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Quantitative Easingand U.S. Financial Asset Returns

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Abstract. This paper is a comprehensive study of the unconventional monetary policy taken by the Federal Reserve since the financial crisis of 2008, specifically on the purchases of different assets by the Fed to change medium and long-term rates. Included in this study are the three rounds of quantitative easing, and the two rounds of Operation Twist. A study as such is needed in order to examine if the Fed's purchases of these various long-term assets had any effect on the financial markets in the longer term perspective since the first announcement of the first round of purchase in November 2008. While there exists a variety of literature on the effects of quantitative easing on Treasuries and mortgage backed securities, there is no single study comprising of all the large scale asset purchases by the Fed, covering their effects on all major financial assets. This study is an attempt to fill this void in current literature on quantitative easing.
Keywords. Unconventional Monetary Policy, Quantitative Easing, the Federal Reserve.
JEL. E52, E58, G14.

1. Introduction

1.1. *Unconventional Monetary Policy Since 2008*

The Federal Reserve has been very visibly pursuing unconventional monetary policy since the 2008 financial crisis, particularly the large-scale asset purchases (LSAPs) of long-term securities including Treasuries, Agency bonds and mortgage-backed securities (MBS). The purchases of these securities are called quantitative easing (QE), for the purpose of reducing medium and long-term interest rates to stimulate economic activity. Quantitative easing has been considered unconventional since the conventional monetary policy taken by the Fed before the financial crisis was to target the short-term fed funds rate. However, the Fed exhausted its conventional monetary influence during the time of crisis when the fed funds rate reached its lower bound of zero, and unusually aggressive monetary stance was needed in order to prevent financial conditions from worsening.

The Federal Reserve initiated several measures to alleviate the deteriorating financial condition, stabilize the financial system, and reduce the damaging impacts of the recession. They included large-scale purchasing of financial assets, providing short-term secured loans to financial institutions, facilitating loans to institutions with commercial papers, lowering the discount rate to zero, and paying interest to banks for their required reserves. Yet another strategy is to manage market expectations of impending Fed actions via communications to the public about its policy stances and economic goals.

The large-scale asset purchases, or quantitative easing, have been the focus of scrutiny of Fed policies since the 2008 financial crisis to the present time, because

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while the financial crisis had passed, the subsequent effects of the recession and the weak employment market have lingered, and the Fed is still engaging in quantitative easing in order to prevent possible economic downturn. Subsequent to the announcement of the first round of quantitative easing on November 28, 2008, there have been three more rounds of large-scale asset purchases in August 2010, September 2012, and December 2012.

1.2. The Three Rounds of Quantitative Easing

The first quantitative easing was announced on November 25, 2008, that the Fed would purchase $500 billion in mortgage-backed securities and up to $100 billion in agency debt of Fannie Mae, Freddie Mac, Ginnie Mae, and Federal Home Loan Banks. Furthermore, in March 2009, the Fed expanded the mortgage buying program with additional purchase of $750 billion more in mortgage-backed securities. Overall, when this first round of LSAP ended on March 31, 2010, it purchased a total of $1.25 trillion in mortgage-back securities and $175 billion in agency debt. The main purpose of this action was "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."[1]

The second quantitative easing was announced on August 10, 2010 Federal Open Market 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." Additionally, the Fed started purchasing $600 billion of longer-term securities. It was intended to promote a stronger pace of economic recovery.

The third quantitative easing was announced on September 13, 2012 that the Fed was committing to an open-ended purchase of $40 billion in agency MBS per month until the labor market improves substantially. On December 12, 2012, the Fed decided to continue and magnify the attempt of the third round of quantitative easing by increasing the amount of open-ended purchase from $40 billion to $85 billion per month. This third round of purchase is still an ongoing process as of the writing of this paper.

To further strengthen the economy and to prevent the recovery from losing its momentum, the Fed also tried to influence the yield curve by selling short-term Treasuries and using the proceeds to purchase longer-term Treasuries in what is conventionally called Operation Twist (OT). The FOMC announced the first round of Operation Twist on September 21, 2011 with the intention of purchasing $400 billion of bonds with maturities of 6 to 30 years and to sell bonds with maturities of less than 3 years, thereby extending the average maturity of the Fed's own portfolio. The second round of Operation Twist was announced on June 20, 2012, extending the first program with additional $267 billion in purchase, and prolonging the program through December 2012. Figures1 Panels A – C on the following three pages illustrate and summarize representations of major financial markets – the stock market, Treasuries market, and the foreign exchange market – a month before and after notable LSAP announcements by the Fed. As depicted in the figures, major financial markets reacted significantly to significant Fed announcements on asset purchases.

[1]Federal Reserve Press Release on November 25, 2008 at 8:15 a.m. EST.

