discuss such uses of the balance sheet.

3. Support Macroeconomic Objectives

This section provides a discussion of the use of asset purchases and sales to foster maximum employment and stable prices. We first review the transmission mechanisms through which balance sheet policies affect asset prices and macroeconomic outcomes. We then examine the macroeconomic benefits and costs of using the balance sheet as part of the monetary policy toolkit. In doing so, we distinguish between the case in which the short-term policy rate is at the ELB and the “normal times” case in which the policy rate is well above the ELB.⁶

maintaining interest rate control and providing large-scale liquidity when the scale of the Federal Reserve's operations outpaced the capacity of the available tools to sterilize these operations.

⁶ One way to define normal times is when the policy rate is at or close to the longer-run level given in the Summary of Economic Projections.

3.1. Transmission Channels

A large literature explores the channels through which asset purchases can, in principle, lower long-term yields and boost the prices of other financial assets.⁷ One channel works through risk premiums, namely, reductions in the term premiums that investors in fixed-income assets require to hold long-duration assets or assets with high convexity risk. When asset purchases remove long-duration assets from the market, investors may be willing to pay a higher price for remaining long-duration assets, thereby driving down term premiums. Moreover, large-scale purchases of agency mortgage-backed securities (MBS) can lower interest rates through a prepayment risk channel that stems from the link between the probability of prepayment (or refinancing) a mortgage and the level of interest rates.⁸ Agency MBS purchases remove prepayment risk from the market (because the Federal Reserve does not hedge such risk), pushing down MBS yields and thus helping to lower primary mortgage rates.⁹

A complementary mechanism through which asset purchases affect risk premiums is the so-called portfolio balance effect: As the Federal Reserve's purchases of Treasury securities lowers their yields, investors rebalance their portfolios, which results in a decline in the yields on various riskier assets (Gagnon *et al.* (2011)).¹⁰ In addition, purchases of longer-term assets may reduce longer-term interest rates by signaling the central bank's determination to provide policy accommodation for a prolonged period of

⁷ The September 30, 2016, memo "Long-Run Framework: Macroeconomic Considerations of Balance Sheet Policies" reviews this literature in detail and summarizes the range of available estimates of the effects of the Federal Reserve's large-scale asset purchase programs. The existence of many transmission channels makes estimating the impact of balance sheet policies on asset prices a challenging task.

⁸ As central bank asset purchases push interest rates lower across the yield curve, the incentive to prepay changes differently across different MBS based on the spread of their coupons over current coupons.

⁹ The endogenous responses of these risk premiums were not typically considered in models of asset pricing pre-crisis. Those models often related the price of a particular financial asset to the present discounted value of future income with an allowance for risk and other premiums. But the risk and other premiums were not generally thought of as being functions of the aggregate quantity of securities or duration or prepayment risk held by the private sector.

¹⁰ A portfolio balance effect is also present when monetary policy is conducted through standard changes in the short-term interest rate. However, use of the balance sheet as a monetary policy tool introduces a unique portfolio balance effect if the sellers of the assets to central bank are different from the holders of central bank liabilities issued to fund such asset purchases.

time. This signaling channel works because longer-term interest rates reflect current and expected future short-term interest rates.

Asset purchase programs may also work through liquidity premiums. This is particularly relevant during periods of financial stress. Under turbulent market conditions, the willingness of a central bank to purchase particular classes of assets can enhance their liquidity and lower the premium investors would require to hold otherwise illiquid securities. This can boost confidence, averting financial panics and hence avoiding undesirable macroeconomic outcomes. Finally, because the effects of asset purchases can be anticipated, a credible announcement of such purchases may have the immediate effect of raising asset prices and reducing yields.¹¹

The reduction in interest rates stimulates economic activity and raises inflation by reducing borrowing costs for firms and households. At the same time, the rise in asset prices boosts consumption through a wealth effect and by easing borrowing constraints. In addition, the depreciation of the foreign exchange value of the dollar, by stimulating net exports, helps boost aggregate demand.¹²

3.2. Macroeconomic Benefits and Costs of Balance Sheet Policies

The overall experience of the past several years seems to suggest that balance sheet tools do have appreciable macroeconomic benefits when the ELB binds, particularly in the event of stressed market conditions. Moreover, at a time when acute financial stress may induce adverse self-fulfilling outcomes, the signal from actively using balance sheet policies that policymakers intend to provide considerable macroeconomic stimulus may help avoid such bad equilibria, leaving the economy on a better path (Gertler and

¹¹ These channels emphasize “stock” effects, whereby a central bank’s asset purchases (or sales) affect asset prices by changing expectations about the size and duration of assets available to the public. Kandrac and Schlusche (2013) consider “flow” effects, in which the transactions associated with a central bank’s asset purchases or sales can affect an asset price by altering market liquidity and functioning, and find that such effects dissipate quickly. Accordingly, these effects are likely to be less relevant for assessing the macroeconomic benefits of asset purchases than “stock” effects.

¹² Confidence effects may also spur aggregate spending, but these effects are uncertain and difficult to quantify. A first attempt to measure the effects of balance sheet policies on the public’s expectations is found in Engen *et al.* (2015).

Kiyotaki (2015) and Caballero and Farhi (2016)).¹³ Balance sheet tools may, in principle, also be helpful away from the ELB; using such tools could lead to better control over the yield curve, thus helping to improve macroeconomic outcomes. However, because experience with using the balance sheet to influence the stance of monetary policy is mostly limited to activities since the recent financial crisis, there is a paucity of empirical evidence on the macroeconomic effects of balance sheet tools in normal times—defined as those in which the short-term policy rate is well above the ELB.

While there are many studies examining the effects of asset purchases on financial variables, there are few studies that attempt to quantify the effects on economic activity and inflation. As reviewed in the memo, “Long-Run Framework: Macroeconomic Considerations of Balance Sheet Policies,” a consensus seems to be emerging that balance sheet policies have important macroeconomic effects. Nonetheless, there is little agreement on the magnitude and duration of such effects. Differences in estimates can be ascribed mainly to alternative modeling frameworks and, in particular, to assumptions made about the (systematic) policy rate response to changes in balance sheet policy.

Simulations using the FRB/US model suggest that a \$1 trillion purchase of long-term Treasury securities—operating mostly through a reduction in term premiums—boosts the level of real GDP by about 1 percent after two years when the economy is at the ELB and slightly less than $\frac{3}{4}$ percent when the economy is away from the ELB.¹⁴ These estimates are roughly equivalent to the effects of a one-percentage-point reduction in the federal funds rate sustained for a year.¹⁵ The GDP effects would be even larger if the asset

¹³ The “whatever it takes” speech by President Draghi and the European Central Bank’s Outright Monetary Transactions (OMT) Program can be thought of as examples describing a “credible threat” or an announcement of willingness to conduct asset purchases that also may have helped rule out possible bad equilibriums.

¹⁴ Two comments are in order. First, this differential effect reflects the fact that further reductions of the overnight rate are ruled out at the ELB. Second, in the simulations, an important assumption is that the public anticipates that after liftoff the federal funds rate will follow the prescriptions of the inertial Taylor rule.

¹⁵ The translation of the balance sheet programs into a decline in longer-term Treasury yields is made through a reduction of the term premium component that is consistent with the estimates of Ihrig *et al.* (2012). Their estimates roughly correspond to a 5 basis point reduction per \$100 billion in purchases.

purchases caused private agents to expect a lower federal funds rate path due to a signaling effect, or if the purchases buttressed household and business confidence through channels not explicitly modeled.

The cost of balance sheet policies includes uncertainty about managing multiple tools and the degree of substitutability among them. The difficulty of managing multiple tools—the current and expected policy rate and the size and composition of the balance sheet—in an environment where the impact of each of the tools is uncertain and probably interconnected could pose some risk to achieving macroeconomic objectives.¹⁶ Theory suggests using all available tools in such an environment, especially in the presence of multiple goals (Tinbergen (1952)). However, this approach ignores the difficulties of coordinating the settings of different tools; in addition, policymakers may not be able to determine the appropriate settings for all instruments, which may lead to less desirable outcomes (Brainard (1967)). Furthermore, balance sheet actions, by pushing risk premiums to very low or even negative levels, could prompt excessive risk taking. Such behavior could have detrimental effects on macroeconomic performance by increasing the vulnerability of the financial system.¹⁷

A related risk with using balance sheet policies relates to communication. The use of the size and composition of the balance sheet could have effects on the public's expectations by serving as a commitment device. In particular, purchases of longer-term assets may help signal the central bank's determination to provide policy accommodation for a prolonged period of time. Nevertheless, the macroeconomic effectiveness of any asset purchase or sales program will depend a great deal on the public's understanding of the Committee's reaction function and its stopping rule for the balance sheet policy, in conjunction with forward guidance on the short-term interest rate.

