

## FEDERAL RESERVE SYSTEM

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**Date:** June 16, 2009  
**To:** Federal Open Market Committee  
**From:** Brian F. Madigan and Brian Sack  
**Subject:** Attached Memos Regarding Experience with Large-Scale Asset Purchases

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Attached are two memos regarding large-scale asset purchases. The first memo, "Large-Scale Asset Purchases: Recent Experience and Some Policy Considerations," was prepared by staff of the Board of Governors and Federal Reserve Bank of New York; we expect this memo to be discussed at the June FOMC meeting. Also attached is a background memo, "The Recent Use of Large-Scale Asset Purchases by Foreign Central Banks," which was prepared by staff of the Board of Governors.

June 16, 2009

## **Large-Scale Asset Purchases: Recent Experience and Some Policy Considerations**

Staff of the Board of Governors of the Federal Reserve System and the Federal Reserve Bank of New York<sup>1</sup>

### **I. Introduction**

Since November 2008, the Federal Reserve has announced and initiated three large-scale asset purchase (LSAP) programs. On November 25, 2008, programs to purchase up to \$500 billion of agency MBS and up to \$100 billion of direct agency debt through the first half of 2009 were announced. The stated objective of these programs is to “support mortgage and housing markets” and “foster improved conditions in financial markets more generally.” At the March FOMC meeting, the agency MBS and agency debt programs were expanded, and a program to purchase Treasury securities was added to “help improve conditions in private credit markets.” These additions brought total anticipated LSAP program sizes to up to \$1.25 trillion in agency MBS, up to \$200 billion of agency debt, and up to \$300 billion of Treasuries, with Treasury purchases to be completed by September and agency MBS and agency debt purchases to be completed by year-end.

Although yields fell substantially on these announcements, yields have risen sharply over the current intermeeting period and are now considerably above levels observed prior to the March and April FOMC meetings. Market participants and policymakers have attributed the rise in yields to a variety of factors, including an improvement in the economic outlook, concerns about large federal deficits, a reversal of flight-to-quality flows, and technical factors related to the hedging of mortgage holdings. However, uncertainty surrounding the implementation and policy goals of LSAP programs reportedly has also played a role in this market response. Although expectations for expansion of the LSAP programs have been reduced over recent weeks, market participants have noted that they are still looking to the June FOMC statement for further clarity on LSAP program objectives and implementation.

This memo summarizes the experience to date with the LSAP programs in light of the goals and objectives of the Committee. It then discusses a variety of strategic decisions that the Committee could consider regarding the implementation of those programs.

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<sup>1</sup> Seamus Brown, Michelle Ezer, Patricia Mosser, Brian Sack, Julie Remache, David Zervos. Thanks to Jim Clouse, Joshua Frost, Joseph Gagnon, Andrew Huszar, Lorie Logan, David Lucca, Brian Madigan, Angela O’Connor, Roberto Perli, Matthew Raskin, Tony Rodrigues, and James Vickery for helpful comments.

## II. Evidence on the Impact of Large-Scale Asset Purchases

Over the last few months, several memos have examined the impact of LSAP programs. A memo by Gapen et al. (included in Appendix I) provides a conceptual framework for understanding the effects of the LSAP programs based on a review of the economics and finance literature. The main points we draw on from this work in our discussion of recent market events are as follows:

- The primary view from the economics and finance literature is that the effects of LSAP programs on asset prices come through changing the *stock* of the financial assets that investors hold in their portfolios. In particular, LSAPs can affect credit, term and liquidity premiums of the targeted assets and other related assets. We will refer to this as the portfolio balance effect, although we acknowledge that not all models within this literature are of this type.
- For the most part, market responses occur following announcements of LSAP programs rather than at the time of execution. It is fairly straightforward to identify a significant and immediate impact of LSAP announcements on long-term interest rates. However, identifying the medium-term effect is more difficult, and any such estimates are accompanied by wide bands of statistical uncertainty.<sup>2</sup>
- Short- and medium-term effects may be different because of distortions induced by uncertainty about the size, path, and effect of LSAPs. Furthermore, in general, short-run price responses may be partly attributable to technical rather than fundamental reasons, such as market microstructure issues, that cause relative inelasticity of demand and supply in the short-term. This may imply that LSAP programs can have effects through their impact on market *flows*.
- Moreover, ongoing purchases of assets may have considerable effects on long-term market interest rates if investors are heterogeneous (or if there are “segmented markets”). An LSAP program, if large enough, could leave the remaining outstanding securities in the hands of investors with a strong and more inelastic demand for the asset, enhancing the effect of asset purchases.
- If the effects of LSAPs on asset prices arise primarily through portfolio balance effects, then a fully anticipated end of the LSAPs would not be disruptive to the markets. However, to the extent that market flows do matter or that markets are segmented, it is possible that even a fully anticipated end of a program could be associated with a rise in yields.
- Announcing a yield target rather than a quantity target may have a larger effect on yields for a given quantity because it involves an implicit commitment to adjust the quantity of purchases without limit. A hybrid approach is to announce an endogenous response of purchases to movements in yields. Strategies that incorporate such responsiveness could act to lean against increases in yields, which may reduce yield volatility and even lower the term premium.
- A high degree of transparency is necessary to minimize uncertainty of program intent and implementation that undermines price discovery amongst market

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<sup>2</sup> Bikbov-Lucca, “The persistence of Treasury yield responses to LSAP announcements” (6/15/2009)

participants. This is likely to be especially true due to the novelty and uncertainty surrounding LSAPs at this time.

It is useful to consider the recent experience with the LSAP programs in light of the above conclusions. As has been discussed in recent memos and presentations to the Committee, Treasury yields declined sharply following Federal Reserve communications regarding LSAPs, including a 48 basis point drop in the 10-year yield on the announcement of Treasury purchases at the March FOMC meeting. These moves are consistent with the view that purchases of long-term assets affect long-term yields at the time of announcement and through a portfolio balance effect. However, since the day after the March FOMC meeting, yields have moved steadily higher. At 3.71 percent, the 10-year Treasury yield is nearly 117 basis points higher than the low reached following the expansion of the LSAP programs at the March meeting.<sup>3</sup> This move is most likely attributable to a number of fundamental factors (cited in the introduction), but it also underscores the difficulty in assessing the permanence of the effect on yields of the LSAP programs. Nevertheless, staff believe that yields remain lower than they otherwise would be in the absence of the LSAP programs.

Since the November 25 announcement, agency debt spreads have narrowed from historically wide levels to levels in line with or below historical norms. Limited mortgage portfolio growth at the agencies has reduced their issuance needs, so that LSAPs constitute a high percentage of new issuance. This pattern has led to rich valuations in benchmark agency debt and has forced some investors to reallocate their investments into other, non-benchmark agency products. While these effects are in line with the intentions of the program, these market developments also highlight the problems that LSAPs can create for market functioning, as participants have commented that continued agency purchases at the current rate could reduce liquidity by decreasing available trading supply and displacing traditional buy-and-hold investors.

Similar to agency debt, agency MBS purchases have compressed the spread of yields on MBS to yields on Treasuries. Prior to the announcement of the agency MBS purchase program, the Treasury-MBS spread was unusually wide.<sup>4</sup> This spread narrowed through the first several months of 2009, even as Treasury yields were also falling. When Treasury yields rose in April and early May, Federal Reserve purchases of newly-issued agency MBS were a dominant flow against increased issuance in the market, reportedly helping to stabilize the level of secondary mortgage rates and further compress spreads. In late May, however, continued increases in 10-year Treasury yields began to feed through to MBS rates, as market participants resisted further compression of historically low spreads to Treasury yields. The rise in MBS rates prompted waves of convexity-related selling that put further upward pressure on long-term interest rates, leading to a more abrupt upward adjustment in rates. Many market participants reportedly had expected the LSAP programs to be responsive to market conditions and, specifically, to increase as rates rose. The fact that purchases remained relatively steady

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<sup>3</sup> Data as of Monday, June 15 2009.

<sup>4</sup> Vickery, "Transmission from Treasury yields to agency MBS yields" (6/10/2009)

led them to revise their understanding of the responsiveness of Federal Reserve purchases, which reportedly contributed to the rise in yields.

Primary mortgage rates responded to the reduction in agency MBS yields with a moderate lag, and rates on conforming 30-year fixed-rate mortgages reached all-time lows in April. However, the spread between primary and secondary rates has been elevated. This spread hit a record wide level of 120 basis points in January, and although it has since narrowed, it remains roughly 20 to 40 basis points above its average value since 1992. Analysis suggests that the elevated level of the spread is due to diminished mortgage origination capacity coinciding with increased demand for mortgage refinancing, which has led to record profits for originators.<sup>5</sup> In addition, rising delinquency rates continue to increase both underwriting and servicing costs, which are passed through to primary rates. Primary mortgage rates have increased sharply with MBS and Treasury yields in recent weeks, though some portion of the rise in the MBS rate was absorbed via a reduction in the spread to the primary rate.

The importance of communication regarding LSAP programs has been evident since the first program announcement last year. Since that time, market participants have been highly attuned to any information about the Federal Reserve's policy and operational objectives and, in particular, to any information about how LSAPs would respond to changes in long-term interest rates. To date, the Desk has implemented a strategy of relatively consistent and transparent purchase amounts that have been largely invariant to market developments. While agency MBS and agency debt programs consider market dynamics at the margin in determining purchase amounts, these adjustments are relatively unnoticed by the market.<sup>6</sup>

Though LSAP program announcements provided no indication that the FOMC had an implicit rate target, many market participants reportedly believed that the Committee's rationale for implementing the LSAP programs was to maintain Treasury and secondary mortgage rates below certain thresholds in order to support a nascent refinancing wave.<sup>7</sup> In general, market participants believed that the size of the agency MBS and agency debt programs would enable the Committee to keep spreads low relative to Treasury yields and collectively all three LSAP programs would help mitigate any upward pressure on the level of Treasury yields. Because the relatively small size of the Treasury purchase program was viewed as a risk to the ability of LSAPs to keep long-term Treasuries yields low, many market participants anticipated a significant escalation

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<sup>5</sup> Chu-Gagnon-Raskin, "The Spread between Primary and Secondary Mortgage Rates" (6/15/2009)

<sup>6</sup> See Appendix II for a discussion of operational details pertaining to the Desk's implementation of the Treasury, Agency debt and Agency MBS LSAP programs.

<sup>7</sup> With primary rates below 5 percent, up to 50 percent of agency-guaranteed mortgages would be considered economically refinable, even under the assumption that a wide spread of at least 100 basis points between a homeowner's existing mortgage rate and the new mortgage rate would be required in the current environment. This high proportion of refinable mortgages, combined with initiatives undertaken by the Administration (including the Making Homes Affordable programs), were signs that policymakers viewed a refinancing wave as an important part of the economic recovery. At current levels, with primary rates at or greater than 5.5 percent, estimates suggest that only 10 percent of agency-guaranteed mortgages have the incentive to refinance.

of the Treasury purchase program when long-term yields began to rise. During the recent experience of high volatility and sharp increases in longer-term yields, market participants looked for some escalation in the size of Desk operations for signals of policymakers' views of market developments. In practice, as noted above, LSAPs reacted less to price developments than many expected. The fact that the pace of purchases remained relatively unchanged has led many to conclude that the Federal Reserve would "permit" higher yields, a view that contributed to the sharp rise in rates.

Given the differences in expectations for the program, it is not surprising that the recent large increases in long-term rates have led to increased uncertainty about the Federal Reserve's reaction function to interest rate moves. In turn, increased uncertainty may have exacerbated recent volatility in fixed-income markets. Indeed, many market participants now report much less certainty over the objectives of LSAP programs, suggesting that investors would welcome further communication by the Committee on the nature of the programs' objectives.

Despite these considerations, LSAP programs have likely lowered yields from where they would otherwise be. Staff see evidence of both stock and flow impacts through our experience so far, although we cannot be certain of the precise mechanism by which they work, or if the effects are permanent or transitory. That leaves a considerable degree of uncertainty in designing and implementing the LSAP programs, which we consider in the policy suggestions below.

