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Identified?**

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An Evaluation of Event-Study Evidence on the Effectiveness of the FOMC's LSAP Program: Are the Announcement Effects Identified?

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Abstract

The consensus in monetary policy circles that the Fed's large-scale asset purchases, known as quantitative easing (QE), have significantly reduced long-term yields is due in part to event studies, which show that long-term yields decline on QE announcement days. However, little attention has been given to whether these announcement effects are identified. This paper contributes to the literature by investigating whether announcement effects associated with the QE announcements used in the literature are identified. The analysis shows that none of announcement effects satisfy the strict requirements for identification. At best, event-studies provide modest evidence that QE reduces long-term yields.

JEL Codes: E43, E52, E58

Key Words: quantitative easing, large-scale asset purchases, FOMC, event-studies, announcement effect

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1.0 INTRODUCTION

Since the start of the great recession, the Federal Reserve, and many other central banks, engaged in so-called unconventional monetary policies, of which quantitative easing (QE) is the most prominent example. QE is the large-scale purchase of assets (government and agency debt and mortgage-back securities, MBS) with the objective of reducing long-term yields relative to what they would have otherwise been. The macroeconomic objective is to increase aggregate demand relative to what it would have otherwise been and, thereby, output, and employment. It is difficult to identify the effects of QE (or other unconventional policies) on economic activity because (i) QE has rarely been used and (ii) many other factors affect the course of both monetary policy and the real economy during financial crises. Consequently, researchers have focused on the narrower question of whether QE reduced long-term yields. It is also difficult to determine whether QE reduced long-term yields relative to what they would have otherwise been. Consequently, researchers have focused on event studies to evaluate the effect of QE on long-term yields. Indeed, the consensus in monetary policy circles that QE has significantly reduced long-term yields is due in part to event-studies (e.g., Gagnon et al., 2011; Krishnamurthy and Vissing-Jorgensen, 2011; Joyce et al., 2010; Neely, 2011; Swanson, 2011; Bauer and Rudebusch, 2012; and Wright, 2012) that find that long-term yields declined after selected QE announcements and speeches by chairman Bernanke.¹

The event-study methodology has several advantages over lower-frequency methodologies. In particular, it is model-free so the estimated announcement effects are not contaminated by model uncertainty that plague other methods. Moreover, the use of high-frequency data effectively eliminates the endogeneity problem associated with methodologies

¹ For example, in discussing the evidence of the effectiveness of QE in reducing long-term bond yields Bernanke (2012) references several studies that use the event-study methodology, alone or in combination with other methodologies.

that rely on lower-frequency data. However, to be considered evidence that QE reduced long-term yields, the event-study announcement effects must be identified; the announcement effects must be due solely to the QE news, not to other news, and the announcement effects must be statistically significant. This paper contributes to the literature by investigating whether the announcement effects obtained in the event-study literature meet these identification requirements. Specifically, this paper applies the event-study methodology to three bond yields: the 10-year Treasury yield and the yields on *Aaa*- and *Baa*-rated corporate bonds. The QE announcements are those used in the literature, so the results obtained here apply directly to the results found in the literature.

To preview the results, the analysis finds that none of the 53 QE announcements considered in the literature meet the strict requirements for identification. Moreover, only 11 of the announcements meet some of the requirements: Specifically, they are statistically significant and are likely due to the particular announcement, but not necessarily to the QE news in the announcement. A detailed analysis of these eleven QE announcements suggests the event-study conclusion that QE reduced long-term yields is fragile.

The remainder of the paper is divided into the following sections. Section 2 obtains the announcement effects associated with 53 QE announcements used in the literature and discuss the problem of identification and how the QE event-study literature has handled the problem of identification. Section 3 analyzes the extent to which the announcement effects obtained in Section 2 are identified. Section 4 undertakes a more detailed investigation of a subset of announcements that show the most promise of providing evidence on the effectiveness of QE. The conclusions are presented in Section 5.

2.0 IDENTIFICATION

Event studies look at the high-frequency (daily or higher) response of yields to important QE announcements. There are two requirements for identification of announcement effects: (i) the announcement effect must be solely due to the QE news, and (ii) the announcement effect must be statistically significant. This section discusses the problems associated with determining whether the announcement effects are identified and how the QE event-study literature has typically dealt with the issue of identification.

2.1 QE Event-Study Announcement Effects

The analysis begins with estimates of the announcement effects typical of those found in the literature. Table 1 shows the daily change 10-year Treasury yield ($T10$) and the yields on *Aaa* and *Baa* corporate bonds associated with 53 announcements used in the QE event-study literature. The sample period is October 1, 2008, through December 31, 2011. The announcements are those used by Gagnon et al. (2011) and Wright (2012). There are three types of announcements: FOMC statements and other Fed announcements, speeches by Chairman Bernanke, and the release of FOMC minutes. The “Announcement” columns of Table 1 show the announcement effects associated with Federal Reserve press releases, Bernanke speeches, and FOMC statements. The “Minutes” columns show the announcement effects on days when FOMC minutes were released. The magnitude and direction of these announcement effects are similar to those reported in the literature. The announcements suggested by Gagnon et al. (2011) and Wright (2012) as particularly important are shown in bold type. As is done in the literature, the announcements are also partitioned into “buy” and “sell” announcements: Buy announcements should cause bond yields to decline, while sell announcement should cause yields to rise. Sell announcements are shown in italics.

The efficient market hypothesis implies that the changes in bond yields shown in Table 1 reflect the markets' reactions to the new information (news) that the markets received on these days. If the markets respond only to the QE news in the announcement, the announcement effect would be evidence of the effect of QE on long-term yields. This requirement is most easily satisfied if the announcement only contains QE news. However, this is true only for the November 25, 2008, announcement, which informed the public that the Fed would purchase up to \$600 billion in agency and mortgage-backed securities (MBS).

Identification becomes more complicated if the announcement contains other news in addition to QE news. This is the case for FOMC policy statements because each statement begins with an assessment of how the FOMC's view on the economy or the economic outlook has changed during the intermeeting period. Some FOMC participants may have provided their views about such matters prior to the meeting. However, the FOMC statement presumably reflects the view of the Committee. Hence, all policy statements provide news in addition to QE news.

Speeches by Chairman Bernanke also contain other news. For example, Chairman Bernanke's December 1, 2008, speech alluded to the possibility of additional LSAPs when he noted that it was encouraging that the Fed's November 25 announcement "was met by a fall in mortgage interest rates," and suggested that the Fed might undertake additional "purchases of agency debt and mortgage-backed securities as conditions warrant." However, the Chairman discussed several other issues, such as the economic outlook and the difficulty keeping the funds rate close to its 1 percent target level. Hence, it is possible that bond yields might have reacted to other news in the speech and not solely to the QE news.

When an announcement contains two or more pieces of news identification can be achieved only if the sign of the announcement effect can be uniquely attributed to a particular piece of news. If two or pieces of information could have caused yields to move in the same direction, the announcement effect might be “judgmentally identified” if it can be reasonably argued that only one piece of news was important enough to move the market. Otherwise, the announcement effect is not identified. The appendix provides the QE and other news associated with all of the announcements in the “announcements” column of Table 1.

Identification of announcement effects associated with the release of FOMC minutes is particularly problematic because it is unlikely that the FOMC minutes contain any QE news. The minutes are released with a lag and the QE news relevant for that meeting was previously released in the policy statement. At best, the minutes provide information about differing views of FOMC members about the desirability and/or the effectiveness of QE. Identification is further complicated by the fact that the QE or other news that the minutes might contain is so opaque that it is impossible to determine the sign of the announcement effect: If the announcement effect cannot be signed, it cannot be identified.

Identification requires that the announcement effects be statistically significant. Determining whether announcement effects are statistical significant is difficult because there is no measure of the “quantity” of news contained in the announcements: The announcement effect is merely the change in bond yields per announcement. This measure is valid only if the announcements are homogeneous, i.e., every announcement contains the same quantity of news. However, this is extremely unlikely: The November 25, 2008, and March 18, 2009, announcements provided news about unprecedented large asset purchases. In contrast, the August 12, 2009, announcement merely stated that “the Committee has decided to gradually

slow the pace of these transactions and anticipates that the full amount will be purchased by the end of October.” The FOMC had previously indicated “autumn” (autumn starts on the September equinox—September 22 in 2009). The amount of news in the August 12, 2009 announcement appears to be tiny relative to that in the November 25, 2008, and March 18, 2009, announcements.

This problem can be overcome if one can find a unit of measure that is homogeneous for each announcement. For example, Kuttner (2001) noted that the announcement effects associated with changes in FOMC’s target for the federal funds rate were not homogeneous because the unexpected component of target changes could differ in size even if the change in the target was identical. A 5-basis-point change in a yield associated with a 50-basis-point change in the target would be relatively small and perhaps not statistically insignificant; however, if only 10 basis points of the 50-basis-point change were unanticipated, the announcement effect would be relatively large and more likely statistically significant. Kuttner (2001) dealt with this problem by using the federal funds futures rate to determine the unexpected component of target changes; the announcement effects are the percentage point change in bond yields per percentage point change in the federal funds futures rate (i.e., the unexpected change in the target). Kuttner’s methodology solves the measurement problem, but introduces another. Specifically, it gives rise to an identification problem because bond yields and federal funds futures rates respond to the same information even on days when there are no changes in the funds rate target (e.g., Thornton, 2014).²

² The event-study literature does not attempt to identify the unexpected component of QE announcements nor does it address the issue of the markets’ response to anticipated QE actions that were not taken. Of course, the absence of an announcement effect does not necessarily imply that QE does not reduce bond yields because there would be no announcement effect if the QE news was anticipated. While it is possible that some of the QE actions might have been anticipated later in the sample period used here, it seems reasonable to assume that the QE announcement in the early part of the sample period were unanticipated.

The QE event-study literature is aware that the announcements are not homogeneous. Researchers have attempted to deal with this problem by paying special attention to a subset of the QE announcements which they consider particularly important. For example, Gagnon et al. (2011) focus on “a narrow set of official communications, each of which contained new information concerning the potential or actual expansion of the size, composition, and/or timing of LSAPs” (p. 17). They call these announcements their “baseline” event set. The announcements that the literature has identified as being particularly important are in bold type in Table 1. However, it is unlikely that the quantity of news is homogeneous even for the narrower set of announcements: The measurement problem is mitigated but not eliminated.³

To ensure that the announcement effect is due to the announcement and not to other news during the day, some event studies calculate the announcement effect over a sufficiently short period of time that the response is likely due only to the announcement and not to other information. This approach reasonably identifies the response to the announcements from other information during the day; however, it cannot separate the effect of the QE news from the effect of other news in the announcement, which is a problem for FOMC statements and Bernanke’s speeches. Moreover, estimating the announcement effect over a short period immediately following the announcement runs the risk of overstating the effect on bond yields over the day: The daily change could be much smaller, or possibly opposite in sign, than the immediate response. This would happen if the market overreacted to the announcement or if the announcement effect was partially or totally offset by subsequent news. However, the high-

³ Wright (2012) measures the quantity of news in each of the QE announcements in terms of one standard deviation of the first principal component of high-frequency changes in the 2-, 5-, 10-, and 30-year bond futures on QE announcement days. The changes in bond futures are measured from 15 minutes before each QE announcement to 1 hour and 45 minutes after each announcement. He then estimates the effect of QE in terms of the impulse response function of a VAR identified using a procedure called identification through heteroscedasticity. He finds a small (about 15 basis points) and short-live effect of QE on the 10-year Treasury yield. In any event, Wright’s measurement cannot be used in the event study methodology because the measure is not available on days when there are no QE announcements.

frequency response is useful. Indeed, it is used here to help determine whether the daily change is likely due to the announcement or other news received by the market during the day.