¹⁶ Even at the ELB, forward guidance provides a monetary policy tool in addition to balance sheet policies.

¹⁷ A final set of costs, which will be addressed in Section 6, are related to the possible effect of the balance sheet on Federal Reserve net income and its remittances to the Treasury. The possibility of negative net income could also impose significant political risks for the Federal Reserve, and may ultimately impair its independence.

3.3. Implications for When Balance Sheet Tools Might be Used

The tradeoff between the costs and benefits discussed above has implications for the long-run size of the balance sheet and for the extent to which balance sheet policies might appropriately be used along with traditional interest rate policies away from the ELB.

One possible approach is to use balance sheet tools to achieve macroeconomic objectives only when the policy rate is at the ELB or during periods of stressed market conditions, and otherwise let the balance sheet passively support the monetary policy operating regime. There are several considerations in support of this approach. First, central bank purchases of longer-duration assets likely play a more forceful role in reinforcing forward guidance on the policy rate when the ELB binds. Second, some of the transmission channels of balance sheet policies appear to be less potent away from the ELB because at least some distortions begin to wane (Kiley (2014)). Third, given limited experience, there is greater uncertainty about the macroeconomic effects of balance sheet tools away from the ELB than there is for conventional interest rate policy.¹⁸ If balance sheet policy and interest rate policy are highly substitutable for one another—if, for example, both affect economic outcomes only through their effects on longer-term interest rates—then it might be preferable to use balance sheet policies only when the interest rate is at the ELB (Williams (2013)).

Another consideration is that the post-crisis “new normal” may involve more frequent and protracted spells at the ELB.¹⁹ Consequently, there may be less room than in the past to cut policy rates following a recessionary shock. If so, from an *ex ante* perspective, there may be a greater role for the balance sheet as a tool for monetary policy. However, ongoing active use of the balance sheet could, *ex post*, lead to a very large balance sheet that alters policymakers’ cost-benefit assessments. Such a balance sheet could potentially

¹⁸ Even so, the existing literature suggests that, away from the ELB, more accommodative conventional policy tends to amplify the effects of the balance sheet policy.

¹⁹ The risk that the longer-run value of the neutral real rate going forward could be lower than currently anticipated by the Committee is especially pertinent, because such a scenario would likely increase the probability that monetary policy will be constrained by the ELB on nominal interest rates in the future, with adverse consequences for macroeconomic outcomes (Williams (2016)).

raise political economy costs (discussed below). It could also be the case that the macroeconomic benefits of asset purchases will diminish as the central bank holds a greater share of outstanding securities, although this is an open question. These potential costs imply that it may be prudent for the Federal Reserve to preserve space for balance sheet expansion by maintaining a smaller balance sheet that is not actively used outside of ELB episodes.

An open question is whether a permanently large central bank balance sheet would permanently reduce risk premiums and thus raise the equilibrium real risk-free rate (r^*).²⁰ If this was the case, as above noted, from an *ex ante* viewpoint, maintaining a large balance sheet could create additional scope to cut policy rates in the event of a recessionary shock and so help limit the frequency and duration of ELB-constrained periods (Caballero and Farhi (2016)). Moreover, maintaining a large balance sheet might reduce deflationary risks associated with such episodes. None of that is to say that decisions that are beneficial *ex ante* would generate satisfactory outcomes *ex post*. That is, a large balance sheet may create scope *ex ante* to cut rates if it raises r^* , but at the *ex post* cost, after hitting the ELB, of less space to further expand the balance sheet. Moreover, a permanently large balance sheet may raise concerns regarding inflation risks.

4. Support Financial Stability Objectives

In this section we examine a number of issues related to the possible use of the balance sheet as a tool to meet financial stability objectives. It is important to note that, while there is a nascent literature on the interaction between a central bank's balance sheet and financial stability, there is hardly any evidence to go by.²¹ In addition, a number of questions lie beyond the scope of this analysis, for example whether the governance of

²⁰ Conceivably, a version of the “stock” view of LSAPs may suggest such a permanent increase in r^* is feasible. However, the empirical evidence presented in Li and Wei (2013) is consistent with a persistent but not necessarily permanent effect of asset purchases on the term premium. Moreover, analysis of historical data does not answer the question of whether a permanently large balance sheet may permanently affect term premiums.

²¹ Financial stability issues for consideration in designing the Federal Reserve's long-run framework are discussed in more detail in the September 30, 2016, memo “The Federal Reserve's Balance Sheet and Financial Stability.”

financial stability objectives and tools should be separated from that of monetary policy objectives and tools (as at the Bank of England), the possible interaction between balance sheet policies and macroprudential policies, and the extent to which actions taken by the Federal Reserve for financial stability purposes should be coordinated with other regulatory agencies and the Treasury Department.

4.1. Asset Purchases During Periods of Market Stress

The Federal Reserve's experience with the first large-scale asset purchase program (LSAP), initiated at the height of the financial crisis in December 2008 and expanded in March 2009, suggests that asset purchases have the potential to promote liquidity and improve functioning during periods of stress in financial markets. Measures of Treasury market liquidity—including average trading volumes, on- versus off-the-run premiums, average yield-curve fitting errors, and failures to deliver in repo transactions—improved over the course of the first purchase program. Measures of market functioning—such as the spread of one-month agency MBS repo over Treasury repo and implied financing rates from dollar roll transactions—displayed a similar pattern in agency MBS markets.

The efficacy of the first LSAP program, especially when compared with subsequent programs, suggests that asset purchases operate in part by easing limits to arbitrage, limits that can become pronounced during stressed market conditions. Consequently, policymakers might consider undertaking asset purchases during future periods of market stress to enhance market functioning at such times. Toward this end, it may be important to maintain some operational readiness in order to be prepared to conduct purchases in Treasury and agency MBS markets on short notice if needed. Of note, simply retaining some expertise and flexibility would not necessarily require large Federal Reserve holdings in normal times.

4.2. Actions to Reduce Financial Sector Vulnerabilities

In addition to policy responses during periods of stress, policymakers may consider using the size and composition of the balance sheet to preemptively reduce vulnerabilities in the financial sector. This section discusses a few possible balance sheet approaches.

4.2.1. Provision of Safe Money-Like Assets

Short-term, safe, liquid assets—either publicly or privately created—have money-like properties, making them useful to investors as a store of value, as a means to facilitate trade, or as collateral to obtain funding. Consistent with this observation, there is some empirical evidence that the price of money-like assets incorporates a money premium—that is, investors are willing to accept lower yields on these assets relative to assets that do not offer such nonpecuniary benefits.²² An estimate of the money premium on very short-term Treasury bills can be seen in Figure 1, which displays the gap between yields on Treasury bills with remaining maturities longer than one week and the yield on bills that mature in one week.²³ Researchers have interpreted this premium as suggesting that the public sector has not fully met investors’ demand for money-like assets, leaving room for the provision of such assets in the form of private money-like liabilities issued by financial institutions.²⁴ Such private money-like assets and public money-like assets

²² Greenwood, Hanson and Stein (2015) present evidence that this money premium is especially large at the short end of the Treasury curve, reflecting the extra moneyness of Treasury bills above and beyond the “convenience premium” that stems from the liquidity and safety of both short- and longer-term Treasury securities.

²³ See Carlson *et al.* (2016) for a discussion of the money premium calculated in terms of the realized one-month holding period return on a Treasury bill with n weeks to maturity in excess of the month-average one-week rate. As they note, if the money premium results in very low yields at the front end of the curve, then buying bills with longer maturities and holding them as they become more money-like should be profitable. They find that this holding return increases steeply at the very short end of the curve and diminishes as maturities grow and the securities become less money-like.

²⁴ There is clear evidence on the rising demand for money-like assets among domestic investors in recent decades (Gorton and Metrick (2012)). In particular, there has been a compositional shift toward privately produced money-like assets (between the late 1970s and the mid-2000s, the fraction of Treasury bills and checking deposits in businesses’ and households’ holdings of money-like assets dropped, while the share of money market funds and uninsured deposits rose, Greenwood, Hanson and Stein (2016)). However, it is unclear to what extent legal and institutional features unique to U.S. financial markets have contributed to this growth in demand for, and supply of, short-term, safe assets in past decades. For example, the liquidity-coverage ratio (LCR) changes the incentives of large banks in favor of holdings of specified liquid assets; the supplementary leverage ratio (SLR) may shift the demand of large banks away from low-return liquid assets; and money market fund reform could increase investor demand for government-only money

typically have similar characteristics during normal times, when investors perceive them as safe and liquid. The ability to issue such private money-like assets at a yield that reflects a money premium, and then to invest the proceeds in higher-yielding, longer-duration assets, has provided a strong incentive for investors to engage in maturity and liquidity transformation.