### **III. Policy Objectives and Tradeoffs**

The stated objective of the LSAP programs is to lower private credit rates and increase credit availability in an effort to stimulate economic activity. For the LSAP programs, the private credit rates of particular interest are considered to be residential mortgage and corporate borrowing rates. Staff view this objective as subject to the constraints that the LSAP programs not overly distort normal market relationships, and, where possible, improve market functioning through the provision of trading liquidity. In addition, LSAP program structure perhaps should consider potential risk to the future capital and income position of the Federal Reserve.

There may be a tension between the objective and constraints for LSAP programs that requires active management by the Desk in implementing LSAP programs. By way of illustration, large increases in asset purchases may lower rates, but risk creating market dislocation, particularly in programs where spreads are lower than historical norms and SOMA purchases represent a substantial majority of new origination or supply. In this case, continuing to purchase in large size and to concentrate purchases in certain securities in amounts up to the total amount of supply raises the risk that other investors will move away from these particular assets. This is the current position of the agency debt purchase program and, to some extent, the agency MBS program. If done for a prolonged period of time, such a strategy could have a lasting adverse effect on market structure. Additionally, a successful LSAP policy may result in future losses or reduced income for the SOMA portfolio, as any success in lowering long-term yields implies that

the SOMA is accumulating assets with a relatively high price and low yield. Decisions about future modifications to the LSAPs could depend on what weight the Committee places on preserving good market functioning and on future SOMA income relative to the primary objective of lowering private credit rates.

#### IV. Policy Considerations Regarding LSAPs

Below, staff discuss a number of considerations regarding the design and implementation of LSAP programs and present several policy options for the Committee to consider. The policy options reflect the tradeoffs discussed in section III and are informed by our experience with the LSAP programs to date. We divide the discussion into two areas: (A) Policy options related to size and flexibility of LSAP program implementation; and (B) other considerations for the implementation of LSAPs based on policy goals and experience to date.

##### A. Policy Options Related to Size and Flexibility of LSAP Programs

Thus far, the Desk has purchased relatively fixed quantities of the various asset classes each month, factoring in the overall size of the purchase programs relative to the stated time horizons of those programs.<sup>8</sup> Program totals through June 12 are summarized in Table 1. Going forward, the Committee could consider one or more possible changes to the programs in order to improve program effectiveness. The changes outlined below are covered in two parts: (1) Alteration of LSAP program parameters; and (2) increased LSAP program flexibility. These changes could be considered in isolation or in some combination.

Table 1. Summary of Large Scale Asset Purchase Programs

	Total Purchases (billions of dollars)	Program Limit (billions of dollars)	Target End Date	Percent Completion
Treasury	\$157	\$300	Sept. 2009	52%
Agency Debt	\$89	\$200	Dec. 2009	45%
Agency MBS	\$549	\$1,250	Dec. 2009	44%
Total	\$791	\$1,750		45%

Total purchases are reported in par value and reflect purchases through June 12.

1. **Alteration of LSAP Program Parameters.** A first set of possible changes pertains to the size and composition of the LSAP programs. These include:

- a. **Expand LSAP Size and Extend Time Frame.** If it viewed the recent run-up in longer-term interest rates as problematic, the FOMC may want to consider an expansion of the LSAP programs at the June meeting. An expansion of the LSAP programs could lower the level of yields, particularly if it were to exceed the

<sup>8</sup> While there has been some daily variation in purchase sizes in MBS and agency securities in response to market events, these are not noticeable at monthly horizons. See Appendix II for more details on LSAP implementation.

expectations of market participants. Based upon the Desk's June monetary policy survey, expectations for an increase in LSAP programs are modest, with the median probability of an expansion of each LSAP program between 10 and 15 percent.

- Expansion of the Treasury program is a natural choice given the relatively small size of this program and the considerable amount of net new supply coming to the Treasury market.<sup>9</sup> While the Treasury purchases will not fully offset the supply that is coming to market, they can still act to keep Treasury yields lower than would otherwise be the case. Moreover, although expectations for an expansion are relatively low, all respondents to the Desk's monetary policy survey assigned a positive probability to the potential expansion of the program in June. In line with this, the FOMC may want to consider that a decision not to expand LSAP programs may put some upward pressure on yields. If the Committee wishes to move in this direction, there are two options that staff believe are worth consideration:

The *first option* could be to announce a large increase in purchases, such as an expansion of the Treasury LSAP program of up to a total size of \$800 billion (including the current \$300 billion allocation), to be accompanied by an extension of the program execution time frame to year-end. These changes would involve a step-up in the frequency and/or size of Treasury purchases and would make the expiration of the program consistent with the agency MBS and agency debt LSAP programs. By increasing the size notably, the Federal Reserve would be conveying its intent to resist a sizable increase in long-term interest rates. However, a large increase in the Treasury program may also heighten investor concerns about debt monetization and inflation, limiting the effectiveness of the program.

The *second option* could be to announce a more modest expansion of the Treasury program. In particular, if the Committee preferred not to commit to a large scale expansion of the Treasury LSAP program but felt that it was premature to signal a conclusion to the LSAP programs, it could announce that the current pace of Treasury purchases would be extended through the end of the year, bringing the total size of the Treasury program to \$450 billion (including the current \$300 billion allocation). One benefit of this approach would be to delay assessment of whether to end the Treasury LSAP program, as this assessment would otherwise come into focus within a short time of the June FOMC meeting. The smaller size of the expansion should lead to fewer concerns regarding monetization and

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<sup>9</sup> Agency debt and agency MBS purchases represent approximately 30 percent of the current stock of assets and 200-300 percent of expected issuance through year-end within their respective asset classes, while the Treasury program represents 10 percent of the current stock of Treasury securities and 35 percent of expected new issuance through September.



inflation than in the first option mentioned above. The primary risk under this approach may be that, as a result of the small size of the expansion, it could be perceived as a futile step. However, this risk could be addressed by communicating that this is a technical change to align the end dates of all three LSAP programs, and that future decisions about the size of the programs will depend on the evolution of economic and financial conditions.

- As an alternative to increased Treasury purchases, the Committee could consider an expansion of the agency MBS LSAP program. This would have the advantage of being a step removed from the monetization concern and would more directly operate on mortgage rates. However, given expectations for low issuance at the current level of interest rates and the large size of the existing program, a sizable expansion of agency MBS purchases could increase the risk of market distortion from LSAPs. It would be important to shift the pattern of purchases even further away from new production securities in order to minimize this risk. In addition, policymakers may have some concern that MBS purchases are targeted at a particular market sector.
- For agency debt securities, the staff feel that any expansion of the purchase program is inadvisable, given the narrow spread evident in agency debt and shrinking supply. In fact, the staff note that current market conditions strongly suggest that the Federal Reserve not purchase the full amount of the announced limit for agency debt, exercising the flexibility provided by using the “up to \$200 billion” language in the FOMC statement and the Desk directive.

**b. *LSAP Program Reallocation.*** An alternative approach the Committee may wish to consider, but that the staff would not recommend, is an explicit reallocation of the \$1.75 trillion LSAP programs’ budget between the three programs. This change might involve a reallocation of some portion of the funds assigned to agency debt or agency MBS programs to Treasury purchases. Since the agency MBS and agency debt programs are much larger in relation to their respective markets than the Treasury program is in relation to the total supply of Treasury securities, a diversion of funds allocated to agency MBS and/or agency debt to Treasuries may be beneficial on the margin. For example, the agency program could be decreased to \$150 billion and the agency MBS program to \$900 billion, while the total Treasury program could be increased to \$700 billion. A significant risk to this approach, however, is that a decrease in the commitment of purchases to agency debt and agency MBS would be a surprise to market participants, and could be expected to lead to a reversal of some of the spread tightening seen since LSAPs were implemented. In addition, such a change could increase ongoing uncertainty regarding LSAP program objectives and implementation. However, to some degree this uncertainty could be addressed through clear communication.

A variant of this approach is to allow the Desk to have more flexibility in sizing and asset allocation amongst the LSAP programs, which is discussed below.

2. ***Increased LSAP Program Flexibility.*** A second set of changes that the Committee may wish to consider pertain to the flexibility of the execution of the various LSAP programs. Broadly speaking, this flexibility would be designed to make the LSAP programs more responsive to changes in market interest rates and other short-term market dynamics by adjusting either the types of assets purchased, the magnitude of those purchases, or both. Such a dynamic strategy could be thought of as influencing market pricing by providing a direct counterbalance to market flows, which may serve to limit volatility. Depending on the Committee's views about the overall size and allocation of LSAP programs, the Desk could implement more responsive operations in one of two ways:

a. ***Responsive operation sizing and pace.*** The Committee may wish to instruct the Desk to pursue a more actively managed implementation strategy that is more responsive to short-term market developments. As opposed to the relatively steady approach adopted thus far, a strategy that is more directly guided by short-term interest rate developments may serve to reinforce market participants' understanding of the policy objective for the LSAP programs. For example, the Desk could purchase larger quantities of assets during periods when yields are rising and fewer assets when yields are falling. This more responsive approach would serve to reinforce the commitment of LSAPs on an ongoing basis and provide information about the Committee's reaction function. In that regard, such adjustments take a step towards providing a soft commitment to interest rate targets. That approach has the advantage that, if the markets came to understand such a strategy was in place, it may reduce volatility and could even lessen the need for actually making large adjustments to operations. However, an obvious drawback is the complication of determining an appropriate rate level that should trigger increased purchases. Indeed, that level will presumably depend on a number of considerations, including the source of the upward pressure on rates, in which case it may be infeasible to define the points at which the Desk would be responsive. Indeed, any such shift in this direction would require very clear direction to the Desk as to the objective of the LSAP programs and a commensurately firm level of commitment to those objectives. In addition, success implementing such a strategy may be limited if the program size was not adequate to smooth market adjustments or credible enough to demonstrate the necessary commitment. In particular, undertaking this approach with the Treasury LSAP program could be difficult at the current size of the program, since increasing purchases in the near-term would only hasten concerns around the end of the program, particularly in the absence of a marked expansion. This approach is likely to be more effective if the program size were larger relative to the market, or if the Committee were to indicate a willingness to allocate additional balance sheet based on market developments.

- b. *Combined LSAP portfolio approach.*** The Committee may also wish to consider an approach in which funds are considered fungible across asset classes or part of one “portfolio” of LSAPs targeting a set of asset classes, rather than the current approach of having a predetermined allocation to each specific asset class. The Committee would presumably instruct the Desk to adjust size, timing, and allocation of resources to apply LSAP funds in the most efficient manner. For example, a scenario of rising yields accompanied by narrowing spreads on agency MBS and agency debt may call for larger purchases of Treasury securities, whereas a scenario of declining yields and widening spreads may call for larger purchases of agency debt and agency MBS.<sup>10</sup> This option may be particularly useful in light of the constraint that LSAP programs not distort market conditions excessively, and the relative imbalances of the current LSAP asset allocations. This approach could have the added advantage of containing the future size of the Federal Reserve’s balance sheet, to the extent that it allows the Desk to target LSAPs where they are perceived to have the greatest policy impact. In fact, a large portion of the benefit of the portfolio approach would arise from its signaling effects to markets about the levels at which the LSAP programs seek to resist further rate movements. However, as noted above, it may be difficult to provide these signals in an effective manner because the desired level of long-term interest rates will depend on what factors are pushing rates higher. It would be particularly critical that the Committee articulate to the public the policy goals of the program, and that the Desk clearly understand and implement an operating framework consistent with the Committee’s views in order to minimize uncertainty with this approach. In addition, there is also a smaller risk that the combined size of the programs may no longer be considered large relative to the combined markets.

*B. Other Implementation Issues and Policy Considerations*

In addition to issues pertaining to size, composition and flexibility of the LSAP programs, we outline four additional areas for consideration below:

- 1. *Consider LSAP exit strategy.*** Regardless of decisions about changes to size, duration, or flexibility of the LSAP programs, the Committee may wish to carefully consider “cliff effects” around program end dates—that is, the risk of a sharp, volatile adjustment in rates given an abrupt end to LSAP programs. If LSAPs impact rates only through a stock effect and the program end is fully anticipated, then cliff effects are of little concern, since cessation of Federal Reserve purchases would cause no further adjustment of rates. However, if one believes that flows matter in price determination, then cliff effects are important to consider in thinking about the design and evolution of LSAP programs. Since we cannot conclude definitively whether LSAPs affect prices through just one or

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<sup>10</sup> One approach would be to define a set of market-based criteria to direct the purchases. Such a framework might consider normal relationships between the targeted asset classes, amongst other things. Boundaries could be established for substitution between asset classes and a process for regular consultation on program direction could be instituted.

both of these channels, the Committee may wish to consider scaling the amount of purchases down slowly over time to mitigate the risk that an abrupt change in flows could lead to an abrupt adjustment in market prices. Such scaling down could be done by speeding up purchases now in order to slow down purchases before the programs end, or by extending the purchase programs past their current expiration dates but in smaller sizes.