Figure 1. Panel A. *Responses of SPY Prices on QE Announcement*

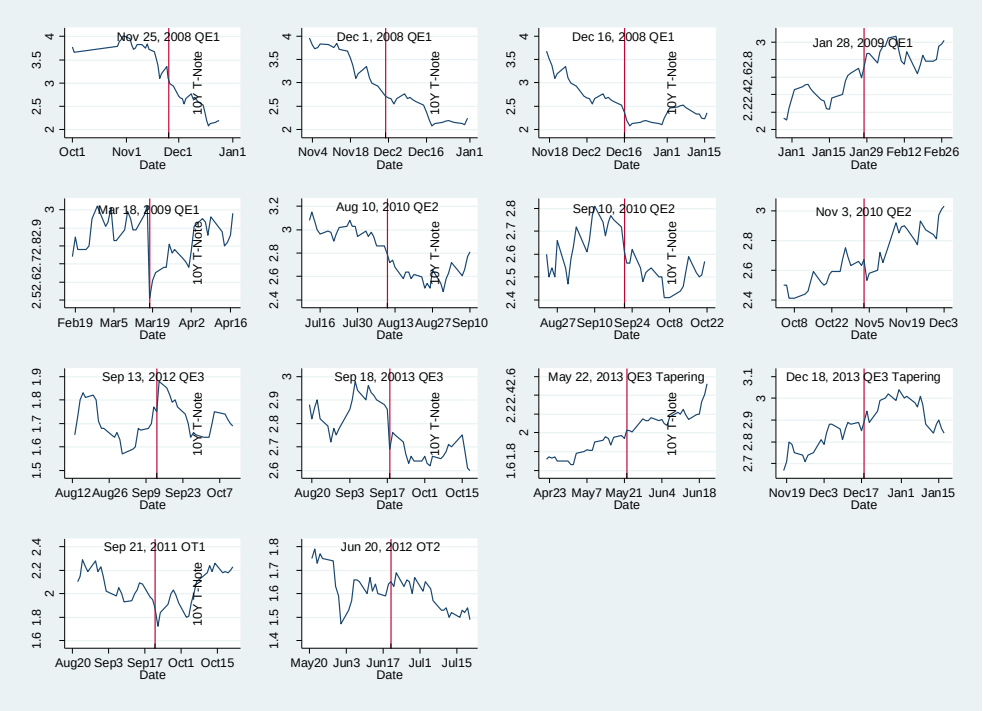

Figure 1. Panel B. *Responses of 10-Year Treasury Yields on QE Announcements*

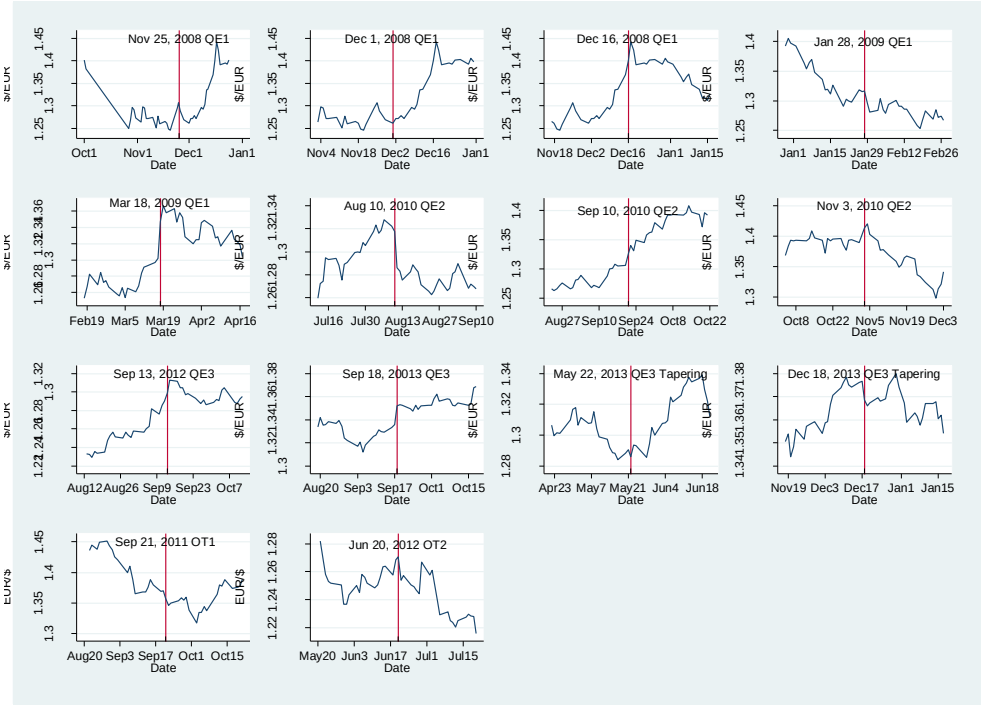

Figure 1. Panel C. *Responses of $/EURO on QE Announcements*

1.3. Outline of the Chapter

This paper is a comprehensive study of the unconventional monetary policy taken by the Fed since the financial crisis, specifically on the purchases of different assets by the Fed to change medium and long-term rates. Included in this study are the three rounds quantitative easing, and the two rounds of Operation Twist. A study as such is needed in order to examine whether the Fed's purchases of these various long-term assets had any effect on the financial markets in the longer term perspective since the first announcement of such LSAP in November 2008. While there exists a variety of literature on the effects of quantitative easing on Treasuries and mortgage backed securities, there is no single study comprising of all the LSAPs by the Fed, covering the effects of all of these LSAPs on all major financial assets. Figure 1 illustrate price and yield movements of the equity, fixed-income, and currency markets before and after for some notable QE announcement dates.

A complete and thorough study on the effects of these LSAPs on all sectors of the financial market is necessary since these monetary easings by the Fed not only affect the yields for Treasuries and mortgage-backed securities, but also prices and yields of other types of financial assets. Bernanke & Reinhart (2004) maintain that the pricing of financial assets such as equities and mortgages depends partly on the entire expected future path of short-term interest rates, as well as the current short-term interest rate. A central bank can then affect asset prices and economic activity by guiding market expectations of future short-term rates. Recent literature, i.e. Svensson (2001), Eggertsson & Woodford (2003), suggests that additional monetary stimulus such as quantitative easing can be introduced together with some form of commitment to the public to keep short-term interest rate low for a prolonged period of time, even after when the economy shows some sign of recovering. This commitment should lower yields via the term structure component of bonds and support other asset prices, provided that the commitment is a credible one.

Since each of these LSAPs are different, and occurred under different economic circumstances, they should have different impacts on the economy. Krishnamurthy & Vissing-Jorgensen (2011) conclude that effects of QE on particular assets depend on which assets are being purchased by the Fed, and find that it is inappropriate to focus solely on a policy target, such as Treasury rates, since QEs have different effects on different assets via several channels, such as a prepayment channel for MBS.

Gagnon et al (2010) present evidence that the purchases led to economically meaningful and long lasting declines on treasuries, agency bonds, mortgage backed securities, Treasury inflation protected securities (TIPS), SWAPS, and corporate bonds. However, many such studies only include the fixed-income sector. By lowering Treasury and MBS yields, the effects of these LSAPs also potentially spilled over to the broad financial market since stocks and other financial assets are influenced by the Fed's current actions and expectations on its future monetary policy stance.

By conducting an event-study on the major LSAP announcement dates since November 2008 to August 2014 (the date of this writing) on all the major financial assets, this paper identifies the effects of the Fed's purchases throughout the economy, and compares the effectiveness of all these large scale asset purchases since the 2008 financial crisis. This paper fills the void of current literature and provides a complete picture of the Fed's asset purchases since the 2008 financial crisis.

The paper is structured as follows. Section 2 is a survey of current literature on the impact of quantitative easing on different financial assets. Section 3 describes the data, model, and methodology. Section 4 discusses the empirical results, and Section 5 concludes.

2. Literature Review

2.1. The Portfolio Balance Channel and Signaling Channel of Quantitative Easing

A vast literature exists on using the event-study approach to observe the effects of the recent large scale asset purchases on different financial assets, as central banks of Japan, England, Europe, and the United States initiate and continue purchases of financial assets to support the economy since the 2008 financial crisis. Even before the financial crisis, the Fed has been studying alternative monetary policy given the zero-bound constraint of the Fed Funds rate. Using the standard method to decompose yields on safe long-term government bonds, the predominant observation is that there are two channels that a central bank's purchasing program can work through to impact broader market bond yields and other types of interest rates: the portfolio balance channel and the signaling channel. The portfolio balance channel emerges from a central bank's large purchases of long-term bonds, thereby decreasing the supply in private-sector portfolios and reducing the term premium. The signaling channel occurs via the central bank's announcements of such large-scale asset purchases, where it influences market participants to expectation that future short-term interest rates will be kept very low for a prolonged period of time, even as the economy show signs of recovery.

The existing literature considers the portfolio balance channel to be the key channel of how a central bank's large-scale asset purchase works through to impact interest rates. In his speech on August 27, 2010, the Fed Chairman Ben Bernanke described this channel as follows:

> "The channels through which the Fed's purchases affect longer-term interest rates and financial conditions more generally have been subject to debate. I

> see the evidence as most favorable to the view that such purchases work primarily through the so-called portfolio balance channel, which holds that once short-term interest rates have reached zero, the Federal Reserve's purchases of longer-term securities affect financial conditions by changing the quantity and mix of financial assets held by the public. Specifically, the Fed's strategy relies on the presumption that different financial assets are not perfect substitutes in investors' portfolios, so that changes in the net supply of an asset available to investors affect its yield and those of broadly similar assets. Thus, our purchases of Treasury, agency debt, and agency MBS likely both reduced the yields on those securities and also pushed investors into holding other assets with similar characteristics, such as credit risk and duration. For example, some investors who sold MBS to the Fed may have replaced them in their portfolios with longer-term, high-quality corporate bonds, depressing the yields on those assets as well. The logic of the portfolio balance channel implies that the degree of accommodation delivered by the Federal Reserve's securities purchase program is determined primarily by the quantity and mix of securities the central bank holds or is anticipated to hold at a point in time (the "stock view"), rather than by the current pace of new purchases (the "flow view"). In support of the stock view, the cessation of the Federal Reserve's purchases of agency securities at the end of the first quarter of this year seems to have had only negligible effects on longer-term rates and spreads."[2]

Daniel L. Thornton, Vice President and Economic Advisor at the Federal Reserve Bank of St. Louis, presents several reasons to be skeptical of the theoretical foundations of the portfolio balance channel, and presents empirical results that show little evidence of a statistically significant portfolio balance channel and no evidence of an economically meaningful effect (Thornton, 2012). However, his work focuses more on the longer-term effects of QE, and uses less frequent monthly data.

2.2. Literature on the Fed's Asset Purchases Before and After the 2008 Financial Crisis

Clouse et al (2000) explore scenarios where the nominal Treasury-bill rate is assumed to be zero. They consider the effectiveness of further open market purchases of Treasuries to stimulate the economy via managing expectations of the future paths of short-term interest rates, inflation, and asset prices. They also examine alternative monetary policies available for the Fed to deploy in theory when the nominal short-term interest rate is zero. These possible policy tools include open market purchases of Treasury bonds, discount window lending, and use of options.