Although private money-like assets can provide money-like services to market participants during normal times, investors can suddenly become dubious about their liquidity or safety, leading to stressed market conditions. Indeed, such shifts in investor perceptions were powerful catalysts for instability during the financial crisis.²⁵ In light of these concerns, a recent literature has suggested that publicly provided money-like assets may be able to crowd out excessive (inefficient) private money-like assets.²⁶ According to this hypothesis, an increased supply of short-term, safe, public-sector liabilities would satisfy a potentially large share of the demand for short-term safe assets and decrease the money premium, reducing the incentives of private agents to create money-like assets.²⁷

While the empirical research has primarily examined the role of short-term Treasury securities, Federal Reserve liabilities such as reserve balances and ON RRP could, in principle, play a similar role in satisfying at least a portion of investor demand for short-term safe assets (Greenwood, Hanson, and Stein (2016)).²⁸ Other researchers have gone even further and suggested that policymakers may consider actively using changes in the

funds. Finally, demand for money-like assets may also vary in response to changes in investors' perceptions of, and tolerance for, liquidity risk.

²⁵ For example, see Brunnermeier (2009), McCabe (2010), Gorton and Metrick (2012), and Covitz, Liang, and Suarez (2013).

²⁶ For example, see Stein (2012) and Krishnamurthy and Vissing-Jorgenson (2015).

²⁷ For example, Greenwood, Hanson, and Stein (2015) estimate that a given increase in short-term Treasury bills tends to crowd out about half as much privately produced money-like assets. Carlson *et al.* (2016) show that the supply of private money-like assets tends to respond within two or three months to unanticipated changes in government securities and find that an increase in the supply of Treasury bills leads to a decrease in the spread between the yields on private short-term safe assets and Treasury bills.

²⁸ The choice of assets held against these liabilities may have financial stability effects of their own. For example, purchasing short-term assets would reduce the supply of money-like assets in the market, thereby offsetting the original benefits of this strategy. However, purchasing longer-term assets would influence the level of the yield curve, all else equal.

size or composition of Federal Reserve's liabilities to target the level of private money-like asset creation as perceptions of fragility change over time.^{29,30}

Whether Federal Reserve liabilities, rather than Treasury bills, could effectively crowd out excessive private money-like assets remains an open question. Unlike Treasury bills, which can be held by any investor, access to Fed liabilities varies by instrument.

Reserves are limited to the banking sector, which, though large, offers safe assets only up to FDIC-insured limits.³¹ By contrast, ON RRP, which can be held by additional types of counterparties, may be able to provide deeper investor access to money-like assets.³² Treasury bills may still be preferred to ON RRP investments by investors, as bills may be perceived as having special characteristics and value to the holder, such as serving as cash-equivalent collateral in funding markets or at central counterparties. However, the provision of a large amount of Treasury bills may ultimately be incompatible with debt management objectives of the Treasury Department.³³ Another publicly provided instrument potentially effective at crowding out private money-like assets would be central bank bills ("Fed bills").³⁴ Fed bills would be a Federal Reserve liability broadly available to investors and presumably pledgable as collateral in a manner similar to Treasury bills.³⁵ Although the possibility of the Federal Reserve issuing Fed bills was

²⁹ See Kashyap and Stein (2012), Stein (2012), Greenwood, Hanson, and Stein (2016), and Woodford (2016).

³⁰ The provision of money-like assets by the Federal Reserve could be seen as consistent with furnishing an elastic currency as envisioned in the Federal Reserve Act (1913).

³¹ Segregated balance accounts could, in principle, widen access to risk-free assets to a broader population.

³² Although they do not emphasize financial stability considerations, Duffie and Krishnamurthy (2016) underscore market segmentation and the ability of the ON RRP facility to improve the pass-through of monetary policy rates to wholesale money market rates.

³³ That said, as discussed in Section 6, the Federal Reserve's balance sheet decisions also have implications for debt management.

³⁴ Many foreign central banks issue their own debt. In the advanced foreign economies, central banks mainly use them for liquidity management. The Swedish Riksbank is currently issuing bills while it has a large portfolio of assets it has purchased in order to implement a corridor system. Moreover, both the Swiss National Bank and the Bank of England used central bank bills during and just after the global financial crisis to manage liquidity. Many emerging market economy central banks also issue central bank bills, but primarily to sterilize their exchange rate interventions.

³⁵ Fed bills would also be a useful instrument to drain reserves from money markets. However, bills issued by the central bank may interfere with the existing market for government debt, potentially creating a source of conflict between the Treasury and the central bank. In light of this risk, some central banks have established arrangements to sell debt on behalf of the sovereign entity, with proceeds held in a designated central bank account.

discussed during the financial crisis, the Federal Reserve Act (FRA) currently does not provide authority to do so.

While the potential for public money-like debt to substitute for private money-like instruments is an ongoing area of research, there appear to be a number of challenges associated with such a proposal.³⁶ First, to the extent that the growth in demand for money-like assets reflects legal and institutional features of U.S. financial markets, other policy options, for example regulatory policies, may be used to change the incentives that investors have to hold short-term safe assets. Second, it is difficult to identify the “efficient” level of privately produced money-like assets. Accordingly, it is unclear how much crowding out of private money-like assets would be consistent with a stable and efficient financial system. Crowding out a substantial portion of private money may require a large Federal Reserve balance sheet, and very large Federal Reserve holdings of Treasury securities or MBS may have negative implications for the functioning and liquidity of these markets.^{37,38}

Third, it is not clear the Federal Reserve would need to take the lead in displacing private money-like assets. In principle, Treasury could satiate investor demand for short-term safe assets by issuing a mix of bills and floating-rate notes. Moreover, the fact that bills, unlike reserves and ON RRP, can circulate freely suggests that the Treasury may have a comparative advantage in doing so.³⁹ Finally, while the complete displacement of runnable private money would eliminate run risk, incomplete displacement in the presence of a potentially perfectly elastic supply of safe assets in the form of ON RRP

³⁶ While a number of central banks now have either explicit or implicit financial stability objectives, no central bank has explicitly articulated aims of using the balance sheet as a financial stability tool (let alone to provide short-term safe assets) going forward.

³⁷ Of course, the composition of publicly provided money (among Treasury bills, reserves, or ON RRP) would be an important factor in pinning down the size of the balance sheet.

³⁸ Another important open question regards implementation. For example, whether the public sector should aim to displace private money by targeting a proxy of the money premium or supplying short-term safe assets with the goal of accommodating demand. Some estimates of the impact of supply of Treasury bills on the money premium are provided in Carlson *et al.* (2016).

³⁹ However, Greenwood, Hanson, and Stein (2016) argue that, unlike the Federal Reserve, the Treasury faces the risk that its auctions of bills could fail, and, therefore, it may be more advantageous for the Federal Reserve to supply money-like assets.

could exacerbate run risk or the severity of a run.⁴⁰ It is worth noting that the provision of safe assets in the form of ON RRP could also have beneficial effects in terms of financial stability, both by broadening the set of investors with access to Federal Reserve liabilities and by possibly lessening the odds of a run on private money.

4.2.2. *Influencing the Shape of the Yield Curve to Reduce Private Sector Maturity Transformation*

The unwinding of excessive private maturity and liquidity transformation contributed significantly to the severity of the financial crisis. Investors financed exposure to higher-yielding long-term assets with what they perceived to be relatively safe short-term debt. When buyers of such debt came to question its safety and liquidity, massive fire sales across a number of asset classes ensued. A reasonable conjecture is that, if investors faced higher costs of short-term borrowing relative to yields on longer-duration assets, they would engage in less maturity and liquidity transformation.

The Federal Reserve's purchases of long-term Treasury securities can flatten the yield curve by lowering term premiums (as in LSAPs), thus potentially reducing the amount of maturity transformation taking place in the private sector. The slope of the yield curve can also be affected by balance sheet actions that alter the composition but not the size of the balance sheet (the Maturity Extension Program (MEP), for example). Nevertheless, there is only limited evidence about the degree to which balance sheet policies of this type can meaningfully affect private sector maturity transformation. The literature has focused primarily on the effects of balance sheet actions on the yield curve itself. As shown in Figure 2, the MEP is estimated to have pushed up yields on Treasury securities with 3 to 4 years in duration by about 10 basis points, while yields at the 10- or 15-year horizon declined as much as 20 basis points.^{41,42} Based on this limited evidence, it is

⁴⁰To address this concern, Frost *et al.* (2015) have proposed design features for an ON RRP facility that could mitigate these risks. For example, predetermined "dynamic" caps on the aggregate amount of RRP balances could substantially limit cash investors' ability to rapidly shift a large portion of their portfolio to the facility.