3.0 ARE THE QE ANNOUNCEMENT EFFECTS IDENTIFIED?

This section investigates whether the announcement effects presented in Table 1 are identified. The analysis begins with the problem of determining whether the announcement effects shown in Table 1 are statistically significant. As noted previously, determining statistical significance is complicated by the lack of a unit of measure of the quantity of news contained in the announcements. In the absence of an appropriate unit of measure the statistical significance of daily changes in bond yields on QE announcement days is evaluated by comparing the absolute value of the change in bond yields on announcement days with the absolute value of changes in bond yields on days when there were no QE announcements or other macroeconomic announcements. This metric is particularly relevant for determining the statistical significance of the announcement effects associated with the release of minutes because these announcement effect cannot be signed.

Specifically, daily changes in bond yields are partitioned into announcement days (the QE announcement days shown in Table 1 plus days with important macroeconomic announcements) and non-announcement days.⁴ The announcement effects for each of the announcements in Table 1 are then compared with the 90th percentile for the absolute value of changes in bond yields on non-announcement days. A change larger than the 90th percentile value is determined to be statistically significant. The 90th percentile value is 12 basis points for all three bonds.

⁴ The macroeconomic announcements considered are the releases for GDP, industrial production, employment, and the unemployment rate. There were 53 QE announcements and 109 macroeconomic announcements during the sample period (19 percent of the days).

It is not surprising that nearly all announcement effects associated with the release of FOMC minutes are not statistically significant by this metric. Moreover, consistent with the fact that it is impossible to confidently predict the direction of bond yields associated with any news that the minutes might contain, the announcement effects are nearly equally distributed between positive and negative changes—34 negative and 38 positive. These results combined with the likelihood that FOMC’s minutes contain little if any news strongly suggests that release of the minutes did not generate statistically significant announcement effects.

A complementary approach to determining the statistical significance of a set of announcements is to estimate the equation

$$(1) \quad \Delta i_t = \alpha + \beta^{imp} Dum_t^{imp} + \beta^{Limp} Dum_t^{Limp} + \beta^{min} Dum_t^{min} + \varepsilon_t,$$

where Dum_t^{imp} and Dum_t^{Limp} are dummy variables that are 1 (-1 for sales) on days that are important or less important announcements in the “announcement” columns of Table 1, respectively, and 0 otherwise, and Dum_t^{min} is a dummy variable that is 1 on days when FOMC minutes are released and 0 otherwise. The β coefficients measure the extent to which the change in the bond yield is different from that on non-announcement days, α . To insure that the change on non-announcement days is not contaminated by other headline announcements, days when there were macroeconomic announcements are deleted from the sample.⁵

The estimates of equation (1) for the three bond yields are reported in Table 2. Consistent with the fact that FOMC minutes contain no QE or other news, the estimates of β^{min} are small and not statistically significant—the average change in bond yields on days when the minutes are released is not statistically significantly different for the average change on non-announcement days. Given this result and the previous discussion, none of the announcement effects associated

⁵ The results are quantitatively similar and qualitative identical if the macroeconomic announcement days are not removed.

with the release of FOMC minutes is identified. Consequently, these announcements are not considered further

Estimates of β^{imp} are negative for all three bond yields, but statistically significant at the 10 percent significance level only for the 10-year Treasury yield. The estimates indicate that the 10-year Treasury yield declined by nearly 9 basis points relative to non-announcement days, while the *Aaa* and *Baa* declined by about 4 basis points. Bernanke's August 27, 2010, speech, is considered a buy announcement; however, in discussing three policy options for further easing (making additional asset purchases, modifying the Committee's communication, and reducing interest paid on excess reserves), Bernanke noted that while additional purchases "would be effective in further easing financial conditions...the expected benefits of additional stimulus from further expanding the Fed's balance sheet would have to be weighed against potential risks and costs." This statement could have given market participants concern about how much additional QE the FOMC would do. Consequently, this announcement could be considered a sell announcement, which is consistent with the fact that bond yields increased by about 17 basis points that day.

To allow for this possibility, the August 27, 2010, announcement is recoded as a sell announcement and the equation is reestimated. The results are presented in the bottom portion of Table 2. The estimates of β^{imp} for all three yields are larger in absolute value than before and are statistically significant. This change suggests that collectively the QE announcements that have been deemed important are associated with a statistically significant decline in long-term bond yields.

The estimates of β^{Limp} are also statistically significant. However, they are positive, suggesting that the QE announcements of asset purchased caused bond yields to increase.

However, the fact that the coefficients are statistically significant does not necessarily rule out the possibility that these announcements had no statistically significant effect on bond yields because the sample size is small (15 observations) and only 5 of the 45 changes in the three bond yields were 12 basis points or larger and nearly all of the changes in bond yields on these days were positive. Hence, the statistical significance could be spurious.

3.1 Are the Changes in Bond Yields Due to QE News?

The results in Table 2 suggest that the announcements that are considered especially important are associated with statistically significant declines in bond yields: However, in the case of corporate bond yields, only if Benanke's 2010 speech is assumed to be indicative of a bond sale rather than a purchase. Identification requires that the statistically significant announcement effect must be due QE news and not to other news, either in the announcement or received by the markets that day. This section investigates the extent to which the announcement effects shown in the "Announcement" columns in Table 1 are due to QE news or other news.

The analysis begins by using intraday data on the price of the 10-year Treasury futures contract the extent to which the announcement effects in Table 1 are due to the specific announcement rather than other news during the day. If the response is due to the announcement, there should be a relatively large change in the futures price immediately following the announcement. Moreover, the immediate response should account for a relatively large percentage of the daily price change. If there is no immediate response, it is unlikely that the estimated announcement effect is due to the announcement. It is also unlikely that the observed daily change in bond yields is due to the announcement if the immediate response accounts for a small amount of the daily change in the 10-year futures contract.

Table 3 shows the percent change in the price of the 10-year Treasury futures from 5 minutes before the announcement to 15 and 45 minutes after the announcement. The FOMC's policy statement is normally released at 2:15 p.m. and is highly anticipated, so the market should respond very quickly to it: The 15-minute window would seem appropriate for FOMC policy statements. Bernanke's speeches and other announcements are not as well anticipated, so the 45-minute window would seem more appropriate. The change in the futures price from open to close is also calculated to determine the percent of the daily change accounted for the immediate reaction to the announcements. The first column shows the date and time of the announcement. The rows associated with the QE announcements that are considered to be important are shown in bold type. Columns (2) and (3) show the returns for the 15-minute and 45-minute windows, respectively. Column (4) shows the daily return. Columns (5) and (6) show 15- and 45-minute returns as a percent of the daily return. A negative sign indicates that the direction of the change after the announcement was opposite that of the daily change. A number greater than 100 indicates that part of the immediate response was reversed during the day—other news moved futures prices in the opposite direction or the market overreacted. The numbers for the most appropriate window size for the announcement are shown in bold type. The table is misleading for the two announcements that occurred at 8:15 because both the both the 10-year Treasury futures market and the 10-year Treasury market open at 8:20, five minutes after these announcements. Hence, the numbers for these announcements reflect the change in the futures price during the first 10 and 40 minutes of trading.

Consistent with the idea that many of announcements that are not designated as important did not cause a statistically significant market reaction, the 15-minute response for most of these announcements (i) is very small (less than 0.2 percent), (ii) is in the opposite direction of the

daily change, or (iii) accounts for a relatively small percentage of the daily change. There are four possible exceptions. The first two are the two FOMC statements following the FOMC's dramatic March 18, 2009, announcement. The immediate change in the futures price was relatively large and each announcement accounts for a large percentage of the daily change. However, the futures prices decreased rather than increased, as they should have in response to buy announcements. The daily change in the three bond yields was very small for both of these announcements and there was no uniformity in the direction of changes for the April announcement. The implication that these announcements produced no meaningful announcement effect is consistent with the fact that these announcements contained relatively little QE or other news (see the appendix).

The other two exceptions are the January 27, 2010, and March 16, 2010, FOMC statements. The immediate change in the futures price was relatively large on both days. However, futures price decrease after the January announcement. The conclusion that these announcements did not produce a meaningful announcement effect is supported by these facts: (i) changes in the three bond yields were small and not uniform in direction following the January announcement, (ii) the March announcement accounts for less than half of the change in the futures price on the day, (iii) neither announcement provides much QE or other news (see the appendix). The evidence strongly suggests that the announcement effects that are associated with the announcements that are not designated as important are not identified. These announcements are not considered further.

3.2 The Identification of Important QE Announcements

The results in Table 3 suggest that, with five exceptions, the announcement effects associated with announcements that considered important can be attributed to the announcement.

The five exceptions are: August 12, 2009; September 21, and November 3, 2010; and August 26, and September 21, 2011. For four of these announcements the immediate response was very small, suggesting no meaningful announcement effect.

The immediate response is relatively large and, in most cases, accounts for a relatively large percentage of the daily response for the remaining announcements. The evidence is particularly strong for the first five announcements. However, there is an anomaly: Two nearly identical QE statements are associated with relatively large changes in bond yields in the opposite direction. The December 16, 2008, policy statement read “The Federal Reserve will continue to consider ways of using its balance sheet to further support credit markets and economic activity,” and bond yields declined. The January 28, 2009, policy statement indicated the Committee “stands ready to expand the quantity of such purchases and the duration of the purchase program as conditions warrant,” and bond yields increased. Moreover, other news in both statements suggested that the incoming information since the previous meeting indicated economic activity had weakened; if anything, this should have caused yields to decline.

The high-frequency evidence is relatively strong for the remaining six announcements—September 23 and November 4, 2009; August 10 and 27 and October 15, 2010; and August 9, 2011. All of these announcements contained information about the FOMC’s LSAP program. However, there is a caveat. Specifically, only two announcements are associated with changes in bond yields greater than or equal to 12 basis points.