In the case of the Fed conducting open market purchase of Treasury bills when this asset's yield reaches zero, the private-sector considers Treasury bills and the monetary base as perfect substitutes. As such, open market purchases of Treasury bills do not change Treasury-bill rates since the initial portfolio is not in disequilibrium. Additionally, such purchases have no direct effect on the public wealth as there are no longer any potential capital gains since the Treasury bill rate cannot be reduced any further. However, this supposition does not consider the case of the Treasury bill rate being negative, as it did when the 3-month T-bill dipped below zero on December 9, 2008, and the one-month T-bill has yielded as low as -0.03% on August 4, 2011.

In the case of the Fed purchasing assets other than Treasuries, even if these assets are perfect substitutes for Treasuries, quantitative easing could have an impact on the economy through a "signaling effect." This effect leads market

[2]http://www.federalreserve.gov/newsevents/speech/bernanke20100827a.htm

participants to lower their expectations for future short-term interest rates, and possibly lengthening the expected duration of very low or zero target Fed Funds rate. Clouse et al conclude that aside from the signaling effect, the impact of asset purchases by the Fed depends on whether the assets purchased are imperfect substitutes for the monetary base and Treasuries. If the assets purchased are imperfect substitutes, then purchasing these assets can have an impact through their supply in the market. Furthermore, very large open market purchases of domestic and foreign government bonds might well lower domestic bond yield and cause the home currency to depreciate, but the likely size of these effects is unknown.

Bernanke, Reinhart, & Sack (2004) apply the tools of modern empirical finance to the present experiences of the United States and Japan. They examine possible effectiveness of different nonstandard monetary tools when the conventional monetary tool of targeting Fed Funds rate is near the zero bound. Policy alternatives, other than the fed funds rate, are grouped into three classes: (1) using communications policies to shape public expectations about the future direction of interest rates; (2) quantitative easing, or increasing the size of the central bank's balance sheet: and (3) changing the composition of the central bank's balance sheet, e.g. selling its holding of shorter-term bonds in exchange for longer-term bonds in order to lower longer-term interest rates[3]. Bernanke, Reinhart, & Sack employ two approaches in order to garner new evidence concerning the effectiveness of unconventional monetary policy tools. First, by utilizing an event-study approach, they measure and analyze the behavior of selected asset prices and yields over a short period of time surrounding central bank new releases and statement, or other types of financial or economic news. The event studies confirm that FOMC statements do have important impacts on private sector policy expectations, both directly and indirectly. This finding leads to the suggestion that the FOMC does have some capacity to influence yields and prices of longer-term assets by using communications policies.

Second, Bernanke, Reinhart, and Sack estimate "no-arbitrage" models of the term structure for the United States and Japan so as to allow for the prediction of interest rates at all maturities. The predicted term structure then is used as a benchmark to assess whether factors not included in the model have any effects on interest rates, such as a large scale asset purchase by a central bank. Moreover, they find some evidence that suggests the relative supplies of securities matter for yields for U.S. bonds, and that this is a necessary condition for achieving the desired effects from targeted asset purchases. They conclude that unconventional monetary policies do appear to affect asset prices and yields, and consequently, aggregate demand.

Swanson (2011) undertakes a modern event-study analysis of the 1961 Operation Twist and uses its estimated effects to assess what should be expected for QE2. The paper presents evidence that the 1961 Operation Twist and the second round of quantitative easing in 2010 are similar in magnitude. The author concludes that with high statistical significance, the cumulative effect of the six major announcements of Operation Twist amounts to about 15 basis points. The effects of Operations Twist on long-term agency and corporate bond yields are smaller but also statistically significant. The evidence indicates that Operation Twist has a larger impact on Treasury securities, and its effect is weaker on private sector credit instruments.

[3] This is often referred to as Operation Twist, since the central bank is attempting to "twist" the shape of the yield curve with the combined actions of selling shorter-term bonds and purchasing longer-term bonds.

Gagnon et al (2010) explains how the Fed implemented the first quantitative easing in 2008, and discusses the channels through which they can affect the economy. The paper concludes that the Fed's purchases were effective in lowering longer-term private borrowing rates and in stimulating the ailing economy. The evidence suggests that the impacts of the Fed's actions are widespread throughout the different securities studied in the paper, including Treasuries, corporate bonds, and interest-rate swaps. The impact is the most pronounced in the mortgage market, thus achieving the Fed's primary intention of supporting economic activity, especially the housing market at that time.

Gagnon et al find that the primary channel through which QE1 appears to work is the risk premium on the asset being purchased, by bidding up the price of the asset being purchased and thus lowering its yield. This process, which applies to only longer-term yields, is commonly known as the portfolio balance effect. The portfolio balance effect can be decomposed into two components: the average level of short-term risk-free interest rates expected over the term to maturity of the asset, and the risk premium. The authors acknowledge that in theory, the effects of QE1 could result from changing either of these two components. However, they believe that the Fed has not been using quantitative easing as a signal that the future path of short-term risk-free interest rates would remain low. They find that neither the language about future policy rates in the FOMC statements nor the LSAP announcements appear to have had a substantial effect on the expected future federal funds rate. Therefore, they conclude that any decrease in longer-term yields as a result of the Fed's LSAP has likely come through in the form of narrowing risk premiums. Additionally, they find that since the most important part of the risk premium for Treasury securities is referred to as the "term premium," the LSAPs have also lowered the duration risk in the financial market in general. Thus, the LSAPs have caused the decrease of duration risk and the term premium across all asset classes.

Krishnamurthy & Vissing-Jorgensen (2011) evaluate the effects of QE1 and QE2 on interest rates using an event-study methodology. They feel that it is inappropriate to focus only on Treasury rates as a policy target since QE works through several channels to affect specific asset differently, since there are several channels of how the Fed's purchases work through the economy to impact different assets in different ways. One of their main findings is that the large reductions in mortgage rates after QE1 can be attributed to the large purchases of agency MBS, thereby reducing the price of mortgage-specific risk. However, for QE2, which involved only Treasury purchases, the impact on treasury and Agency bond rates are substantial, but not so much on MBS and corporate bond rates. Moreover, they find a significant reduction in the default risk/default risk premium for corporate bonds only for QE1, but not QE2, which suggests that the MBS purchases initiated during QE1 may also have facilitated the lowering of corporate credit risk and thus corporate bond yield.

The paper details and examines the seven channels through which quantitative easing may be expected to affect different financial assets, and mentions the Eggertson & Woodford (2003) finding that via a signaling channel, non-traditional monetary policy can have an effect in lowering long-term bond yields. But this signaling channel can work only if the policy is a credible commitment by the central bank in keeping the interest rate low for an extended period of time, even after the economy recovers. Clouse et al (2000) recommend the central bank to purchase a large quantity of long-term assets to show commitment. With the expectations hypothesis, this signaling channel affects all interest rates.

Another noteworthy channel that QE works through is duration risk, which comes from the term premium of bonds. It reflects the reluctance of investors to

bear interest risk with longer-term bonds, thus longer duration bonds carry a term premium—the additional return that investors require from a bond with fixed long-term yield, beyond the average of expected future short-term interest rates.

By purchasing long-term securities, monetary policy can decrease duration risk and reduce longer-term bond yields relative to shorter-term bond yields. Furthermore, there is a liquidity channel, where QE increases liquidity for long-term securities and decreases the premium yield investors pay for shorter-term, more liquid bonds.

