

Expectations of Large-Scale Asset Purchases

By Andrew Foerster and Guangye Cao

During and after the recent financial crisis, the Federal Reserve took several unprecedented actions in an attempt to bolster the economy. Before the crisis, monetary policy typically consisted of the Federal Open Market Committee (FOMC) setting a target for the federal funds rate, the overnight interest rate at which banks lend to one another. Once the federal funds rate reached its effective zero lower bound, however, the FOMC turned to a number of unconventional tools to stimulate the economy. One such tool, large-scale asset purchases (LSAPs)—often referred to as quantitative easing (QE)—consists of the Federal Reserve purchasing U.S. Treasury securities and agency mortgage-backed securities (MBS) with the aim of driving down longer-term interest rates, thereby stimulating economic activity.

Because LSAPs are an unconventional tool for the FOMC, their effectiveness remains uncertain due to several factors. First, because the use of LSAPs has been limited, any assessment of their impact relies on relatively few observations. Second, after the financial crisis, many factors had substantial impact on the U.S. economy—including the

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European debt crisis, changes in U.S. fiscal policy, and the use of other unconventional FOMC tools such as forward guidance for the federal funds rate. Thus, isolating the impact of LSAPs is difficult. Third, the extent to which markets expected the FOMC's announcement of LSAPs is uncertain, and these market expectations can affect estimates of LSAP efficacy.

Attempts to estimate the effectiveness of LSAPs often use an "event study" approach. This approach focuses on a short interval around key program announcements, which isolates the impact of the announcements and documents interest rate movements during that interval. However, event studies often ignore the possibility that financial market participants expected the announcements. Such expectations can affect interest rates well ahead of the interval considered.

This article presents evidence from surveys of market participants, news articles, and Internet searches that indicate financial markets expected LSAP announcements prior to the various Federal Reserve programs. The article concludes that, because event studies inadequately control for expectations, they likely understate the effects of LSAPs. The first section of the article discusses the event study approach and how it typically excludes the effects of expectations. Section II presents evidence on expectations from several sources: surveys, news stories, and Internet searches. Section III discusses how expectations affected interest rates before Federal Reserve announcements of recent asset purchase programs.

I. EVENT STUDIES AND EXPECTATIONS

In theory, asset purchases stimulate the economy by lowering interest rates at various time horizons. When the Federal Reserve purchases either Treasuries or agency MBS, which are securities that represent claims to the cash flow of sets of mortgages, this additional source of demand for these assets pushes up their price, hence lowering their yield. As a result, the interest rates associated with these assets fall. The decline in interest rates pushes investment from Treasuries or MBS into other sectors of the economy, which in turn stimulates economic activity and drives growth. Lower interest rates also make mortgages less expensive, fueling home purchases.

Table 1

MAJOR ANNOUNCEMENT DATES FOR LSAPS

Program	Dates	Notes
QE1	11/25/2008	FOMC announces plans for purchasing \$600 billion in MBS and agency debt
	12/15/2008	Plan officially implemented
	3/18/2009	FOMC announces extension of \$750 billion in MBS, \$300 billion Treasuries
QE2	8/27/2010	Bernanke Jackson Hole speech suggests QE2
	11/3/2010	FOMC announces plans for purchasing \$600 billion in Treasuries
MEP	9/21/2011	FOMC announces plans for purchasing \$400 billion in longer-dated Treasuries by selling shorter-dated ones
	6/20/2012	FOMC announces extension of \$267 billion
QE3	9/13/2012	FOMC announces plans for purchasing \$40 billion in MBS per month
	12/12/2012	FOMC announces plans for purchasing \$40 billion in MBS and \$45 billion in Treasuries per month

Source: Federal Reserve Board.

Since the start of the financial crisis, the Federal Reserve has implemented several rounds of LSAPs. Table 1 shows the four major programs along with key announcement dates.¹ The first round, labeled QE1, came in November and December 2008, followed by an extension in March 2009. The second round, QE2, officially was announced in November 2010. However, many people consider a speech three months earlier by Federal Reserve Chairman Ben S. Bernanke in Jackson Hole, Wyoming, as having already provided a strong signal that the FOMC would pursue additional LSAPs. The Jackson Hole speech, part of the Economic Policy Symposium conducted by the Federal Reserve Bank of Kansas City, had been delivered in August 2010. After QE2, a third round of purchases, called the Maturity Extension Program (MEP), used the proceeds from sales of short-term Treasuries to finance longer-term Treasury purchases. The MEP began in September 2011 and was extended in June 2012. The fourth and latest round, QE3, was announced in September 2012 and extended in December 2012.

Estimating the effects of asset purchases on interest rates often relies on an event study. Event studies typically focus on an LSAP announcement, tracing interest rate changes over a short time frame around the announcement. Assuming no other major economic news, announcements, or developments occur within the given time frame, only the LSAP announcement would be expected to produce interest rate movements, and any such movements are therefore attributed to the LSAP.

Table 2

ESTIMATES OF IMPACT OF ASSET PURCHASES ON 10-YEAR TREASURY YIELD

Paper	Program	Total Impact (Basis Points)	Impact Per \$100 Billion (Basis Points)
Hamilton and Wu	QE1	-13	-3
Doh	QE1	-39	-4
D'Amico and King	QE1	-45	-15
Bomfim and Meyer	QE1	-60	-3
Gagnon and others	QE1	-58 to -91	-3 to -5
Neely	QE1	-107	-6
Krishnamurthy and Vissing-Jorgensen	QE2	-33	-5
D'Amico and others	QE2	-55	-9
Swanson	MEP	-15	—

Source: Chen and others.

Much of the literature uses the Federal Reserve's early LSAP programs to estimate the impact of their announcements on interest rates. Table 2 shows several estimates of how asset purchases affected 10-year Treasury interest rates. The estimates vary depending on the program and the exact methodology, but the negative values all suggest asset purchases lowered long-term interest rates, as theory predicts. For example, Gagnon and others estimate the effects of QE1 by measuring the cumulative change in interest rates from the end of the day prior to an LSAP announcement to the end of the day of the announcement. Because interest rates on 10-year Treasuries declined up to 91 basis points during the announcement days, Gagnon and others conclude the announcement caused this reduction.