4.0 ARE THESE 11 ANNOUNCEMENT EFFECTS IDENTIFIED?

The analysis in the previous sections indicates that 11 of the announcements considered might provide evidence of the effectiveness of QE in that these announcements contained specific QE news and the immediate changes in the 10-year Treasury future price are relatively

large and accounts for a relatively large proportion of the change on the day. Moreover, six of these announcements are associated with changes in bond yields greater than or equal to 12 basis points, and most of the others are associated with changes in bond yields greater than or equal to 7 basis points (the absolute change in the three bond yields on non-announcement days was at least 7 basis points on between 28 and 33 percent of the days).

This section investigates the extent to which these 11 announcement effects provide evidence that QE reduces long-term yields. The November 25 announcement is the only announcement that contains only QE news. However, this announcement occurred 5 minutes before the markets opened. Hence, it is not clear whether the announcement effects in Table 1 are due to the QE news or other news. Bernanke's speeches and FOMC announcements contain news in addition to QE news. Hence, whether the announcement effects associated with these announcements provide evidence of that QE reduced long-term yields depends on an assessment of the relative news content in these announcements.

Figure 1 shows the *Aaa*, and *Baa* corporate bond yields and the 10-year Treasury yield 30 trading days before and 30 trading days after each of the 11 announcements. The shaded vertical bars show the change in the bond yields on the announcement day. Announcements that occurred within 30 trading days of each other are presented in the same panel with the yields 30 trading days before the first announcement and 30 trading days after the last announcement.

Panel A of Figure 1 with shows the first three event-study announcements. The 10-year Treasury yield was unusually volatile for a period of months following Lehman's announcement.⁶ Indeed, the 10-year Treasury yield changed by 12 basis points on 5 of the 7 days prior to the November 25 announcement, with a cumulative change of -49 basis points.

⁶ The standard deviation of changes in bond yields or the absolute value of changes in bond yields on non-announcement days is 50 to 80 percent larger from September 1, 2008, to March 31, 2009, than over the remainder of the sample.

Moreover, the Treasury yield declined relative to the *Aaa* corporate yields, while the *Aaa* yield declined relative to the *Baa* yield. Hence, the announcement effect on November 25, 2008, could reflect a continuation of general news of economic conditions driving bond yield lower and risk premiums high just prior to the Fed's announcement. This possibility seems more credible because this announcement occurred 5 minutes before the market opened. In any event, this fact means that it is impossible to determine whether the announcement effects are due to QE or other news—the announcement effects are not identified.

Of course, it could be argued that the Fed's announcement was so large and dramatic that the announcement effects in Table 1 had to be caused this the announcement and not to this announcement and not to other news during the day. While plausible, it does not necessary imply that the announcement effects are evidence of the effectiveness of QE. It is possible that market participants interpreted the Fed's decision to purchase a large quantity of government debt as an indicator that the Fed believed that economic and financial market conditions were deteriorating and market participants were responding to this rather than the QE news in the announcement per se.⁷ Neely (2011) and others note that there was no corresponding large negative change in equity prices on that day, suggesting that if market participants' economic outlook had become more pessimistic, equity prices should have declined significantly that day as well. This critique of the alternative explanation for the behavior of bond yields is valid only if daily changes in bond yields and stock prices are highly correlated on days when there is important news that could affect market participants' economic outlook. If there is a strong correlation between changes in bond yields and changes in stock prices on such days, the lack of a significantly large

⁷ Raskin (2013) finds that the market interpreted changes in the FOMC's date-based forward guidance as indicating a weaker economic outlook. Similarly, Thornton (2011) finds that the Fed announcement of the Term Auction Facility (which was part of a joint statement of several central banks concerning measures to "address elevated pressures in short-term funding markets) caused market risk premiums to increase significantly.

move in stock prices would provide relatively strong evidence against the revision-in-economic-outlook explanation for the decline in bond yields. This does not appear to be the case, however. Over the sample period used here the correlation between changes in the S&P 500 index and changes in these bond yields is nearly zero on all days in the sample and only slightly higher on days with relatively large changes in bond yields (defined as 12 basis points or larger), ranging from 6 percent for the *Baa* yield to 12 percent for the *Aaa* bond yield. The correlation is only slightly higher, 17 percent for the 10-year Treasury yield and 19 percent for the *Aaa* and *Baa* bond yields, on days with important macroeconomic announcements about the real economy.⁸

The possibility that the November 25, 2008, announcement effects were caused by a continuation of the sort of news that caused bond yields to fall and risk premiums to rise prior to the announcement is consistent with the response of bond yields to the January 28, 2009. Panel B shows that bond yields had been rising since late December 2008. The January 28, 2009, FOMC statement noted “that the economy has weakened further” since the last meeting and that “the Committee also is prepared to purchase longer-term Treasury securities if evolving circumstances indicate that such transactions would be particularly effective in improving conditions in private credit markets.” Either of these statements should have caused rates to decline; however, bond yields rose between 12 and 15 basis points on January 28 and continued to rise for a period thereafter. Hence, it is possible that the change in bond yields was due to a continuation of the type of news that had been causing bond yields to rise prior to the announcement and for a period thereafter.⁹ That the announcement effects were due to other news and not QE news is consistent with the fact that the immediate response of the Treasury

⁸ Moreover, a regression of the change in the stock price on the unexpected component of these macroeconomic shows that only one of the unexpected announcements (employment) is statistically significant and accounts for only about 1 percent of the variation of the change in stock prices.

⁹ One possibility is that bond yields were reflecting some improvement in the economy that was not reflected in the FOMC statement. Bond yields began rising in late December 2008 and the recession ended in June 2009.

future price to the January 29, 2009, announcement accounts for less than 30 percent of the daily change.

Panel C in Figure 1 shows the response of bond yields to the FOMC's March 18, 2009, announcement. The QE news in this announcement was more dramatic than that in the November 25, 2008, announcement. The response the Treasury futures price was immediate and large, and accounted for nearly all of the change on that day. The daily changes in bond yields were corresponding large; 51 basis points for 10-year Treasury yield and 24 and 23 basis points, respectively, for the *Aaa* and *Baa* bonds. Bond yields had been rising. Hence, there is little doubt that the announcement effects were due to anything other than the FOMC's statement. The fact that the QE news was stunningly large—additional purchases in the amount of \$1.15 trillion—lends credence to the interpretation that it was the QE news that caused bond yields to fall. However, this does not necessarily lead to the conclusion that QE cause long-term yields to decline. Again, there is an alternative hypothesis. The Committee's economic outlook was more pessimistic: "Information received since the Federal Open Market Committee met in January indicates that the economy continues to contract. Job losses, declining equity and housing wealth, and tight credit conditions have weighed on consumer sentiment and spending. Weaker sales prospects and difficulties in obtaining credit have led businesses to cut back on inventories and fixed investment." The market may have been surprised by the FOMC's pessimistic outlook; credit risks spreads had narrowed considerably by early March and there were other indications that conditions in the credit market and the economy were improving—indeed, the recession ended in just three months later. Consequently, it is possible the combination of FOMC's pessimism coupled with its unprecedented action caused long-term yields to decline.

The marked decline in bond yields was short-lived: The 10-year Treasury yield regained 30 basis points of its 51-basis-point loss on March 18 by March 25, and all of the loss within 30 days of the announcement. This behavior is consistent with the possibility that the dramatic, but relatively temporary, decline in bond yields occurred because the FOMC's economic outlook ran counter to market participants' economic outlook: The FOMC's more pessimistic outlook, coupled with the unprecedented action, caused market participants to temporarily reassess their economic outlook of an improving economy. The fact that the effect was very temporary would appear more consistent with the shock-to-the-economic-outlook hypothesis than with the effectiveness-of-QE hypothesis. If bond yields declined because the market believed that the massive increase in demand for debt would reduce bond yields relative to what they would have otherwise been, the effect should have been more persistent.

Identifying whether the remaining seven announcement effects are due to the FOMC's QE announcement or other information is equally difficult. The responses to the September 23, 2009, FOMC statement are presented in Panel D. This announcement is treated as a sell announcement: "The Committee will gradually slow the pace of these purchases in order to promote a smooth transition in markets and anticipates that they will be executed by the end of the first quarter of 2010." Nevertheless, bond yields declined modestly, just 1 or 2 basis points.

Panel E in Figure 1 shows there were relatively large increases in bond yields associated with the November 4, 2009, announcement. This announcement is also treated as a sell announcement: "The Committee will gradually slow the pace of its purchases of both agency debt and agency mortgage-backed securities and anticipates that these transactions will be executed by the end of the first quarter of 2010." The other information was somewhat bullish: "Information received since the Federal Open Market Committee met in September suggests that

economic activity has continued to pick up.” Hence, either piece of news could account for the 7 to 9-basis-point rise in bond yields. However, the immediate response of the 10-year Treasury futures price was rather small, 0.11 percent, and accounted for only about 40 percent of the change that day. Hence, the possibility that there was not statistically significant announcement effect on this day cannot be ruled out. In any event, bond yields began falling shortly after the announcement.

The announcement effects on August 10 and 27, 2010, are shown in Panel F in Figure 1. The August 10 FOMC statement noted that “To help support the economic recovery in a context of price stability, the Committee will keep constant the Federal Reserve’s holdings of securities at their current level by reinvesting principal payments from agency debt and agency mortgage-backed securities in longer-term Treasury securities” and “Information received since the Federal Open Market Committee met in June indicates that the pace of recovery in output and employment has slowed in recent months.” Both pieces of news could have reduced bond yields; however, the Treasury yield decreased 7 basis points while the corporate yields increased just 2 to 3 basis points. Given the small size of the announcement effects and the fact that they are not uniform in direction, suggest that there was no statistically significant announcement effect on this day.

Yields, which had been declining, increased following Bernanke’s August 27, 2010, speech and continued to increase for a period thereafter. Moreover, the immediate response of the Treasury futures price was relatively large, about a half of percentage point, and accounts for about half of the daily change. Hence, the evidence is fairly strong that the market responded to Bernanke’s speech and the response was statistically significant. However, the direction of the change in yields implied by the QE news in the speech is unclear. On the one hand, Bernanke

indicated that the Committee was prepared to take additional unconventional measures especially should the outlook deteriorate significantly. On the other hand, he suggested that additional measures might entail additional risks, which would seem to suggest that a larger deterioration in the outlook might be necessary for the FOMC to make additional asset purchases than previously. Hence, it is difficult to know the expected sign of the response to the QE news. On balance Bernanke's assessment of the economic outlook was pessimistic, which should have caused bond yields to fall, not rise.

Moreover, the speech did contain other information. In summing up the economic outlook, Bernanke noted that "Recently, inflation has declined to a level that is slightly below that which FOMC participants view as most conducive to a healthy economy in the long run. With inflation expectations reasonably stable and the economy growing, inflation should remain near current readings for some time before rising slowly toward levels more consistent with the Committee's objectives." Hence, this statement could have caused market participants to revise their expectations for inflation upward, causing bond yields to rise. In any event, Panel F shows the effect on the Treasury yield was completely offset within two days of the announcement, while the change in the corporate bond yields was largely offset. Yields rose for a period after the speech before declining again. Indeed, the Treasury yield was below its August 27 level within 20 days of the announcement, while corporate yields remained above their August 27 levels (i.e., risk premiums generally rose during this period).