- 2. *Increase interest rate duration of purchases.*** If the Committee prefers not to increase the size of LSAP programs at this time, but still wishes to increase the impact of LSAPs on long-term interest rates, purchases of assets within each LSAP program could be shifted to longer-duration securities. While agency MBS and agency debt purchases are already concentrated in long duration securities, there is considerable scope to shift purchases within the Treasury program from the 2- to 10-year sector to focus more directly on 7- to 30-year securities. By purchasing longer duration assets from the market, we would expect that the impact on long-term rates would be enhanced. Depending on how strongly this shift were implemented, it is possible that this action could lead to some distortion of the Treasury yield curve. This shift in tactics would also result in more interest rate and income risk to the SOMA, and may introduce additional uncertainty around program objectives and implementation.
- 3. *Diversify purchases.*** Within the agency MBS LSAP program, there may be some scope to make changes to the specific securities included for purchase. To date, purchases have been largely concentrated in the 30-year fixed-rate agency MBS sector, as this is the largest and most liquid portion of the agency MBS market. At this time, staff recommend that hybrid ARMs guaranteed by Fannie Mae, Freddie Mac, and Ginnie Mae be included in the agency MBS program.<sup>11</sup> Such purchases are covered by the current directive, and by diversifying purchases amongst other agency-guaranteed MBS products, may provide an alternative channel of rate relief to borrowers in spite of the sharp increase in primary rates, consistent with the policy objective of the MBS LSAP program. Given the small size of the hybrid ARM market, even a small allocation of up to \$100 billion could be expected to have a noticeable impact. Inclusion of ARMs would also reduce overall portfolio risk. However, noting the contrast with the previous consideration to shift purchases towards securities with greater duration, shifting funds to lower-duration securities might be expected to lessen the overall impact on long-term interest rates. Furthermore, the Committee may want to consider carefully the potential implications of supporting adjustable rate mortgages with relatively short reset periods (such as 1 year) because of their dependence on the future path of short-term interest rates. More details of this proposal can be found in Appendix III.

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<sup>11</sup> A hybrid ARM is a mortgage product which has a fixed interest rate for a set period of time, e.g. 5 years, after which point the mortgage resets to an adjustable rate mortgage typically tied to either a LIBOR or Treasury benchmark rate.

4. ***Add options to the LSAP strategy.*** Above we discussed the possibility of allowing the pace and composition of asset purchases to be responsive to changes in market conditions. Along these same lines, the Committee may want to consider an approach to sell put options on assets included in the LSAPs as a complement to LSAP programs. The most effective candidates for this approach are options on Treasuries and agency MBS. In many ways, an approach of buying more securities when the yield on the asset gets to a particular level is, in effect, providing an investor with an option to put the security to the Federal Reserve at that price. Selling the option explicitly would not only allow the Federal Reserve to capture the value of that commitment, but would provide clarity to the market about the rate objectives of policymakers. Moreover, the options would be seen as a useful hedging device for market participants, as they would offset some of the increase in duration that mortgage holders experience in a rising rate environment (that is, they provide convexity to offset the negative convexity of MBS). That might reduce the amount of dynamic mortgage hedging that the market has to conduct, which could help to lower volatility and to reduce risk premia and hence long-term rates. Additionally, since uncertainty about long-term interest rates is high and the market places considerable value on convexity, these options currently carry a high price that would be captured by these sales. However, it is not clear how strike prices would be set appropriately. Indeed, policymakers have not set a target for long-term interest rates, in large part because any assessment of the appropriate level of long-term rates will depend on what factors are driving yields, as discussed above. Moreover, there are a number of legal and operational issues that would need to be addressed before this approach could be implemented. Staff estimate that it would take six weeks to bring an agency MBS or Treasury options program to market.

## **V. Conclusions**

There are many challenges surrounding the design and implementation of LSAP programs. The purpose of this memo was to frame some of the key issues that are relevant today; other issues will surely arise as the programs move forward. The effectiveness of the programs will depend on the Committee's decisions on the issues raised above. Unfortunately, those decisions have to be made with little historical guidance, given the lack of experience with such programs. With that constraint, the above discussion relies heavily on the recent behavior of markets and discussions with market participants. This information will hopefully be helpful in reaching the appropriate decisions, though the conclusions reached are surrounded by a considerable amount of uncertainty.

## **Appendix I: A Conceptual Framework for Large-Scale Asset Purchases**<sup>12</sup>

### **I. Introduction and Summary**

This appendix discusses a conceptual framework for large-scale asset purchases drawing from contributions in the economics and finance literature and some of its implications for the implementation of the LSAP program. These implications can be summarized as follows:

- Yields on debt obligations can be expressed as the sum of expected short-term risk-free interest rates and other terms (or “risk premiums”) related, for example, to the credit, term, and liquidity risk of a given debt instrument. By affecting risk premiums, LSAPs may generate persistent effects on debt yields to the extent that these purchases alter the relative stocks of securities in the hands of private investors in long-lasting ways.
- Yield reactions occur when the paths of total purchases are announced rather than when the actual flows of purchases are implemented. Market frictions and price discovery mechanisms amid uncertainty about the effects of LSAPs can, however, distort short-run market responses to LSAPs announcements.
- Upfront announcements regarding the path and total size of asset purchases, as opposed to incremental announcements, appear to be desirable in order to limit market uncertainties.
- The novelty and uncertainty associated with LSAPs and their ultimate effects place a high premium on effective policy communication and provision of adequate forward guidance. Even announcements of targeted levels of asset purchases are unlikely to remove all uncertainty, due to the heterogeneity of beliefs among market participants about the effect of LSAPs. Alternative policies that allow LSAPs to respond to interest rate moves so as to keep yields in a narrow range could in theory reduce such uncertainty. However, reactive LSAPs programs can imply very large asset purchases, complicating exit strategies, and can be perceived by investors as being inconsistent ex-ante with other policy objectives such as price stability.
- Due to forward-looking pricing of financial assets, no abrupt movement in yields should occur at the completion of pre-announced purchases. If an LSAP is, however, large relative to market volume and only relatively yield-insensitive investors hold the targeted asset, it may be desirable to taper off purchases toward the end of the program to avoid sudden increases in yields.

### **II. Neutrality of LSAPs in standard macroeconomic models**

Standard macroeconomic models are not well suited for studying the implications of programs such as LSAPs. The assumptions underlying these models include a complete

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<sup>12</sup> Michael Gapsen, David Lucca, Elmar Mertens, Edward Nelson, Clara Vega, and Tack Yun. We are very grateful to James Clouse, Joseph Gagnon, Brian Madigan, Roberto Perli, and Staff at the Desk for their advice and comments.

set of frictionless financial markets in which prices of financial assets depend only on the assets' payoffs and their correlation with aggregate consumption, because all agents have the option to insure fully against idiosyncratic risks. In addition, frictionless financial markets in these models limit the scope for monetary policy to affect risk premiums. Finally, because Ricardian equivalence is a standard model feature, the choice between different methods of financing government spending, including issuing debt at short vs. long maturities, is irrelevant.<sup>13</sup> Because of these assumptions, these frameworks imply that operations such as LSAPs will not affect risk premiums and are therefore completely neutral, unless they can be used to influence expectations about the future path of short-term interest rates.<sup>14</sup> To contemplate the effects of LSAPs on long-term interest rates, more general model frameworks, such as those discussed in the next section, are needed.

### III. Effects of LSAPs in more general economic frameworks

The size, composition, and distribution of financial assets in the hands of the private sector can affect asset pricing in sufficiently rich frameworks in which financial markets are imperfect. In these frameworks, financial returns matter directly for consumption levels of private investors as well as for investors' relative valuations of cash flows across states of the world and over time. As a result, a shift in the relative supply of an asset will generally affect its price, with spillover effects on other asset prices. In turn, with imperfect financial markets, different forms of risk premiums will affect the level of economic activity through aggregate demand and supply.<sup>15</sup>

The asset price response to a given change in supply crucially depends on the sensitivity of its demand function with respect to prices. The rest of this section summarizes contributions from the finance and macroeconomic literature, which can be helpful in thinking about the reaction of investors to changes in asset supplies through their effects on credit, term, and liquidity risk premiums. Some of these models were promoted in the "Yale" and monetarist literatures during the 1960s and 1970s<sup>16</sup> and have been used more recently in the credit-channel literature.<sup>17</sup>

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<sup>13</sup> See, for example, Charles I. Plosser, "Government Financing Decisions and Asset Returns," *Journal of Monetary Economics*, Vol. 9, 1982, pp. 325-352, especially equation (2), p. 328. Carl E. Walsh (in "Comments on 'Conducting Monetary Policy at Very Low Short-Term Interest Rates,'" ASSA meetings, San Diego, January 3, 2004) describes the insensitivity of long rates to quantities as "almost universal" across "standard models" in macroeconomics.

<sup>14</sup> Gaudi B. Eggertson and Michael Woodford, in "The Zero Bound on Interest Rates and Optimal Monetary Policy," *Brookings Papers on Economic Activity*, 2003, Vol. 1, pp. 139-211.

<sup>15</sup> For example, credit spreads affect economic activity in models of the financial accelerator, for example, Ben Bernanke and Mark Gertler, "Agency Costs, Net Worth, and Business Fluctuations," *American Economic Review*, Vol. 79, 1989, pp. 14-31. With the exception of time-to-build models, investment projects in standard macroeconomic models are short-lived, and generally there is no role for term premiums.

<sup>16</sup> For example, James Tobin, "A General Equilibrium Approach to Monetary Theory," *Journal of Money, Credit, and Banking*, Vol. 1, 1969, pp. 15-29; Karl Brunner and Allan H. Meltzer, "Mr. Hicks and the 'Monetarists,'" *Economica*, Vol. 40, 1973, pp. 44-59.

<sup>17</sup> See Ben Bernanke and Alan S. Blinder, "Credit, Money and Aggregate Demand," *American Economic Association Papers and Proceedings*, Vol. 78, May 1988, pp. 435-439.

A first framework that is helpful in thinking about the effects of LSAPs is the portfolio choice model. This model has been widely used in the finance literature, either in its “mean-variance” or its “utility of consumption” formulation.<sup>18</sup> In this framework, agents’ willingness to hold different types of assets depends on the expected returns of these assets, on their risk aversion, and on the covariance of asset returns with each other and the state of the economy. By affecting relative asset supplies, LSAPs can affect credit- and term-risk premiums by changing income streams to investors from their financial wealth across states of the world and over time.

Some early empirical contributions based on this model type attempted to estimate the effects of increases in the supply of Treasury securities on private yields. These studies indicated relatively limited effects<sup>19</sup> and would therefore suggest that LSAP operations would not achieve broad-based reductions of credit spreads or of long-term yields. More recent empirical work, however, has come to different conclusions. This work, largely based on dynamic portfolio choice models, has shown that changes in asset supplies can, for example, have significant effects on aggregate savings and the ratio of household wealth to GDP.<sup>20</sup> Such findings lend support to the notion that LSAPs can have an influence on yields and economic activity.

In addition to the standard mean-variance approach to portfolio selection, a closely related class of models falls under the label of “preferred habitat.” Preferred-habitat models focus on the implications for long-term interest rate behavior of the fact that different maturity profiles are suited to different classes of investors.<sup>21</sup> Long-term government securities may be especially attractive to institutions such as pension funds which tend to hold these securities to maturity (for example, because these assets match closely the horizon associated with their liabilities, or for regulatory reasons). On the other hand, some agents may be limited by risk aversion or by their financial leverage in

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<sup>18</sup> For early mean-variance analysis see Harry Markowitz, “Portfolio Selection,” *Journal of Finance*, Vol. 7, 1952, pp. 77-91. For the general equilibrium extension of mean-variance analysis, see William Sharpe, “Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk,” *Journal of Finance*, Vol. 19, 1964, pp. 425-442. More recently, John Y. Campbell and Luis M. Viceira, “Who Should Buy Long-Term Bonds?,” *American Economic Review*, Vol. 91, March 2001, pp. 99-127; and “The Term Structure of the Risk-Return Tradeoff,” NBER Working Paper No. 11119, February 2005, present a dynamic portfolio choice framework in which agents prefer, on risk-aversion grounds, to hold assets that serve as insurance against future risks, while the classic mean-variance approach to portfolio selection focuses on contemporaneous covariance matrix of asset returns.