Choosing an adequate time frame for event studies presents a trade-off. On one hand, too large a window allows contamination from other news or economic developments. On the other hand, too small a window potentially ignores some of the effects of purchases.

The time frames chosen in event studies may lead to a misestimation of the effects of LSAPs in two ways. First, they may capture only the immediate response by markets to an announcement rather than the long-run effects. The immediate market response may be an initial overreaction that is offset or extended some time later with a partial reversal, or it may be an initial underreaction that is extended some time

later with further movement in the same direction. Either way, an event study focusing on a time frame that captures only the initial reaction and not the subsequent correction may misestimate the total impact of the announcement.

Second, event studies typically ignore how the markets' expectations of an announcement may have altered interest rates well before the time frame under consideration. Event studies that examine a window of time starting at the time of the announcement, or just briefly before it, may ignore the possibility that interest rates at the time already reflect markets' expectations that an announcement might occur. A hypothetical measure of the full impact of asset purchases on interest rates would need to include the pre-announcement effects stemming from advance expectations, as well as the subsequent response to an actual announcement. In an extreme case where all market participants fully expect an announcement, interest rates will begin to fall in advance of the announcement. The decline in rates will occur as traders, anticipating heightened demand for bonds, begin buying bonds and thus bidding up the bonds' prices, which move inversely with their yields. By the time the LSAPs are announced officially, their impact already will have been factored into bond prices and yields—and thus interest rates—and the actual announcement will have no further effect.

Even if market participants do not fully expect an LSAP announcement, their expectations still could influence interest rates. Participants might bid interest rates downward somewhat in anticipation of the announcement, albeit less so than they would have if they had been certain the announcement would occur. In this case, following the actual announcement, rates would likely decline further due to the removal of uncertainty, but the move would be smaller than it would have been if the announcement were a complete surprise.

Because event studies omit most expectation effects, the studies may misestimate the efficacy of asset purchases. If markets fully expected an announcement, an event study could imply asset purchases had no effect on interest rates, when in reality rates at the time of the announcement already had incorporated this expectation. Alternatively, if market participants expected an announcement of an especially large quantity of asset purchases, only to have a smaller-than-expected program announced, rates actually could move up. In this case, an event

study could conclude asset purchases caused rate to move up only because the purchase program was smaller than expected.

Unfortunately, measuring the effects of LSAP expectations is challenging. For example, identifying a meaningful period over which to consider the effects of expectations has similar pitfalls to setting the time frame for an event study. Examining a small window of time prior to the announcement risks missing any earlier formation of expectations, whereas too large of a window potentially contaminates the study with other factors.

Another challenge in measuring the effects of LSAP expectations on interest rates is that third factors may cause shifts in both the LSAP expectations and the interest rates. For example, a worsening general outlook for the economy may cause interest rates to decline while, at the same time, it also causes rising expectations that the FOMC will announce plans for LSAPs. The extent that the rising LSAP expectations affected interest rates may be hard to disentangle from the effects on both of the worsening economic outlook.

Finally, expectations about LSAP announcements and expectations about the LSAPs' ultimate effects on interest rates do not necessarily coincide. Markets can view a future announcement as highly likely, but expect that the announcement would have little or no effect on interest rates. Alternatively, markets could be unsure about whether an announcement would occur, but expect that an announcement would have a large impact. The latter channel might have dominated in earlier rounds of asset purchases, before markets fully understand the FOMC's new tool. The former channel might have dominated as asset purchases continued and markets understood the tool better, or if subsequent LSAP programs had diminishing effects. These two caveats imply that, given evidence of expectations, it is important to consider the effects of expectations for each LSAP program individually, as well as to consider the systematic relationship between interest rates and measures of expectations.

The remainder of this article argues that markets widely expected recent LSAP announcements and that these expectations tended to influence interest rates. In particular, data from surveys, news stories, and Internet searches show how expectations developed before announce-

ments occurred. These developments imply that event studies that ignore expectation effects may misestimate the impact of asset purchases.

II. EVIDENCE OF EXPECTATIONS

Two types of evidence indicate that markets expected LSAP announcements. One type—survey evidence—measures market participants' expectations directly by asking respondents about their expectations regarding future monetary policy. This evidence, however, tends to have limited scope because surveys are conducted at distinct times, providing only an incomplete description of expectations. Another form of evidence—indirect measures from news coverage and the volume of Internet searches—corroborates the survey finding that LSAPs were expected in the market prior to their announcements.

Direct evidence: Blue Chip and Primary Dealer surveys

Surveys gauge expectations simply by asking a sample of market participants if they believe the FOMC will take a certain action. Depending on the survey, the answers can take the form of either a “Yes/No” response or a percentage representing the likelihood of a given event. Blue Chip Economic Indicators conducts a monthly survey of the first type, while the Federal Reserve Bank of New York's Primary Dealer Survey is an example of the second type. Both surveys provide evidence on expectations of asset purchases.

Blue Chip Economic Indicators conducts a monthly survey of more than 50 business economists, asking questions about a range of economic issues. Although the questions change somewhat from month to month, in most months respondents are asked whether they believe the FOMC will take a certain action at its next meeting or in the near future, requiring a “Yes” or “No” response. Although a simple “Yes” or “No” response may not completely characterize a single respondent's expectations, a survey with enough respondents, nonetheless, can indicate what markets expect. A question that has 100 percent of respondents answering “Yes” masks any potential uncertainty of each individual but still gives a fairly strong indication that the group expects that action. A question with 50 percent of respondents answering “Yes” suggests a

high degree of uncertainty but suggests that the group views the action as at least being possible.

The Blue Chip survey helps gauge expectations through two features. One feature gives a direct indication of market participants' views on specific types of policies. Unfortunately, because the questions typically change from month to month to reflect current topics, they do not produce a lengthy data series. However, the changing nature of the questions constitutes a second feature of the Blue Chip survey evidence: the mere presence of a question in a given monthly round of the survey reflects some degree of expectation at that time. The questions reflect public discourse at the time of the survey and thus give some indication of FOMC actions that markets are viewing as possibilities.

