

## Evaluating the Efficacy of the Federal Reserve's Large-Scale Asset Purchases<sup>1</sup>

### Executive Summary

- Amidst a range of estimates in the literature, we think a good central assumption is that a large-scale asset purchase (LSAP) of \$500 billion of longer-term securities, with a composition similar to current purchases, would lower 10-year Treasury yields by about 20 basis points.
- While the range of estimates is again considerable, we judge from the existing evidence that an LSAP of this magnitude reduces corporate yields by a slightly smaller amount than Treasury yields, lowers agency MBS yields and primary conforming mortgage rates by a slightly larger amount, boosts equity values by about 1¼ percent, and reduces the exchange value of the broad dollar index by about ¾ percent. The responses of some asset prices were larger during the earlier rounds of asset purchases, as those earlier asset purchases occurred in the context of highly stressed market conditions and so contributed to the restoration of confidence in basic market functioning, and because the earlier purchases likely provided more signal regarding greater provision of monetary accommodation via a lower future path of the federal funds rate.
- In simulations of a version of the FRB/US model that closely replicates our judgmental asset price responses, an LSAP of \$500 billion reduces the unemployment rate about 0.2 percentage point within 3 years and raises inflation about 0.1 percentage point. We judge these real effects to be smaller currently than for the first rounds of asset purchases in light of the smaller financial effects.
- A variety of factors could lead to a response of real activity to changes in financial variables that differ from the benchmark FRB/US estimates. For example, the FRB/US response could be overstated because of unusual restraint in credit extension, or because the long-term interest rates that govern aggregate demand in FRB/US—and are particularly sensitive to LSAPs—might not accurately represent the interest rates relevant for actual spending decisions. Alternatively, the FRB/US response could be understated because the model does not include an important channel for LSAPs to affect house prices, or because the model does not capture the possibility that LSAPs could forestall long-run damage to the labor market. We can bring only limited evidence to bear on these issues, which adds to the uncertainty around our estimates of LSAP efficacy.
- Any assessment of the macroeconomic effects of LSAPs depends importantly on whether the asset purchases are associated with changes in the expected future path of the federal funds rate; such changes can either magnify or diminish the overall stimulus associated with a change in asset purchases.

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## **The Effects of LSAPs on Interest Rates and (selected) Asset Prices**

Large-scale asset purchases (LSAPs) by the Federal Reserve are effective for stimulating aggregate demand to the extent they put downward pressure on interest rates paid by businesses and consumers and the foreign exchange value of the dollar and upward pressure on equity prices. We therefore begin our efficacy analysis by summarizing some of the recent evidence on these effects. Based on the analysis of Li and Wei (2012), we think a good central assumption is that a hypothetical LSAP resulting in the Federal Reserve purchasing \$500 billion of longer-term securities can be expected to lower the 10-year Treasury yield about 20 basis points by lowering the term premium embedded in that yield. However, both the range of point estimates in the literature and the complex responses of longer-term Treasury yields to the September and December FOMC announcements are indicative of the considerable uncertainty attending the size of such effects and the specific channels through which they operate.<sup>2</sup>

In their recent study of the effects of the Federal Reserve's nonconventional monetary policies, Hancock and Passmore (2013) estimate substantial effects of LSAPs on the secondary-market yields on agency MBS and only slightly smaller effects on primary-market conforming home mortgage rates. Moreover, they report evidence that the Federal Reserve's purchases of agency MBS has an extra effect on the yields on those securities (relative to Treasury yields) and that, over time, a large portion of those effects also pass through to primary mortgage rates.<sup>3</sup> Their analysis is broadly supported by casual observation of the reaction to the announcement of the new asset purchase program in September 2012. The spread between agency MBS yields and 10-year Treasury yields fell noticeably after both the initial announcement of and subsequent communications about this program. Moreover, although the spread between the interest rates on conforming 30-year fixed-rate loans and agency MBS yields widened at first, this spread gradually moved back down to below its late-August level, which is consistent with essentially all of the decrease in agency MBS yields brought about by the additional purchases eventually passing through to conforming mortgage interest rates.