The announcement effects associated with Bernanke's October 15, 2010, speech are shown in Panel G in Figure 1. His October speech was similar to his August 27 speech in content. The economic outlook was somewhat pessimistic, and he reiterated the point made in his August 27 speech that the FOMC could engage in additional asset purchases if conditions

warrant but noted that the beneficial effects of such an action would have to be weighed against the additional risks. He also discussed the role of forward guidance, noting that the most recent policy statements noted that the funds rate might be zero “for an extended period,” and suggested that the Committee could “modify the language of the statement in some way that indicates that the Committee expects to keep the target for the federal funds rate low for longer than markets expect,” should conditions warrant it. This statement should have caused rates to fall not rise. The immediate response to Bernanke’s speech was relatively large and accounted for about half of the daily change in the futures price; however, the changes in bond yields are relatively small. Hence, the possibility that the announcement effects are not statistically significant cannot be ruled out.

Panel H in Figure 1 shows the announcement effect associated with the August 9, 2011, FOMC statement. The announcement is associated with a 20-basis-point drop in the Treasury yield and a decline in corporate bond yields about half that size. There was no QE news in the policy statement; however, the economic outlook was pessimistic: “The Committee now expects a somewhat slower pace of recovery over coming quarters than it did at the time of the previous meeting and anticipates that the unemployment rate will decline only gradually toward levels that the Committee judges to be consistent with its dual mandate.” Perhaps the bigger news was that three voting members of the Committee dissented against adding a calendar date—“at least through mid-2013”—to the forward guidance statement.

In any event, Panel H shows that bond yields had been declining before the announcement and either increased slightly or declined more slowly after the announcement. The reaction could have been due to the Committee’s more pessimistic outlook, the extension of the forward guidance period, or the large number of dissents. However, the forward guidance

statement could have an effect only if it extended the forward guidance period beyond what the market had anticipated. Given the alternative explanations for the change in bond yields, it is difficult to conclude that the announcement effects associated with this announcement provide useful information about the effectiveness of the FOMC's QE policy.

4.1 An Epilogue

The fact that nearly all of the 11 announcement effects were completely offset within a month or two of the announcement suggests that, irrespective of what caused the response of bond yields, the effect appears to be short lived. Persistence of the effect is critical for the efficacy of QE because the FOMC's LSAPs are intended to reduce longer-term yields relative to what they would have otherwise been in order to stimulate investment and consumption and, thereby, economic growth and employment relative to what they would have otherwise been.

Of course, event studies provide no information about the persistence of the announcement effects; additional information is required. Gagnon et al. (2011) and others are aware of this problem and use other information to infer that the QE announcement effects are persistent. Gagnon et al. (2011) attempt to determine the persistence of their announcement effects by comparing the sum of the changes in bond yields on their baseline announcement days with the sum of the changes in bond yields on non-announcement days. They show that the sum of all the announcement effects on their baseline announcement days is negative for all yields considered. In contrast, with the exception of the *Baa* bond yield, the sum of changes in bond yields on non-announcement days is positive. They attribute the cumulative positive change on non-announcement days to a variety of factors and suggest that "it is likely those factors, and not

a reversal of the effects of the LSAP announcements, that drove Treasury yields higher on other days” (p.21), that is, the announcement effects were long-lasting or permanent.¹⁰

A simple comparison of the cumulative change on eight announcement days with the cumulative change on all other days says nothing about the permanency of the effect unless additional assumptions are made.¹¹ Indeed, this approach would be appropriate only if bonds yields are integrated of order one, $I(1)$, because the response to any news would be permanent. Strictly speaking, bond yields cannot be $I(1)$ because the lower bound nominal interest rates is zero.¹² Nevertheless, bond yields are highly persistent (i.e., they have roots that are very close to 1). Wright (2012) uses the persistence in bond yields to estimate the persistence of the QE announcement effects, which he identifies using a statistical procedure called identification through heteroskedasticity.¹³ His results suggest that the half-life of QE announcements is relatively short, about 2 to 3 months.¹⁴ Either of these approaches assumes that the observed persistence in bond yields is a characteristic of bond yields per se rather than the news (or shocks) that drives bond yields. In any event, the persistence in bond yields may overstate the persistence of the announcement effect because most analysts believe that QE works by reducing the slope of the yield curve (e.g., Gagnon et al., 2011, and Bernanke, 2008). In this case, the persistence of the announcement effect would be better estimated from the persistence of the slope of the yield curve, which is less persistent than bond yields themselves, so the half-life

¹⁰ Gagnon et al. (2011), p. 21.

¹¹ Neely (2011) calls the sum of the individual announcement effects the total effect on bond yields.

¹² To understand why, see Thornton (1999).

¹³ Identification through heteroskedasticity is a method for separating the response of bond yields on QE announcement days from other days by making an assumption about the variance of yields on announcement days relative to other days.

¹⁴ A nearly identical estimate of the half-life is obtained from the own-persistence in daily bond yields. For example, the estimate of the serial correlation for the 10-year Treasury yield over the sample period used here is 0.987, which yields a half-life of approximately 50 days.

would be considerably shorter.¹⁵ Of course, none of these approaches considers the possibility that the market might initially overreact to an LSAP announcement even at the daily frequency. Several examples of overreaction of Treasury futures prices are shown in Table 3. The most dramatic is the reaction to Bernanke's December 1, 2008, speech: The initial reaction was nearly 4.5 times larger than the change on that day.

5.0 SUMMARY AND CONCLUSIONS

Following Lehman Brothers bankruptcy announcement the FOMC engaged in QE in an attempt to stimulate aggregate demand by reducing long-term yields. Given the difficulties associated with evaluating the effect of policy actions on economic activity generally (let alone during in the aftermath of a financial crisis), the literature on the effectiveness of QE has focused on the narrower question of whether QE reduced long-term yields. An important piece of evidence that QE was effective in reducing long-term yields comes from event studies that find relatively large announcement effects associated with various QE announcements. However, the quality of the event-study evidence depends critically on whether these announcement effects obtained in the literature are identified.

This paper investigated the extent to which the announcement effects considered in this literature are identified. The evidence is strong that none of the announcement effects associated with the release of FOMC minutes is identified. For all but 11 of the 28 other announcements considered in the literature, the evidence indicates that the observed announcement effect was not due to the announcement, the announcement effect was not statistically significant, or both. For all but one of the remaining 11 announcements, the announcement contained news in addition to news about QE that could have caused the observed announcement effects. Hence, strictly speaking, these announcement effects are not identified. The one announcement that

¹⁵ This observation was suggested to me by John Cochrane.

contained only QE news occurred prior to the market opening. Hence, it is impossible to determine whether the announcement effects on this day were due to the QE announcement or other news. The remaining 10 announcements contained QE and other news. Hence, even if the announcement effects on these days are due to these announcements, it is impossible to say for sure that the responses are due to the QE news. Hence these announcement effects do not necessarily constitute evidence the effectiveness of QE. Whether one considers these announcement effects to be evidence that QE reduces long-term yields depends on which explanation for the behavior of bond yields one believes to be the most plausible. At a minimum the event-study evidence is fragile, if not, inconclusive.

References:

- Bauer, M.D., and G.D. Rudebusch (2012). "The Signaling Channel for Federal Reserve Bond Purchases," Federal Reserve Bank of San Francisco Working Paper 2011-21, August 2012.
- Bernanke, B.S. (2008) "Federal Reserve Policies in the Financial Crisis," speech at the Greater Austin Chamber of Commerce, Austin, Texas, December 1, 2008.
<http://www.federalreserve.gov/newsevents/speech/bernanke20081201a.htm>.
- Bernanke, B.S. (2012) "Monetary Policy since the Onset of the Crisis," speech at the Federal Reserve Bank of Kansas City Economic Symposium, Jackson Hole, Wyoming August 31, 2012.
- Gagnon, J., M. Raskin, J. Remache, and B. Sack (2011). "The Financial Market Effects of the Federal Reserve's Large-Scale Asset Purchases," *International Journal of Central Banking*, 7(1), pp. 3-43.
- Joyce, M., A. Lasoosa, I. Stevens, and M. Tong (2010). "The Financial Market Impact of Quantitative Easing in the United Kingdom," *International Journal of Central Banking*, 7(3), pp. 113-161.
- Kuttner, K. (2001) "Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Markets," *Journal of Monetary Economics*, 47(3), pp. 523-544.
- Neely, C. (2011) "The Large-Scale Asset Purchases Had Large International Effects," Federal Reserve Bank of St. Louis Working Paper 2010-018C;
http://research.stlouisfed.org/conferences/qe/Neely_-_2010-018_1_.pdf
- Raskin, M.D. (2013). "The Effects of the Federal Reserve's Date-Based Forward Guidance," Finance and Economics Discussion Series 2013-37, Divisions of Research & Statistics and Monetary Affairs, Federal Reserve Board, Washington, D.C.
- Swanson, E. (2011) "Let's Twist Again: A High-Frequency Event-Study Analysis of Operation Twist and Its Implications for QE2," *Bookings Papers on Economics Activity*, 42(1), pp. 151-207.
- Thornton, D.L. (1999). "Can Nominal Interest Rates Be Negative?" Federal Reserve Bank of St. Louis, *Monetary Trends*, January 1999.
- Thornton, D.L. (2011). "The Effectiveness of Unconventional Monetary Policy: The Term Auction Facility," Federal Reserve Bank of St. Louis *Review*, 93(6), 439-54.
- Thornton, D.L. (2013). "The Identification of the Response of Interest Rates to Monetary Policy Actions Using Market-Based Measures of Monetary Policy Shocks," forthcoming,

Oxford Economic Papers. Prepublication version is available at
<http://oep.oxfordjournals.org/content/early/2013/02/13/oep.gps072.full.pdf+html>.

Wright, J.H. (2012). “What Does Monetary Policy do to Long-Term Interest Rates at the Zero Lower Bound?” *Economic Journal*, 122, F447-F466.