<sup>19</sup> These studies indicated that the “portfolio crowding out” effects of Treasury securities were fairly limited under reasonable parameterizations for investors’ risk aversion. See for example, Jeffrey Frankel, “Portfolio Crowding-out, Empirically Estimated,” *Quarterly Journal of Economics*, Supplement 1985, Vol. 100, pp. 1045-1065.

<sup>20</sup> For example, Monica Piazzesi and Martin Schneider, “Asset Prices and Asset Quantities,” *Journal of the European Economic Association*, Vol. 5, April-May 2007, pp. 380-389.

<sup>21</sup> Preferred-habitat models are due to Franco Modigliani and R.C. Sutch, “Innovations in Interest-Rate Policy,” *American Economic Association Papers and Proceedings*, Vol. 56, May 1966, pp. 178-197, and Franco Modigliani and Robert J. Shiller, “Rational Expectations and the Term Structure of Interest Rates,” *Economica*, Vol. 40, February 1973, pp. 12-43. Jessica Wachter, “Risk Aversion and Allocation to Long-Term Bonds,” *Journal of Economic Theory*, Vol. 112, October 2003, pp. 325-333, shows that the implications of preferred-habitat models are equivalent to those obtained from portfolio choice models under very high values of risk aversion.



shifting their portfolios between long- and short-term securities.<sup>22</sup> In this case, LSAPs will affect the relationship linking short- and long-term yields, or the term risk premium, through shifts in the relative supply of short- and long-term debt.<sup>23</sup>

Early empirical work in this literature analyzed the effects of the “Operation Twist” policy experiment, and found only limited effects on the term structure of interest rates, partly due to the limited size of the program.<sup>24</sup> More recent work, not focusing only on Operation Twist and based on long samples, suggests instead that the relative supplies of short- and long-term Treasury securities can have non-negligible effects on the slope of the yield curve for U.S. government debt.<sup>25</sup>

Additional contributions in the finance literature have highlighted the importance of some idiosyncratic factors for certain assets in determining the steepness of the demand functions for those assets. These contributions suggest that LSAPs may affect credit and liquidity premiums of financial assets. Recent work has attributed a significant component of the movement in spreads between yields on Treasury securities and those on other debt securities to agents’ preferences for the high liquidity of Treasury securities.<sup>26</sup> Other work has highlighted the fact that institutional factors may limit the substitutability of different forms of debt in the portfolio of certain agents (for example, the importance of sovereign securities for foreign official investors, and of fixed portfolio weights for passive index investors), leading to steeper aggregate demand functions for certain assets. In particular, LSAPs will have proportionately larger effects if fewer close substitutes are available to the agents investing in these assets.<sup>27</sup>

The model classes summarized above imply that LSAPs can have persistent effects on the pricing of the targeted and related assets by altering the relative stocks of the securities in the hands of the private sector in a long-lasting way. These models, in their

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<sup>22</sup> For example in Robin Greenwood and Dimitri Vayanos, “Bond Supply and Excess Bond Returns,” NBER Working Paper No. 13806, February 2008, the agents carrying out the arbitrage are risk averse and so require a premium to induce them to invest in longer-term assets.

<sup>23</sup> This notion has motivated recent modifications of the FRBUS model, which were the basis for the LSAP simulations conducted by staff. See the discussion in the memo by Joseph Gagnon on April 23, 2009.

<sup>24</sup> Operation Twist refers to the attempts by the Federal Reserve and the Department of the Treasury in the early 1960s to change the slope of the yield curve by changing the maturity composition of the stock of government debt in the hands of the private sector. See Modigliani and Sutch, *op cit*.

<sup>25</sup> Greenwood and Vayanos, *op cit*; Robin Greenwood, Samuel Hanson, and Jeremy Stein, “A Gap-Filling Theory of Corporate Debt Maturity Choice,” NBER Working Paper No. 14087, June 2008; Kenneth Kuttner, “Can Central Banks Target Bond Prices?,” NBER Working Paper No. W12454, August 2006. See also the December 5, 2008, FOMC note by Cabana *et al* for a review of the quantitative effects implied by some of these models.

<sup>26</sup> For example, Annette Vissing-Jorgensen and Arvind Krishnamurthy, “The Aggregate Demand for Treasury Debt,” NBER Working Paper No. 12881, August 2008, on investment-grade corporate bond spreads; Fabio Cortes, “Understanding and Modelling Swap Spreads,” *Bank of England Quarterly Bulletin*, Vol. 34, Winter 2003, pp. 407-416, on swap spreads; Francis Longstaff, “The Flight to Liquidity Premium in U.S. Treasury Bond Prices,” *Journal of Business*, Vol. 77, 2004, pp. 511-526, on RefCorp spreads; and Benjamin M. Friedman and Kenneth Kuttner, “Indicator Properties of the Paper-Bill Spread: Lessons from Recent Experience,” *Review of Economics and Statistics*, Vol. 80, February 1998, pp. 34-44, on short-term debt instruments.

<sup>27</sup> For example, see Annette Vissing-Jorgensen and Arvind Krishnamurthy, *op cit*.

original or in more general formulations, also imply that the yields on different securities will respond not only to the implementation of the programs, but also to initial announcements of the programs. Indeed, standard asset pricing models imply that the current demand of an asset depends both on its current and its expected future price, and so on the entire future expected path of purchases. The announced path of purchases will generally matter for current pricing, with paths implying earlier purchases eliciting relatively more pronounced yield responses after the initial announcements. All else equal, the responses in the targeted market will also depend on the size of the purchases relative to current and future amounts outstanding for those specific securities that are included in the program. For the LSAP Treasury program, the relevant scale is therefore the current and expected stock of both “on-the-run” and “off-the-run” issues. For the MBS program, which has primarily targeted newly issued lower-coupon securities rather than the pre-existing higher-coupon ones, the yield responses should depend on the amount purchased relative to current and future expected issuance of lower-coupon MBS. However, to the extent that investors substitute between lower- and higher-coupon securities, the yield responses to the MBS LSAPs may also depend on the expected stock of higher-coupon securities.

The responses of yields to LSAPs will also depend on the sensitivity of new issuance to yield changes. Yield responses to LSAPs for assets whose issuance is more sensitive to yields will be generally smaller because the initial reduction in yields will be offset in part by increased issuance. Under the “regular and predictable” debt management strategy employed by the Treasury, issuance is rather insensitive to yields, while issuance of other debt instruments, such as corporate bonds and MBS, generally increases with declines in yields.<sup>28</sup> As a result, the effects of LSAPs of Treasury securities on their yields will be more pronounced as compared to those of LSAPs of other assets on the targeted yields, all else equal.

The degree of substitutability of different assets in investor portfolios will also influence the response of yields on securities not directly targeted by LSAPs, with these responses being more pronounced for assets viewed as closer substitutes to the ones targeted. The portfolio choice model, for example, implies that yield responses related to Treasury LSAPs of investment-grade corporate bonds and agency securities should be larger than those of other financial assets, due to the historically high correlation in the returns of the three asset classes. In addition, preferred habitat models imply that assets of comparable maturities are affected in similar ways (that is, the purchases of, say, longer-term Treasury securities would be more effective in lowering longer-term corporate yields). Nonetheless, the substitutability among asset types is not perfect, and demand may be affected by factors specific to certain classes of securities. For example, the spillover to private yields of the LSAP operations in the Treasury market may be weaker if some agents, such as foreign holders of U.S. government securities, demand

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<sup>28</sup> On Treasury issuance, see Kenneth D. Garbade, “The Emergence of ‘Regular and Predictable’ as a Treasury Debt Management Strategy,” *Economic Policy Review*, Vol. 13, Number 1, 2007. On active corporate bond issuance see Malcolm Baker, Robin Greenwood, and Jeffrey Wurgler, “The Maturity of Debt Issues and Predictable Variation in Bond Returns,” *Journal of Financial Economics*, Vol. 70, November 2003, pp. 261-291. MBS issuance responds to yields through the refinancing process.

U.S. government debt because of its sovereign character and so would not view U.S. corporate long-term bonds as an alternative to these assets. Similarly, passive index investors would not adjust their portfolios as a result of LSAPs, leading to limited direct spillovers to other yields and wider spreads relative to the targeted assets.

The models discussed in this section, or some of their extensions, also suggest that the responses to announcements and actual implementations of LSAPs could differ depending on the time horizon considered. Investors may be slow to adjust their portfolios in response to asset price movements because portfolio reallocations (in the targeted or related markets) might take some time. Likewise, price fluctuations may be greater in the short run, when demand functions are more inelastic due, for example, to limited investor participation. Finally, different liquidity levels across markets could lead price responses in the most liquid markets to “overshoot” initially as a result of the thinner trading, and the related price stickiness, in other asset markets. Taken together, these observations suggest that the long-term effect of LSAPs may be significantly different than the reaction immediately following the announcements. In the next section, we explore more short-term dynamics arising from market frictions that could drive further wedges between the immediate- and long-lasting effects of LSAPs.

#### **IV. Market microstructure models: Market frictions and price discovery**

The previous section described how LSAPs could affect bond prices through mechanisms that do not consider the role of trading in the process of price discovery. Typically, the models considered thus far assume no trading costs, and that relevant information for valuing a security is freely available and widely shared. In this case, prices react quickly to the arrival of new information—such as the announcement of LSAPs. In contrast, the microstructure literature shows how certain market frictions can influence asset prices and quantities traded over longer horizons.<sup>29</sup> This literature has implications for how quickly prices will adjust to their new equilibrium value following the announcement of LSAPs. The speed of adjustment will be a function of the transparency of the announcement and the heterogeneity of investors’ beliefs. In this section we discuss the implications of informational frictions and non-information based models of market microstructure.

In microstructure models, security prices are set by financial intermediaries—like securities dealers or market makers—who serve to offset imbalances in the flow of trading orders. Intermediaries need to consider two different issues when quoting prices. First, intermediaries risk trading against investors with better knowledge about the future. Second, intermediaries may want to maintain a desired inventory level. Both issues are sources of potential market frictions with implications for the conduct of LSAPs.

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<sup>29</sup> This literature is surveyed for example by Maureen O’Hara, *Market Microstructure Theory*, Blackwell, 1997; Richard K. Lyons, *The Microstructure Approach to Exchange Rates*, MIT Press, 2001; or Martin D.D. Evans, “Order Flows and the Exchange Rate Disconnect Puzzle,” *Journal of International Economics*, forthcoming, 2009.

### *Informational frictions*

Information-based theories of market microstructure do not supplant but rather complement the mechanisms discussed in the previous by which a particular path of LSAPs could affect bond prices. In these models, some—but not all—investors trade in a security because the market price diverges from their views about the security’s valuation.<sup>30</sup> An excess of “buy” over “sell” orders is then a signal that the aggregate outlook for future prices is optimistic. But this signal is imperfect because some investors trade for liquidity reasons, which are unrelated to current market valuations.

In general, these models assume that there are differences in opinion across informed traders. In the context of LSAPs, two sources of heterogeneous beliefs are particularly relevant. First, investors may hold different beliefs about the future path, ultimate size, and likely wind down of purchases. To some extent, this source of heterogeneous beliefs could be mitigated by transparent announcements and guidance about the conduct of future purchases. Second, even if the precise path of purchases are known, investors are likely to make different assessments about the degree to which LSAPs are likely to influence bond prices (due to, among other factors, uncertainties in the slope of the demand functions) and about the implications for economic activity. Given the unprecedented nature of the current LSAPs, this source of dispersed information should be at least as relevant as the uncertainty regarding the specifics of the programs, and it may be harder to manage since it pertains to divergent views about how the economy works.