Consistent with prior studies, recent research has also reported substantial pass-through of LSAP-induced changes in Treasury yields to yields on investment-grade corporate bonds. Raskin and Zakrajšek (2012) find almost complete pass-through of LSAP-induced reductions in Treasury yields to yields on investment-grade corporate bonds, while Kiley (2013a) estimates that about three-quarters of the drop in Treasury yields passed through, and Li, Wei, and

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<sup>2</sup> Other recent studies reporting significant effects of LSAPs on longer-term Treasury yields include Hamilton and Wu (2012), Bauer and Rudebusch (2012), and D'Amico, English, López-Salido, and Nelson (2012), while earlier studies in this vein include Krishnamurthy and Vissing-Jorgenson (2011) and Gagnon, Raskin, Remache, and Sack (2011). D'Amico, Li, Kitsul, and Raskin (2012) and Egelhof, Femia, and Strzodka (2012) analyze the market responses to the September 2012 FOMC statement, which included disparate moves in nominal and real (TIPS-based) longer-term Treasury yields and relatively large changes in agency MBS yields.

<sup>3</sup> In this and an earlier paper (Hancock and Passmore, 2012), the authors emphasized that the extent of pass-through of changes in agency MBS yields to primary mortgage rates appears to depend on prevailing market conditions, including the level of mortgage rates: Pass-through has tended to be more complete when mortgage rates are higher than lower, likely reflecting in part the effects of limited capacity in the mortgage origination industry.

Barbarino (2012) also find partial pass-through from the earlier rounds of LSAPs (and the maturity extension program). By contrast, pass-through of LSAP effects to yields on speculative-grade corporate bonds has been found to be small (except in some analyses of the first round of LSAPs, which was announced at a time when markets were highly dysfunctional and risk spreads exceptionally wide).<sup>4</sup> As was the case with the earlier LSAPs, looking over a broader time frame, the FOMC announcements in September and December 2012 did not appear to induce a pronounced or persistent rise in the spreads between yields on investment-grade corporate bonds and those on comparable-maturity Treasury securities, consistent with close to complete pass-through in a relatively short time frame.<sup>5</sup>

Another transmission channel for LSAPs operates through the foreign exchange value of the dollar. By lowering the yields on U.S. investments, LSAPs tend to cause the dollar to depreciate. Recent research by Vega and Tudor (2012) documents that LSAP announcements scaled to a 20 basis point reduction in longer-term Treasury yields have tended to lower the major currency index for the U.S. dollar almost 1½ percent and pushed down the broad currency index about ¾ percent. We observed similar-sized responses following the September and December FOMC announcements of changes in the Federal Reserve's balance sheet policies. Kiley's (2013b) recent econometric analysis of selected bilateral exchange rates also reaches similar findings: His results imply that a 20 basis point reduction in the 10-year Treasury yield over the period since nonconventional policies have been undertaken led to a 1½ to 2 percent depreciation of the dollar against the euro and the Japanese yen.

Turning to the stock market reactions to recent news about the Federal Reserve's balance sheet policies, Sharpe and Wang's (2010) event study of stock market responses in narrow windows around FOMC announcements and other communications associated with the first two rounds of LSAPs suggested a response of close to 2 percent for a 20 basis point decrease in the 10-year Treasury yield. Rosa (2012) and Kiley (2013c) estimated the stock market effects of changes in Treasury term premiums induced by LSAPs (holding market expectations for path of the federal funds rate roughly constant) and found smaller responses—averaging about a 1 percent increase in stock prices for an LSAP-induced 20 basis point decrease in the 10-year Treasury term premium.

However, there are reasons to think that the stock market response to LSAPs could depend importantly on prevailing market conditions and that event studies might not always pick up the full effect of such monetary policy actions. The first LSAPs—announced in late-2008 and early 2009—appear to have been key elements in a suite of policy responses to the financial

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<sup>4</sup> For example, focusing on the Federal Reserve's balance sheet actions from late-2008 through 2010, Krishnamurthy and Vissing-Jorgenson (2011) reported essentially complete pass-through of lower long-term Treasury yields to investment-grade corporate bond yields from the first two LSAPs, but sizable pass-through to speculative-grade corporate bond yields only for the first round of LSAPs in the winter of 2008 and 2009.