The results from the Blue Chip survey support the claim that market participants expected LSAP announcements. Table 3 shows survey questions relating to LSAPs from the Blue Chip survey since late 2008 and the percentage of respondents giving a "Yes" response. The wording of each question and the time horizon to which a given question pertains sometimes change in successive versions of the survey, but formation of LSAP expectations prior to actual LSAP announcements is nonetheless clear from the responses.

For example, all of the questions have a greater-than-zero percentage of respondents answering "Yes," but the highest affirmative response rate, at roughly 72 percent, is lower than 100 percent. This result indicates that respondents often expect asset purchase announcements in the future, although, at least at the time of the survey, they do not consider it to be a certainty. In addition, even for QE1—the first round of quantitative easing, which arguably could have been less expected than subsequent rounds because of the new nature of the policy tool—the survey shows respondents expected the FOMC to announce such a policy weeks before the actual announcement. In particular, more than half of respondents to the early November 2008 Blue Chip survey expected the FOMC, in response to the crisis, would engage in LSAPs. In fact, on November 25, the FOMC announced a purchase program with actual purchases beginning on December 16. After 2008, Blue Chip began asking more specific questions about the nature of LSAPs, possibly reflecting recognition that the market was developing a better understanding of the Federal Reserve's new tools.

Table 3

EVIDENCE OF EXPECTATIONS FROM THE BLUE CHIP SURVEY

Question	Date	% Yes
Will the Federal Reserve at some point during this crisis engage in a quantitative easing of monetary policy (ala the Bank of Japan) to spur the economy and mitigate the risk of deflation?	11/10/2008	54.3
Will the Fed ultimately decide to make additional purchases of agency MBS after [March 2010]?	12/10/2009	28.9
Do you think the Fed will ultimately decide to make even more asset purchases beyond the end of Q2 2011?	12/10/2010	27.7
Do you think the FOMC will announce some sort of policy easing move at its September 20-21 meeting?	9/10/2011	50.0
Do you think the Fed will ultimately announce a new asset purchase program (QE3) prior to the end of 2012?	11/10/2011 12/10/2011 1/10/2012 2/10/2012 5/10/2012 6/10/2012	42.6 42.6 39.6 33.3 12.8 32.6
Will the Fed extend the current version of “Operation Twist” beyond its scheduled conclusion in June?	4/10/2012	26.9
Will the Federal Reserve announce a new LSAP (QE3) at or before its September 11-12 meeting?	8/10/2012 9/10/2012	45.8 44.9
Will the Fed’s “Operation Twist” be replaced at the end of this year with a new Fed program of outright monthly purchases of longer-term Treasury securities?	11/10/2012	72.1

Notes: These questions from various monthly Blue Chip surveys since 2008, pertain to various asset purchase programs and the percentage of respondents answering “Yes.”

Source: Blue Chip Economic Indicators.

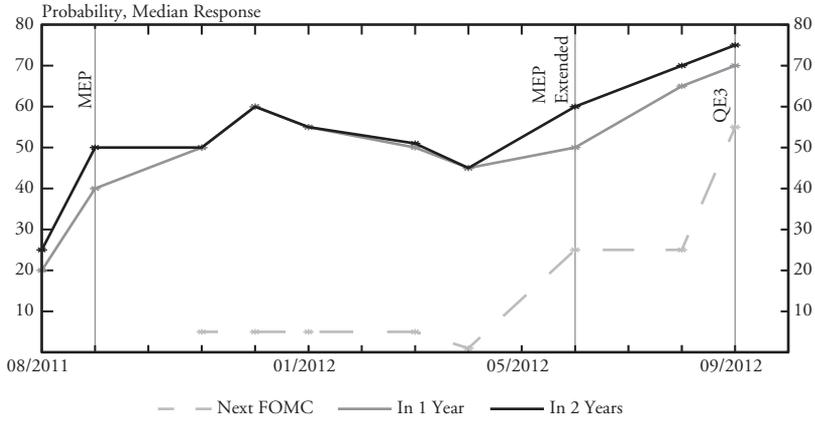
A shortcoming of the “Yes/No” nature of the Blue Chip survey questions, however, is that it can mask uncertainty of the respondents. A second survey illustrates that individuals do have varying degrees of uncertainty in their expectations regarding monetary policy. Prior to every FOMC meeting, the Federal Reserve Bank of New York conducts its Primary Dealer Survey, which asks questions of its roughly 20 primary trading counterparties. The questions vary from expectations about future monetary policy decisions to forecasts of inflation, unemployment, and growth. The survey often repeats questions or themes, giving a good indication of changing expectations over time.

Two sets of repeated questions have gauged dealers’ expectations about future asset purchases. The top panel of Chart 1 shows the median response to a repeated question in the Primary Dealer Survey that asks respondents to assess the likelihood of the FOMC’s announcing an LSAP program. The question solicits separate answers for the prospects for an LSAP announcement over three time horizons: at the next

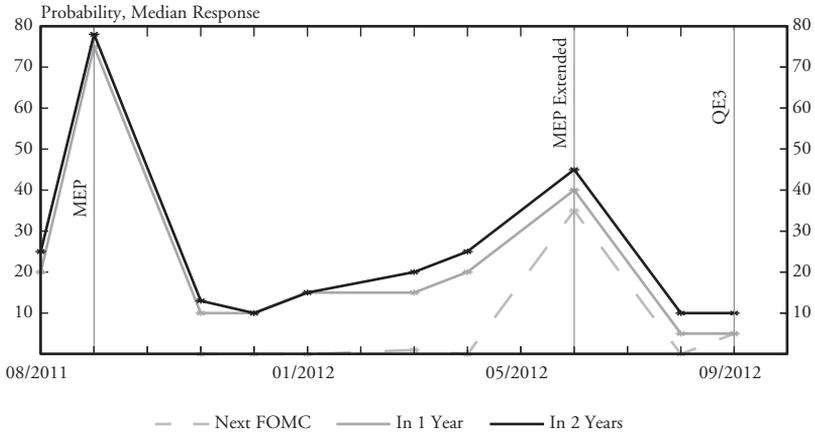
Chart 1

EVIDENCE OF EXPECTATIONS FROM THE PRIMARY DEALER SURVEY

A: Probability of a Balance Sheet Size Increase



B: Probability of a Balance Sheet Duration Lengthening



Source: Primary Dealer Survey, Federal Reserve Bank of New York.