In such an environment, market prices need not fully incorporate the content of economic news, like announcements of LSAP policies, shortly after their release. For example, informed investors may anticipate how intermediaries and other traders learn from incoming orders and choose not to trade aggressively based on their private beliefs. Also, when investors are unsure about the information of other investors, their forecasts may place too much weight on market prices and other public signals, instead of on their private information.<sup>31</sup> In this environment, potentially useful private information may be

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<sup>30</sup> “Informed traders” need not be the kind of corporate insider known from equity markets, who is privy to some factual information. “Private information” may well be the product of introspection and extensive analysis. The relevant assumption in these models is that some investors trade according to their belief regarding the fundamental value of the asset and other investors trade for different reasons.

<sup>31</sup> Keynes described such a market with the analogy of a “beauty contest,” where jurors are rewarded when their vote coincides with the eventual winner of the contest such that their vote will mostly reflect their assessment of other jurors’ tastes instead of their own. In formal models, the effects of “higher order expectations” in finance and macroeconomics have been considered for example by F. Douglas Foster and S. Viswanathan, “Strategic Trading When Agents Forecast the Forecasts of Others,” *Journal of Finance*, Vol. 49, September 1996, pp. 1437-1478, and Stephen Morris and Hyun Shin, “Social Value of Public Information,” *American Economic Review* Vol. 92, December 2002, pp.1521-1534. An extensive literature has successfully applied informational frictions to the foreign exchange market. In stylized but not implausible models it has been shown how the strategic interaction of differently informed investors may protract price discovery for several months, until the expected impact of a change in macroeconomic conditions is incorporated into asset prices. See for example Martin D.D. Evans and Richard K. Lyons, “A New Micro Model of Exchange Rate Dynamics,” NBER Working Paper 10379, March 2004, or Philippe Bacchetta and Eric van Wincoop, “Can Information Heterogeneity Explain the Exchange Rate

incorporated only sluggishly into prices. In addition, noise in public information may have long lasting effects on prices. In the extreme, the initial reaction of prices to new information may occasionally have the opposite sign to the long-run response—which is governed by the channels described in the previous section—and distort findings from traditional event study analysis.<sup>32</sup>

Event studies capture the initial assessment of market participants, which may or may not reflect the ultimate price effect of LSAP operations. If investors were to have identical beliefs and rational expectations about LSAP effects, event studies would measure the complete price impact of LSAPs. But announcement effects need not be identical to the ultimate effects of LSAPs when investors have divergent beliefs about their effectiveness. On net, we expect the event studies to convey useful information for evaluating the effects of LSAPs but, given the small sample and informational frictions, results from event studies should be interpreted with caution.

### *Inventory frictions*

In general, inventory models assume that there is no asymmetric information. Fluctuations in market prices, therefore, result solely from dealers' decisions about the positions of their inventory. This literature focuses on dealers' desire to prevent the accumulation of significant positions on either side of the market, a result which could happen with increased frequency as the market tried to absorb the volume of LSAP orders. When a dealer has accumulated too large an inventory, that is, after having executed a series of "sell" orders, he will try to attract "buy" orders by lowering his ask price. Three simple predictions of the inventory models are that there is mean reversion in asset prices, order flow will have a transitory effect on prices, and we should observe a price that diverges from the expected value of the asset over a short-period of time.<sup>33</sup>

## **V. Policy Implications**

This section discusses implications of the conceptual framework set forth in previous sections for policies related to announcing and initiating LSAPs, conducting actual purchases, and concluding the purchase programs.

### *Implications for announcing and initiating LSAPs*

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Determination Puzzle?," *American Economic Review*, Vol. 96, June 2006, pp. 552-576. The mechanisms considered in this literature are potentially relevant for bonds markets as well.

<sup>32</sup> An opposite sign may occur when in a particular draw of the data a public belief shock is dominated by its noise component. See also Philippe Bacchetta and Eric van Wincoop, "Infrequent Portfolio Decisions: A Solution to the Forward Discount Puzzle," forthcoming in the *American Economic Review*, for an alternative story based on infrequent portfolio adjustment.

<sup>33</sup> Inventory data of financial intermediaries is scarce and empirical studies differ in their conclusions about how "short-term" these deviations could be. Studies have successfully shown that inventories play an important role over daily and intra-daily horizons and possibly for up to two weeks (see Terrence Hendershott and Mark S. Seasholes, "Market Maker Inventories and Stock Prices," *American Economic Association Papers and Proceedings*, Vol. 97, May 2007, pp. 210-214).

The literature summarized in section III suggests that, by affecting various risk premiums, LSAPs may generate persistent yield effects to the extent that these programs change the relative stocks of investors' financial assets. Announcing a targeted level of asset purchases, either through a range or an upper bound, over a time horizon that spans successive FOMC meetings provides forward guidance to investors about how current and future Federal Reserve purchases will impact the relative stocks of available assets, which will ultimately determine the yield responses. This type of announcements also signals commitment to these programs, likely resulting in more pronounced market responses ahead of the actual implementation of the LSAPs.

The same models also suggest that announcing only incremental purchases without an end point may increase uncertainty and amplify volatility in asset markets. To the extent that an optimal path of purchases is known to policy makers in advance, statements that only provide guidance on the amount of assets to be purchased during an intermeeting period would leave participants more uncertain about the continuity and overall size of the purchases. In addition, the information-based models of section IV indicate that market participants would likely scrutinize the flow of purchases in an attempt to ascertain policy intent and other investors' beliefs, potentially leading to misguided inferences and increased volatility. As a result, investors may require overall higher yields to compensate for the increased uncertainty, resulting in wider premiums.

However, while announcing a targeted level of asset purchases increases policy transparency, it is also unlikely to remove all uncertainty about policy intent or its impact. Policymakers and investors may be in agreement about how LSAPs will change the relative stock of assets and that purchases should provide directional influence on private market yields; yet they may differ in their quantitative assessment of the yield impact, or lack consensus on the transmission mechanism through which LSAPs would have their intended effect on yields, market conditions, and ultimately on the economic outlook.

#### *Adjusting the path of LSAPs in response to interest rate moves*

Even if market participants, on net, were to correctly anticipate the ultimate effects of LSAPs, yield responses to announcements of LSAPs may be partially offset by changes in risk premiums related to the uncertainty surrounding these effects. An approach that could limit these uncertainties would be to allow the size of LSAPs to respond to interest rate moves so as to maintain yields around a narrow range, which could depend on the economic outlook. By eliminating risk premiums related to the uncertain efficacy of the programs, such reactive LSAPs could likely achieve selected yield targets with smaller purchases.

Given the uncertainties regarding the effects of LSAPs, however, reactive LSAPs programs could imply very large asset purchases or sales depending on the range of yields targeted or on other hard-to-predict factors and could greatly complicate the exit strategy. In addition, under certain scenarios the purchases implied by a given interest

rate range might be perceived by investors as being inconsistent ex-ante with other policy objectives, leading to an increased, rather than a lower, volatility in yields due to shifts in private sector expectations about policy objectives.

#### *Considerations on the implementation of purchases*

The information-based models described in section IV suggest that the operational conduct of purchases should be as transparent as possible to maximize the price impact of LSAPs by making the Federal Reserve's private information known to all market participants, while leaving liquidity conditions unaffected to the extent possible.

Conducting LSAP auctions separately from the private trading process<sup>34</sup> allows market participants to clearly identify Federal Reserve LSAP-related trades. The current implementation of LSAPs also attempts to limit the information content of the actual purchases relative to those initially announced and thus reduces the probability that—when the pre-announced purchases are implemented—the Federal Reserve would be seen as an “informed investor” with private information about yields and market conditions, resulting in the potential for misguided inferences by investors.<sup>35</sup>

The inventory-based models suggest further that LSAPs should be designed as to minimize price distortions emanating from strains on dealers' inventories that may arise from processing the large-scale order flow from LSAPs. Conducting LSAPs in separate auctions—as opposed to placing direct orders with dealers at unspecified time intervals—puts fewer strains on dealers' inventories and allows for their coordination of supply and demand in advance of the auction. Furthermore, market commentaries indicate that LSAP purchases may have reduced inventory strains on primary dealers in the Treasury market due to recent significant issuance by the Treasury.<sup>36</sup>

#### *Conclusion of LSAPs*

The models discussed in section III suggest that if the paths of the LSAP programs are announced in advance, and investors view these announcements as credible, there should be no abrupt movement in yields when the purchase programs are concluded (or even in anticipation of the program's end). When, however, a program is very large relative to market volume, as with the agency MBS program, it is possible that only relatively yield-insensitive investors (in addition to the Federal Reserve) will hold the targeted asset class. If the program pushed yields below levels required by other

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<sup>34</sup> In the Treasury market, purchases take place in a publicly announced auction process organized by the Federal Reserve Bank of New York. In the MBS market, purchases are channeled as orders from the Federal Reserve Bank of New York to primary dealers, and these orders are public knowledge as well.

<sup>35</sup> In the literature, such “sunshine trading” is typically associated with uninformed liquidity investors who want to avoid the adverse selection costs of being mistaken as an informed trader, see for example Anat R. Admati and Paul Pfleiderer, “Sunshine Trading and Financial Market Equilibrium,” *Review of Financial Studies*, Vol. 4, March 1991, pp. 443-481.

<sup>36</sup> Anecdotal evidence from the Desk even suggests that some dealers have even been willing to actively short their inventories during specific auction operations, which could be taken as an indication that at least some dealers are not concerned about running too low an inventory following purchases from the Desk.

investors to hold these assets, it is likely that the end of the program would be accompanied by a potentially significant increase in yields. This consideration could motivate the Federal Reserve to plan for a transition period for the MBS program in which the rate of purchases is tapered off ahead of the conclusion of the purchases. In addition, because a tapering off of purchases may require more time to complete an LSAP of a preannounced size, market participants may come to expect that an LSAP program might be extended beyond its announced endpoint. It may be therefore important to communicate explicitly whether purchases will be scaled back at the end as well as whether LSAPs will be extended.

A final consideration near the end of an LSAP program is communication regarding future plans for holding or sales of the purchased assets. In particular, yields could sharply increase should market participants contemplate the potential for large-scale asset sales and wrongly anticipate that these would occur in the short term. Clear statements that large-scale asset sales are not anticipated might thus also be instrumental in avoiding rebounds in yields.



## **Appendix II: Details of Program Implementation<sup>37</sup>**

The purpose of this appendix is to provide an overview of the Desk's current implementation strategy for each LSAP program, including the decision-making process for purchases and the communication strategy for open market operations relating to LSAP programs.

### **I. Treasury Purchase Program**

The longer-dated Treasury purchase program is modeled after the Desk's standard Treasury open market operations. All nominal and inflation-linked Treasury coupon securities are eligible for purchase. However, the Desk concentrates purchases in the 2- to 10-year sector of the nominal curve, on both a par and duration basis, to provide relatively more support to the areas of the Treasury curve which most directly affect private borrowing rates. The Desk conducts smaller purchases in other sectors of the Treasury and TIPS yield curves to minimize disruption to the shapes of the nominal and real curves. Treasury bills and very short-dated Treasury coupons are not eligible for purchase and securities trading with heightened scarcity value in the repo market or that are the considered cheapest-to-deliver into Treasury futures contracts are excluded from operations. The Desk also restricts its ownership of individual securities to 35 percent of the outstanding amount of an issue.

Notably, the Desk can and has purchased on-the-run and once off-the-run Treasury securities as part of the Treasury purchase program, in contrast to traditional outright open market operations. The Desk included these on-the-run issues in the Treasury purchase program given that there is no consensus whether private credit rates are priced off of benchmark securities or more seasoned Treasury issues. Additionally, the Desk's relative value curve has suggested that many on-the-run issues do not currently reflect a significant liquidity premium.

A tentative schedule of operations, including dates and targeted sectors, is announced every two weeks to facilitate more orderly trading around operations and enable sufficient time for dealers to obtain interest from customers.<sup>38</sup> Furthermore, with a tight Treasury auction calendar, the pre-announcement of Treasury purchase operations may help dealers and investors set up for both supply and demand risk events, thereby potentially decreasing volatility surrounding the operations.