<sup>5</sup> While corporate bond spreads fluctuated over a moderate range through the fall and winter, in our view, those moves were more a reflection of market sentiment about the European and domestic fiscal and macroeconomic situations than perceptions about nonconventional policy actions by the FOMC.

crisis that significantly bolstered equity prices over time.<sup>6</sup> The equity premium had soared during the most acute phase of the financial crisis that autumn, but, according to Board staff estimates, it narrowed substantially in the spring and summer of 2009, as U.S. stock prices climbed. A similar but less pronounced pattern was evident around the time of LSAP-related news and announcements in the summer of 2010. These observations suggest that a considerable part of the stock market response to the first two rounds of LSAPs occurred outside of narrow event windows. By contrast, the timing of the stock market gains seen since last fall suggests to us that those moves were spurred more by reduced concerns about economic prospects and the fiscal situation in the U.S. and Europe than by delayed reactions to FOMC communications about asset purchases. Hence, since last September, changes in equity prices in relatively narrow event windows around FOMC communications about LSAPs might reasonably capture the full extent of the stock market responses to the corresponding news about monetary policy. The responses to the release of the FOMC statement following the September 2012 FOMC meeting and the release of the minutes from the December meeting (which contained a discussion of LSAP efficacy) in early January showed broad U.S. equity prices rising by an amount close to 2 percent in response to an LSAP that lowers the (real) 10-year Treasury yield 20 basis points.<sup>7</sup>

In addition, the evidence indicates that the earlier rounds of LSAPs led market participants to expect a more accommodative stance of conventional monetary policy (Bauer and Rudebusch, 2012, and Krishnamurthy and Vissing-Jorgenson, 2011), which could have produced a relatively strong transmission since conventional monetary policy actions have been shown to generate sizable stock market responses (Bernanke and Kuttner, 2005, Rosa, 2012, Kiley, 2013c). Because the Committee was already using explicit date-based guidance regarding the likely medium-term path of federal funds rate in September 2012 and shifted to quantitative thresholds for its forward guidance in December 2012, the scope for LSAP announcements to operate forcefully through such a signaling channel may have been limited last fall and winter.

In sum, we think the first two rounds of LSAPs probably spurred larger responses of private interest rates, the exchange value of the dollar, and equity prices than would additional asset purchases today because the earlier programs were announced and implemented at times when market conditions were highly strained and risk premiums were exceptionally large or when there was greater scope for signaling more accommodative intentions with respect to the federal funds rate. The market responses to FOMC communications about LSAPs since last September, while significant, appear consistent with this assessment. The following table reports our current judgmental assumptions for the central estimates of the effects of a hypothetical \$500

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<sup>6</sup> For example, the completion of the Federal Reserve's Supervisory Capital Assessment Program for the major banking firms also appeared to play an important role in allaying some of the concerns among market participants.

<sup>7</sup> We do not think the release of the December FOMC statement conveyed much information about the Federal Reserve's balance sheet policies to market participants because open-ended purchases of longer-term Treasury securities (and the \$45 billion per month initial pace) had reportedly been widely anticipated. While broad U.S. equity prices initially increased slightly following the release of the statement, by the end of the day they registered essentially no net change.

billion LSAP on selected financial market quotes; of course, there is a great deal of uncertainty surrounding all these figures. Compared with the financial market effects implicit in model simulations presented to the FOMC last summer, we have slightly raised the assumed effects of an LSAP including sizable agency MBS purchases on agency MBS yields and primary mortgage rates but slightly lowered the assumed pass-through to yields on BBB-rated corporate bonds.<sup>8</sup> We have more significantly reduced our assessments of the amount by which, in current conditions, a hypothetical LSAP program will likely depreciate the dollar and boost equity prices, though those effects continue to be an important transmission channel.

Table 1  
Judgmental Assessment of the Effects of a Hypothetical \$500 billion  
Large-Scale Asset Purchase Program on Selected Financial Market Quotes

10-year Treasury yield	–20 basis points
30-year current coupon agency MBS yield	–27 basis points
Conforming 30-year (fixed) mortgage rate	–25 basis points
BBB corporate bond yield	–15 basis points
Exchange value of the dollar (broad index)	–3/4 percent
S&P 500 stock price index	1-3/4 percent

Note. This hypothetical program is assumed to involve the Federal Reserve purchasing about \$265 billion of longer-term Treasury securities and \$235 billion of agency MBS with maturities similar to its current asset purchases.