FOMC meeting, within the next year, and within the next two years. Similarly, the bottom panel of Chart 1 shows the median response to a repeated question on the perceived likelihood, over the same time horizons, that the FOMC would announce an LSAP program expanding the average duration of the Federal Reserve's portfolio. For both questions, respondents give the probability of an announcement, and the survey reports the median probability. Responses between zero and 100 indicate that the median respondent viewed an announcement as possible but not certain.

The charts suggest primary dealers had nuanced expectations about future policy announcements. Not only do the responses suggest primary dealers expected the MEP, its extension, and QE3, but the responses also suggest that primary dealers' expectations aligned with the details of the upcoming announcements. Their expectations of an increase in the size of the balance sheet rose in successive months prior to the announcement of QE3, and expectations about expanding the duration of the portfolio increased prior to both the MEP's initial announcement and its extension.

Both surveys support the claim that market participants expected LSAP announcements weeks or months prior to several programs. Unfortunately, the lack of questions about other programs means that the available, direct survey evidence can provide only an incomplete picture of expectations. Indirect evidence, however, may shed further light on the extent to which markets expected various announcements of asset purchases.

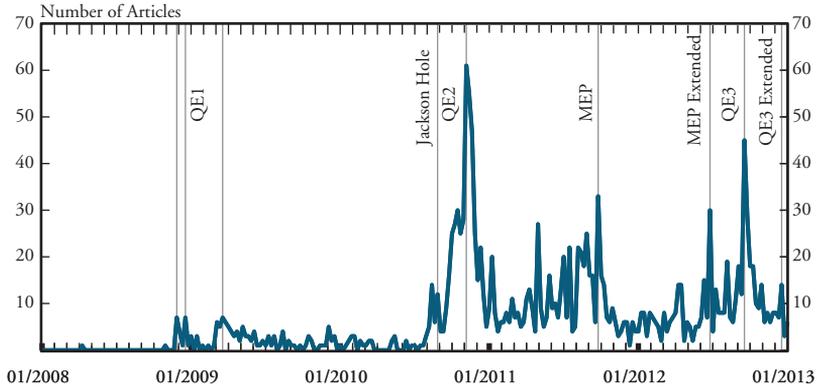
Indirect evidence: News and Internet searches

Indirect measures of the prevalence of given topics in popular discourse can fill in some gaps left by surveys. Two such measures are the number of newspaper articles and the number of Internet searches containing keywords related to asset purchases.

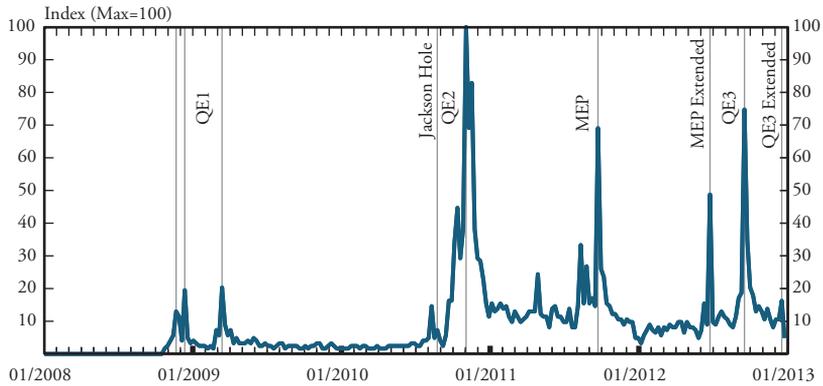
These newspaper and Internet search indices do not measure expectations about asset purchases directly but do provide some indication of the level of public discourse about asset purchases at a given time. When newspaper articles or Internet searches show a significant volume of public discussion of asset purchases prior to announcements, it is reasonable to presume there was some level of expectation in the market

Chart 2
EVIDENCE OF LSAP EXPECTATIONS

A: News Index for Asset Purchases



B: Internet Search Index for Asset Purchases



Notes: The News Index is the weekly article count for 10 major newspapers mentioning keywords related to asset purchases. The Internet Search Index is a measure of the weekly number of Google searches for keywords related to asset purchases.

Sources: Factiva, Google Trends, and authors' calculations.

of a pending announcement. The top panel of Chart 2 shows a weekly news index for asset purchases. For each week, the index equals the total number of articles in major newspapers that mention keywords commonly associated with asset purchases.² The bottom panel of Chart 2 shows a weekly index of Internet searches related to asset purchases. For each week, the index represents the intensity of Google searches for keywords associated with asset purchases.³ This index provides a broader measure of interest in asset purchase announcements, reflecting the interests of a wider segment of the population than the Blue Chip and Primary Dealer surveys or the news index.

One observation from the chart is that LSAP announcements themselves generate news stories and Internet searches, which supports the hypothesis that these indices are capturing popular interest in asset purchases. The largest spike occurred in the week of the QE2 announcement, which saw more than 60 articles published and a peak in the level of Internet searches. Other announcements were associated with spikes in activity as well.

The chart also shows interesting movements outside of the weeks when significant announcements occurred. Both panels contain several large spikes between announcements. These spikes typically occurred during weeks in which FOMC meetings took place without an LSAP announcement or when Chairman Bernanke gave a highly publicized speech. The response of both indices to FOMC events outside of major announcements suggests that expectation effects play a role in these movements. Even without announcements, asset purchases are a frequent topic in public discourse. Certain news releases, such as employment reports that may increase the chance of further asset purchases, also tend to move the indices. For example, a weak employment data release on June 6, 2012, contributed to an increase in activity for both indices.