Announcements				Release of Minutes			
Date	<i>T10</i>	<i>Aaa</i>	<i>Baa</i>	Date	<i>T10</i>	<i>Aaa</i>	<i>Baa</i>
11/25/2008	-0.24	-0.17	-0.09	1/6/2009	0.02	0	-0.03
12/1/2008	-0.21	-0.25	-0.19	2/18/2009	0.1	0.07	0.03
12/16/2008	-0.16	-0.13	-0.15	4/8/2009	-0.07	-0.07	-0.1
1/28/2009	0.12	0.15	0.14	5/20/2009	-0.06	-0.05	-0.11
3/18/2009	-0.51	-0.24	-0.23	7/15/2009	0.13	0.08	0.08
4/29/2009	0.07	-0.04	0	9/2/2009	-0.09	-0.1	-0.11
6/24/2009	0.07	0.06	0.06	10/14/2009	0.11	0.12	0.12
8/12/2009	0.01	0.09	0.1	11/24/2009	-0.05	-0.03	-0.04
9/23/2009	-0.02	-0.01	-0.02	1/6/2010	0.08	0.06	0.04
11/4/2009	0.07	0.08	0.09	2/17/2010	0.08	0.07	0.08
12/16/2009	0.01	-0.03	-0.02	4/6/2010	-0.03	0.01	0
1/27/2010	0.01	-0.02	-0.01	5/19/2010	-0.02	-0.01	0.02
3/16/2010	-0.05	-0.05	-0.06	7/14/2010	-0.08	-0.1	-0.09
4/28/2010	0.09	0.09	0.08	8/31/2010	-0.07	-0.08	-0.05
6/23/2010	-0.05	0	-0.04	10/12/2010	0.03	0.05	0.04
8/10/2010	-0.07	0.02	0.03	11/23/2010	-0.03	-0.04	-0.04
8/27/2010	0.16	0.17	0.17	1/4/2011	0	0.04	0.03
9/21/2010	-0.11	-0.02	-0.08	2/16/2011	0.01	0.01	0.01
10/15/2010	0.07	0.09	0.1	4/5/2011	0.05	0.02	0.02
11/3/2010	0.04	0.12	0.12	5/18/2011	0.06	0.06	0.06
12/14/2010	0.2	0.16	0.15	7/12/2011	-0.02	-0.02	-0.01
1/26/2011	0.1	0.14	0.12	8/30/2011	-0.09	-0.15	-0.12
3/15/2011	-0.03	-0.02	0	10/12/2011	0.06	0.07	0.07
4/27/2011	0.05	0.07	0.05	11/22/2011	-0.03	-0.03	-0.01
6/2/2011	0.08	0.11	0.1	1/3/2012	0.08	0.07	0.1
8/9/2011	-0.2	-0.09	-0.07	--	--	--	--
8/26/2011	-0.04	-0.06	-0.04	--	--	--	--
9/21/2011	-0.07	-0.01	-0.16	--	--	--	--

NOTE: Announcements suggested by Gagnon et al. (2012) and Wright (2012) as particularly important are shown in bold type. Sell announcements are shown in italics. See Appendix A for news contained in the “announcements” columns of the table.

Table 2: Estimates of Equation (1), October 1, 2008 – December 31, 2011						
	$\Delta T10$		ΔAaa		ΔBaa	
	Coef.	<i>t</i> -stat.	Coef.	<i>t</i> -stat.	Coef.	<i>t</i> -stat.
Const.	-0.002	-0.797	-0.003	-1.358	-0.004	-1.214
Dum^{imp}	-0.088	-1.520	-0.046	-1.077	-0.041	-1.052
Dum^{Limp}	0.041	2.260*	0.051	2.855*	0.046	2.637*
Dum^{min}	-0.002	-0.163	-0.002	-0.165	-0.005	-0.285
\bar{R}^2	0.022		0.001		0.008	
s.e.	0.075		0.077		0.076	
Adjusting for the August 27, 2010, Announcement						
	$\Delta T10$		ΔAaa		ΔBaa	
	Coef.	<i>t</i> -stat.	Coef.	<i>t</i> -stat.	Coef.	<i>t</i> -stat.
Const.	-0.003	-1.044	-0.004	-1.338	-0.003	-1.198
Dum^{imp}	-0.095	-1.692*	-0.068	-1.753*	-0.064	-1.775*
Dum^{Limp}	0.041	2.271*	0.051	2.853*	0.046	2.635*
Dum^{min}	-0.002	-0.149	-0.002	-0.133	-0.005	-0.288
\bar{R}^2	0.026		0.017		0.014	
s.e.	0.075		0.077		0.075	

NOTE: s.e. denotes the standard error. * denotes statistically significant at the 5 percent significance level.

Table 3: Response of 10-Year Treasury Futures					
	15 Minutes (2)	45 Minutes (3)	Daily (4)	% 15 (5)	% 45 (6)
11/25/08 8:15 AM*	0.795	1.029	1.507	52.77	68.27
12/1/08 1:45 PM	0.678	1.021	0.230	294.84	444.28
12/16/08 2:15 PM	0.710	1.354	1.504	47.22	90.02
1/28/09 2:15 PM	-0.214	-0.391	-0.767	27.90	50.92
3/18/09 2:15 PM	2.863	3.087	3.628	78.90	85.09
4/29/09 2:15 PM	-0.463	-0.450	-0.450	102.86	100.00
6/24/09 2:15 PM	-0.743	-0.743	-0.271	274.35	274.35
8/12/09 2:15 PM^S	-0.121	0.162	0.081	-150.27	200.08
9/23/09 2:15 PM^S	0.494	0.614	0.360	137.29	170.59
11/4/09 2:15 PM^S	-0.106	-0.093	-0.278	38.13	33.36
12/16/09 2:15 PM	-0.067	-0.160	0.080	-83.19	-199.76
1/27/10 2:15 PM	-0.239	-0.318	-0.133	179.76	239.78
3/16/10 2:15 PM	0.187	0.253	0.427	43.73	59.32
4/28/10 2:15 PM	-0.013	-0.107	-0.573	2.33	18.65
6/23/10 2:15 PM	0.090	0.129	0.361	24.98	35.67
8/10/10 2:15 PM	0.451	0.388	0.388	116.09	100.00
8/27/10 10:00 AM	-0.136	-0.435	-0.820	16.62	52.97
9/21/10 2:15 PM	-0.038	0.512	0.788	-4.77	64.99
10/15/10 8:15 AM*	0.234	-0.185	-0.358	-65.32	51.68
11/3/10 2:15 PM	-0.049	-0.197	0.037	-133.08	-532.71
12/14/10 2:15 PM	-0.039	-0.444	-1.146	3.41	38.77
1/26/11 2:15 PM	-0.013	-0.039	-0.544	2.39	7.16
3/15/11 2:15 PM	-0.233	-0.285	0.104	-224.50	-274.47
4/27/11 12:30 PM	0.143	0.091	-0.207	-68.81	-43.80
6/2/11 12:30 PM	-0.025	-0.089	-0.305	8.33	29.16
8/9/11 2:15 PM	0.316	1.089	0.955	33.06	114.00
8/26/11 10:00 AM	0.048	-0.240	0.216	22.15	-110.91
9/21/11 2:15 PM	-0.036	0.191	0.227	-15.80	84.20

NOTE: Announcements dates suggested by Gagnon et al. (2012) and Wright (2012) as particularly important are shown in bold type and the corresponding column are shaded. The numbers that are most relevant for a particular announcement are in bold type.

*These announcements occurred 5 minutes prior to the opening of the futures market, which is 8:20 EST.