### Effects of Asset Purchases on Real Activity and Inflation

In this section we discuss the next step in the transmission channel, from LSAP-induced changes in asset prices to real activity and inflation. The lagged response of these variables to monetary policy precludes an event-study approach akin to what can be done with high-frequency data on interest rates and asset prices. We therefore cannot produce much in the way of direct evidence of real effects from the LSAPs. Instead, we start from the presumption that the response of the economy to asset price changes will be about the same as it has been historically—a response that embodies the widely accepted view that monetary policy actions have had important effects on the real economy. Specifically, we begin by presenting FRB/US-based simulations, which are informed by this historical response. Importantly, we have adjusted some of the asset-pricing equations in FRB/US in order to cause them to generate responses to LSAPs that are consistent with the evidence discussed in the previous section. We also discuss several reasons why the effects of LSAPs may be smaller or larger than the FRB/US simulations suggest and present what limited evidence there is on those considerations.

<sup>8</sup> We have not significantly changed our estimates for the effects of a hypothetical LSAP program on longer-term Treasury yields since last summer.

*Estimates of Macroeconomic Effects Using FRB/US*

Table 2 presents simulations of the macroeconomic effects of a hypothetical \$500 billion asset purchase program initiated in the current quarter, with the same composition of Treasury securities and MBS as the Committee’s current asset purchases. Initially, we assume in our simulations that the federal funds rate follows the January Tealbook path through the end of 2017, and only thereafter responds to the change in economic conditions. We made similar assumptions in our past assessments of the macroeconomic effects of LSAPs. Toward the end of this memo we discuss the potential interaction of asset purchases with changes in the public’s expectations for the future path of the federal funds rate.

**Table 2: Effects of an Additional \$500 Billion in Asset Purchases**  
(Deviations from baseline of no purchases in basis points, unless otherwise indicated)

Scenario	Exogenous federal funds path			
	Benchmark	Reduced interest sensitivity	Higher house prices	Earlier liftoff
<b>Financial market responses</b> (in 2013Q1)				
10-year Treasury (b.p.)	-18	-19	-18	-15
Stock market (% chg)	2.7	2.3	3.0	1.2
Exchange rate (% chg)	-0.9	-0.7	-1.0	-0.6
<b>Real activity and inflation</b> (in 2015Q4)				
Unemployment rate	-21	-12	-28	-12
Level of real GDP	42	20	55	23
PCE inflation	12	1	19	3

In all of the simulations reported in this memo, we calibrate the path of Treasury term premiums based on Li and Wei (2012), and allow all other asset prices to respond endogenously to the changes in Treasury yields as governed by the FRB/US model. In the first simulation, labeled “Benchmark,” the asset price responses when the hypothetical LSAP is initiated (announced or fully anticipated), shown in the first three rows, are close—though not identical—to the event-study-based estimates that were summarized in table 1. The decline in 10-year Treasury yields passes fully through to corporate bond yields (not shown), whereas mortgage rates (also not shown) decline 25 basis points—a little more than the decline in Treasury yields—since one-half of the assets purchased are agency MBS. The program also raises equity prices 2¾ percent, a little larger than our judgmental assessment of the stock market response discussed in the previous section but substantially smaller than in previous FRB/US-based

simulations.<sup>9</sup> The broad dollar index declines 0.9 percent, close to the event-study evidence cited above but also smaller than in previous simulations.

The final three rows provide the estimated effects of the hypothetical \$500 billion LSAP on real activity and inflation after about three years. In this simulation—that is, assuming the funds rate is held at baseline for the first five years of the simulation—the unemployment rate is reduced about 0.2 percentage point, the level of real GDP is 0.4 percent higher, and inflation is about 0.1 percentage point higher. These effects on real activity and inflation are smaller than ones we have reported in earlier assessments, mostly because of the smaller stock market and exchange rate responses.<sup>10</sup>

As noted, this first simulation has the property that the decline in Treasury yields passes fully through to corporate yields, and is associated with a rise in equity values that is slightly larger than our assessment based on event-study evidence. The less-than-complete pass-through to corporate yields observed in the event studies probably reflects some form of segmentation between markets for corporate securities and Treasury markets that is not captured by FRB/US. A simulation (not shown) in which we add-factor corporate risk premiums so that only 80 percent of the decline in the 10-year Treasury yield passes through to corporate yields and stock prices rise only 2 percent leads to a decline in the unemployment rate after three years of 19 basis points, and a rise in inflation of 10 basis points. In light of the minor differences in results compared to the benchmark results, the remaining simulations make no such ad-hoc adjustments to corporate risk premiums.<sup>11</sup>

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<sup>9</sup> The changes made to the equity valuation equation in FRB/US to bring about the smaller responses reflect several considerations. The expected rate of return on equity used to discount future dividends is now tied to the 30-year real Treasury yield (plus a premium) instead of the 10-year real Treasury yield. Because we estimate that the effect on the 30-year Treasury term premium of the LSAPs is only about one-third of the effect on the 10-year term premium, this is consistent with the view that some investors may discount stock market returns using rates that are little affected by the term premium reductions. Moreover, at this point asset purchases seem unlikely to reduce risk premiums on corporate bonds and equity by any measurable amount, whereas in our previous analyses we allowed for an endogenous reduction of these risk premiums in response to stronger economic activity.