In order to examine how QE affects different interest rates via these different channels, Krishnamurthy and Vissing-Jorgensen use the difference-in-difference approach supplemented with information from derivatives as their main empirical methodology. Financial assets in their study include long-term Agency bond yields, long-term treasury bond yields, MBS yields, corporate bond yields, TIPS, federal funds futures contracts, the CDS swap rates, the inflation swap rates, and the implied volatility on interest rate options. Their main conclusions are that the Federal Reserve's purchase of long-term bonds during QE1 and QE2 significantly lowered nominal interest rates on Treasuries, Agencies, corporate bonds, and MBS, but these effects are not of the same magnitudes across different types of bonds, maturities, and Fed purchase programs. One of the primary channels that both QEs work through is a signaling channel which drives down the yield on all bonds, with stronger effects on intermediate bonds rather than longer termed bonds. Further, the authors decompose the portfolio balance effect/channel so as to pinpoint the specifics of how QE works through this channel to affect interest rates. The authors quote Brian Sack, the head of the Federal Reserve Bank of New York's Open Market desk, when discussing how the portfolio balance channel can work in a large-scale asset purchase by the Fed[4]:

> "The purchases bid up the price of the asset and hence lower its yields. These effects would be expected to spill over into other assets that are similar in nature, to the extent that investors are willing to substitute between the assets. These patterns describe what researchers often refer to as the portfolio balance channel."

Krishnamurthy and Vissing-Jorgensen conclude that one portfolio balance channel that is prominent in both QE1 and QE2 is the safety channel affecting safe long and medium-term bonds with low default risks. This safety channel highlights the substitutability of assets within a class with low-default risks.

Another element in the portfolio-balance channel is the duration-risk channel. Brian Sack spoke of this particular channel in a later speech[5]:

> "The effects of the asset purchase programs are thought to arise from the amount of duration risk that they remove from the portfolios of private investors. By removing duration risk, the Federal Reserve puts downward pressure on the longer-term real interest rates, which in turn pulls down private borrowing costs and makes broader financial conditions more supportive of growth. Duration risk can be measured in a variety of ways, but one common measure for a securities portfolio is ten-year equivalents, or the amount of 10-year Treasury notes that an investor would have to buy to be exposed to the same amount of duration risk contained in the portfolio. Some of the staff work that calibrates the economic impact of the Federal Reserve's balance sheet policies assumes that the effects on yields and financial conditions are driven by the amount of ten-year equivalents that the Fed takes into its portfolio."

[4]http://www.newyorkfed.org/newsevents/speeches/2009/sac091202.html
[5] http://www.newyorkfed.org/newsevents/speeches/2011/sac111024.html

While the Fed believes that duration risk channel is the main proponent of how QE works, Krishnamurthy and Vissing-Jorgensen do not find support for the presence of duration-risk channel in either QE1 or QE2.

Stroebel and Taylor (2012) examine the quantitative impact of the Fed's purchase of mortgage-backed securities during the financial crisis on mortgage interest rate spreads. They use a multivariate statistical framework and take into account other possible influences on spreads, while controlling for two other possible influences on mortgage spread, namely changes in prepayment and default risk. Their empirical results assign a considerable portion of the decline in mortgage rates to prepayment and default risks, and a relatively small and uncertain portion to the Fed's asset purchasing program. For instances where the existence or announcement of the quantitative easing seems likely to have decreased spreads, their results show no separate effect of the Fed's purchases. Additionally, they show that the estimated size of the impact of the Fed's MBS purchase on mortgage spreads can be traced to a shift in the spread between Treasuries and swaps at the time of the panic in October 2008. However, this paper does not address the issue that if the MBS purchase by the Fed lowered the spread between Treasuries and swaps, then there is a possibility that the Fed's purchase has spillover effects on other financial assets.

In light of the survey of literature, numerous questions have emerged that haven't been answered fully, which this paper attempts to accomplish. They include:

- Did the QEs decrease yields on all long-term nominal assets, including Treasuries, Agency bonds, corporate bonds, and MBS?
- Were the effects of QE larger for longer duration assets?
- Which round of QE was more effective?
- Did QE raises yields on the most liquid assets such as Treasuries, relative to other less liquid assets.
- Did QEs involving the purchase of Treasuries and agencies lower the yields on very safe assets such as treasuries, Agencies, and possible high-grade bonds, relative to less safe assets such as lower-grade corporate bonds or bonds with prepayment risk such as MBS?
- Did QE affect only fixed income assets, or were there spillover effects into other types of financial assets?

Did QE depreciate the home currency?

3. Model, Dates, and Methodology

3.1. Relevant Event Dates

Following Gagnon et al (2010) and Krishnamurthy & Vissing-Jorgensen (2011), this paper utilizes an event-study approach to examine the impact of all of the recent large-scale asset purchases based on announcements from the Fed of such purchases, spanning from the first announcement of QE1 on November 25, 2008 to the latest QE on December 12, 2012. Including in this study are the three rounds of QE and two rounds of Operation Twist, spanning from the month before QE1 to one month after the latest announcement of QE3 tapering, October 1, 2008 to August 31, 2014. The following is a brief description of somenotable announcement dates included in this study:

QE1:

- November 25, 2008 – The initial LSAP announcement in which the Federal Reserve announced it would purchase up to $100 billion in agency debt, and up to $500 billion in agency MBS.

- December 1, 2008 – Chairman Bernanke gave a speech at the Greater Austin Chamber of Commerce, Austin Texas. He reiterated the Fed's purchasing plan over the next few quarters
- December 16, 2008 – FOMC statement repeating the previous announcement that the Fed would purchase large quantities of agency debt and mortgage-backed securities to provide support to the mortgage and housing markets, and stood ready to expand purchase of agency debt and MBS as conditions warrant. It also announced that the Committee is evaluating the potential benefits of purchasing longer-term Treasury securities.
- January 28, 2009 – FOMC statement reiterating the Fed's purchasing plan.
- March 18, 2009 – FOMC statement repeating the Fed's continuing support to mortgage lending and housing markets by increasing the size of the Fed's balance sheet further by purchasing up to an additional $750 billion of agency MBS, bring its total purchases of these securities to up to $1.25 trillion in 2009. Moreover, the Fed announced increasing its purchase of agency debt that year by up to $100 billion to a total of up to $200 billion. Additionally, to help improve conditions in the private credit markets, the Committee decided to purchase up to $300 billion of longer-term Treasury securities over the next six months.

QE2:

- August 10, 2010 – FOMC statement announcing that "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 MBS in longer-term Treasury securities."
- September 21, 2010 – FOMC statement announcing that the Fed would continue to maintain its existing policy of reinvesting principal payments from its securities holdings.
- November 3, 2010 – FOMC statement announcing its intent to promote a stronger pace of economic recovery by maintaining its existing policy of reinvesting principal payments from its securities holdings. In addition, the Committee planned to purchase a further $600 billion of longer-term Treasury securities by the end of the second quarter of 2011, at a pace of $75 billion per month.

QE 3:

- September 13, 2012 – FOMC announced an open-ended commitment to purchase $40 billion agency MBS per month until the labor market improves substantially.
- December 12, 2012 – FOMC statement to increase the amount of open-ended purchase from $40 billion to $85 billion per month.
- September 18, 2013 – FOMC statement to continue purchasing additional agency MBS at a pace of $40 per month and longer-term Treasury securities at a pace of $45 billion per month. This announcement is significant because the Fed changed its language on its press release regarding the nature of it asset purchasing program. Since December 12, 2012, its press releases included the following two paragraphs:

> To support a stronger economic recovery and to help ensure that inflation, over time, is at the rate most consistent with its dual mandate, the Committee will continue purchasing additional agency mortgage-backed securities at a pace of $40 billion per month. The Committee also will purchase longer-term Treasury securities after its program to extend the average maturity of its holdings of Treasury securities is completed at the end of the year, initially at a pace of $45 billion per month. The Committee is maintaining its existing policy of reinvesting principal payments from its holdings of agency debt and agency mortgage-backed securities in agency