Figure 1: Analysis of QE Announcement Effects

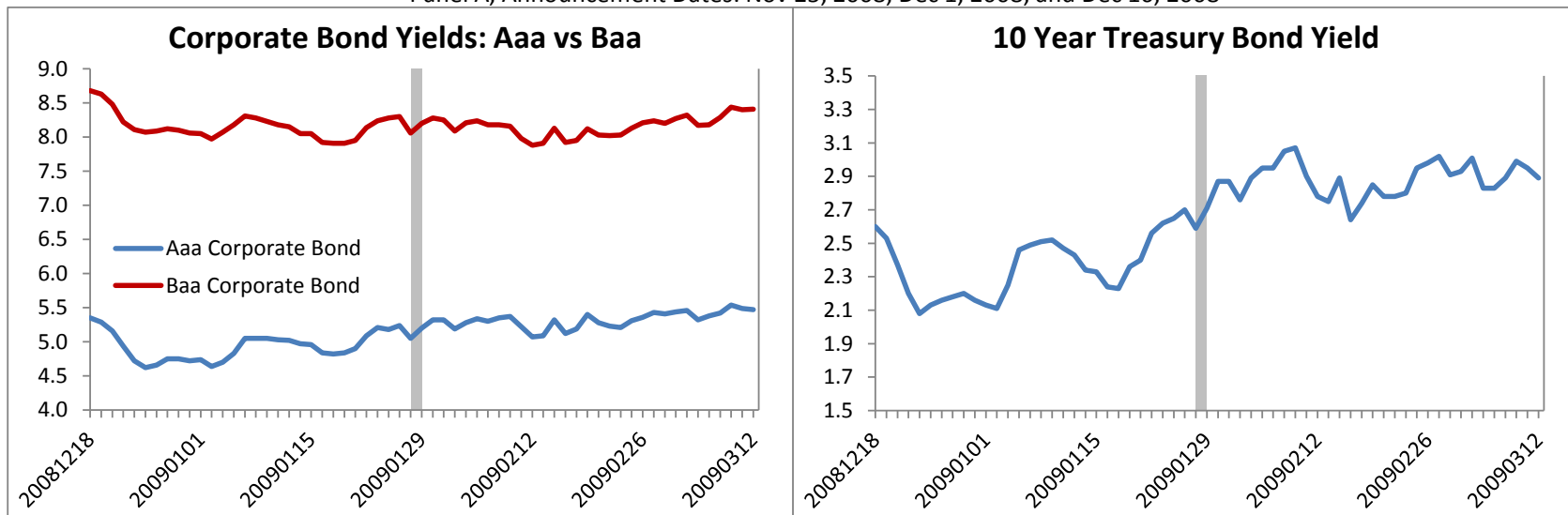
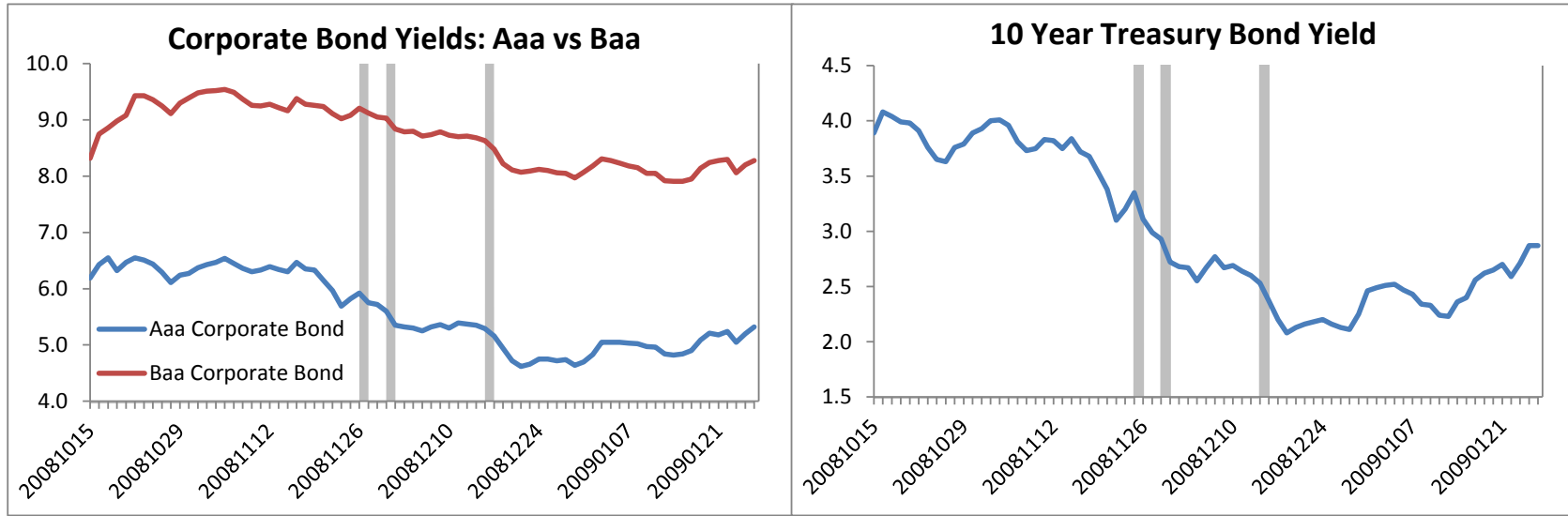
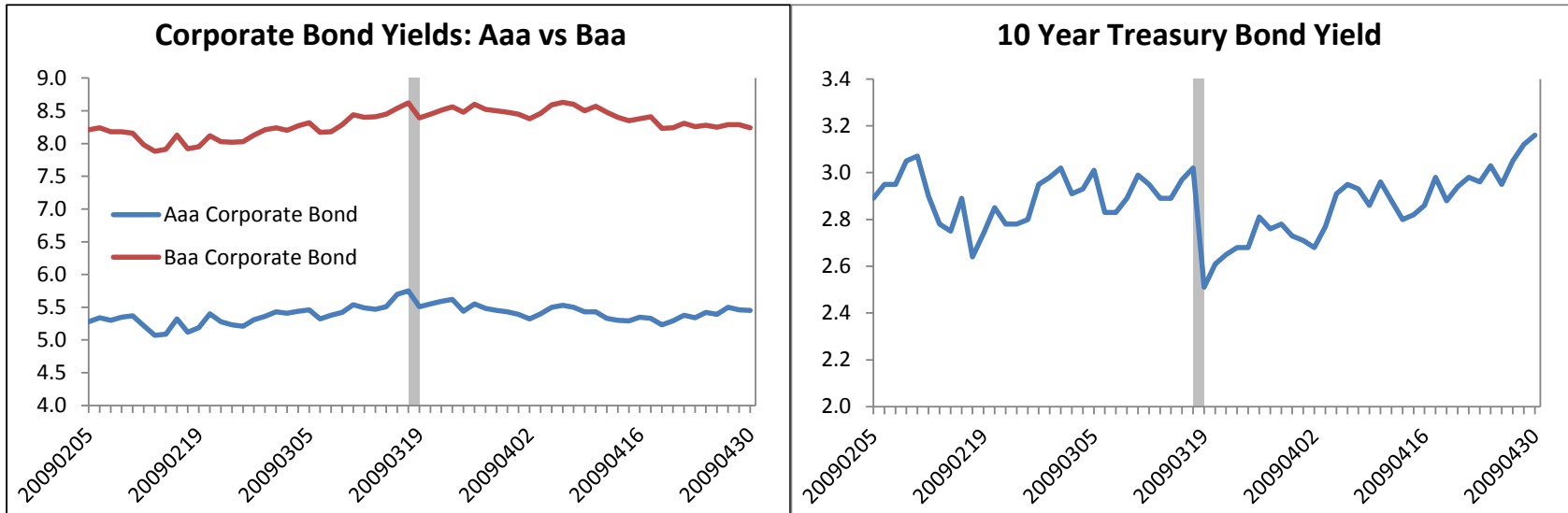
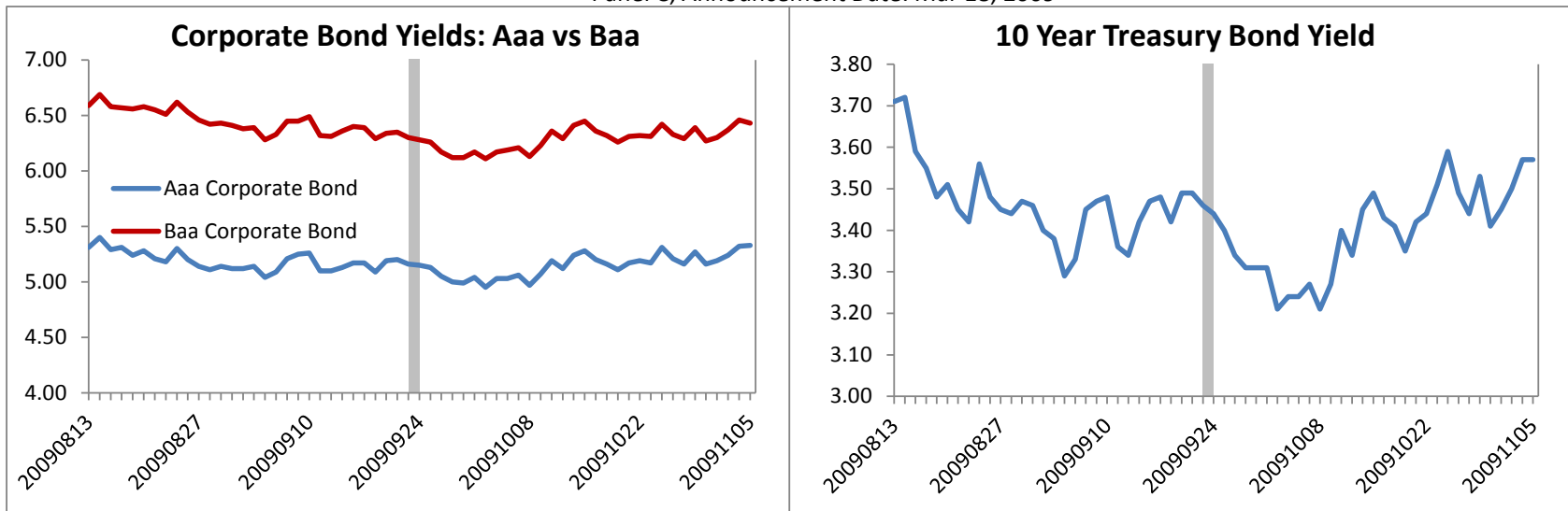