⁴¹ See Ehlers (2012) and Cahill *et al.* (2013) for more details on the MEP.

⁴² A conceptually similar operation was the so-called Operation Twist in 1961. In an effort to "encourage bank credit and monetary expansion while avoiding direct downward pressure on short-term interest rates,

unclear whether changes of this magnitude would have any meaningful effect on the amount of maturity transformation taking place in the financial sector.^{43,44}

4.3. Expanding Availability of HQLAs and Private Sector Risk-Bearing Capacity

The Federal Reserve's holdings of long-term Treasury securities could have consequences for financial institutions' management of macroeconomic and liquidity risks, as well as for certain aspects of the reformed regulatory regime.

For example, under the Basel III rules, both Treasury securities and reserves (as level-1 assets) count equally as high-quality-liquid assets (HQLA) under the liquidity coverage ratio (LCR). In contrast, GSE securities are level-2 assets, which face haircuts and quantitative limits. Thus, if a shortage of HQLAs were to arise, all else equal, policymakers could increase the supply by tilting the Federal Reserve's portfolio toward agency MBS while issuing reserves or selling Treasury securities.⁴⁵

Separately, the academic literature has emphasized that investors' demand for safe assets includes long-maturity assets such as Treasury bonds (Gorton, Lewellen, and Metrick (2012), and Krishnamurthy and Vissing-Jorgensen (2012)). These authors argue that long-term Treasury securities provide a unique benefit: They provide investors a valuable hedge against certain macroeconomic risks, as the value of these instruments rises during (future) economic downturns (i.e., they have a "negative beta"). If this is the case, diminished availability of long-term Treasury securities brought about by an

thereby moderating pressures on the U.S. balance of payments," the Treasury Department increased the supply of shorter-term Treasury securities while the Federal Reserve purchased long-term securities. Swanson (2011) estimated that Operation Twist reduced the slope of the yield curve by approximately 25 basis points, with roughly equal declines in long-term yields and increases in short-term rates.

⁴³ The par value of the MEP totaled \$634 billion, but only \$122 billion in 10-year equivalents.

⁴⁴ Balance sheet policies may also have important implications for investor behavior and therefore for maturity transformation activities. For example, Adrian and Shin (2008) find that broker-dealers' use of repo is an increasing function of the slope of the yield curve. However, yield-oriented investors may end up taking on risk in other ways, such as by increasing financial leverage or moving out the duration or credit curve. These incentives could offset the benefits of any reduction in maturity transformation, leaving the ultimate impact on the stability of the financial system unclear.

⁴⁵ While the possibility of a shortage of HQLAs exists in principle, current estimates suggest that HQLAs are available in more-than-sufficient supply.

expansion of the Federal Reserve's balance sheet could potentially decrease, all else equal, the ability of the private sector to hedge against macro risks.

4.4. Affecting Financial Conditions in the Housing Market

During the first LSAP program, the Federal Reserve's purchases of agency MBS at times of stress in markets resulted in a significant contraction of MBS spreads, which passed through to primary mortgage rates and ultimately helped stabilize the housing market.⁴⁶ Based on this experience, some commentators have suggested that adjustments in the Federal Reserve's holdings of agency MBS may be a useful tool in mitigating boom and bust cycles in the housing market. For example, the Federal Reserve could sell agency MBS during a period of rapid growth in mortgage debt and home prices, thereby tightening conditions in mortgage markets. "Leaning against the wind" at times of an exuberant housing market may help prevent distress in a sector often connected to severe recessions or banking crises.

An important objection to using the central bank's balance sheet for purposes of managing conditions in mortgage markets is that it could be perceived as credit allocation. Indeed, the FOMC's Policy Normalization Principles and Plans state a long-run portfolio objective of holding primarily Treasury securities in order to minimize the effect of Federal Reserve holdings on the allocation of credit across sectors of the economy.

There is also uncertainty about the size and effects associated with such purchases or sales. One open question is to what extent the experience of the first LSAP program, which occurred during strained market conditions, can be extrapolated to normal times. Impaired liquidity conditions and market functioning were likely important factors that contributed to the sizable effect of purchases in the 2009-10 episode. Estimates of the effect of agency MBS purchases during the third LSAP program were smaller, likely because they took place in a market that was no longer dislocated.

⁴⁶ For example, Hancock and Passmore (2011) argue that the Federal Reserve's 2009 purchases of \$1.25 trillion of agency MBS reduced mortgage rates by 100 to 150 basis points.

Another question is whether the effects of agency MBS purchases and sales are symmetric. Most research has emphasized stock effects in gauging the impact of the Federal Reserve's agency MBS purchases on mortgage market conditions, but one may expect flow effects to be more important during sales.⁴⁷ One episode that may shed some light on this issue is the Treasury Department's sale of its agency MBS portfolio in 2011-12.⁴⁸ The immediate impact on the MBS market was relatively modest, with current coupon spreads widening only a few basis points on the announcement.⁴⁹ Meanwhile, while MBS purchases have been executed in the liquid "to be announced" (TBA) market, sales of a larger portfolio could likely include specified pools.⁵⁰

The extent to which prior sales experience can be generalized to a situation where agency MBS sales are actively used for financial stability purposes is unclear. Moreover, since the Policy Normalization Principles and Plans (2014) indicate that the FOMC currently does not anticipate selling agency MBS as part of the normalization process, investors perceive little interest by the Federal Reserve to use agency MBS sales as an active policy tool.

⁴⁷ While there is no comprehensive research examining possible asymmetries between the effects of asset purchases and asset sales, flow-effect regressions based on the MEP suggest that such asymmetries were small in the cash market for Treasury securities. However, sales appear to have had smaller effects on the repo market than purchases did. (See D'Amico *et al.* (2014).)

⁴⁸ On March 21, 2011, the Treasury Department announced that it would begin winding down its remaining portfolio of \$142 billion agency MBS and that it would exit at a gradual and orderly pace (selling up to \$10 billion per month). The Treasury had acquired its portfolio of agency MBS under the authority of the Housing and Economic Recovery Act of 2008 in order to preserve access to mortgage credit and promote economic stability during a period of unprecedented market stress and volatility.

⁴⁹ Three other episodes of asset sales (albeit not of agency MBS) include the Federal Reserve's sales of roughly \$275 billion Treasury bills and other short-term coupon securities in mid- to late 2008 to help drain reserve balances prior to the introduction of IOER, the Treasury's sales of bills through the Supplementary Financing Program (\$560 billion at its peak), and the MEP in 2011. The first two episodes had little price impact, likely reflecting high demand for safe and liquid assets in the thick of the crisis. In the case of the MEP, sales appear to have had a notable effect on repo rates, pushing them up by about 10 basis points. These increases were later reversed, suggesting that flow effects may have played a role.

⁵⁰ The Desk has aggregated individual agency MBS holdings into fewer, larger securities, which could be more liquid than traditional "seasoned" individual pool in the secondary market because of their larger size. However, the Desk has no practical experience with large-scale sales of specified pools.

5. Implications of Balance Sheet Objectives for SOMA Portfolio Design

The Federal Reserve's September 2014 Policy Normalization Principles and Plans state that, in the longer run, the Committee intends to hold no more securities than necessary to implement monetary policy efficiently and effectively, and that it will hold primarily Treasury securities.⁵¹ The size and composition of the SOMA securities portfolio that will achieve these principles—or perhaps warrant an adjustment in the principles—will depend on policymakers' decisions about the macroeconomic or financial stability roles the balance sheet is to play in a long-run framework, as well as the interaction of the balance sheet with the operating regime chosen to control short-term interest rates. Some of the implications that the possible balance sheet uses described above might have for the structure of the SOMA portfolio are summarized in Table 1.

5.1. Balance Sheet Used as Active Tool Only at ELB or in a Crisis

As an illustrative baseline for the size and composition of the balance sheet, suppose that the Committee decides to use the balance sheet passively to support operations related to control of short-term interest rates in normal times (and as an active tool only in special circumstances.) Examples of special circumstances would be purchasing assets to provide additional monetary policy accommodation when the ELB binds, or using asset purchases to improve liquidity and market functioning in periods of stress. These objectives are shaded in green in Table 1.