> mortgage-backed securities and, in January, will resume rolling over maturing Treasury securities at auction. Taken together, these actions should maintain downward pressure on longer-term interest rates, support mortgage markets, and help to make broader financial conditions more accommodative. The Committee will closely monitor incoming information on economic and financial developments in coming months. If the outlook for the labor market does not improve substantially, the Committee will continue its purchases of Treasury and agency mortgage-backed securities, and employ its other policy tools as appropriate, until such improvement is achieved in a context of price stability. In determining the size, pace, and composition of its asset purchases, the Committee will, as always, take appropriate account of the likely efficacy and costs of such purchases. [6]

On September 18, 2013, it changed its language in the first paragraph regarding its asset purchasing program to the following:

> Taking into account the extent of federal fiscal retrenchment, the Committee sees the improvement in economic activity and labor market conditions since it began its asset purchase program a year ago as consistent with growing underlying strength in the broader economy. However, the Committee decided to await more evidence that progress will be sustained before adjusting the pace of its purchases. Accordingly, the Committee decided to continue purchasing additional agency mortgage-backed securities at a pace of $40 billion per month and longer-term Treasury securities at a pace of $45 billion per month.[7]

Tapering:

- May 22, 2013 –Chairman Ben S. Bernanke Testimony Before the Joint Economic Committee, U.S. Congress, Washington, D.C., signaling the withdrawal of QE3 for the first time.
- December 18, 2013 – FOMC statement to begin tapering of QE3, at a pace of $35 billion per month rather than $40 billion per month, and will add to its holdings of longer-term Treasury securities at a pace of $40 billion per month rather than $45 billion per month

Operation Twist (First Round)

- September 21, 2011 – FOMC statement announcing the purchase of $400 billion of bonds with maturities of 6 to 30 years and to sell bonds with maturities of less than 3 years, thereby extending the average maturity of the Fed's own portfolio.

Operation Twist (Second Round)

- June 20, 2012 –FOMC announced an extension to the Twist Program by additional $267 billion and extending the program through December 2012.

For the announcement dates in QE1 and QE2, this paper uses the five dates selected by Krishnamurthy and Vissing-Jorgensen (2011), but also included other QE announcement dates from FOMC up to the most recent time. Krishnamurthy and Vissing-Jorgensen (2011) remark on the identification issue for these five QE1 event dates that there is some uncertainty that the identified events are in fact the dominant events for the identified event day. This is due to the possibility that other newsworthy economic news arriving through this period and potentially creating measurement error problems for their event study. To remedy such potential problem for this paper, a thorough review on major newswires, including Dow Jones and Reuters, is conducted in order to ascertain that no other major economic news announcements were released on that date, and that there were no leaks of the Fed's decision on QEs prior to the announcement dates.

Krishnamurthy & Vissing-Jorgensen (2011) also raise the issue of omitted event dates and how that would affect their event study. They comment that while there

[6]December 12, 2012 FOMC Statement.
[7]September 18, 2013 FOMC Statement.

is a possibility of other "true" event dates being excluded from their study, potentially reducing the power of tests by increasing the noise in the sample. Nonetheless, this exclusion of other event dates does not result in any biases.

Furthermore, this paper includes more event dates than in literature, since a study on the impact of QE cannot be complete or unbiased if it only contained hand-selected dates that affected financial asset prices more than the other announcement dates as in the other studies. As such, besides running a baseline regression using the event dates from Krishnamurthy & Vissing-Jorgensen (2011), I also performed a robustness check, included all FOMC announcements regarding QE, not just the select, earlier ones that had more impact on the market. Table 1 on the following page is the list of event dates for robustness check.

Table 1. *List of Event Dates for Robustness Check*

QE1	QE2	QE3	QE3 Tapering	OT1	OT2
November 25, 2008	August 10, 2010	September 13, 2012	May 22, 2013	September 21, 2011	June 20, 2012
December 1, 2008	September 21, 2010	October 24, 2012	December 18, 2013		
December 16, 2008	November 3, 2010	December 12, 2012	January 29, 2013		
December 30, 2008	December 14, 2010	January 30, 2013	March 19, 2014		
January 28, 2009	January 26, 2011	March 20, 2013	April 30, 2014		
March 18, 2009	March 15, 2011	May 1, 2013	June 18, 2014		
April 29, 2009	April 27, 2011	June 19, 2013	July 30, 2014		
June 24, 2009	June 22, 2011	July 31, 2013			
August 12, 2009		September 18, 2013			
September 23, 2009		October 30, 2013			
November 4, 2009					
December 16, 2009					
January 27, 2010					
March 16, 2010					

3.2. Data Description

This study is a comprehensive study on the effects of quantitative easing on all major asset classes in the financial markets, including equity, fixed-income, and foreign exchange, by using daily asset returns/yields for all the assets included in the study. Following Hasbrouk (2003) and Wang, Yang, & Wu (2006), exchange-traded funds (ETFs) are used to measure equity and gold returns instead of broad market indices as the use of ETFs reveals new findings on the impact of monetary policy news on asset prices. This is because ETFs are regularly and continuously traded, and circumvent the nonsynchronous trading problem of market indexes. Therefore, ETFs more closely mimics real time trading behavior of other financial assets than that of cash market indexes. The following is the list of assets included in this study:

1. SPY – The SPDR® S&P 500® ETF – the exchange traded fund that seeks to provide investment results, before expenses, corresponding generally to the price and yield performance of the S&P 500® Index.
2. MDY – The SPDR® S&P MIDCAP 400® ETF -- the exchange traded fund that

seeks to provide investment results, before expenses, corresponding generally to the price and yield performance of the S&P®MidCap 400®Index™.

3. IWM – iShares Russell 2000 ETF – the exchange traded fund that seeks to provide investment results, before expenses, corresponding generally to the price and yield performance of the S&P®MidCap 400®Index™.

4. GLD -- The SPDR® Gold Shares ETF – the exchange traded fund that seeks to mimic the performance of the price of gold bullion, less expenses.

5. Euro per dollar EUR
6. British pound per dollar GBP
7. Japanese yen per dollar YEN
8. Swiss franc per dollar CHF
9. One-year treasury bill
10. Three-year treasury note
11. Five-year treasury note
12. Ten-year treasury note
13. Thirty-year treasury bond
14. Moody's corporate bonds rated Aaa
15. Moody's corporate bonds rated Baa
16. One-year interest rate swap[8]
17. Three-year interest rate swap
18. Five-year interest rate swap
19. Ten-year interest rate swap
20. Thirty-year interest rate swap
21. Fannie Mae fixed rate fifteen-year mortgage
22. Fannie Mae fixed rate thirty-year mortgage
23. Freddie Mac fixed rate fifteen-year mortgage
24. Freddie Mac fixed rate thirty-year mortgage

3.3. Event-Study Methodology

An event-study is conducted to measure the impact of QE announcements on the returns of different financial assets, following the literature including Bernanke, Reinhart, & Sack (2004), Gagnon et al (2010) and Krishnamurthy & Vissing-Jorgensen (2011). However, unlike Krishnamurthy and Vissing-Jorgensen (2011) who used OLS with robust standard error for their event study, this paper uses the Seemingly Unrelated Regressions (SUR) estimator as in Wang, Yang, Wu (2006), since the SUR estimator is considered more efficient as compared to OLS. This is because the errors between the financial assets examined in this paper are likely to be contemporaneously correlated. Adopting an alternative approach to time-series analysis, the event-study approach examines changes in asset yields around official communications regarding quantitative easing, while using the cumulative changes as a measure of the overall effects. The dates selected for this study include only official Fed announcements, each disclosing new information regarding the potential or actual expansion of the size, composition, duration of the quantitative easing.

[8]International Swaps and Derivatives Association (ISDA®) mid-market par swap rates. Rates are for a Fixed Rate Payer in return for receiving three month LIBOR, and are based on rates collected at 11:00 a.m. Eastern time by Thomson Reuters and published on Thomson Reuters Page ISDAFIX®1. ISDAFIX is a registered service mark of ISDA®. Source: Thomson Reuters.