The Desk conducts two to three outright Treasury purchase operations each week. The operations are arranged via a reverse auction process conducted using the Desk's trading system with the primary dealers. Offers are submitted by dealers for their own accounts and on behalf of their customers. Offers are evaluated against both market

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<sup>37</sup> Michelle Ezer, Mark Cabana, Jeremy Forster, Joshua Frost, Andrew Huszar, Angela O'Connor, Julie Remache, Seamus Brown.

<sup>38</sup> This is a departure from traditional Treasury outright operations, which were announced at the start of the operation. Traditionally, the announcement is made 30 minutes in advance of the operation close.

prices and a theoretical price curve to judge attractiveness. The purchase amount is based on the maturity sector included in the operation and the attractiveness of propositions to market and theoretical prices. For example, Desk purchases in the 2- to 10-year concentration range average around \$7.2 billion. In contrast, the average size of operations outside this concentration range is approximately \$2.6 billion. The operation results are published to the Federal Reserve Bank of New York's (FRBNY) website immediately following the close of an operation.<sup>39</sup>

The pace of Treasury purchases is not dependent on market conditions. Therefore, over the life of the program, the Desk expects to purchase approximately \$50 billion each month.

## **II. Agency Debt Purchase Program**

Agency purchases are conducted through a process similar to that used for Treasury purchases. Eligible securities are limited to "benchmark" issues.<sup>40</sup> However, recently auctioned securities are excluded from the operation to preserve liquidity and market functioning in these issues. Agency outright operations are announced one day in advance on the FRBNY's website, including details about the operation time and included issues. Since the Desk typically avoids operating when the GSEs are pricing new benchmark issues and Treasury outright operation days, most market participants are able to predict when the Desk will conduct an outright agency purchase.

The Desk conducts outright agency purchases, on average, once per week, but has done as many as two operations in one week. Purchases are arranged via reverse auction using the Desk's trading system with the primary dealers and dealers are encouraged to show offers on behalf of their customers. Similar to Treasury outright purchases, offers are accepted based on the attractiveness of propositions to market and theoretical prices. An announcement of operation details is published to the FRBNY website immediately following the close of an operation.<sup>41</sup>

One notable change from the Treasury purchase program is that the purchase amount at each operation is based upon the total amount of propositions received. For much of the agency debt purchase program to-date, this meant that the Desk purchased between 35 and 65 percent of submitted propositions. On June 5, 2009, the Desk implemented a new purchase strategy which explicitly takes into account current market conditions. For example, the Desk will purchase a much smaller percent of submitted propositions if agency spreads to Treasuries are trading below their historic averages and the lower bound of levels observed since the start of 2007. This shift in strategy was

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<sup>39</sup> The operation details include the total amount of propositions submitted and the amounts of specific securities purchased. Consistent with the practice for other LSAP programs, no price information is released to the public given that the Desk does not want to become the price setter for Treasury securities. Additionally, since it is a private transaction the Desk asks dealers not to disclose transaction prices.

<sup>40</sup> Benchmark issues are fixed-rate coupon, non-callable, senior debt with maturities greater than 1-year and issue sizes generally larger than \$3 billion.

<sup>41</sup> The operation details include the total amount of propositions submitted and the amounts of specific securities purchased. No price information is released to the public.

taken based on the following observations: (1) GSEs portfolio growth is expected to be moderate or decline in 2009; (2) agency purchases have already narrowed the spreads to Treasuries near historic norms; and (3) housing-related GSEs have increased access to term financing.

### **III. Agency MBS Purchase Program**

Purchases of agency MBS are quite different from the other purchase programs owing to the more complex nature of the agency MBS market.<sup>42</sup> Most notably these purchases are not arranged via reverse auction, but instead are arranged directly with primary dealer counterparties. Purchases are made daily on a continuous basis throughout the day. Trades are generally executed via an electronic trading platform seeking offers from multiple counterparties to ensure fair market pricing. In an effort to also ensure that market participants see that the Federal Reserve is active, each trade clearly denotes that the Federal Reserve is the counterparty to the transaction. On a weekly basis, the FRBNY publishes a report summarizing the weekly trading activity.<sup>43</sup>

Purchases are made both on an outright basis as well as on a temporary basis through dollar roll transactions.<sup>44</sup> The selection of securities to purchase depends largely on supply conditions. To date, outright purchases have generally been concentrated in low coupon 30-year fixed rate MBS guaranteed by Fannie Mae and Freddie Mac where new issuance has been high.<sup>45</sup> Since the pricing of higher coupon, existing MBS has little to do with the pricing of new mortgages, this approach has ensured that the program is most directly supporting its goal of “supporting housing and mortgage markets.” However, this focus on low coupon securities has evolved over the course of the program. When purchases began in January, outright purchases were made across multiple coupons in an effort to also meet the program’s second objective to “foster improved market functioning.” By supporting the market more broadly, liquidity was improved which supported a well functioning market. With the introduction of dollar rolls to the strategy in early March, outright purchases shifted towards lower coupon production securities given that dollar roll activity provided the necessary liquidity support to the market for higher coupon securities. Given the sharp increase in interest

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<sup>42</sup> It was mainly for this reason and in an effort to reduce operational and financial risks that the Desk hired four external investment managers to execute purchases on the Federal Reserve’s behalf. In this way, the market actually interacts directly with these managers in executing agency MBS transactions rather than the Desk. However, the Desk works very closely with these managers on a daily basis to direct the day-to-day purchasing activities and to ensure that the program is being implemented in a manner consistent with policy goals.

<sup>43</sup> CUSIP level data and pricing information are not released to the public.

<sup>44</sup> Dollar roll transactions are similar to secured financing transactions and are an important feature of a well functioning MBS market. Dollar rolls were instituted to address dislocations in MBS financing which were evident through the end of 2008 and early 2009. Since dollar rolls were added to the portfolio strategy in March, implied financing rates have declined markedly relative to MBS repo.

<sup>45</sup> Mortgage purchases are focused on 30-year Fannie Mae and Freddie Mac issuance as that represents the majority of mortgage issuance. The MBS purchase program purchases other securities as well, like 30-year Ginnie Mae and 15-year securities, in amounts representative of outstanding issuance for support and overall smooth market functioning.

rates and expectations for much lower origination supply, the focus of purchases may shift again.

In determining the amount of purchases to make, the Desk considers the average pace implied by the program size and timeframe and has developed a framework which provides further guidance for marginally increasing or reducing purchases based on certain market-based factors. These factors include the relative valuation of secondary MBS yields to Treasuries on both a nominal and option-adjusted basis, the level of secondary and primary mortgage rates, and judgments of market supply and demand for MBS. In general, this framework guides purchases lower when relative spreads to Treasuries are tight compared to historical norms and guides purchases higher when origination is high. This allows the program to support market functioning and smooth price adjustments, but is generally steady in its approach.

## **Appendix III: Including Hybrid ARMs in MBS purchase program<sup>46</sup>**

### **I. Introduction**

This appendix considers the costs and benefits of including hybrid ARMs as part of the MBS LSAP program. A hybrid ARM carries a fixed rate for a number of years (typically 3, 5, 7 or 10) and then converts to a standard one-year adjustable rate mortgage tied to either a Treasury or LIBOR benchmark. Currently, in the agency MBS LSAP program, purchases are limited to fixed rate securities and have been concentrated in MBS backed by 30-year fixed-rate mortgages. The decision to limit purchases to fixed-rate securities was made when the program was first initiated and was made on the basis that hybrid ARMs are less liquid, less common and more complex than their fixed rate counterparts. Nevertheless, at this time staff believe that the liquidity and complexity costs are outweighed by the benefits, especially in light of the recent increase in interest rates. Those benefits include, but are not limited to, supporting a broader array of consumer mortgage products which makes access to mortgage credit more affordable, and reducing interest rate and income risks relative to fixed rate MBS. Such products would also strengthen the monetary policy transmission mechanism. While this would be beneficial in many ways, it may also introduce some additional complications due to the direct dependence on the future path of short-term interest rates.

### **II. Considerations of Hybrid ARMs for LSAPs**

Given the sizeable increase in long-term mortgage rates since the last FOMC meeting, there will likely be little in the way of any refinancing activity into 30-year fixed rate mortgages in the near term if rates remain at current levels. Despite a significant tightening of secondary fixed-rate MBS yields to Treasury yields, the recent increase in long-term interest rates has led primary mortgage rates over 5 ½ percent. At these levels, less than 10 percent of agency mortgages would have an economic incentive to refinance. Hybrid ARMs offer another means to channel primary mortgage rate relief to consumers.

So far in 2009, despite the steep yield curve, rates on hybrid ARMs have been very similar to rates on 30-year fixed rate mortgages. Issuance has been limited and demand for these securities has been muted. Although market participants report some renewed interest in ARMs following the sharp increase in long-term yields, activity is still reported to be light. Purchases of hybrid ARMS by the MBS LSAP program could be expected to support this activity. One market participant suggested that even a \$100 billion allocation to hybrid ARMs could reduce these rates as much as 200bps. Especially in light of the recent increase in fixed mortgage rates, this would be another way for the MBS LSAP program to achieve to its policy objective to “support mortgage and housing markets.”

In addition to offering lower effective borrowing rates independent of long-term yield movements, hybrid ARMs offer a better interest rate and income risk profile for the balance sheet than 30-year fixed rate product. In a rising rate environment, it is

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<sup>46</sup> Julie Remache and David Zervos.

conceivable that the market price of 30-year fixed-rate MBS could fall up to 30 percent or more. Holding some portion of the SOMA in hybrid ARMs rather than fixed-rate MBS would lower these risks to the total portfolio on the margin. It should be noted, however, that the lower duration of these securities, which is precisely what makes them a better portfolio fit, also implies that these purchases would lessen the impact of LSAP programs on long-term interest rates.

A shift of borrowers from fixed-rate mortgages to adjustable rate mortgages will also increase the sensitivity of the monetary policy transmission mechanism. This could be seen as either a benefit or a cost. On the one hand, rates on ARMs fall precisely when the FOMC is lowering interest rates. Borrowers would not need to refinance to realize the benefits (something many borrowers are having trouble doing today). As an international comparison, the Australian Reserve Bank has lowered base rates by 425 basis points during this cycle. The overwhelming majority of Australian mortgages are ARMs; as a result, the primary residential benchmark mortgage rate has fallen 380 basis points in response to this easing. On the other hand, when the Committee chooses to increase rates, borrowers with ARMs will face increased payments. This will of course act as a natural check on consumption, but would certainly also be a more politically unpalatable method for constraining credit conditions. The Committee will have to carefully manage communications if it begins buying agency hybrids given the transparent and immediate impact of policy changes to consumer borrower rates.

### **III. Operational Considerations**

If the Committee were to adopt this recommendation, purchases of ARMs could begin almost immediately. Some changes would need to be made to the FAQs posted on the FRBNY's website regarding the MBS purchase program and specific details of what would be included and excluded from purchases would need to be finalized. The investment managers currently working with the Desk for the agency MBS purchase program could execute purchases on the Federal Reserve's behalf with the primary dealers. Based on historical issuance figures, staff anticipate that purchases would begin with 5/1 and 7/1 ARMs. Traditionally, these have been the most liquid sectors of the market. This could be revised based on the initial experience with purchases. One thing to note is that the market for ARMs is considerably less liquid and less transparent than that of fixed-rate MBS. As a result, it would be important to proceed cautiously to fully understand the impact of the Desk's purchases.

June 15, 2009

## **The Recent Use of Large-Scale Asset Purchases by Foreign Central Banks**

David Bowman and Clara Vega

### **Summary**

This note provides a brief summary of the recent use of large-scale asset purchases by central banks in the advanced foreign economies as well as the movements in market rates associated with these programs.

We discuss asset purchases by the Bank of England, Bank of Japan, European Central Bank, and Swiss National Bank. As shown in Table 1, the Bank of England and Bank of Japan have purchased both government and corporate debt, although focusing primarily on government debt. In contrast, the European Central Bank has focused on purchasing corporate debt instruments, and the Swiss National Bank has focused on intervening in the foreign exchange market and purchasing corporate debt instruments.