<sup>10</sup> Despite the smaller stock market and exchange rate responses that the FRB/US model now generates, the effects on the unemployment rate and inflation are only modestly smaller than those reported in earlier memos on this subject. For example, the simulation called Option 2 in the memo “Options for an Additional LSAP Program” sent to the FOMC on August 28, 2012 implied that a \$500 billion program with a similar mix between Treasury and agency MBS purchases would reduce the unemployment rate over the next three years 23 basis points and raise inflation 13 basis points. In that simulation, the federal funds rate was held at the baseline path for the first four years of the simulation.

<sup>11</sup> The benchmark simulation assumes that not only financial market participants but also price and wage setters fully anticipate the stimulative effect of the lower path for term premiums and longer-term interest rates. Because of their preference for smooth price and wage adjustment, the anticipation of stronger future activity results in higher inflation within a few quarters of the program’s initiation. Were we instead to assume that the lower path of long-term yields comes as a surprise to price and wage setters, the inflation response would be reduced by half. However, the effects of this temporarily lower inflation (relative to the benchmark simulation) on real activity are very small because financial market participants are still assumed to have model-consistent expectations. They therefore anticipate that the temporarily higher path for real *short-term* rates relative to the benchmark simulation will be offset by lower real short-term rates later on, leaving the path of real *long-term* yields, which matter for spending decisions in FRB/US, little changed.

### *Further Considerations Concerning the Transmission Channels*

The simulations described so far are predicated on the assumption that the transmission from financial conditions to economic activity and inflation in current circumstances is about in line with historical norms. And of course, they are also predicated on the particular structure of FRB/US. However, economic activity might respond differently to LSAPs than to other sources of monetary stimulus, and the structure of FRB/US might be inaccurate. Here we discuss several possible departures from our baseline assumptions.

#### *Effects of credit restraints and house prices*

Recent years have seen a substantial curtailment in the availability of many types of credit, including home mortgages and credit card debt for households as well as credit extensions to smaller businesses and loans to finance construction activity. Although conditions have improved overall, credit remains relatively tight in these areas. As a result, historically low borrowing rates might still have limited impetus on spending relative to more usual times because fewer potential borrowers may be in a position to benefit from those lower rates.<sup>12</sup> Attenuation of this type is not captured in FRB/US, and would probably cause the model to overstate the influence of LSAPs on economic conditions.

However, other factors may be causing the model to *understate* the influence of LSAPs on economic conditions. For example, if monetary policy actions result in higher house prices—a possibility not captured in FRB/US—LSAPs could have a larger influence than shown in the benchmark simulation. Higher home prices would strengthen consumer spending through wealth effects and perhaps through higher consumer confidence. They might also help ease the lending constraints for some homeowners by improving their net worth and, in some cases, pushing them above water on their mortgages; this “financial accelerator” effect could therefore offset the attenuation channel discussed above. Such a dynamic could be present outside the housing sector as well, as a stronger economy will tend to improve the creditworthiness of other potential borrowers, including small business owners, which could also ease credit availability and so strengthen an impulse from the LSAPs.

#### *Spending decisions and the term structure of interest rates*

The effect of LSAPs on economic conditions might also differ from the FRB/US simulations because LSAPs affect the broad array of financial conditions differently than

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<sup>12</sup> An unusual degree of uncertainty about the economic outlook could provide another reason for attenuated effects of policy, as uncertainty may not only restrain the spending of many households and businesses directly, but it may also make spending less sensitive than usual to changes in interest rates and asset values. However, uncertainty is surely lower at present than it was in the midst of the financial crisis or early stages of the recovery, and in that regard, one potential benefit of the LSAPs—particularly the current program that is open-ended and so can respond to economic conditions—may be to reduce downside risks to the outlook.