Using seemingly unrelated regression method, the responses of asset returns/yields are considered using both 1-day and 2-day event windows around the announcements, measured from the closing level the day prior to the announcement to the closing level the day after the announcement. The reason for using a 2-day event-window instead of a 1-day event window is due to the challenge of conducting an event-study during a time of significant turmoil in financial markets, especially during the time span of the first quantitative easing, from the fall of 2008 to the spring of 2009. During this period, the prices of assets such as corporate bonds and CDSs may react slowly to Fed announcements due to lower liquidity versus other higher liquid assets such as Treasuries. Krishnamurthy & Vissing-Jorgensen (2011) deal with this issue by presenting 2-day windows for all assets. They find that for assets that are less liquid, the changes in 2-day windows are almost always larger than the 1-day changes. And for the higher liquid assets such as Treasuries, 2-day changes are almost the same as 1-day changes. For this paper, regressions for event windows of both one day and two days are performed and reported, since my paper spans a wider time frame, and financial markets have since been more stable after the crisis period.

The data set includes a zero-one dummy variable $D_{\tau,t}$ in the return equation rather than modeling abnormal return as prediction errors from the market model equation, thus parameterizes the abnormal return in the market model regression equation [Binder (1998)]. The system of equations with one equation for each of the N assets experiencing the announcement dates from t_1 to A. The system comprises twenty-four regression equations:

$$R_{N,t} = \gamma_{N,\tau} D_{\tau,t} + u_{N,t} N = 1, \dots, 24 \; and \tau = t_1, t_2$$

Each equation represents each asset examined in this paper, with a total of N = 24 assets, where $R_{N,t}$ is the intraday return/yield for each asset, with a time frame from October 1, 2008 to August 31, 2014. Additionally, $D_{\tau,t}$ is a dummy variable, which assumes the value of one on event day $t = \tau$ and zero otherwise, where $\tau = t_1, t_2, \dots A$ (and $\tau = t_1, t_1 + 1, \dots A, A + 1$ if a two-day event window is used). The assumption is that error terms are independent across time, but may have cross equation contemporaneous correlations. This method has been suggested by Jaffe (1974), Brown & Warner (1980; 1985), and Pynnönen (2005).

In the hypothesis testing under SUR, whether the impacts of quantitative easing announcement has an impact on the various financial assets is examined by testing the null of $\gamma_{1,\tau} = \gamma_{2,\tau} = \cdots = \gamma_{N,\tau} = 0$. The dummy variables are the announcement dates for the three rounds of QE, plus the two rounds of Operation Twist.

4. Empirical Results

Tables 2 and 3 summarize the one-day and two-day return/yield changes (in basis points) for stocks, currencies, and treasuries. The more notable changes are for the stock and currency markets for QE1, especially on December 1, 2008 – the day former Fed Chairman Ben Bernanke gave a speech on the Fed's intent to stabilize the financial markets. Table 3 summarizes the one-day and two-day yield changes (in basis points) for corporate bonds, interest rate swaps, and MBSs. The more notable changes are for the MBSs, particularly for QE1 announcements.

Tables 4 – 7 report regression results in this study, together with hypothesis tests of whether the different rounds of QE have the same effect on asset returns/yields. First, baseline one-day and two-day event windows regressions are performed following QE1 and QE2 dates used by Krishnamurthy & Vissing-

Jorgensen (2011). Those regressions show that QE1 has a larger impact on financial assets than QE2. Additionally, all the coefficients have the expected signs. For instance, QE1 had a positive effect on stocks, lowered yields on fixed income assets, and depreciated the dollar against other major currencies. However, this regression includes only certain select announcement dates, and does not tell the complete story of the effects of the Fed's unconventional monetary policy on financial market. Therefore, robustness check regressions are also performed for one-day and two-day events, using more official FOMC press release dates on these large-scale asset purchases. Additionally, F-tests are also performed for all of these regressions on whether all these events have the same effects on financial asset returns or yields.

Table 2. *Equity, Currency, and Treasuries One-day and Two-day Return/Yield Changes (in basis points)*

Announcement Dates	Change	SPY	MDY	IWM	GDL	$/EUR	$/GBP	$/YEN	$/CHF	1Y T-Bill	3Y T-Note	5Y T-Note	10Y T-Note	30Y T-Bond
11/25/2008 (QE1)	1-day	74	108	166	-5	86	190	222	82	0	-12	-18	-24	-15
	2-day	463	756	775	-66	-56	94	175	-94	-2	-15	-23	-36	-24
12/1/2008 (QE1)	1-day	-886	-1026	-1124	-580	-63	-321	249	62	-9	-11	-22	-21	-23
	2-day	-535	-629	-657	-418	18	-297	252	62	-13	-15	-28	-25	-27
12/16/2009 (QE1)	1-day	471	630	650	225	229	180	179	312	-5	-14	-16	-16	-12
	2-day	369	701	747	343	535	150	393	814	-5	-4	-15	-33	-32
1/28/2009 (QE1)	1-day	338	386	412	-109	5	84	-149	-77	1	7	11	12	18
	2-day	2	41	4	127	-157	122	-116	-94	4	19	28	28	31
3/18/2009 (QE1)	1-day	224	328	346	339	353	170	248	359	-9	-31	-46	-51	-26
	2-day	97	246	237	479	499	334	431	526	-9	-24	-36	-41	-21
8/10/2010 (QE2)	1-day	-55	118	-188	28	-34	-25	58	7	-1	-3	-8	-7	-1
	2-day	-327	-459	-574	-5	-272	-147	71	-103	-1	-3	-10	-14	-8
9/21/2010 (QE2)	1-day	-20	55	-59	91	155	50	70	86	0	-5	-9	-11	-8
	2-day	-69	-136	-176	107	264	77	141	191	-1	-5	-10	-16	-13
11/3/2010 (QE2)	1-day	40	32	39	-69	85	25	-57	90	0	-2	-4	4	16
	2-day	233	217	293	267	123	142	-15	220	-1	-6	-11	-10	11
9/13/2012 (QE3)	1-day	152	99	131	202	71	30	47	21	-1	-1	-5	-2	3
	2-day	197	210	226	231	178	68	-69	113	0	2	2	11	17
9/18/2013 (QE3)	1-day	22	18	55	12	-4	45	17	10	0	0	-1	-2	-1
	2-day	80	75	77	-96	26	58	49	35	0	-7	-7	-4	2
5/22/2013 (Tapering)	1-day	-74	-170	-146	-71	-37	-69	-66	-85	-1	2	7	9	7
	2-day	-103	-180	-134	130	22	-31	45	14	0	3	7	8	6
12/18/2013 (Tapering)	1-day	171	125	137	-88	-60	78	-154	-10	-1	-1	3	4	2
	2-day	159	41	62	-323	-78	65	-151	-145	-1	5	11	9	3
9/21/2011 (OT1)	1-day	-295	-354	-370	-125	-94	-151	0	-137	2	7	3	-7	-17
	2-day	-608	-701	-639	-383	-173	-250	28	-231	1	4	-6	-23	-42
6/20/2012 (OT2)	1-day	-16	-7	-15	-76	17	-4	-76	15	2	2	3	1	-1
	2-day	-240	-269	-258	-327	-114	-85	-167	-114	1	2	2	-1	-5

Table 3. *Corporate Bond, Swaps[9] and MBS One-day and Two-day Yield Changes (in basis points)*