In general, there was an initial decline in the yields of the targeted assets following the announcement of each of these programs, and the impact on yields appeared to strengthen over the next several days following an announcement. However, in each case yields eventually rose and are now higher than at the time the purchases were announced. Although this might be interpreted as implying that the programs have had only temporary impacts on interest rates, there are good reasons to believe that other, independent forces, have driven interest rates higher. As shown in Figure 1, long-term interest rates have risen in most advanced foreign economies since March. The global rise in yields has likely been driven by several factors, including: an increased willingness to move out of safe assets such as government bonds and into riskier investments, the improvement in the global outlook, and concerns that rising fiscal deficits may lead to rising inflation. Accordingly, our sense is that the asset purchase programs have exerted some downward pressure on yields, although it is difficult to assess to what extent.

### **The Bank of England**

There was little market reaction when the U.K. Treasury announced on January 19 that it would authorize the Bank of England to purchase up to £50 billion of a range of high-quality corporate assets on a sterilized basis, or when the Bank of England announced its initial plans to use this authority on February 5, perhaps because statements by Bank officials led some observers to believe that it might purchase substantially less than the full £50 billion.<sup>1</sup> However,

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<sup>1</sup> In its February 6 press release the Bank of England stated that it would purchase investment-grade commercial paper but did not specify an amount to be purchased and it stated that it expected to purchase “modest” amounts of investment-grade corporate bonds. The release also stated that the Bank would consider whether the funds might also be used to purchase syndicated loans or asset-backed securities.

there was a noticeable impact on market interest rates on March 5, when the Bank of England announced plans to purchase up to £75 billion of U.K. gilts and corporate debt on an unsterilized basis and stated that it would concentrate its purchases on medium- and longer-dated gilt purchases in the secondary market. This represented a fairly large purchase program given the size of the gilt market; £75 billion constitutes about 10 percent of the total amount of outstanding gilts.

As shown in Table 2, U.K. ten-year government bond yields declined about 30 basis points on the day of the March 5 announcement and fell further over the course of the following week. The Monetary Policy Committee also cut its policy rate by 50 basis points at the March 5 meeting, and it is possible that the decline in rates was due, at least in part, to the easing of monetary policy rather than the announcement concerning asset purchases. However, market commentary focused mainly on asset purchases. As shown in Table 2, two-year rates, which should be more directly affected by policy easing, fell considerably less than yields on the gilts directly targeted by the asset purchase plan and actually rose over the rest of the week.

Markets continued to be attuned to developments in the purchase program in the following months, though the response of interest rates to further announcements concerning the program may have diminished over time. Ten-year gilt yields increased 20 basis points on March 24 when, following a higher-than-expected U.K. CPI reading, Governor King created some uncertainty by suggesting that the BoE might purchase less than £75 billion. On May 7, the BOE increased its asset purchase program by £50 billion, to £125 billion (about 17 percent of the outstanding gilts as shown in Table 1). Ten-year gilt yields decreased 10 basis points immediately following the announcement, but this decline was insufficient to offset the rise that had occurred earlier in the day, and yields ended the day 7 basis points higher than at the beginning of the trading session. As of June 11, the Bank of England has purchased £86 billion of assets, mainly gilts, and it has stated that it expects to finish its purchases by the end of July.

As shown in the top panel of Figure 2, by the end of May ten-year gilt yields had risen above their levels at the beginning of March. As noted in the introduction, the increase in long-term interest rates since March has been a global phenomenon, and the rise in gilt yields over this period should not necessarily be interpreted as implying that the effects of the asset purchases were temporary. In the case of the United Kingdom, the improved economic outlook has led investors to expect tighter monetary conditions, which is one possible factor behind the rise in long-term gilt yields. Between March 4 and June 12, expectations for the Bank of England's policy rate one year from now have increased about 100 basis points. Rising fiscal deficits may have also led to an increase in long-term rates. In April the U.K. Debt Management Office forecasted that it would have to issue a record £220 billion in debt for the current fiscal year, roughly £80 billion more than the previous year, nearly matching the amount of gilts that the Bank of England has purchased so far. Long-term gilt yields rose about 15 basis points following the announcement of the debt forecast.



## The Bank of Japan

At its December 18-19, 2008, monetary policy meeting, the Bank of Japan cut its policy rate to 10 basis points from 30 basis points and announced an increase in the monthly amount of outright purchases of long-term JGBs from ¥ 1.2 trillion to ¥ 1.4 trillion per month.<sup>2</sup> In addition to the increase in size of its purchases, the Bank of Japan expanded the set of government bonds it would purchase to include inflation-linked securities, floating-rate notes, and 30-year bonds. Market participants noted that while no one of the individual policy changes announced on December 19 was surprising, the combination of measures was more aggressive than had been expected. Nonetheless, Japanese ten-year government bond yields declined only 4 basis points following the announcement.

On March 18, 2009, the Bank of Japan announced that it would increase its regular purchases of JGBs to ¥1.8 trillion a month. The increase in purchases was about twice as large as many participants had expected. There was virtually no detectable market reaction to this announcement.

The price reaction to Bank of Japan announcements regarding the outright purchase of long-term JGBs has been very small compared with the reactions to announcements of the FOMC and Bank of England. This is likely due to several factors. Most importantly, the scale of purchases is small; cumulating the ¥600 billion increase in JGBs purchased per month over the course of a year, these additional purchases represent only about 1 percent of outstanding JGBs. In addition, the Bank of Japan announcements were partly anticipated by market participants, which would also lessen the impact of the announcement on market rates.

The Bank of Japan has also announced plans to purchase some forms of corporate debt and equity. On January 23, the Bank indicated that it would purchase ¥3 trillion yen in commercial paper and that it was considering purchasing short-term corporate bonds. The Bank of Japan later confirmed a plan to purchase up to ¥1 trillion in short-term corporate debt on February 19. Rates on commercial paper dropped sharply following the January 23 announcement, but rates on short-term corporate debt instruments were little affected by either the January 23 or February 19 announcements. The Bank of Japan's announcement on February 3 that it would resume purchasing stocks held by financial firms also had little impact, as it was thought unlikely that firms would be willing to incur capital losses by selling their equity holdings at then low market prices

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<sup>2</sup> The Bank of Japan's purchases of long-term JGBs were part of its already existing Rinban buyback operations, which were originally established in March 2001 when it began its Quantitative Easing Policy. Under the Quantitative Easing Policy, the Bank of Japan cut its policy rate to zero and changed its operating target to the level of outstanding current account balances held by financial institutions, promising to maintain this policy until core CPI stopped falling on a year-on-year basis, and also announced that it would purchase of ¥400 billion per month of long-term government bonds. On the day the policy was announced, Japanese ten-year government bond yields fell 9 basis points. In August 2001, the Bank of Japan raised its outright purchases of long-term government bonds to ¥ 600 billion per month, and in October 2002 it raised the amount again to ¥ 1.2 trillion per month. The Bank of Japan ended its Quantitative Easing Policy in March 2006, allowing bank reserves to drain off, but continued its monthly purchases of long-term JGBs. The Bank of Japan's holdings of Japanese long-term government bonds peaked in August 2004 at ¥ 67 trillion and currently stand at ¥ 46.1 trillion.

## **The European Central Bank**

On May 7, the European Central Bank (ECB) lowered the main refinancing rate by 25 basis points, as expected, and announced that it would buy up to €60 billion of euro-denominated covered bonds (about 6 percent of the total size of the market, as shown in Table 1).<sup>3</sup> The purchase of covered bonds was not expected by the market and as shown in Table 4, although rates on covered bonds did not immediately decline, they did decline 19 basis points over the following week and spreads between yields on covered bonds and comparable government bonds fell 13 basis points. Details of the purchases were specified following the ECB's June 4 policy meeting, stating that it would buy AA-rated bonds from this July through June 2010 in both primary and secondary markets, focusing on maturities between 3 and 10 years. These details had been broadly anticipated by markets, and there was little reaction in covered bond rates, although spreads between covered and government bond yields did decline.

As with the other purchase programs discussed in this note, yields on covered bonds have since moved higher and are now above the levels that prevailed at the time the ECB's program was announced. However, as shown in the top panel of Figure 3, spreads between covered bond yields and yields on comparable government bonds have not moved higher and remain below the levels that prevailed before the ECB's announcements. .

## **The Swiss National Bank**

On March 12, the Swiss National Bank (SNB) lowered its target range for three-month Libor as was widely expected, but surprised market participants by announcing that it would purchase private sector domestic bonds and foreign currencies. Although many market participants had anticipated some discussion of unconventional policy measures at the meeting, the vast majority of investors did not anticipate an immediate implementation of such policies. The SNB further surprised market participants by selling Swiss francs against euros just moments after its policies were announced. The SNB did not specify any desired level for the exchange rate between the franc and euro, but market participants reportedly viewed an exchange rate of 1.6 francs per euro as a rough target.

The SNB did not specify the amount or nature of its planned purchases of corporate debt; however, a board member of the Swiss National Bank later stated that the SNB was making daily purchases of corporate debt, including covered bonds. Based on the publicly available balance sheet of the SNB, market participants estimate that the SNB has purchased about 1.9 billion swiss francs of covered bonds as of April (about 4 percent of the covered bond market). As shown in Table 5, rates on three-year Swiss covered bonds declined 13 basis points in the week following the March 12 announcement.

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<sup>3</sup> Covered bonds are debt securities with recourse to a pool of assets that secures or "covers" the bond if the originator becomes insolvent. These bonds are typically assigned very high credit ratings. In the press conference following the decision, ECB President Trichet stressed that these purchases would be sterilized and should not be considered to be quantitative easing. The ECB took several other steps at the meeting, including narrowing the corridor around the main refinancing rate (the ECB's policy target), extending until end-2010 its expanded list of eligible collateral for its refinancing operations, and announcing it would conduct 12-month liquidity operations at fixed rates with full allotment.

The SNB's purchases of euros appeared to be particularly effective. Estimates of the intervention size vary greatly, but most dealers suggest that the SNB purchased between €1 and €2.25 billion on March 12. The Swiss franc depreciated 3.25 percent against the euro following the SNB's actions, and the franc remained down against the euro for the next month.<sup>4</sup>

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<sup>4</sup> In an action that was not publicly announced, the SNB again purchased euros on May 15. Market participants quickly became aware of the action. The franc depreciated 1.6 percent against the euro in response, but reversed the move the following day.

**Table 1. Asset Purchase Programs**

	ECB	BoE	BoJ	SNB
Program	€60 billion of covered bonds	£125 billion of gilts and corporate debt	Increased JGB purchases by ¥600 billion per month*	Corporate debt and foreign currency
Program as percent of total size of the market**	6%	17%	1%	Unknown
Amount Spent (as of June 11, 2009)	None	£86 billion†	¥ 2.5 trillion	Unknown‡

\* The Bank of Japan has also announced programs to purchase ¥3 trillion in commercial paper, ¥1 trillion in corporate debt, and up to ¥1 trillion in equities held by financial firms.

\*\* €60 billion is about 6 percent of the euro-area jumbo covered bond market, £125 billion is about 17 percent of the gilt market, and ¥600 billion accumulated over a year is about 1 percent of the domestic Japanese government debt market.

† The Bank of England has currently spent £83 billion on gilts and £3 billion on corporate debt instruments.

‡ Based on the publicly available balance sheet of the SNB, market participants estimate that the SNB has purchased about 1.9 billion swiss francs of covered bonds as of April (about 4 percent of the covered bond market)

**Table 2. Bank of England Announcements**

Date	Announcement	Change in Ten-Year Gilt Yields*		Change in Two-Year Gilt Yields*	
		One-Day	One-Week	One-Day	One-Week
3/5/2009	The Bank of England announced a plan to purchase up to £75 billion in assets, concentrating on medium- and longer-dated gilts, and reduced its policy rate 50 basis points.	-28	-69	-6	11
3/24/2009	Governor King indicated that the BoE might purchase less than £75 billion in assets.	20	3	-6	-13
5/7/2009	The Bank of England announced an increase in its planned asset purchases to £125 billion	7	-13	2	-14

\*Changes in yields are in basis points and are calculated using the closing rate the day before the announcement and the closing rate the day of or the week after the announcement.

**Table 3. Bank of Japan Announcements**

Date	Announcement	Change in Ten-Year JGB Yields*		Change in Two-Year JGB Yields*	
		One-Day	One-Week	One-Day	One-Week
12/19/2008	The Bank of Japan increased its outright purchases of long-term JGBs from t¥ 1.2 trillion o ¥ 1.4 trillion per month and cut its policy rate by 20 basis points	-4	-6	-3	-5
3/18/2009	The Bank of Japan increased its outright purchases of long-term JGBs to ¥ 1.8 trillion per month	0	-2	0	0

\*Changes in yields are in basis points and are calculated using the closing rate the day before the announcement and the closing rate the day of or the week after the announcement.