The two indices also tend to increase before major announcements, again reflecting the fact that these indices capture expectations of an announcement. In the weeks before the late-November 2008 announcement of QE1, the Internet search index increased above zero. In the period immediately before Chairman Bernanke's Jackson Hole speech in 2010, and between that speech and the announcement of QE2, the indices increased. The indices also show similar increases

before the announcement of the MEP, before its extension, and before the QE3 announcement.

Thus, evidence suggests that public discussion of asset purchases was taking place even before policy announcements occurred, suggesting that markets expected the announcements to some degree. However, the fact that the news and search indices suggest an expectation before announcements does not establish that these expectations affected interest rates. The next section considers movements in interest rates and their possible association with movements in expectations of FOMC announcements.

III. THE EFFECT OF EXPECTATIONS OF LSAP ANNOUNCEMENTS ON INTEREST RATES

The direct and indirect evidence suggests markets expected LSAP purchase announcements, but such expectations only matter in assessing the efficacy of LSAPs if the expectations affect interest rates. Economic theory implies that expectations of LSAP announcements should exert downward pressure on interest rates prior to the announcements—an effect separate from upward or downward pressures that may be exerted at the same time by any changes in economic fundamentals. Examining the recent LSAP announcements shows that, in general, interest rates decline as expectations rise prior to the announcement. In addition, a statistical regression analysis shows that the indirect measures of expectations are negatively correlated with interest rates, indicating that expectations tended to lower rates.

Overview of relationship

Examining interest rate movements alongside of the evidence of expectations of LSAP announcements can shed light on how these expectations affect interest rates. However, due to the interdependence of interest rates and expectations, measuring the impact of one on the other is difficult. On one hand, expectations of an LSAP program announcement may affect interest rates, but on the other hand, the interest rates themselves are taken into consideration by the FOMC, along with other macroeconomic variables, when it decides whether or not to implement an LSAP program. Still, given the evidence that expectations of a possible announcement often rise before the announcement is made, economic

theory suggests that at least some of the movements in interest rates prior to the announcement likely were due to expectations.

The co-movement of expectations and interest rates is consistent with the hypothesis that expectations affect interest rates. One of the primary objectives of asset purchases is to put downward pressure on the 10-year Treasury rates. Lower Treasury rates then are expected to place downward pressure on other market rates, thereby stimulating economic activity. The top panel of Chart 3 shows the Internet Search Index with the 10-year Treasury rate. Some of the decline in the 10-year Treasury rate prior to asset purchase announcements may be due to expectations, and some of it may be due to declining economic fundamentals that create the need for asset purchases. Although it may be difficult to determine how much of the movement in interest rates is due to expectations, it seems likely that at least some of it is. In addition, examining a measure of interest rates that is more sensitive to LSAPs and potentially less affected by economic fundamentals may bolster the case that expectations played a role in interest rate movements.

One way of distinguishing the impact of expectations on interest rates from the impact of economic fundamentals is by examining the term premium, which is one channel through which asset purchases affect long-term interest rates—a point emphasized by Woodford, Stein, and others. For a long-term bond, the term premium is the excess yield needed to compensate investors for the risk of purchasing one longer-term bond rather than a series of short-term bonds. The bottom panel of Chart 3 shows the Internet Search Index with a measure of the 10-year Treasury risk premium. If only the 10-year interest rate decreased prior to asset-purchase announcements, this movement may have been solely due to declining economic fundamentals. Because the associated term premium also decreased, the decline in interest rates is more likely to be due to expectations of asset purchases as well as economic fundamentals.

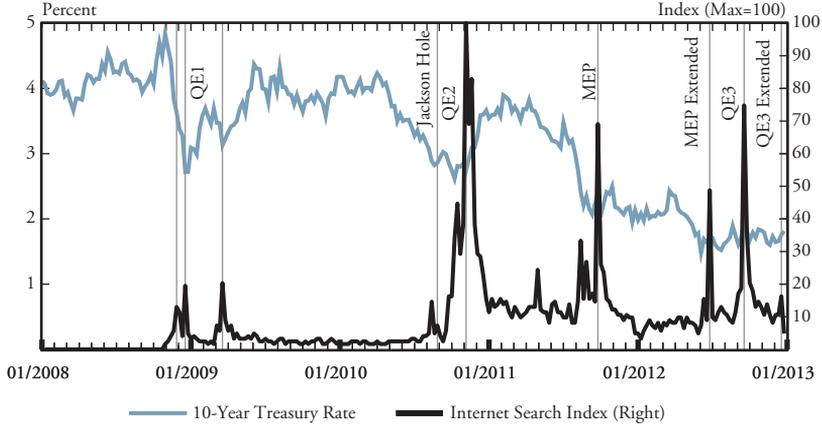
Recent Federal Reserve LSAP programs

A review of the Federal Reserve's asset purchase programs highlights the importance of expectations. The timing of movements in interest rates and in the four measures of expectations discussed previously, relative to the Federal Reserve's LSAP announcements, suggests

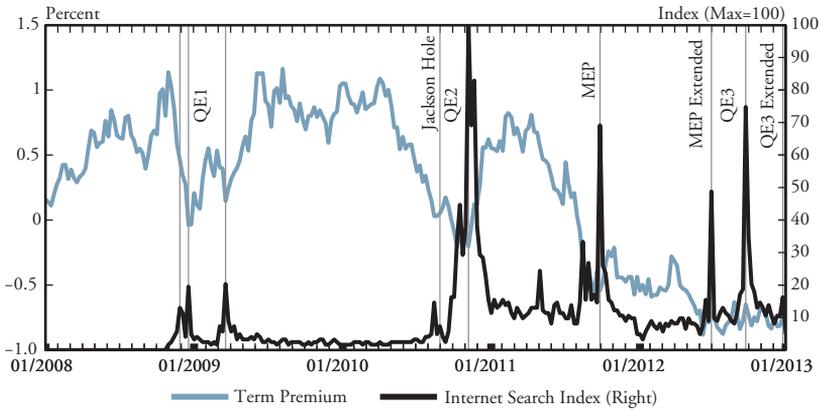
Chart 3

INTEREST RATES, TERM PREMIUM, AND EXPECTATIONS OF LSAPS

A: Search Index and 10-Year Treasury Rates



B: Search Index and the Term Premium



Notes: The Internet Search Index is a measure of the weekly number of Google searches for keywords related to asset purchases. The Interest Rate is the end-of-week rate for 10-year Treasuries. The term premium is the end-of-week rate for 10-year Treasuries.