Figure 1: Continued

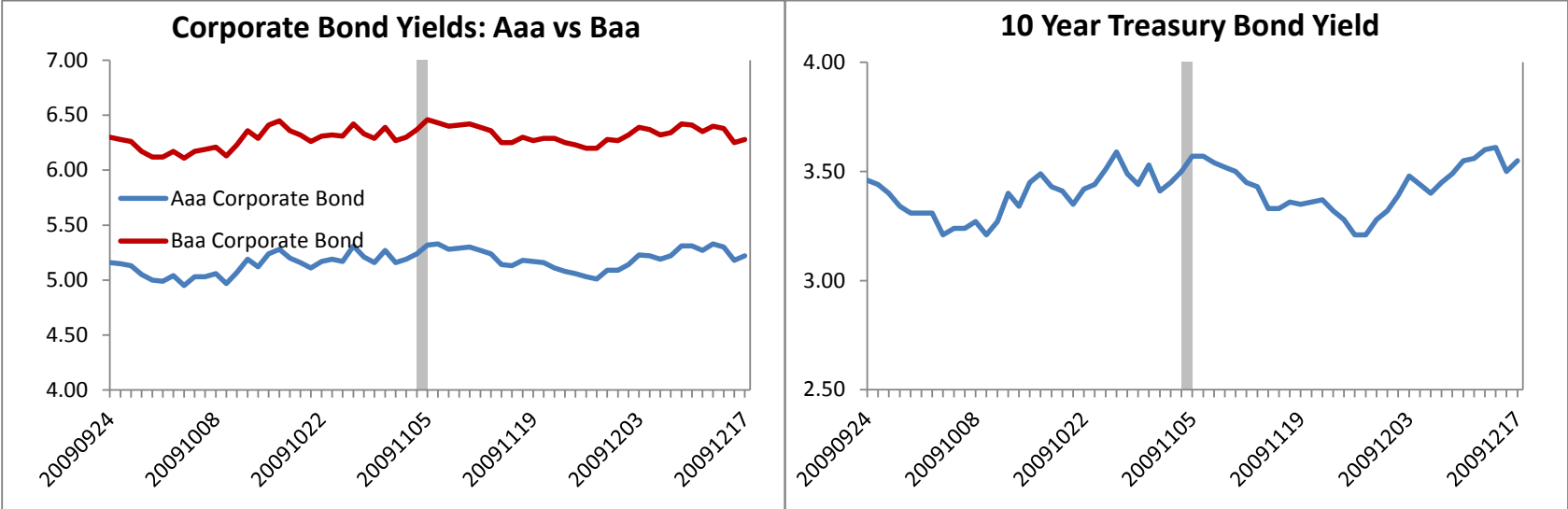


Panel C, Announcement Date: Mar 18, 2009

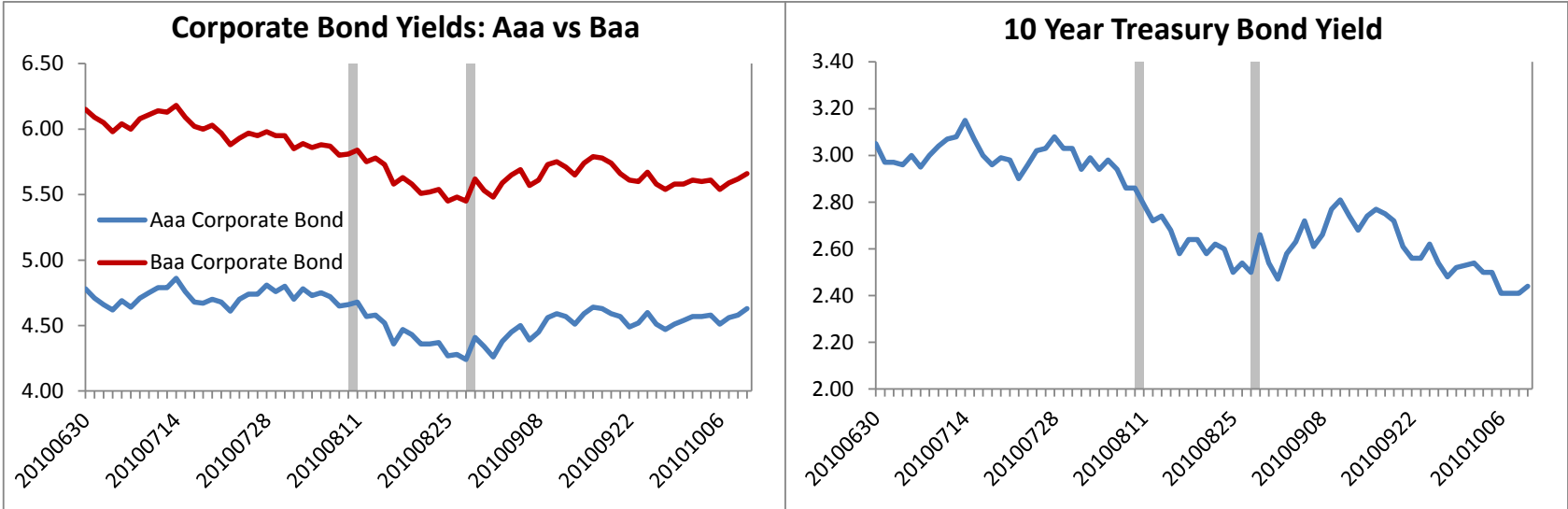


Panel D, Announcement Date: Sep 23, 2009

Figure 1: Continued

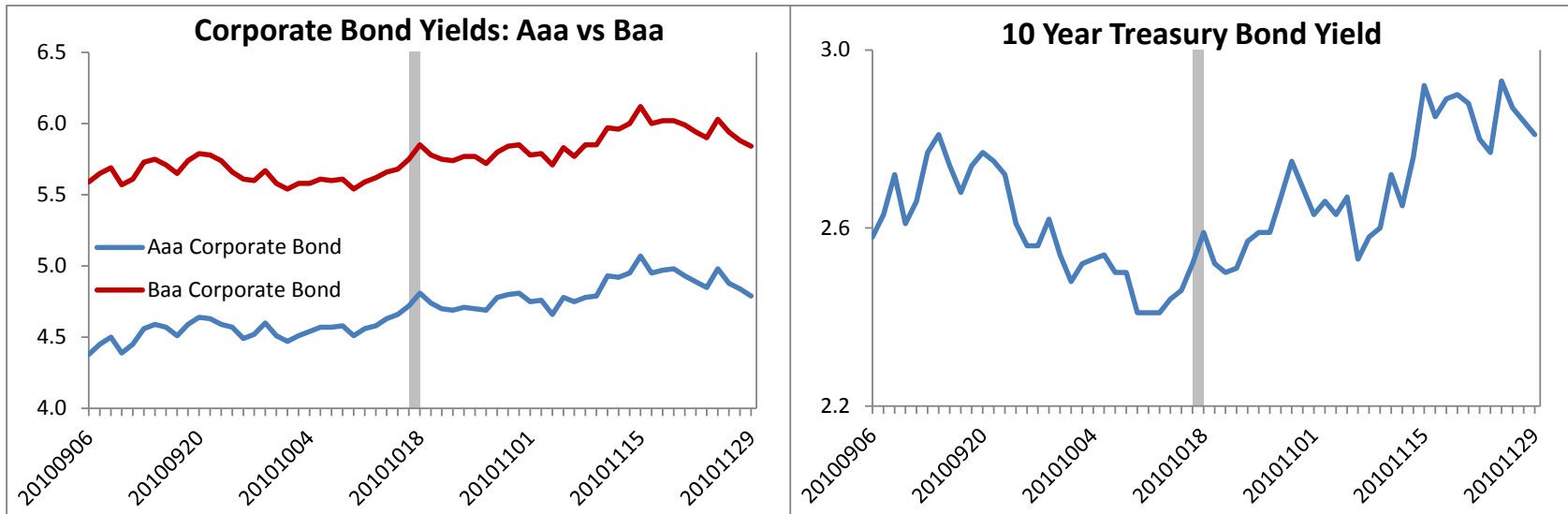


Panel E, Announcement Date: Nov 4, 2009

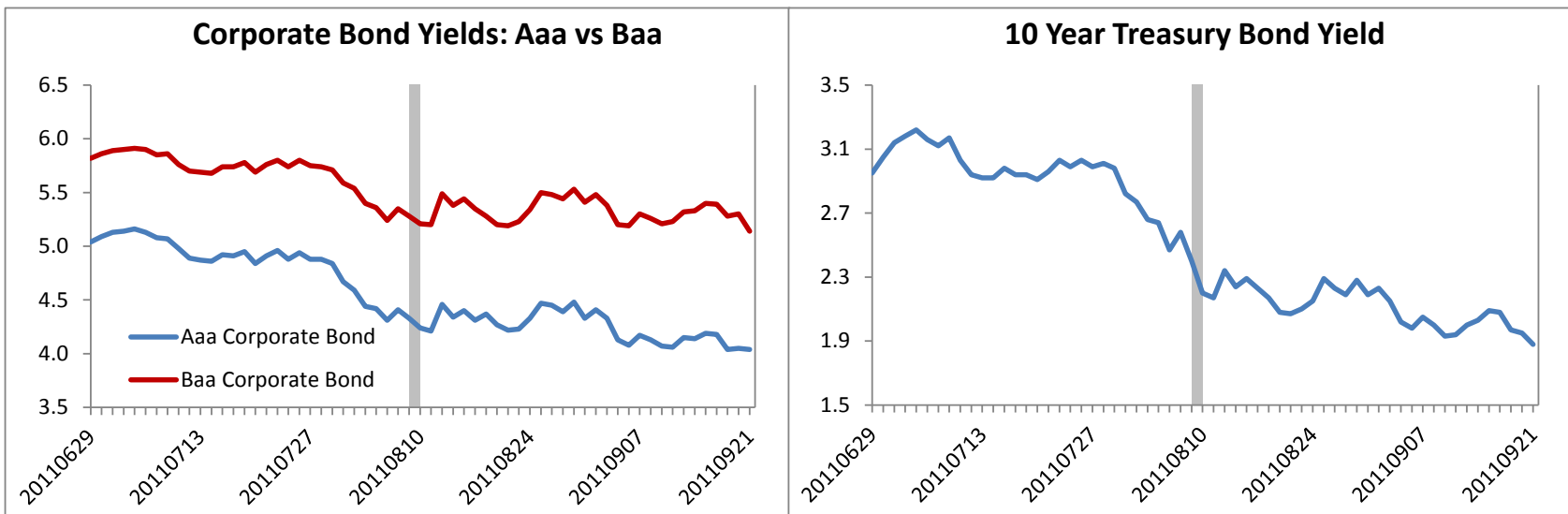


Panel F, Announcement Dates: Aug 10, 2010 and Aug 27, 2010

Figure 1: Continued



Panel G, Announcement Dates: Oct 15, 2010 and Nov 3, 2010



Panel H, Announcement Date: Aug 9, 2011

Appendix

News Contained in Event-Study Announcements²⁰

Federal Reserve Press Release, 11/25/2008

QE News:

The Federal Reserve announced on Tuesday that it will initiate a program to purchase the direct obligations of housing-related government-sponsored enterprises (GSEs)—Fannie Mae, Freddie Mac, and the Federal Home Loan Banks—and mortgage-backed securities (MBS) backed by Fannie Mae, Freddie Mac, and Ginnie Mae. Spreads of rates on GSE debt and on GSE-guaranteed mortgages have widened appreciably of late. This action is being taken to reduce the cost and increase the availability of credit for the purchase of houses, which in turn should support housing markets and foster improved conditions in financial markets more generally.

Purchases of up to \$100 billion in GSE direct obligations under the program will be conducted with the Federal Reserve's primary dealers through a series of competitive auctions and will begin next week. Purchases of up to \$500 billion in MBS will be conducted by asset managers selected via a competitive process with a goal of beginning these purchases before year-end. Purchases of both direct obligations and MBS are expected to take place over several quarters. Further information regarding the operational details of this program will be provided after consultation with market participants.

Other News:

None

Bernanke speech, 12/1/2008

QE News:

...there are several means by which the Fed could influence financial conditions through the use of its balance sheet, beyond expanding our lending to financial institutions. First, the Fed could purchase longer-term Treasury or agency securities on the open market in substantial quantities. This approach might influence the yields on these securities, thus helping to spur aggregate demand. Indeed, last week the Fed announced plans to purchase up to \$100 billion in GSE debt and up to \$500 billion in GSE mortgage-backed securities over the next few quarters. It is encouraging that the announcement of that action was met by a fall in mortgage interest rates.

Other News:

None

FOMC Statement, 12/16/2008

QE News:

The Committee is also evaluating the potential benefits of purchasing longer-term Treasury securities. Early next year, the Federal Reserve will also implement the Term Asset-Backed Securities Loan Facility to facilitate the extension of credit to households and small businesses. The Federal Reserve will continue to consider ways of using its balance sheet to further support credit markets and economic activity.

Other News:

Since the Committee's last meeting, labor market conditions have deteriorated, and the available data indicate that consumer spending, business investment, and industrial production have declined. Financial markets remain quite strained and credit conditions tight. Overall, the outlook for economic activity has weakened further.

FOMC Statement, 1/28/2009

QE News:

The Federal Reserve will employ all available tools to promote the resumption of sustainable economic growth and to preserve price stability. The focus of the Committee's policy is to support the functioning of financial markets and stimulate the economy through open market operations and other measures that are likely to keep the size of the Federal Reserve's balance sheet at a high level. The Federal Reserve continues to purchase large quantities of agency debt and mortgage-backed securities to provide support to the mortgage and housing markets, and it stands ready to expand the quantity of such purchases and the duration of the purchase program as conditions warrant. The Committee also is prepared to purchase longer-term Treasury securities if evolving circumstances indicate that such transactions would be particularly effective in improving conditions in private credit markets.

Other News:

Information received since the Committee met in December suggests that the economy has weakened further. Industrial production, housing starts, and employment have continued to decline steeply, as consumers and businesses have cut back spending. Furthermore, global demand appears to be slowing significantly.

FOMC Statement, 3/18/2009

QE News:

In these circumstances, the Federal Reserve will employ all available tools to promote economic recovery and to preserve price stability... To provide greater support to mortgage lending and housing markets, the Committee decided today to increase the size of the Federal Reserve's balance sheet further by purchasing up to an additional \$750 billion of agency mortgage-backed securities, bringing its total purchases of these securities to up to \$1.25 trillion this year, and to increase its purchases of agency debt this year by up to \$100 billion to a total of up to \$200 billion. Moreover, to help improve conditions in private credit markets, the Committee decided to purchase up to \$300 billion of longer-term Treasury securities over the next six months.

Other News:

Information received since the Federal Open Market Committee met in January indicates that the economy continues to contract. Job losses, declining equity and housing wealth, and tight credit conditions have weighed on consumer sentiment and spending. Weaker sales prospects and difficulties in obtaining credit have led businesses to cut back on inventories and fixed investment. U.S. exports have slumped as a number of major trading partners have also fallen into recession.

FOMC Statement, 4/29/2009

QE News:

In addition, the Federal Reserve will buy up to \$300 billion of Treasury securities by autumn.

Other News:

Information received since the Federal Open Market Committee met in March indicates that the economy has continued to contract, though the pace of contraction appears to be somewhat slower.

FOMC Statement, 6/24/2009

QE News:

None

Other News:

Information received since the Federal Open Market Committee met in April suggests that the pace of economic contraction is slowing.