One strategy for structuring the balance sheet in this framework would be to preserve space and operational capabilities to use LSAPs should doing so become necessary when such special circumstances arise. The balance sheet's steady-state size would be determined primarily by the level of currency and other autonomous factors plus the level of reserve balances that is deemed appropriate for efficient and effective operation of the

⁵¹ The statement advises that the Committee does not anticipate selling any agency MBS as part of the normalization process, although limited sales might be warranted in the longer run to reduce or eliminate residual holdings.

interest rate control regime.⁵² A steady-state composition of the SOMA portfolio weighted towards relatively short- to medium-term Treasury holdings would bring more capacity for purchasing longer-term securities in future LSAPs or MEPs should such programs become necessary. Inclusion of at least a small agency MBS portfolio in the SOMA, even under normal times, would maintain operational readiness and hands-on expertise in a segment of the financial markets in which speedy future interventions might be desired in a crisis.

A limitation of this strategy is that it assumes the balance sheet can be expeditiously normalized to the desired, lean steady-state size and composition between LSAP deployments, when in fact the starting point for the portfolio depends on economic developments. With a persistently low r^* suggesting that spells at the ELB may be more frequent and persistent, it is possible that the time between visits to the ELB will not be sufficiently long to be able to achieve such normalization without large asset sales, leading to ongoing expansions of the balance sheet.⁵³ Such a scenario raises a number of important fiscal and political economy risks (discussed in Section 6), as well as questions about practical limits to operational capacity and effects on market functioning.

For instance, simulations for an adverse scenario that considers recurring visits to the ELB that motivate additional LSAP programs every five years suggest that SOMA holdings could peak at nearly 50 percent or greater of the stock of outstanding Treasury securities in longer-dated tenors at the completion of each purchase program.⁵⁴ Its

⁵² As noted in Section 2, a steady-state balance sheet size could be relatively small or relatively large, depending on the use of reserves in the operating framework, though maintaining a small balance sheet in normal times may provide more room for future expansions. However, shifts in the composition of assets through a maturity extension program could provide monetary policy accommodation without expanding the size of the balance sheet.

⁵³ In principle, asset sales could help to accelerate reductions in the size of the balance sheet. However, our experience with asset sales is confined to sales of shorter-duration Treasury securities, which are of limited use in trying to speed the path to a leaner balance sheet. Sales of agency MBS would be more useful, but as discussed in Section 4.4, a number of uncertainties surround the effects of such sales. Moreover, any strategy that contemplates asset sales would need to be accompanied by communications that help to manage market participants' expectations and clarify the objective of such sales. Holding a stock of purchased assets for a shorter period of time than market participants anticipate could make future asset purchases less effective.

⁵⁴ Staff simulated five-year cycles from 2017 through 2040. Each cycle included one year of Treasury LSAPs, two years of maintaining the Treasury portfolio's size through rollovers, and two years of

market share could bump up against current holding limits of 70 percent per issue (a level that aims to preserve ample private market activity) for securities with more than 10 years remaining to maturity (Figure 3).⁵⁵ In contrast, the SOMA's peak ownership following asset purchase programs to date was about 45 percent of securities with more than 10 years to maturity. Capacity for agency MBS programs (not included in the simulation) would depend on the pace of LSAP and reinvestment purchases relative to gross issuance and the existing stock of securities available for purchase.

5.2. Balance Sheet with More Permanent Active Role(s)

Pursuing other macroeconomic or financial stability objectives described in the previous sections may entail a more permanent, active role for the balance sheet. These objectives are shaded in orange in Table 1.⁵⁶ All of these scenarios suggest the possibility of providing a potentially large supply of Federal Reserve liabilities or of holding a large stock of assets. A choice to pursue one or more of these objectives would therefore likely require the adoption of an interest rate control regime that can function in an environment with a relatively large aggregate level of non-currency liabilities.

The steady-state composition of the SOMA portfolio would be influenced by which specific objectives were prioritized, although different objectives may lead to different portfolio constructions. For example, as noted in Section 3, a desire to use the balance sheet to maintain monetary policy accommodation away from the ELB would likely require holding a large amount of duration risk in the portfolio in order to apply

redemptions. Purchases were assumed to follow the purchase distribution employed in LSAP3. Fiscal deficits were assumed to grow in line with average growth projected by the Office of Debt Management through 2026 and roughly in line with historical averages thereafter; purchase program sizes were scaled accordingly.

⁵⁵ These results are highly dependent on assumptions about the fiscal deficit and Treasury issuance patterns. Staff considered both a continuation of the Treasury's current debt management strategy, as well as one in which the Treasury increased issuance of securities with tenors of more than 7 years and decreased issuance of tenors of 2 to 5 years. This alteration in debt issuance resulted in a slight reduction in the SOMA's share of securities with more than 7 years to maturity and a slight increase in SOMA's share of securities with 4 to 7 years to maturity. The exercise did not consider the general equilibrium effects that Treasury debt management decisions have on interest rates and other economic outcomes.

⁵⁶ Adding objectives for the balance sheet beyond supporting interest rate control would likely require an adjustment to the current normalization principles.

downward pressure on term premiums. This strategy might suggest maintaining a sizable portfolio of longer-term Treasury securities.⁵⁷ However, positioning the balance sheet to be able to reduce incentives for private sector maturity transformation suggests holding an inventory of relatively short-term Treasury securities that could be sold when there is a desire to flatten the yield curve. And making more long-term Treasury securities available to private investors, as HQLA or hedging instruments, suggests shifting SOMA holdings to instruments such as agency MBS.

Maintaining a permanently larger balance sheet and securities portfolio with longer-duration or riskier assets in steady state could, in some situations, have adverse effects on market functioning.^{58,59} It also might limit how much room is available to conduct additional asset purchases should they become necessary upon a return to the ELB or other crisis. If market capacity limits could eventually constrain the Committee's ability to use asset purchases to provide monetary policy accommodation, a prudent approach might be to reserve that capacity for special situations.

⁵⁷ Under a portfolio balance theory of asset purchases, the term premium effects are driven by the combination of the size of the balance sheet and the interest rate risk, predominantly duration risk, of securities held. It is therefore conceivable that holding a relatively larger portfolio of shorter-term Treasury securities could have the same term premium effects of a relatively smaller portfolio of longer-term securities.

⁵⁸ The size and pace of the Federal Reserve's asset purchase programs, and the current concentration of its securities holdings, do not appear to have had any sustained adverse impact on Treasury or agency MBS market functioning (though at times, operations were adjusted to help ensure smooth sourcing and settlement). However, very large purchases conducted by some central banks over a sustained period of time have reportedly contributed to some market strains in their fixed income markets.

⁵⁹ Ensuring smooth market functioning is particularly important given the dollar's role as a reserve currency. Choices the Federal Reserve makes about the size and composition of its portfolio could, in principle, have implications for the market environment facing foreign reserve managers. However, balance sheet choices seem unlikely to have material implications for the international role of the dollar, so long as the fundamentals that support it—including the depth, liquidity, and openness of U.S. financial markets; secure legal and regulatory frameworks governing those markets; relative stability and predictability of money market rates; long history of political and macroeconomic stability; and creditworthiness of the U.S. government—remain intact. The background note, "The Federal Reserve's Long-Run Framework and the International Role of the Dollar" provides more information.

5.3. Principles Guiding Portfolio Design

A central bank has some leeway, within the bounds of its statutory authority, in determining the composition of its assets.⁶⁰ Before the crisis, the Federal Reserve's monetary policy implementation entailed a relatively small volume of repos; meanwhile, outright holdings of U.S. Treasury securities were generally the counterpart to CIC, the largest component of the liability structure.⁶¹ However, intentions to use the balance sheet as an active tool towards policy objectives beyond interest rate control, as discussed in this memo, may add further constraints around asset selection. Several principles that might guide decisions about the composition of the SOMA portfolio are discussed below.⁶²

Managing the level of financial risk associated with the balance sheet stems from the Federal Reserve's responsibility to use public resources wisely. The FRA generally limits the Federal Reserve's assets to a "safe" set of instruments that entail little to no credit risk.⁶³ However, a decision to pursue balance sheet objectives that require permanent allocations to longer-term Treasury securities or agency MBS means accepting some exposure to duration risk, while agency MBS also carry prepayment risk (indeed, acceptance of these risks is a direct consequence of some of the channels through which LSAPs are believed to work).⁶⁴ These risks can be contained by adopting a buy-and-hold portfolio management strategy, although mismatches between rates of

⁶⁰ Bindseil (2016) introduces the concept of a central bank's "not policy constrained" assets, which he uses to describe central bank assets other than those necessary to achieve the operational target and foreign reserves. Throughout this memo, we discuss several broader policy objectives that the balance sheet could conceivably support.