Sources: Updated data from Gürkaynak and others, updated data from Kim and Wright, Google Trends, authors' calculations.

that expectations of the announcements may play a key role prior to the announcements themselves.

Quantitative Easing 1. Up until a few weeks prior to the announcement of QE1 in late November 2008, the evidence suggests markets did not expect asset purchases. Because the FOMC had not used asset purchases as a policy tool, it makes sense to believe markets did not expect the announcement. Indeed, outside of the Bank of Japan's experience, central banks did not use QE systematically. Neither of the surveys ask about LSAPs, and the News Index and Internet Search Index equal zero for most months in 2008, providing no evidence of expectations until November.

Expectations of an LSAP announcement began to emerge and rise sharply a few weeks prior to the initial QE1 announcement. While the Primary Dealer Survey didn't ask questions about LSAPs during that time period, 54 percent of Blue Chip Survey respondents on November 10, 2008, expected some sort of QE in response to the crisis (Table 3). In addition, in the last week of October, the Internet Search Index (Chart 2, Panel A) moved above zero, suggesting some popular interest in this new tool.

Determining whether LSAP expectations moved interest rates is difficult, however, because economic conditions are changing. During fall 2008, the economy slowed rapidly, causing interest rates to fall significantly—the 10-year Treasury rate dropped 2 percentage points between October and December, and the term premium fell more than a percentage point as investors flocked to safe assets such as 10-year Treasuries. However, because the evidence suggests that expectations of a pending announcement took hold in early November, these expectations also may have contributed to some of the decline in interest rates that occurred in November prior to the actual QE1 announcement.

Quantitative Easing 2. In the lead up to QE2, the News Index and Internet Search Index both show movements consistent with the hypothesis that markets expected asset purchases. Between early 2009 and mid-2010, both the News Index and Internet Search Index show a low level of interest in asset purchases, although not the total absence of interest indicated in the months before the crisis. Many commentators point to the speech given by Chairman Bernanke in late August 2010 at the Jackson Hole symposium as laying the groundwork for QE2, interpreting this speech as a signal that LSAPs could

be announced in the future. However, both the News and Internet Search indices spiked weeks before Chairman Bernanke's speech during the FOMC's meeting week, suggesting Chairman Bernanke's Jackson Hole speech wasn't the initial signal. The FOMC statement issued during that week, on August 10, 2010, specifically mentioned that the Fed, in contrast to past practice, would reinvest proceeds from maturing assets rather than allowing them to roll off its books. This language perhaps signaled to markets the possibility of QE2. Between Chairman Bernanke's speech and the QE2 announcement in early November 2010, both indices increased, with a substantial spike during the week of the September 2010 FOMC meeting, despite no policy change. In addition, an October 2010 speech by Chairman Bernanke at the Federal Reserve Bank of Boston, in which he discussed the potential for additional monetary policy accommodation, caused both indices to rise. During this period, expectations of a QE2 announcement rose substantially.

The interest rate and term premium data in Chart 3 are again difficult to interpret. A slowing economy contributed to falling interest rates. The 10-year Treasury rate dropped 1.5 percentage points from April to October and the slowing economy prompted the announcement of QE2. However, the two indices suggest expectations of QE2 caused some of this drop after the FOMC meeting in August. A second factor, however, further complicates the analysis. The 10-year Treasury rate actually increased at various points during this period. The upward movement in interest rates could have been caused by any number of factors, including a higher forecast for economic growth, higher inflation expectations, or the response when anticipated LSAP announcements did not materialize.

Maturity Extension Program. After the announcement of QE2, both the News Index and the Internet Search Index exhibited a higher level and volatility than before the announcement. A higher average level than in the period between QE1 and QE2 highlights an increased awareness of the new asset purchase programs. Higher volatility, particularly in weeks with FOMC meetings, also suggested heightened awareness of asset purchases in those weeks.

Movements in the News Index and Internet Search Index, along with survey evidence, suggest that markets expected the MEP well be-

fore its announcement. Even in December 2010, about 28 percent of Blue Chip respondents expected asset purchases beyond QE2 (Table 3). One particular meeting, in April 2011, moved the indices sharply, despite no announcement of a change in policy. However, the FOMC statement from that meeting specifically mentioned that the Committee would consider adjusting the composition of its asset holdings—a clear signal of an MEP-type program. At the same time, interest rates began falling for a period before the MEP announcement in September. After the June meeting, when the FOMC again mentioned adjusting the composition of its holdings, the indices spiked again. The top panel of Chart 3 shows long-term interest rates fell 1.5 percentage points, with a corresponding fall in the term premium shown in the bottom panel. Some of this decline occurred because of the downgrade of U.S. debt in August, which created heightened economic uncertainty, causing investors to flock to safe assets such as the 10-year Treasury—still considered a safe asset despite the debt downgrade itself. In addition, August 2011 saw the introduction of the FOMC’s new policy of forward guidance, as the statement indicated economic conditions “warrant exceptionally low levels for the federal funds rate at least through mid-2013.”

MEP Extension. The movements of both indices corroborate the evidence from the surveys, which becomes more informative for subsequent LSAP programs. In September 2011, the Primary Dealers had high confidence that there would be a program extending the duration of the Federal Reserve’s portfolio of assets (Chart 1, Panel B), and 50 percent of Blue Chip respondents said they thought there would be a policy easing move at the September 2011 meeting (Table 3).