**Table 4. ECB Announcements**

Date	Announcement	Change in Three-Year Covered Bond Yields*		Change in Spreads over Government Yields*	
		One-Day	One-Week	One-Day	One-Week
5/7/2009	The ECB announced that it would buy up to €60 billion of euro-denominated covered bonds and lowered the main refinancing rate by 25 basis points.	7	-19	1	-13
6/4/2009	The ECB specified details of its covered bond purchases.	2	23	-10	-7

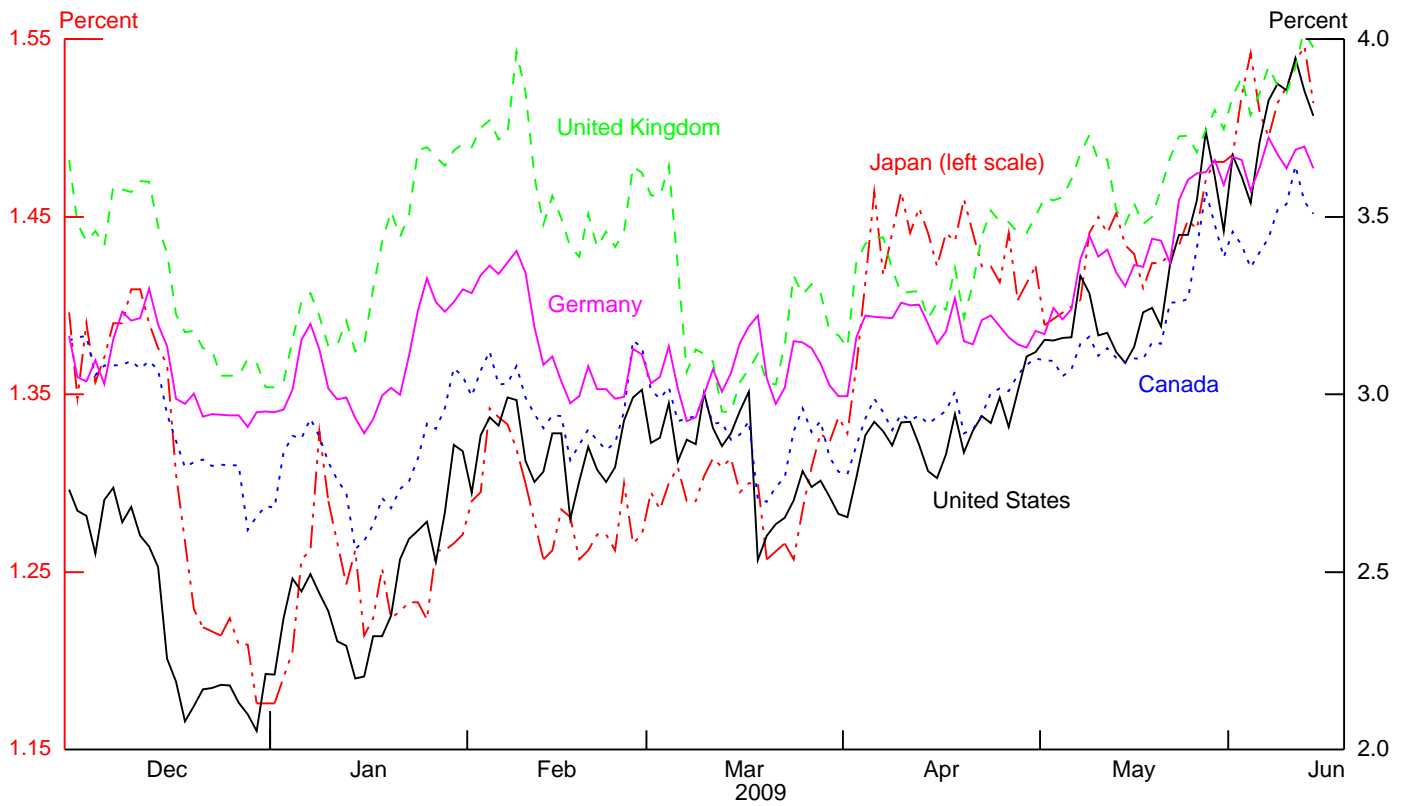
\* Changes in yields and spreads are in basis points and are calculated using the closing rates the day before the announcement and the closing rates the day of or the week after the announcement.

**Table 5. Swiss National Bank Announcements**

Date	Announcement	Change in Three-Year Covered Bond Yields*		Change in Spreads over Government Yields*	
		One-Day	One-Week	One-Day	One-Week
03/12/2009	The Swiss National Bank announced that it would begin purchasing corporate debt and foreign currency, immediately intervening to purchase euros, and cut its target for three-month Libor rates.	-5	-13	0	-5

\* Changes in yields and spreads are in basis points and are calculated using the closing rates the day before the announcement and the closing rates the day of or the week after the announcement.

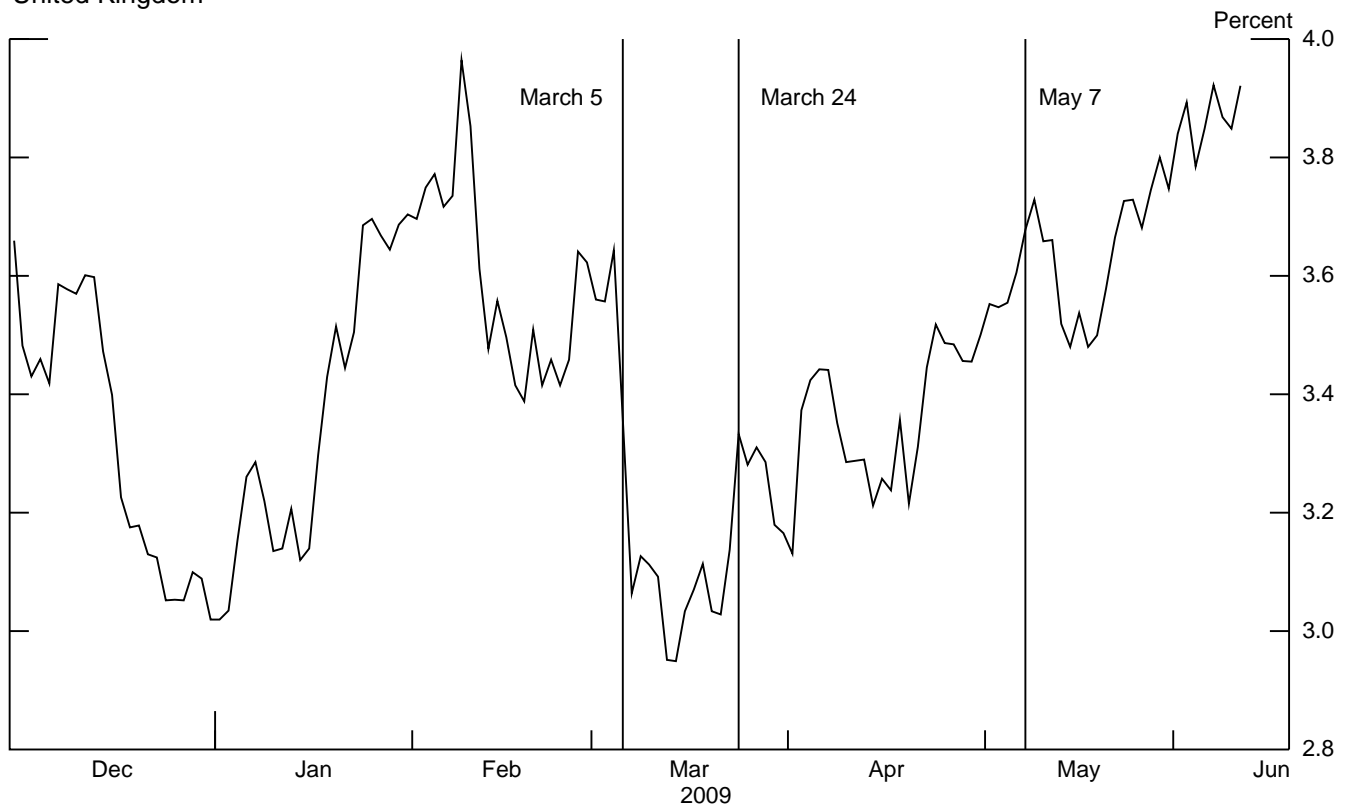
**Figure 1. Ten-Year Government Bond Yields**



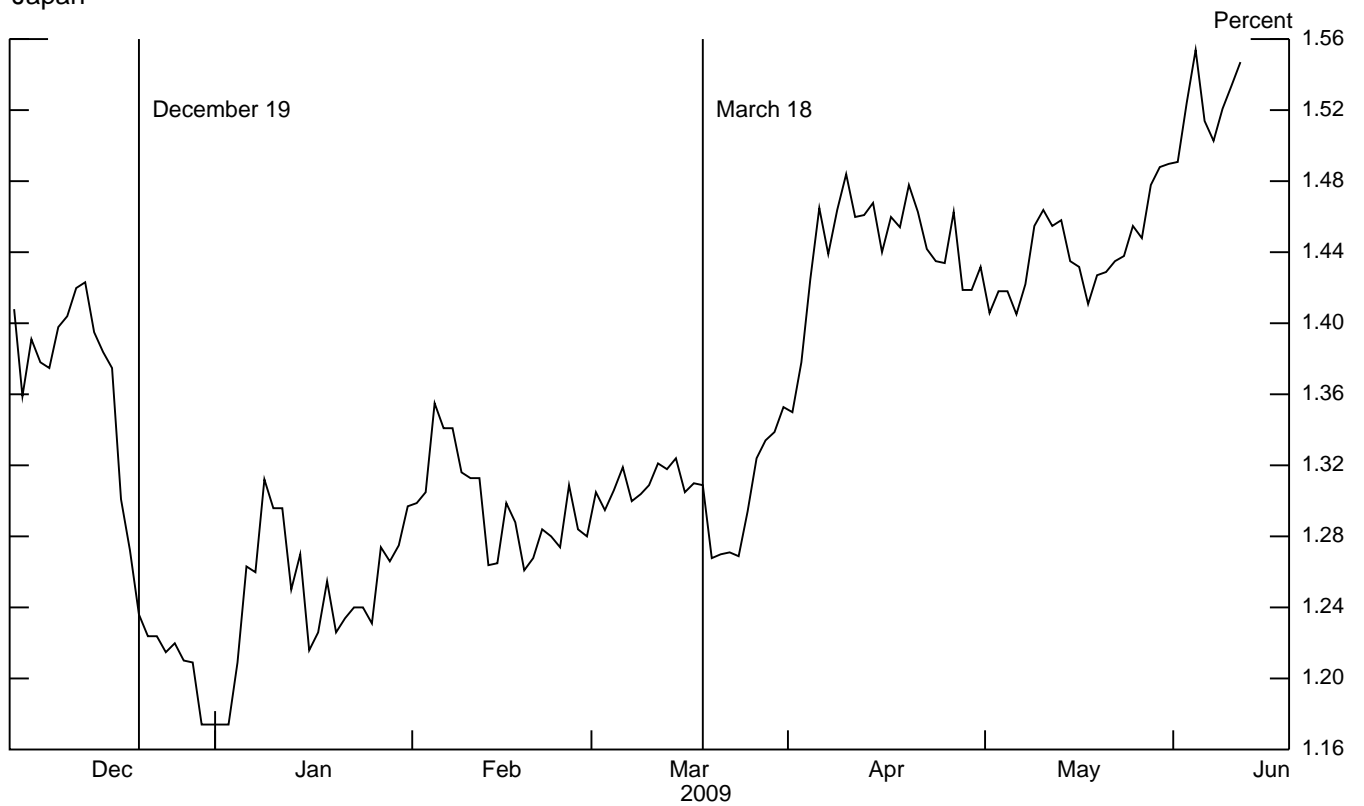
06-12-09

**Figure 2. Ten-Year Government Bond Yields**

United Kingdom



Japan





06-12-09

**Figure 3. Three-Year Covered Bond Yields and Spreads over Government Bonds**