⁶¹ In contrast, other central banks carried mostly shorter-term claims against the private sector, which arose either through repos, FX swaps, or loans to financial institutions. Central banks in small, open economies largely held assets in foreign currency or gold. For more information on other central bank's balance sheets, refer to the July 8, 2016, memo "The Foreign Experience with Monetary Policy Implementation."

⁶² It is worth noting that the compositions of the SOMA portfolio and the principles guiding its construction have varied considerably over the course of the Federal Reserve's history. A brief history of the SOMA portfolio is provided in the background note, "The SOMA Portfolio's Evolution, 1935 to Present." The Federal Reserve's 2002 study, "Alternative Instruments for Open Market and Discount Window Operations" also provides useful background.

⁶³ These include primarily direct obligations of, or fully guaranteed as to principal and interest by, any agency of the United States, among a few other very safe instruments. Refer to the background note, "A Review of Asset Classes Eligible for Open Market Operations" for more information.

⁶⁴ Of course, as noted in footnote 57, the degree of interest rate risk is ultimately a function of both the size and the duration of the portfolio.

interest paid on liabilities and earned on assets may bring on greater year-to-year volatility in income and raise the probability of recording negative income in some years.

Portfolio *liquidity* aims to provide the elasticity needed to respond to shocks. On one hand, a lesson from the crisis was that portfolio liquidity needs in the face of systemic liquidity assistance far exceeded pre-crisis estimates of the sterilization capacity needed in the SOMA to manage reserve conditions in a manner that could maintain interest rate control. This lesson might suggest the Federal Reserve should hold a far larger share of assets in short-term instruments in the SOMA in the long run. On the other hand, the need for an elastic portfolio is likely less critical in an operating regime, like the current one, in which IOER and ON RRP appear able to provide interest rate control despite the elevated level of reserves, and where adequate liability management tools offer alternatives for reducing the supply of reserve balances (in addition to reducing outright holdings of securities) should such actions be deemed desirable.⁶⁵ Without the need for portfolio liquidity to support sterilization, the Federal Reserve could conceivably hold less-liquid assets against its relatively long-term liabilities (currency).⁶⁶ That said, maintaining some short-term, liquid assets in the portfolio might remain a priority if policymakers are not indifferent to changes in the size of the balance sheet in the face of shocks or to where short-term market rates trade inside an interest-rate corridor. They might also see the flexibility that short-term holdings provide as insurance in meeting monetary policy goals in a broad range of economic or market circumstances.

Market neutrality, or the desire to minimize the effects of Federal Reserve operations on credit allocation and relative asset prices, was a pillar of SOMA portfolio management before the crisis. Although asset prices are affected by the current and expected path of short-term interest rates, before the crisis, central banks traditionally sought to avoid causing direct effects on the prices of securities associated with their operations. In the years immediately preceding the crisis, the SOMA portfolio held only Treasury securities

⁶⁵ The introduction of large-scale reverse repos with a wide set of counterparties and term deposits with depository institutions provides liquidity-absorbing capabilities that did not exist prior to the crisis.

⁶⁶ Although a secular decline in demand for currency would affect the size of the balance sheet, this type of shock could likely be addressed through gradual adjustments over time.

outright, which enabled the Federal Reserve to maintain neutrality vis-à-vis the rest of government and the private sector (although agency debt and agency MBS, along with Treasury securities, were accepted as collateral in repo operations).^{67,68} The FOMC's Policy Normalization Principles and Plans expressly indicate an intent to hold primarily Treasury securities in the longer run in order to “minimiz[e] the effect of Federal Reserve holdings on the allocation of credit across sectors of the economy.”

Another aspect of market neutrality relates to market functioning. Prior to the crisis, the Federal Reserve sought to hold a portfolio of Treasury securities that was similar to that held by the private sector, after meeting portfolio liquidity objectives. Spreading holdings across the maturity spectrum helped to prevent situations in which the Federal Reserve's operations might cause distortions in market prices across the curve. Moreover, the Federal Reserve's holdings of newly issued securities, obtained by rolling over maturing securities at auction, could be employed in securities lending operations as a tool to foster efficient trading conditions in the Treasury markets.⁶⁹

These aspects of market neutrality are inherently inconsistent with uses of the portfolio as an active tool to support macroeconomic and financial stability objectives that aim explicitly to affect risk premiums or relative market prices. In the case of LSAPs or strategies to influence the yield curve, a competing principle would be duration

⁶⁷ One way to define “neutrality” is by defining the universe of investable assets. The Federal Reserve's approach regarding its exposure to government debt is consistent with the view that the central bank is part of a consolidated official sector, implying a lean consolidated official sector balance sheet. An alternative view, adopted by some major central banks, sees the central bank as an independent entity, implying that interconnectedness between the central bank and government is problematic (Bindseil, 2016). A neutral portfolio for an independent-entity central bank would hold in its portfolio both government-issued risk-free assets as well as a diversified representation of the market. Yet another approach to market neutrality could be to hold only bills, to the extent that shortening the duration of the central bank's portfolio holdings would eliminate any term premium effect caused by its securities holdings.

⁶⁸ This principle of market neutrality did not apply when the Federal Reserve began purchasing federal agency debt in the 1970s, in part to support the development of a liquid secondary market for these securities and to address pressures in the housing markets arising from episodes of high interest rates. The purchases stopped entirely in the early 1990s, and remaining agency debt was allowed to mature, as policymakers became increasingly concerned about their direct support of the housing sector and the unresolved nature of U.S. Government credit support to the GSEs.

⁶⁹ The requirement that SOMA holdings of Treasury securities not be increased at auction (therefore rolled over or run off), combined with variability in Treasury auction amounts, led to uneven holdings of similar securities that may have affected the specialness of some individual issues. Nonetheless, SOMA holdings were generally representative of the maturity distribution of outstanding issuance of Treasury securities across the curve.

absorption, through which the Federal Reserve purposefully undertakes maturity transformation services. Moreover, holding agency MBS with the intention to affect credit conditions in the housing market would mean choosing to take a purposeful role in the allocation of credit across sectors of the economy.

The recent crisis highlighted the need for central banks to be prepared to provide liquidity when needed and to act quickly to adopt unconventional monetary policy measures once the policy rate reached the ELB. Indeed, one of the key lessons from the crisis was that, once a decision was made to undertake asset purchases, *operational readiness* was insufficient with regard to the analysis, accounting, reporting, and preparation of operational systems and procedures needed to support the speedy execution of LSAPs (particularly in agency MBS, given the inherent complexity of MBS securities and the MBS market). Going forward, policymakers may wish to preserve the institutional expertise, operational capabilities, and human capital needed to operate in important markets by maintaining ongoing operations in them. This would suggest maintaining at least a small agency MBS portfolio over the longer run, regardless of the long-run objectives adopted for the balance sheet, if policymakers believe they might one day need to operate in size in the MBS market again.

Transparency around use of the Federal Reserve's balance sheet in its long-run framework is also an important principle that supports the Federal Reserve's ability to achieve its dual mandate. Communicating anticipated changes in the size and composition of the portfolio, actions that will be taken to alter it, and the purpose driving those actions will help to maintain confidence and avoid misunderstanding. Moreover, transparency about portfolio operations enhances accountability by enabling the public and Congress to judge whether the central bank's actions are consistent with its stated portfolio policies. This is all the more important in light of the possible fiscal and political economy costs that could accompany certain balance sheet strategies, which could warrant a dedicated outreach strategy.

Return has not traditionally been a driver of the Federal Reserve's portfolio management decisions.⁷⁰ Decisions about the size and composition of the portfolio are meant to serve a policy purpose of promoting the Federal Reserve's statutory dual mandate, as a central bank's success is measured by its ability to achieve its macroeconomic objectives, not return. However, all else equal, Bindseil (2016) argues that a central bank, after pursuing its goals, should maximize the return on assets not constrained by policy. The long-term and stable nature of a central bank's currency liabilities may put it in a position to be able to hold less-liquid or longer-duration assets, which generates additional central bank income that will eventually be shared with the taxpayer.⁷¹ However, as discussed in the next section, such choices could be seen as having public debt management implications. Moreover, a central bank pursuing such a strategy could not elevate this over achievement of its macroeconomic mandate, and must remain committed to tightening monetary policy when necessary even at the cost of incurring losses in its outright portfolio.