conventional monetary policy actions—in particular, LSAPs largely affect longer-term financing rates, and do not affect the cost of shorter-term or variable-rate borrowing in the same manner that, for example, a lower trajectory for the federal funds rate affects such costs. The FRB/US spending equations generally are based on 5- or 10-year real interest rates, but some spending decisions likely depend on shorter-term rates, and as a result, the FRB/US simulations may overstate some of the effects of LSAPs on spending.<sup>13</sup>

A related argument is that changes in longer-term interest rates brought about by changes in term premiums might have smaller effects on spending than those associated with changes in expected future short-term interest rates. (While LSAPs have likely affected long-term interest rates, at some times, through a signaling of lower future federal funds rates—see Bauer and Rudebusch, 2012, and Krishnamurthy and Vissing-Jorgenson, 2011—we believe that, since the Committee adopted calendar-based forward guidance for the federal funds rate, the effect has been primarily due to reductions in term premiums.) Indeed, Stein (2012) argues that, in some situations, changes in term premiums may not be an important consideration for spending decisions for businesses making investment decisions. In his stylized example, for firms that can freely borrow and lend in credit markets at all maturities, the short-term lending rate represents the relevant opportunity cost of funds, and borrowing long-term to take advantage of a low term premium ought to have no influence on real activity. That logic may well apply for borrowers with ready access to capital markets—and so with the ability to use long-term debt to refinance existing debt—but for many other borrowers, spending decisions likely depend on the longer-term lending rates that finance that spending; the fact that capital purchases frequently serve as collateral for the loan makes that connection even more direct.

Empirical analyses of these issues are hampered by difficult identification issues, especially given the limited historical precedents for a monetary policy regime that influences spending primarily by affecting term premiums. These identification issues are particularly acute for business investment spending, a category where most empirical time-series models have trouble identifying clearly a meaningful effect of interest rates, much less a differentiation between the effects of short rates and long rates or between the effects of term premiums and the expected path of short rates. Nevertheless, some research has found either important effects on GDP growth of both long-term and short-term interest rates or relatively small effects of term premiums (see Andrés and others, 2004, Chen and others, 2012, and Kiley, 2012). The studies therefore provide some reason to think that the effects of LSAPs on real activity could be smaller than those found in the FRB/US simulations.<sup>14</sup> (Note, however, that the much smaller effects of LSAPs on real activity and inflation reported in Chen and others, 2012, are in part due to a

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<sup>13</sup> Note, however, that the response in FRB/US of real activity and inflation to conventional federal funds rate movements (“shocks”) is in line with the empirical evidence from VAR analyses, suggesting that FRB/US is not in general excessively interest sensitive.

<sup>14</sup> Research on the term structure as an indicator for future GDP growth is also relevant to this discussion. Results from Rudebusch and others (2007) suggest that changes in term premiums have significant predictive power for future GDP growth. This result conflicts with earlier studies by Hamilton and Kim (2002), Favero and others (2005), Wright (2006), and Ang and others (2006).

higher path of the federal funds rate over the medium-term, offsetting some of the accommodation provided by the LSAP.)

### *Macroeconomic evidence*

Beyond the studies just cited, there is only limited direct empirical evidence we can bring to bear on the reliability of our benchmark estimates. Here we present three exercises. First, we ask whether FRB/US can identify any changes in the interest sensitivity of spending relative to historical norms, perhaps as a result of the issues discussed above. We therefore updated an exercise from last year's memo on attenuation, in which Board staff investigated the overall magnitude of attenuation by estimating the FRB/US spending equations while allowing the equations' coefficients to vary over time. This exercise generated a modestly smaller response of GDP to monetary policy in 2009:Q1, the height of the financial crisis, but the estimated output response had moved part way back to its historical average by late 2012.<sup>15</sup> Thus, this exercise provides at least a bit of macroeconomic evidence that, overall, any attenuation of policy effects has likely been modest.

Second, we note some informal evidence that interest-sensitive components of spending have improved notably during the recovery. The housing sector is traditionally thought to be highly interest sensitive, and the improvement in housing over the past year could be taken as evidence that very low mortgage interest rates are playing some role. Certainly, anecdotal evidence suggests that this is so, and about one-half of households responding to the Michigan survey report that low interest rates help make this a good time to buy a home. Regarding consumer spending, while this recovery has been weaker than average in general, the pickup in sales of durable goods, and motor vehicles in particular, has been stronger relative to previous recoveries than has been the case for spending on nondurable goods and services—again, suggestive of some positive role for low interest rates. To be sure, this evidence is far from dispositive, as factors other than low interest rates could, in principle, have accounted for the increases; for example, a relatively large rebound probably should have been expected after the particularly large declines in durable goods spending during the recession. Nevertheless, this informal evidence is suggestive of some positive role for low interest rates.