Interest rates declined in the weeks before the MEP extension announcement. In this case, interest rates moved down prior to any substantial increase in the Internet Search Index. However, the News Index showed a slight increase in April 2011 when the FOMC signaled the possibility of the MEP and interest rates moved down. In April 2012, 27 percent of Blue Chip respondents said they believed that the MEP would be extended past its scheduled June conclusion (Table 3). Primary dealers’ expectations of an extension in the Federal Reserve’s balance sheet increased rapidly starting in April 2012 (Chart 1, Panel B).

Both the initial MEP announcement and the announcement of its extension highlight the importance of expectations. In both cases, survey evidence and the two indirect evidence indices point to expecta-

tions of a future policy announcement. In both cases, interest rates fell even before the announcement.

Quantitative Easing 3. The most recent round of asset purchase announcements, in September and December 2012, had different effects from the previous announcements. The announcement of QE3 in September 2012 generated the second-largest spike in both the News and Internet Search indices. The announcement of the QE3 extension in December 2012 moved both indices only slightly.

The survey evidence suggests that markets largely anticipated both announcements. Immediately prior to the announcement of QE3, the median respondent in the Primary Dealer Survey put more than a 50 percent probability on a balance sheet expansion program at the September 2012 meeting and more than a 40 percent probability on an announcement within a year or two (Chart 1, Panel A). The Blue Chip survey showed a similar picture, with a varying number of respondents expecting QE3 in 2012 and slightly less than half expecting an announcement at the September meeting specifically (Table 3). For the QE3 extension announcement in December 2012, the only relevant question in the Blue Chip survey came in November 2012, when 77 percent of respondents said they believed an announcement of longer-dated assets would occur in December.

Despite this clear evidence of expectations, both panels of Chart 3 show minimal movements in interest rates and in the term premium around the announcement period, either in the weeks before or after. Diminishing efficiency of purchases may explain this lack of movement: as more asset purchase programs were implemented, they may have exerted progressively less effect on lowering interest rates, perhaps eventually having minimal impact. Examining the decreases in interest rates around the different announcements supports this argument because they became smaller over time. However, even if these later asset purchase announcements had less impact on interest rates, if they helped keep 10-year Treasury rates from rising, they still may have had a desired effect of supporting economic growth.

Regression results

While the recent history of LSAP programs produced co-movements between the measures of expectations and interest rates that

support the hypothesis that expectations mattered for each of the programs, statistical regressions are required to determine if a systematic relationship held over the time period. In addition, to correctly measure the impact of expectations, the regressions need to control for other economic factors that may affect interest rates and the term premium. Having controlled for these other factors, a negative correlation between the indirect measures of expectations and the 10-year interest rate or term premium would suggest that higher degrees of expectations tended to lower rates.

The regression results in Table 4 support the hypothesis that long-term interest rates are affected by market expectations of LSAP announcements. The table displays results from several regressions analyzing the relationship between 10-year Treasury rates, economic variables, and the News Index and Internet Search Index, all at a weekly frequency. To control for economic conditions, the regressions include short-term interest rates, general economic conditions (by using the Federal Reserve Bank of Philadelphia's business cycle index), other surprises in data releases or policy changes (by using Bloomberg's Economic Surprise Index), and the actual LSAP announcements.⁴ Including the weekly News or Internet Search indices as variables in the regression improves its explanatory power. Both variables have statistically significant coefficients. The coefficients are also negative, implying that increases in the two measures of expectations lead to lower interest rates. An increase in the News Index by one article tended to lower the interest rate by 0.020 percentage point, and an increase in the Search Index by one unit tended to lower the interest rate by 0.012 percentage point.

In Table 5, the regression results also provide evidence that expectations affected the term premium. Both the News and Search Index variables improve fit of the regressions, and have statistically significant coefficients that imply that higher expectation measures lowered the term premium. In particular, an increase in the News Index by one article tended to lower the term premium by 0.018 percentage point, and an increase in the Search Index tended to lower the term premium by 0.011 percentage point.

In addition, the results from both sets of regressions illustrate that event studies focusing only on announcement dates and disregarding preceding market expectations likely are missing important factors that

Table 4

THE EFFECT OF EXPECTATIONS ON INTEREST RATES

Dependent Variable: 10-Year Treasury Rate	Regression 1	Regression 2	Regression 3	Regression 4
Constant	2.623** (0.068)	2.650** (0.069)	2.854** (0.091)	2.809** (0.089)
1-Year Overnight Index Swap	0.506** (0.061)	0.492** (0.061)	0.424** (0.063)	0.439** (0.063)
Business Cycle Index	-0.131* (0.054)	-0.138* (0.054)	-0.110* (0.053)	-0.120* (0.053)
Economic Surprise Index	0.627** (0.125)	0.592** (0.126)	0.491** (0.127)	0.530** (0.127)
Announcement Dummy	—	-0.502* (0.247)	-0.178 (0.260)	-0.134 (0.277)
News Index	—	—	-0.020** (0.006)	—
Search Index	—	—	—	-0.012** (0.004)
Adj R-Squared	0.353	0.361	0.386	0.377

Standard errors are in parentheses.

*Significant at the 0.05 level.

**Significant at the 0.01 level.

Sources: Authors' calculations, Federal Reserve Board, Federal Reserve Bank of Philadelphia, and Bloomberg.

Table 5

THE EFFECT OF EXPECTATIONS ON THE TERM PREMIUM

Dependent Variable: 10-Year Treasury Term Premium	Regression 1	Regression 2	Regression 3	Regression 4
Constant	-0.029 (0.050)	-0.010 (0.051)	0.178* (0.066)	0.138* (0.065)
1-Year Overnight Index Swap	0.176** (0.045)	0.167** (0.045)	0.104* (0.046)	0.117* (0.046)
Business Cycle Index	-0.131** (0.040)	-0.135** (0.040)	-0.109** (0.039)	-0.119** (0.039)
Economic Surprise Index	0.522** (0.093)	0.498** (0.093)	0.405** (0.093)	0.440** (0.093)
Announcement Dummy	—	-0.349 (0.182)	-0.051 (0.190)	-0.005 (0.203)
News Index	—	—	-0.018** (0.004)	—
Search Index	—	—	—	-0.011** (0.003)
Adj R-Squared	0.198	0.207	0.256	0.241

Standard errors are in parentheses.