6. Fiscal Implications of Federal Reserve Balance Sheet Strategies

Regardless of the size and composition of the central bank's balance sheet, monetary policy has broad fiscal implications. By affecting economic activity and inflation, monetary policy affects both public revenues and expenditures. Additionally, monetary policy influences the real and nominal rates at which the government finances its debt.⁷² However, the size and composition of the central bank's balance sheet—particularly a large one composed of long-term U.S. Treasury securities, as proposed in several of the strategies discussed in this memo—may pose even more prominent fiscal or political economy issues. These include the division of responsibility for debt management

⁷⁰ On the margin, return has driven some operational implementation choices, such as purchasing Treasury securities that appear cheap versus their theoretical values in secondary market purchase operations. This approach to purchases is also economically efficient.

⁷¹ In contrast, assets held against interest-bearing liabilities might be more appropriately invested in shorter-term instruments that bear less risk.

⁷² Indeed, one of the key pillars of monetary dominance—that is, the central bank's ability to control inflation—is the assumption that monetary policy sets interest rates, and fiscal policy eventually adjusts primary surpluses to satisfy the intertemporal budget constraint. See, for example, Leeper (1991) and Sims (2016).

decisions between the central bank and the fiscal authority; issues related to balance sheet funding costs; and the impact on central bank income, remittances, and central bank independence.⁷³ Several of these issues raise questions about coordination with the Treasury Department.

6.1. Implications for Government Debt Management and Funding Costs

Ultimately, the nation's fiscal position depends on the consolidated government balance sheet, where the budget constraints of the central bank and the fiscal authority are treated as one. As such, the size and composition of a central bank's balance sheet can alter the liability structure and funding costs of the government. All else equal, Federal Reserve purchases of longer-term Treasury securities shorten the duration of overall government liabilities in the hands of the public, as they replace long-term government debt with overnight liabilities. This shortening can lower average funding costs if the term and liquidity premiums on long-term securities are positive. To the extent the central bank holds non-government assets on its balance sheet, purchases of non-government securities enlarge the public sector's balance sheet and potentially increase its risk profile.

This effect on funding costs generates an incentive for the fiscal authority to alter its debt issuance policies—perhaps in ways that reverse the effect of the central bank's actions. In the U.S., the Federal Reserve aims to achieve the dual mandate of maximum employment and stable prices, while the Treasury seeks to minimize debt service costs and rollover risk. Those different goals may appear to be inconsistent in certain circumstances.⁷⁴ As term premiums decline as a result of the Federal Reserve's large-scale asset purchases, for example, the Treasury may find it is in taxpayers' interest to

⁷³ The academic literature, additional discussion about these issues, and results of model simulations, are explored in the September 30, 2016, memo "Fiscal Implications of the Size and Composition of the Central Bank's Balance Sheet" and in the three background notes, "Fiscal Implications of the Central Bank's Balance Sheet from a Consolidated Government Budget Constraint Perspective," "The Implications of the Size and Composition of the Balance Sheet for Remittances and Central Bank Solvency," and "Implications of the Size and Composition of the Balance Sheet for Remittances: Results from Model Simulations."

⁷⁴ Experiences of other central banks also suggest that the policy mix might be suboptimal if the central bank and fiscal authority pursue their own objectives without cooperation.

extend the duration of the debt outstanding and to increase its issuance. Such an action could result in upward pressure on term premiums, offsetting the Federal Reserve's intended easing of financial conditions.⁷⁵ This raises an underlying question about coordination between the fiscal and monetary authorities, as well as political economy considerations about the role of each entity and boundaries between them.

The costs associated with funding a permanently large central bank balance sheet could raise additional political economy concerns. One concern relates to interest paid by the central bank to its counterparties, which can generate political pressures to the extent such payments are viewed as unfair, unwarranted, or a subsidy—particularly in situations where remittances to the Treasury are zero. Large payments to the banking system, which includes a large share of foreign banking organizations (FBOs), may attract particular attention, building pressures against maintaining or raising the rate of IOER. Of course, tightening the spread between the ON RRP rate and the IOER rate is one way to lower overall funding costs, but such a step would need other adjustments of tools in order to maintain the intended stance of monetary policy.

Interest payments on central bank liabilities can be seen simply as a component of overall government interest expense, which highlights a second concern: Is financing a large portion of public debt using central bank liabilities the least expensive way for the government to obtain short-term financing? Short-term Treasury bill rates, for example, are generally lower than the rate of interest paid on reserve balances.⁷⁶ As a result, a large outstanding amount of reserves can be perceived as a subsidy to the part of the financial system that has access to earn interest on them.

To be sure, a central bank's decision to raise short-term interest rates always makes funding public debt more expensive in the short run, regardless of the size of the central bank's balance sheet, and issuers and holders of public liabilities. Nevertheless, a larger

⁷⁵ Following the financial crisis, the Treasury Department increased its issuance of long-term debt. Whether this lengthening of average maturity was long-planned or an endogenous response to LSAPs is disputed. Regardless, Greenwood *et al.* (2015) estimate that the Treasury's actions offset 35 percent of the maturity-shortening impact of the LSAP programs.

⁷⁶ That said, the Treasury may not be willing to issue bills in amounts sufficiently large to replace Fed liabilities.

balance sheet, implying larger interest payments by the central bank to counterparties, focuses greater attention on these payments.

6.2. Central Bank Income, Remittances to the Treasury, and Independence

As an independent entity with its own balance sheet and income statement, the Federal Reserve generates a published flow of remittances to the U.S. Treasury.⁷⁷ The level and variability of remittances are related to a number of factors, several of which fall directly under the central bank's control, including the size of the balance sheet and the maturity mismatch between central bank assets and liabilities, holdings of agency MBS, and the realization of gains and losses through asset sales.

The central bank's net income and remittances highlight the narrow fiscal implications of shortening the duration of publicly held government debt. For example, a larger and longer-duration Federal Reserve balance sheet should lead to levels of income and remittances that are higher on average (as long as the term premium is positive), but possibly also more variable. However, a focus solely on highly visible remittances obscures a fuller picture of the fiscal effects of monetary policy. As the economy improves, the effects on public financing costs and government revenues can be significant, potentially overwhelming the contribution of central bank remittances in terms of the overall impact on government debt.

Purchasing assets while term premiums are negative across the yield curve implies expectations of future negative net income on those assets. Income losses, which could temporarily erode capital, however, are not an impediment to executing monetary policy, *per se*, as long as these losses are not so large as to impair the central bank's solvency—that is, as long as they are not large enough that the central bank is forced to ask for

⁷⁷ By law, the Federal Reserve distributes its earnings to the Treasury, net of operating expenses and dividends, allowing for a retained surplus of no more than \$10 billion. In the event that earnings are insufficient to cover these costs, no remittances are made and a “deferred asset” is booked as a negative liability on the Federal Reserve's balance sheet. Remittances resume only once the deferred asset is paid down.

recapitalization from the fiscal authority.⁷⁸ Yet, the size of a central bank's capital is not the relevant measure of solvency, as it does not take into account the future income from seigniorage. The academic literature focuses on an intertemporal budget constraint: A central bank is solvent if the sum of its tangible wealth (defined as the difference between the current market value of assets minus interest-bearing liabilities and operating costs) and intangible wealth (the expected present discounted value, or EPDV, of future seigniorage) is positive. If the EPDV of remittances is positive, the central bank, in principle, should not require recapitalization from the fiscal authority in order to pursue its mandate.

Existing research and staff projections generally paint a benign picture of the Federal Reserve's net income and solvency in future years under baseline projections for the evolution of the balance sheet.⁷⁹ These studies show that the likelihood of recording a sizable and long-lasting deferred asset is quite small, although these results are very sensitive to assumptions about the paths of short- and long-term interest rates.

Additional simulations conducted for this long-run study consider scenarios using different long-run balance sheet sizes and asset compositions.⁸⁰ Results show that a very large long-run level of reserve balances leads to lower remittances, on average relative to balance sheets with lower reserves, over a transition period in which effects of low term premiums on the existing SOMA portfolio wear off. This exercise illustrates how maintaining a relatively large balance sheet while the term premium is negative implies purchasing assets that are associated with expected future negative net income. However, the overall fiscal impact of a large balance sheet, including general equilibrium effects on

⁷⁸ In the Federal Reserve's case, this would mean not allowing a deferred asset to become so large that it cannot be covered by future income. Of course, a central bank in a fiat money regime can always address insolvency by printing money (that is, generating more liabilities), but at the cost of potentially compromising its inflation objective.