Announcement Dates	Change	Corp Aaa	Corp Baa	1Y Swap	3Y Swap	5Y Swap	10Y Swap	30Y Swap	15Y Fannie Mae	30Y Fannie Mae	15Y Freddie Mac	30Y Freddie Mac
11/25/2008 (QE1)	1-day	-17	-9	-15	-25	-29	-33	-25	-28	-45	-38	-43
	2-day	-20	-16	-9	-21	-26	-32	-23	-54	-67	-64	-74
12/1/2008 (QE1)	1-day	-25	-19	-8	-15	-18	-17	-18	-32	-12	-27	-18
	2-day	-28	-24	-14	-22	-28	-24	-23	-21	-24	-2	-8
12/16/2009 (QE1)	1-day	-13	-15	-5	-7	-5	-4	-4	-11	-28	-22	-25
	2-day	-35	-41	-35	-41	-49	-54	-43	-24	-24	-15	-23
1/28/2009 (QE1)	1-day	15	14	-6	-7	-8	-9	-11	-7	-7	-7	-16
	2-day	27	22	-5	-2	1	5	6	22	42	21	46
3/18/2009 (QE1)	1-day	-24	-23	0	3	5	6	10	-22	-15	-24	-16
	2-day	-20	-17	-18	-25	-31	35	17	16	-31	-14	-31
8/10/2010 (QE2)	1-day	2	3	0	3	2	0	-4	-5	-1	-2	-3
	2-day	-9	-6	-4	-7	-11	-13	-10	-11	-1	-9	-2
9/21/2010 (QE2)	1-day	-2	-8	-1	-4	-6	-6	-5	-12	-11	-12	-7
	2-day	-10	-13	-4	-11	-17	-19	-16	-9	-12	-10	-4
11/3/2010 (QE2)	1-day	12	12	-2	-2	-4	-8	-8	-6	-2	-4	-5
	2-day	9	6	-3	-7	-14	-11	1	-11	-7	-12	-11
9/13/2012 (QE3)	1-day	3	1	-1	-2	-3	-2	0	-16	-24	-19	-23
	2-day	11	8	-1	-1	1	8	16	-12	-13	-13	-13
9/18/2013 (QE3)	1-day	0	1	0	2	2	2	1	-2	-2	-2	-3
	2-day	3	3	-2	-8	-11	-8	-3	-5	-7	-5	-6
5/22/2013 (Tapering)	1-day	6	6	0	0	0	1	2	9	10	8	10
	2-day	5	4	1	3	5	7	5	18	15	18	13
12/18/2013 (Tapering)	1-day	0	4	-1	-1	1	2	2	5	7	6	8
	2-day	-6	1	2	5	10	7	2	8	9	8	10
9/21/2011 (OT1)	1-day	-1	-16	-2	-3	-3	-4	-2	-1	-25	-7	-25
	2-day	-21	-26	4	2	-5	-19	-32	-20	-38	-16	-13
6/20/2012 (OT2)	1-day	-3	-2	-2	0	1	4	7	5	7	6	7
	2-day	-6	-7	1	3	2	-1	-1	-1	2	0	2

[9]International Swaps and Derivatives Association (ISDA®) mid-market par swap rates. Rates are for a Fixed Rate Payer in return for receiving three month LIBOR, and are based on rates collected at 11:00 a.m. Eastern time by Thomson Reuters and published on Thomson Reuters Page ISDAFIX®1. ISDAFIX is a registered service mark of ISDA®. Source: Thomson Reuters.

4.1. Baseline One-Day and Two-Day Event Windows Regressions

Table 4 Panels A and B summarized baseline regression results for 1-day event window for all quantitative easing and Operation Twist announcements from October 1, 2008 to August 31, 2014, using the same QE1 and QE2 dates as Krishnamurthy & Vissing-Jorgensen (2011). According to regression results, QE1 had the largest impact on equities, fixed income assets, and currencies. One notable result is for Operation Twist round one, that it had enormous negative impacts, especially on equities. This was mostly due to investors disappointed by the amount of purchase for OT1. Additionally, OT1 and OT2 had the intended effects of increasing short-term treasury yields and decreasing long-term treasury yields, thereby "twisting" the yield curve. While one-day event window hypothesis tests are significant for fixed income assets, two-day event windows are significant for most of assets in this study.

Table 5 Panels A and B report the two-day event window regressions, and they have similar results as one-day results. According to both of these results, QE1 has much larger and statistically significant results vs. QE2 and QE3. The overall effect of tapering is still debatable, even though current literature believes that tapering is damaging to financial markets. However, regression results so far do not support that, as it is still an ongoing process and a more appropriate study needs to be done after it ends. Moreover, the first round of Operation Twist had notable effects on the equity market, and the intended result of "twisting" the yield curve.

Table 4 Panel A.*Baseline Regression with 1-day Event Window*

	SPY	MDY	IWM	GLD	EUR	GBP	YEN	CHF	1Y T-Bill	3Y T-Note	5Y T-Note	10Y T-Note	30Y T-Bond
QE1	-0.0573	0.181	0.198	-1.210*	0.649*	0.336	1.250***	0.936**	-0.0315***	-0.0744***	-0.112***	-0.122***	-0.0794**
	(0.730)	(0.854)	(0.907)	(0.633)	(0.341)	(0.326)	(0.350)	(0.371)	(0.0115)	(0.0229)	(0.0298)	(0.0319)	(0.0310)
QE2	-0.167	-0.538	-0.753	0.130	0.660*	0.170	0.232	0.600	-0.00231	-0.0327	-0.0695**	-0.0461	0.0240
	(0.842)	(0.985)	(1.047)	(0.730)	(0.393)	(0.376)	(0.404)	(0.429)	(0.0133)	(0.0264)	(0.0344)	(0.0369)	(0.0358)
QE3	-0.0431	-0.251	-0.430	0.344	0.295	0.173	-0.177	0.326	-0.00297	-0.00639	-0.00850	0.000614	0.0106
	(0.462)	(0.541)	(0.575)	(0.401)	(0.216)	(0.206)	(0.222)	(0.235)	(0.00729)	(0.0145)	(0.0189)	(0.0202)	(0.0197)
Tapering	0.0232	-0.189	-0.125	-0.430	-0.151	-0.00413	-0.351	-0.274	0.00103	0.0135	0.0262	0.0235	0.0192
	(0.552)	(0.646)	(0.687)	(0.479)	(0.258)	(0.246)	(0.265)	(0.281)	(0.00870)	(0.0173)	(0.0226)	(0.0242)	(0.0235)
OT1	-2.996**	-3.603**	-3.763**	-1.283	-0.936	-1.502**	-0.00305	-1.380*	0.0210	0.0706	0.0305	-0.0694	-0.169***
	(1.458)	(1.705)	(1.813)	(1.264)	(0.681)	(0.650)	(0.700)	(0.742)	(0.0230)	(0.0457)	(0.0596)	(0.0638)	(0.0620)
OT2	-0.213	-0.137	-0.214	-0.794	0.179	-0.0409	-0.761	0.139	0.0210	0.0206	0.0305	0.0106	-0.00936
	(1.458)	(1.705)	(1.813)	(1.264)	(0.681)	(0.650)	(0.700)	(0.742)	(0.0230)	(0.0457)	(0.0596)	(0.0638)	(0.0620)
Constant	0.0506	0.0669	0.0612	0.0369	-0.00592	-0.00358	0.00305	0.0128	-0.00103*	-0.000614	-0.000503	-0.000614	-0.000641
	(0.0383)	(0.0448)	(0.0476)	(0.0332)	(0.0179)	(0.0171)	(0.0184)	(0.0195)	(0.000603)	(0.00120)	(0.00157)	(0.00167)	(0.00163)
No. Obs.	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.003	0.003	0.004	0.004	0.007	0.005	0.011	0.010	0.006	0.010	0.014	0.012	0.010
F-stat	3.99	4.17	4.17	5.78	7.93	6.96	16.65***	12.48**	8.46	14.13**	17.62***	15.83***	15.15***