*Significant at the 0.05 level.

**Significant at the 0.01 level.

Sources: Authors' calculations, Federal Reserve Board, Federal Reserve Bank of Philadelphia, and Bloomberg.

influence the efficacy of LSAPs. Regression 2 in Table 4 shows that weeks with announcements tended to feature 10-year interest rates that were about half a percentage point lower than in weeks without an announcement. However, Regressions 3 and 4 in Table 4, which include the two indices measuring expectations, have smaller and statistically insignificant coefficients associated with announcements. This result suggests that failure to control for expectations may lead to understating the efficacy of LSAPs, since announcement effects only capture a portion of the decline in the 10-year Treasury rate. For the term premium regressions, Table 5 shows a similar decrease in the magnitude of the coefficient on announcements for Regressions 3 and 4, relative to Regression 2, but without statistical significance. This result implies that the potential understatement of the efficacy of is less for the term premium than for interest rates.

CONCLUSION

Event studies often measure the efficacy of LSAPs using major announcement dates, highlighting the change in interest rates that occurs right after the announcements. However, evidence drawn from surveys and from newspaper and Internet searches suggests that markets had some degree of advance expectation of the announcements for all the Federal Reserve's recent rounds of LSAPs. Measures drawn from the surveys and news searches tended to move significantly prior to all of the recent announcements, implying that expectations of announcements may have affected long-term interest rates and the term premium before the announcements occurred. Statistical evidence supports the hypothesis that the measures of expectations correlate with interest rates and with the term premium, indicating that higher expectations were associated with decreases in both interest rates and term premiums.

Because event studies typically focus on a short window of time around the announcement of an LSAP program and disregard the potential impact of market expectations, these studies understate the total efficacy of LSAPs. The full effect of an asset purchase program should include both the direct effects of the announcement and the effects of expectations.

ENDNOTES

¹This paper follows common terminology and uses “QE” and “LSAP” interchangeably.

²Following Baker and others, the news index includes *USA Today*, *The Miami Herald*, *Chicago Tribune*, *The Washington Post*, *Los Angeles Times*, *The Boston Globe*, *San Francisco Chronicle*, *The Dallas Morning News*, *The New York Times*, and *The Wall Street Journal*. The index counts any article that mentions at least one of the following keywords: “quantitative easing,” “QE,” “QE1,” “QE2,” “QE3,” “large-scale asset purchase,” “operation twist,” and “maturity extension program.”

³The index is based on searches in the United States using Google that include at least one of the following terms: “quantitative easing,” “large-scale asset purchase,” “operation twist,” “maturity extension program.” Also included are searches that contain at least one item from both of the following lists:

“Federal Reserve,” “Fed,” or “Bernanke”

“QE,” “QE1,” “QE2,” “QE3,” “QE4,” or “LSAP.”

⁴The Bloomberg Surprise Index is a measure of how recent economic data releases compared with consensus expectations. Including the Surprise Index helps control for the impact of market participants’ potentially reacting to news that suggests an improving or worsening economic outlook.

REFERENCES

- Baker, Scott, Nick Bloom, and Stephen Davis. 2013. "Measuring Economic Policy Uncertainty," working paper.
- Bomfim, Antulio, and Laurence Meyer. 2010. "Quantifying the Effects of Fed Asset Purchases on Treasury Yields," *Monetary Policy Insights: Fixed Income Focus*.
- Chen, Han, Vasco Curdia, and Andrea Ferrero. 2012. "The Macroeconomic Effects of Large-Scale Asset Purchase Programs," *Economic Journal*.
- D'Amico, Stefania, and Thomas B. King. 2010. "Flow and Stock Effects of Large-Scale Treasury Purchases," Federal Reserve Board, Finance and Economics Discussion Series.
- D'Amico, Stefania, William English, David Lopez-Salido, and Edward Nelson. 2012. "The Federal Reserve's Large-Scale Asset Purchase Programs: Rationale and Effects," Federal Reserve Board, working paper.
- Doh, Taeyoung. 2010. "The Efficacy of Large-Scale Asset Purchases at the Zero Lower Bound," Federal Reserve Bank of Kansas City, *Economic Review*, Second Quarter.
- Gagnon, Joseph, Matthew Raskin, Julie Remache, and Brian Sack. 2011. "The Financial-Market Effects of the Federal Reserve's Large-Scale Asset Purchases," *International Journal of Central Banking*.
- Gürkaynak, Refet, Brian Sack, and Jonathan Wright. 2006. "The U.S. Treasury Yield Curve: 1961 to the Present," Federal Reserve Board, working paper 2006-28.
- Hamilton, James, and Jing Cynthia Wu. 2012. "The Effectiveness of Alternative Monetary Policy Tools in a Zero Lower Bound Environment," *Journal of Money, Credit, and Banking*, February.
- Kim, Don, and Johnathan Wright. 2005. "An Arbitrage-Free Three-Factor Term Structure Model and the Recent Behavior of Long-Term Yields and Distant Horizon Forward Rates," Federal Reserve Board, working paper 2005-33.
- Krishnamurthy, Arvind, and Annette Vissing-Jorgensen. 2011. "The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy," working paper.
- Neely, Christopher. 2011. "The Large-Scale Asset Purchases Had Large International Effects," Federal Reserve Bank of St. Louis, working paper.
- Stein, Jeremy. 2012. "Large-Scale Asset Purchases," remarks at the Third Boston University/Boston Fed Conference on Macro-Finance Linkages, Boston, MA, November 30.
- Swanson, Eric T. 2011. "Let's Twist Again: A High-Frequency Event-Study Analysis of Operation Twist and Its Implications for QE2," Federal Reserve Bank of San Francisco, working paper 2011-08.
- Woodford, Michael. 2012. "Methods of Policy Accommodation at the Interest-Rate Lower Bound," *The Changing Policy Landscape*, Jackson Hole Economic Symposium, Federal Reserve Bank of Kansas City, August 30-September 1.