⁷⁹ Hall and Reis (2013), Greenlaw *et al.* (2013), Carpenter *et al.* (2015), Christensen *et al.* (2015), Del Negro and Sims (2015); Reis (2016), SOMA Annual Report (2016).

⁸⁰ Simulation scenarios included balance sheets with \$100 billion, \$1 trillion, and \$2.5 trillion in reserves, and with various maturity and asset type allocations. Recessionary scenarios in which additional asset purchases are undertaken from the balance sheet's current elevated size are also considered. Detailed analysis can be found in the background note, "Implications of the Size and Composition of the Balance Sheet for Remittances: Results from Model Simulations."

revenues and expenditures, is positive under certain conditions. In a recessionary scenario in which LSAPs are undertaken from the balance sheet's currently elevated level, both the likelihood and projected magnitude of a deferred asset increase further; however, expanding the balance sheet also has substantial positive broader fiscal effects, which must be taken into account when assessing the desirability of such a policy.

Although a need for recapitalization appears to be a relatively low risk in the range of scenarios examined, maintaining a large balance sheet as an active tool towards macroeconomic or financial stability does increase the variability of future remittances. As discussed in Section 6.1, this type of permanent balance sheet strategy could lead to debt management coordination problems between the Federal Reserve and the Treasury. It also might jeopardize the Federal Reserve's independence or ability to pursue its policy mandate should concerns about income losses call into question policymakers' commitment to raising interest rates when economic and financial conditions call for it.

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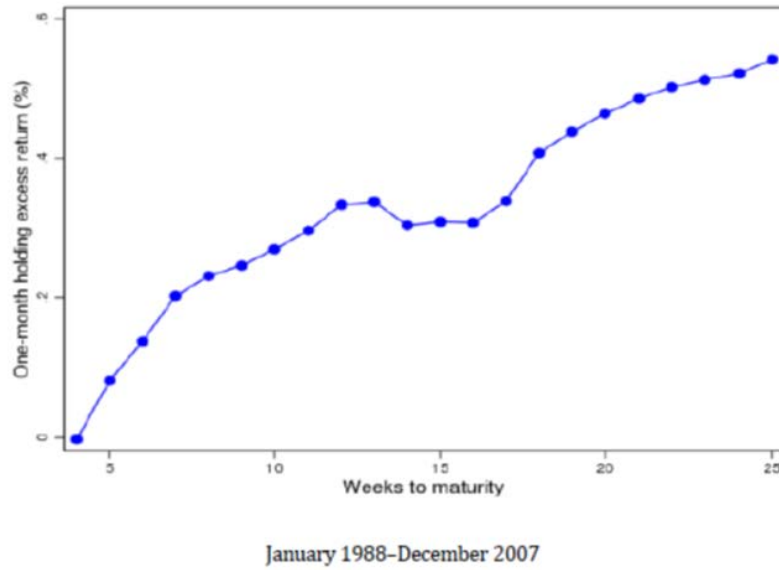
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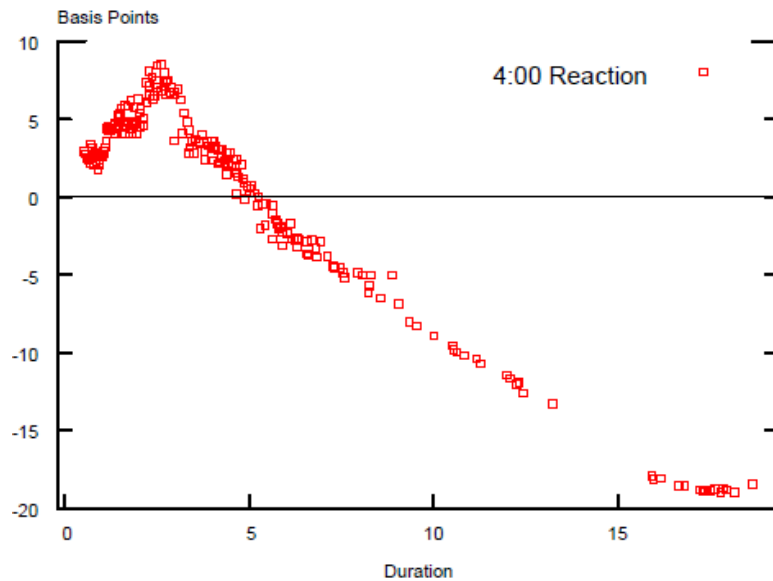
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Figure 1
Excess Returns on Treasury Bills, Relative to One-Week Rate



Source: Carlson *et al.* (2016)

Figure 2
Event Study around the announcement of the Maturity Extension Program



Source: Cahill *et al.* (2015)

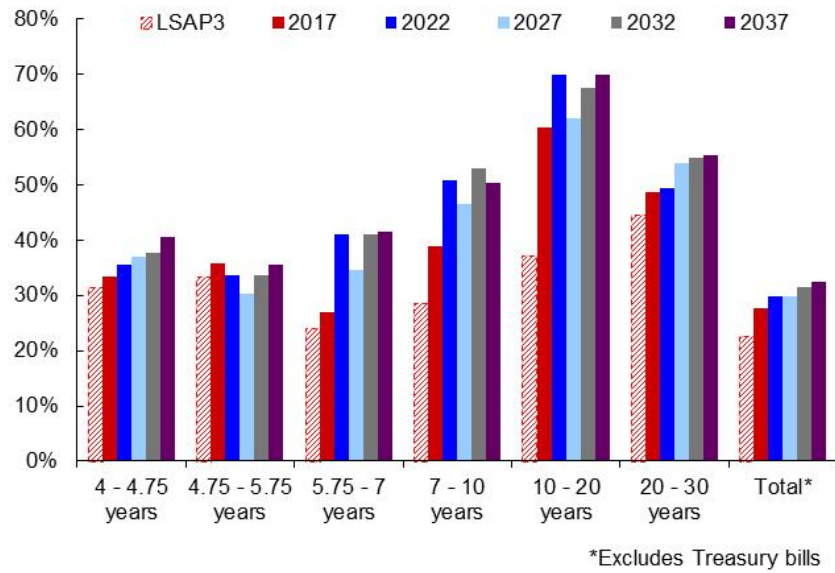
Table 1: Balance Sheet Size and Composition to be Able to Achieve Stated Objective

Balance Sheet as Active Tool Only at ELB/in a Crisis		Balance Sheet as More Permanent Active Tool		
	Normal/Ex-Ante Balance Sheet			Ex-Post Balance Sheet (if change applies)
	Balance Sheet Size (relative to currency)	SOMA Portfolio Composition		Balance Sheet Action
		Treasury Securities	Agency MBS	
Support Interest Rate Control (Passive Tool)				
Operate on steep part of demand curve	Small or large	Any duration*	Unnecessary**	n/a
Operate on flat part of demand curve	Small or large	Any duration	Unnecessary**	n/a
Support Macroeconomic Objectives (Active Tool)				
Provide monetary policy accommodation when ELB binds	Size determined by operating regime (small provides more scope to expand)	Relatively short-to medium-term holdings maximize future MEP/LSAP capacity	Small portfolio to maintain operational readiness	Expand size, lengthen maturity structure, buy agency MBS at ELB
Provide monetary policy accommodation away from ELB	Large	Longer-term holdings	Small portfolio to maintain operational readiness (but larger if used to provide accommodation)	(Could reduce size or maturity structure to remove accommodation)
Support Financial Stability Objectives (Active Tool)				
Improve market liquidity/functioning in periods of stress	Size determined by operating regime (small provides more scope to expand)	Relatively short-to medium-term holdings maximize future MEP/LSAP capacity	Small portfolio to maintain operational readiness	Expand size, lengthen maturity structure, buy agency MBS in crisis
Provide money-like assets	Likely large	Any duration (but medium-term assets may reduce political economy risk)	Unnecessary	n/a
Flatten yield curve	Possibly large	Relatively short-term holdings maximize future MEP capacity	Unnecessary	Lengthen maturity structure to flatten yield curve when desired
Expand HQLAs and risk-bearing capacity	Large	Avoid longer-term holdings	Large portfolio to free up Treasury securities for private investors	n/a
Lean against wind in housing market	Likely large	Any duration	Likely large portfolio	Sell agency MBS when conditions warrant

*Assumes effective use of IOER and liability management tools for interest rate control.

**Assumes sufficient supply of Treasury securities to support normal monetary policy implementation.

Figure 3
Projected SOMA Holdings as Share of Outstanding Treasury Supply Following
Conclusion of LSAP Programs



Source: Staff projections