FOMC Statement, 8/12/2009

QE News:

To promote a smooth transition in markets as these purchases of Treasury securities are completed, the Committee has decided to gradually slow the pace of these transactions and anticipates that the full amount will be purchased by the end of October.

Other News:

Information received since the Federal Open Market Committee met in June suggests that economic activity is leveling out. Conditions in financial markets have improved further in recent weeks. Household spending has continued to show signs of stabilizing.

FOMC Statement, 9/23/2009

QE News:

The Committee will gradually slow the pace of these purchases in order to promote a smooth transition in markets and anticipates that they will be executed by the end of the first quarter of 2010.

Other News:

Information received since the Federal Open Market Committee met in August suggests that economic activity has picked up following its severe downturn. Conditions in financial markets have improved further, and activity in the housing sector has increased.

FOMC Statement, 11/4/2009

QE News:

To provide support to mortgage lending and housing markets and to improve overall conditions in private credit markets, the Federal Reserve will purchase a total of \$1.25 trillion of agency mortgage-backed securities and about \$175 billion of agency debt. The amount of agency debt purchases, while somewhat less than the previously announced maximum of \$200 billion, is consistent with the recent path of purchases and reflects the limited availability of agency debt. In order to promote a smooth transition in markets, the Committee will gradually slow the pace of its purchases of both agency debt and agency mortgage-backed securities and anticipates that these transactions will be executed by the end of the first quarter of 2010.

Other News:

Information received since the Federal Open Market Committee met in September suggests that economic activity has continued to pick up. Conditions in financial markets were roughly unchanged, on balance, over the intermeeting period.

FOMC Statement, 12/16/2009

QE News:

None

Other News:

Information received since the Federal Open Market Committee met in November suggests that economic activity has continued to pick up and that the deterioration in the labor market is abating. The housing sector has shown some signs of improvement over recent months.

FOMC Statement, 1/27/2010

QE News:

None

Other News:

Information received since the Federal Open Market Committee met in December suggests that economic activity has continued to strengthen and that the deterioration in the labor market is abating.

FOMC Statement, 3/16/2010

QE News:

To provide support to mortgage lending and housing markets and to improve overall conditions in private credit markets, the Federal Reserve has been purchasing \$1.25 trillion of agency mortgage-backed securities and about \$175 billion of agency debt; those purchases are nearing completion, and the remaining transactions will be executed by the end of this month.

Other News:

Information received since the Federal Open Market Committee met in January suggests that economic activity has continued to strengthen and that the labor market is stabilizing.

FOMC Statement, 4/28/2010

QE News:

None

Other News:

Information received since the Federal Open Market Committee met in March suggests that economic activity has continued to strengthen and that the labor market is beginning to improve.

FOMC Statement, 6/23/2010

QE News:

None

Other News:

Information received since the Federal Open Market Committee met in April suggests that the economic recovery is proceeding and that the labor market is improving gradually.

FOMC Statement, 8/10/2010

QE News:

To help support the economic recovery in a context of price stability, the Committee will keep constant the Federal Reserve's holdings of securities at their current level by reinvesting

principal payments from agency debt and agency mortgage-backed securities in longer-term Treasury securities.

Other News:

Information received since the Federal Open Market Committee met in June indicates that the pace of recovery in output and employment has slowed in recent months.

Bernanke speech, 8/27/2010

QE News:

The Committee...will continue to monitor economic developments closely and to evaluate whether additional monetary easing would be beneficial. In particular, the Committee is prepared to provide additional monetary accommodation through unconventional measures if it proves necessary, especially if the outlook were to deteriorate significantly.

A first option for providing additional monetary accommodation, if necessary, is to expand the Federal Reserve's holdings of longer-term securities. As I noted earlier, the evidence suggests that the Fed's earlier program of purchases was effective in bringing down term premiums and lowering the costs of borrowing in a number of private credit markets. I regard the program (which was significantly expanded in March 2009) as having made an important contribution to the economic stabilization and recovery that began in the spring of 2009...I believe that additional purchases of longer-term securities, should the FOMC choose to undertake them, would be effective in further easing financial conditions. However, the expected benefits of additional stimulus from further expanding the Fed's balance sheet would have to be weighed against potential risks and costs. One risk of further balance sheet expansion arises from the fact that, lacking much experience with this option, we do not have very precise knowledge of the quantitative effect of changes in our holdings on financial conditions. In particular, the impact of securities purchases may depend to some extent on the state of financial markets and the economy; for example, such purchases seem likely to have their largest effects during periods of economic and financial stress, when markets are less liquid and term premiums are unusually high. The possibility that securities purchases would be most effective at times when they are most needed can be viewed as a positive feature of this tool. However, uncertainty about the quantitative effect of securities purchases increases the difficulty of calibrating and communicating policy responses.

Another concern associated with additional securities purchases is that substantial further expansions of the balance sheet could reduce public confidence in the Fed's ability to execute a smooth exit from its accommodative policies at the appropriate time. Even if unjustified, such a reduction in confidence might lead to an undesired increase in inflation expectations. (Of course, if inflation expectations were too low, or even negative, an increase in inflation expectations could become a benefit.) To mitigate this concern, the Federal Reserve has expended considerable effort in developing a suite of tools to ensure that the exit from highly accommodative policies can be smoothly accomplished when appropriate, and FOMC participants have spoken publicly about these tools on numerous occasions. Indeed, by providing

maximum clarity to the public about the methods by which the FOMC will exit its highly accommodative policy stance—and thereby helping to anchor inflation expectations—the Committee increases its own flexibility to use securities purchases to provide additional accommodation, should conditions warrant.

Other News:

Although private final demand, output, and employment have indeed been growing for more than a year, the pace of that growth recently appears somewhat less vigorous than we expected... Incoming data on the labor market have remained disappointing. Private-sector employment has grown only sluggishly, the small decline in the unemployment rate is attributable more to reduced labor force participation than to job creation, and initial claims for unemployment insurance remain high. Firms are reluctant to add permanent employees, citing slow growth of sales and elevated economic and regulatory uncertainty. In lieu of adding permanent workers, some firms have increased labor input by increasing workweeks, offering full-time work to part-time workers, and making extensive use of temporary workers... Overall, the incoming data suggest that the recovery of output and employment in the United States has slowed in recent months, to a pace somewhat weaker than most FOMC participants projected earlier this year. Much of the unexpected slowing is attributable to the household sector, where consumer spending and the demand for housing have both grown less quickly than was anticipated. Consumer spending may continue to grow relatively slowly in the near term as households focus on repairing their balance sheets. I expect the economy to continue to expand in the second half of this year, albeit at a relatively modest pace.

FOMC Statement, 9/21/2010

QE News:

None

Other News:

Information received since the Federal Open Market Committee met in August indicates that the pace of recovery in output and employment has slowed in recent months.

Bernanke speech, 10/15/2010

QE News:

For example, a means of providing additional monetary stimulus, if warranted, would be to expand the Federal Reserve's holdings of longer-term securities. Empirical evidence suggests that our previous program of securities purchases was successful in bringing down longer-term interest rates and thereby supporting the economic recovery. A similar program conducted by the Bank of England also appears to have had benefits.

Other News:

See text

FOMC Statement, 11/3/2010

QE News:

To promote a stronger pace of economic recovery and to help ensure that inflation, over time, is at levels consistent with its mandate, the Committee decided today to expand its holdings of securities. The Committee will maintain its existing policy of reinvesting principal payments from its securities holdings. In addition, the Committee intends to purchase a further \$600 billion of longer-term Treasury securities by the end of the second quarter of 2011, a pace of about \$75 billion per month.

Other News:

Information received since the Federal Open Market Committee met in September confirms that the pace of recovery in output and employment continues to be slow.

FOMC Statement, 12/14/2010

QE News:

None

Other News:

Information received since the Federal Open Market Committee met in November confirms that the economic recovery is continuing, though at a rate that has been insufficient to bring down unemployment.

FOMC Statement, 1/26/2011

QE News:

None

Other News:

Information received since the Federal Open Market Committee met in December confirms that the economic recovery is continuing, though at a rate that has been insufficient to bring about a significant improvement in labor market conditions.

FOMC Statement, 3/15/2011

QE News

None

Other News:

Information received since the Federal Open Market Committee met in January suggests that the economic recovery is on a firmer footing, and overall conditions in the labor market appear to be improving gradually.

FOMC Statement, 4/27/2011

QE News:

In particular, the Committee is maintaining its existing policy of reinvesting principal payments from its securities holdings and will complete purchases of \$600 billion of longer-term Treasury securities by the end of the current quarter.

Other News:

Information received since the Federal Open Market Committee met in March indicates that the economic recovery is proceeding at a moderate pace and overall conditions in the labor market are improving gradually.

FOMC Statement, 6/22/2011

QE News:

The Committee will complete its purchases of \$600 billion of longer-term Treasury securities by the end of this month and will maintain its existing policy of reinvesting principal payments from its securities holdings.

Other News:

Information received since the Federal Open Market Committee met in April indicates that the economic recovery is continuing at a moderate pace, though somewhat more slowly than the Committee had expected. Also, recent labor market indicators have been weaker than anticipated. The slower pace of the recovery reflects in part factors that are likely to be temporary, including the damping effect of higher food and energy prices on consumer purchasing power and spending as well as supply chain disruptions associated with the tragic events in Japan.

FOMC Statement, 8/9/2011

QE News:

None

Other News:

Information received since the Federal Open Market Committee met in June indicates that economic growth so far this year has been considerably slower than the Committee had expected. Indicators suggest a deterioration in overall labor market conditions in recent months, and the unemployment rate has moved up. Household spending has flattened out, investment in nonresidential structures is still weak, and the housing sector remains depressed.

Bernanke speech, 8/26, 2011

QE News:

None

Other News:

None

FOMC Statement, 9/21/2011

QE News:

To support a stronger economic recovery and to help ensure that inflation, over time, is at levels consistent with the dual mandate, the Committee decided today to extend the average maturity of its holdings of securities. The Committee intends to purchase, by the end of June 2012, \$400 billion of Treasury securities with remaining maturities of 6 years to 30 years and to sell an equal amount of Treasury securities with remaining maturities of 3 years or less. This program should put downward pressure on longer-term interest rates and help make broader financial conditions more accommodative.

Other News:

Information received since the Federal Open Market Committee met in August indicates that economic growth remains slow. Recent indicators point to continuing weakness in overall labor market conditions, and the unemployment rate remains elevated.

²⁰ This appendix provides the news contained in the event-study announcements listed in the first column of Table 1. The FOMC's statements begin by summarizing the change in the Committee's economic outlook since the last meeting. Since this is new information about the Committee's outlook, it is news. However, the change in the outlook may not be completely unanticipated. The appendix also records the news associated with the FOMC's LSAPs (QE). If the announcement contained no information about QE that was not stated in a previous announcement, the announcement was considered to contain no QE news. If the announcement contained information that was not contained in a previous announcement, the relevant section of the announcement is reported.