Third, because the evidence is far from clear regarding the issues discussed above, namely, changes in interest rate sensitivity over time, the relative importance of term premiums, and the importance of house-price effects, we present two simulations to help frame the possible magnitude of these factors. In the second column of table 2, we present a fairly extreme example in which spending on residential real estate and business equipment in FRB/US is assumed to be entirely unresponsive to the changes in interest rates induced by a \$500 billion LSAP. In other words, we entirely turn off the interest rate channel of policy on these spending categories, while

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<sup>15</sup> See the April 6, 2012 memo by Chung and others for details. The small estimated reduction in interest sensitivity was concentrated in the equations for spending on consumer durables and residential investment. The latter result appears consistent with micro evidence that suggests attenuated policy effects in the housing sector.

leaving intact the effects working through other asset values including the exchange rate and equity prices, as well as endogenous multiplier effects. As can be seen, the simulated effects on real activity are only one-half as large as the benchmark estimates shown in column 1. Then, in the third column of table 2, we present a simulation in which, contrary to the benchmark case, the LSAPs lead to a rise in house prices of similar magnitude as the rise in equity prices, and this feeds into a stronger recovery through the wealth effect (but not, in this simulation, through any change in confidence or credit availability). In that simulation, the effects on real activity are appreciably stronger than in the benchmark estimates.

### *Hysteresis effects*

We also note one additional reason to suspect that the effects of policy could be larger than the standard FRB/US estimates presented above. Suppose hysteresis is present in labor markets such that high unemployment becomes structural over time as workers lose skills or labor market attachments, or that the persistently weak labor market leads to a long-lasting reduction in labor force participation. To date, we do not see strong evidence that these types of effects have occurred, and no such hysteresis effects are present in the FRB/US simulations. But if monetary policy actions have, in fact, helped forestall such hysteresis effects, then policy may have had much larger and longer-lasting effects on real activity than is indicated in the benchmark FRB/US estimates.

To illustrate the potential importance of such a hysteresis channel, we consider the following hypothetical example. In the benchmark simulation exercise cited above, the LSAP program strengthens the labor market enough to reduce the unemployment rate about 20 basis points after two years; that unemployment differential diminishes over time, however, as we assume the unemployment rate would eventually move back to its long-run level with or without the LSAPs. Suppose, conversely, that if not for the LSAPs we would have had a persistent shortfall in employment, equivalent in magnitude to 10 basis points on the unemployment rate for ten years, and that the LSAPs prevented that outcome from occurring. In that case, the LSAP program would have reduced the unemployment rate over the next 10 years a cumulative 1.9 percentage point-years, twice as large as the 0.9 percentage point-year reduction associated with the benchmark simulation in table 1. If the effects were to last longer than 10 years, the benefits of the LSAPs would be greater still.

### ***Interaction between Asset Purchases and the Expected Future Federal Funds Path***

Although not properly an aspect of LSAP efficacy, it is important to note that the simulated macroeconomic effects of the LSAPs depend importantly on how, if at all, the federal funds rate is assumed to respond to the change in economic conditions generated by the asset purchases. All the simulations presented so far are based on the premise that the path for the federal funds rate follows the baseline for the first five years. While there is no necessary

inconsistency between this approach and the forward guidance based on quantitative thresholds introduced by the Committee in December, those quantitative thresholds could lead the public to now expect an earlier liftoff to result from the stronger economic conditions induced by the LSAP. In the simulation reported in the rightmost column of table 2, the federal funds rate is not held fixed for five years but is instead governed by the inertial Taylor (1999) rule once either the unemployment or the inflation threshold is crossed. Endogenizing the funds rate in this way undoes nearly half of the effects on the financial variables as well as those for economic activity and inflation. This finding highlights the importance of the Committee's communications regarding its intentions for the future path of the federal funds rate in conjunction with changes to its asset purchases. In contrast to this simulation, if financial markets viewed the asset purchases as signaling a lower federal funds rate path than had been previously expected—perhaps because the additional asset purchases are taken to signal a shift to a more accommodative conduct of monetary policy—the effects of the hypothetical asset purchase program would be larger than in the benchmark.

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