Table 4 Panel B. *Baseline Regression with 1-day Event Window*

	Corp Aaa Bond	Corp Baa Bond	1Y Swap	3Y Swap	5Y Swap	10Y Swap	30Y Swap	15Y Fannie Mae	30Y Fannie Mae	15Y Freddie Mac	30Y Freddie Mac
QE1	-0.0987***	-0.0704**	-0.0833***	-0.134***	-0.149***	-0.157***	-0.144***	-0.159***	-0.194***	-0.149***	-0.173*
	(0.0327)	(0.0317)	(0.0140)	(0.0241)	(0.0298)	(0.0328)	(0.0320)	(0.0347)	(0.0359)	(0.0346)	(0.0956)
QE2	0.0413	0.0255	-0.00828	-0.00872	-0.0256	-0.0458	-0.0560	-0.0730*	-0.0450	-0.0607	-0.0469
	(0.0378)	(0.0366)	(0.0162)	(0.0278)	(0.0344)	(0.0378)	(0.0369)	(0.0401)	(0.0415)	(0.0399)	(0.110)
QE3	0.0113	0.00913	-0.000276	0.00328	0.0161	0.0189	0.0197	-0.0201	-0.0273	-0.0205	-0.0276
	(0.0207)	(0.0201)	(0.00890)	(0.0153)	(0.0189)	(0.0208)	(0.0203)	(0.0220)	(0.0228)	(0.0219)	(0.0606)
Tapering	0.0128	0.0207	0.00315	-0.00157	-0.00606	0.000869	0.00354	0.0252	0.0294	0.0237	0.0321
	(0.0248)	(0.0240)	(0.0106)	(0.0183)	(0.0225)	(0.0248)	(0.0242)	(0.0263)	(0.0272)	(0.0262)	(0.0724)
OT1	-0.00867	-0.158**	-0.0183	-0.0287	-0.0289	-0.0391	-0.0193	-0.103	-0.245***	-0.0663	-0.249
	(0.0654)	(0.0633)	(0.0281)	(0.0482)	(0.0595)	(0.0654)	(0.0639)	(0.0694)	(0.0718)	(0.0691)	(0.191)
OT2	-0.0287	-0.0179	-0.0183	0.00128	0.0111	0.0409	0.0707	0.0487	0.0725	0.0603	0.0683
	(0.0654)	(0.0633)	(0.0281)	(0.0482)	(0.0595)	(0.0654)	(0.0639)	(0.0694)	(0.0718)	(0.0691)	(0.191)
Constant	-0.00133	-0.00213	-0.00172**	-0.00128	-0.00108	-0.000869	-0.000683	-0.00131	-0.000868	-0.00143	-0.000954
	(0.00172)	(0.00166)	(0.000737)	(0.00127)	(0.00156)	(0.00172)	(0.00168)	(0.00182)	(0.00188)	(0.00181)	(0.00501)
No. Obs.	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.007	0.009	0.024	0.021	0.018	0.017	0.017	0.019	0.030	0.016	0.004
F-stat	10.99*	12.48**	29.58***	26.01***	23.17***	23.09***	22.88***	21.89***	35.82***	18.91***	4.51

*** p<0.01, ** p<0.05, * p<0.1

Table 5 Panel A. *Baseline Regression with 2-Day Event Window*

	SPY	MDY	IWM	GLD	EUR	GBP	YEN	CHF	1Y T-Bill	3Y T-Note	5Y T-Note	10Y T-Note	30Y T-Bond
QE1	0.392	1.097**	1.108*	0.431	0.834***	0.408**	1.126***	1.185***	-0.0241***	-0.0383***	-0.0735***	-0.107***	-0.0727***
	(0.461)	(0.539)	(0.574)	(0.400)	(0.215)	(0.206)	(0.221)	(0.234)	(0.00728)	(0.0145)	(0.0189)	(0.0201)	(0.0195)
QE2	-0.330	-0.707	-0.838	0.580	0.194	0.122	0.326	0.501*	-0.00408	-0.0227	-0.0512**	-0.0664**	-0.0163
	(0.595)	(0.695)	(0.740)	(0.516)	(0.278)	(0.265)	(0.284)	(0.301)	(0.00939)	(0.0187)	(0.0244)	(0.0259)	(0.0251)
QE3	-0.142	-0.141	-0.239	-0.216	0.0214	0.102	-0.400**	0.0762	-7.88e-05	0.00565	0.0170	0.0253*	0.0243*
	(0.327)	(0.382)	(0.407)	(0.284)	(0.153)	(0.146)	(0.156)	(0.166)	(0.00517)	(0.0103)	(0.0134)	(0.0142)	(0.0138)
Tapering	-0.0619	-0.212	-0.181	-0.288	-0.123	-0.0152	-0.138	-0.173	-0.00194	0.00923	0.0169	0.0175	0.0118
	(0.390)	(0.456)	(0.485)	(0.339)	(0.182)	(0.174)	(0.187)	(0.198)	(0.00616)	(0.0123)	(0.0160)	(0.0170)	(0.0165)
OT1	-3.144***	-3.637***	-3.309***	-1.969**	-0.863*	-1.255***	0.139	-1.170**	0.00592	0.0207	-0.0295	-0.115**	-0.210***
	(1.028)	(1.202)	(1.279)	(0.892)	(0.480)	(0.459)	(0.492)	(0.521)	(0.0162)	(0.0324)	(0.0421)	(0.0447)	(0.0435)
OT2	-1.258	-1.412	-1.354	-1.685*	-0.565	-0.419	-0.839*	-0.577	0.00592	0.0107	0.0105	-0.00468	-0.0247
	(1.028)	(1.202)	(1.279)	(0.892)	(0.480)	(0.459)	(0.492)	(0.521)	(0.0162)	(0.0324)	(0.0421)	(0.0447)	(0.0435)
Constant	0.0549	0.0673	0.0612	0.0381	-0.00568	-0.00444	0.00224	0.00949	-0.000921	-0.000654	-0.000499	-0.000316	-0.000331
	(0.0385)	(0.0450)	(0.0479)	(0.0334)	(0.0180)	(0.0172)	(0.0184)	(0.0195)	(0.000609)	(0.00121)	(0.00158)	(0.00168)	(0.00163)
No. Obs.	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.008	0.011	0.009	0.008	0.014	0.009	0.025	0.024	0.008	0.007	0.015	0.030	0.027
F-stat	11.13**	15.58***	12.73**	11.48**	19.55***	12.50**	37.60***	32.16***	8.99	9.46*	21.66***	41.77***	39.70***

*** p<0.01, ** p<0.05, * p<0.1

Table 5 Panel B. *Baseline Regression with 2-Day Event Window*

	Corp Aaa Bond	Corp Baa Bond	1Y Swap	3Y Swap	5Y Swap	10Y Swap	30Y Swap	15Y Fannie Mae	30Y Fannie Mae	15Y Freddie Mac	30Y Freddie Mac
QE1	-0.0750***	-0.0742***	-0.0796***	-0.110***	-0.132***	-0.140***	-0.0997***	-0.0913***	-0.102***	-0.0725***	-0.0894
	(0.0207)	(0.0200)	(0.00876)	(0.0151)	(0.0186)	(0.0205)	(0.0202)	(0.0220)	(0.0228)	(0.0220)	(0.0607)
QE2	-0.0157	-0.0199	-0.0169	-0.0406**	-0.0693***	-0.0713***	-0.0413	-0.0522*	-0.0333	-0.0486*	-0.0275
	(0.0266)	(0.0258)	(0.0113)	(0.0195)	(0.0240)	(0.0265)	(0.0260)	(0.0284)	(0.0294)	(0.0283)	(0.0782)
QE3	0.0255*	0.0233	0.000449	0.00803	0.0212	0.0243*	0.0253*	0.0141	0.0170	0.0179	0.0208
	(0.0147)	(0.0142)	(0.00621)	(0.0107)	(0.0132)	(0.0146)	(0.0143)	(0.0156)	(0.0162)	(0.0156)	(0.0430)
Tapering	0.00101	0.00536	0.00359	0.0139	0.0150	0.0118	0.00461	0.0183	0.0191	0.0202	0.0193
	(0.0175)	(0.0169)	(0.00741)	(0.0128)	(0.0158)	(0.0174)	(0.0171)	(0.0186)	(0.0193)	(0.0186)	(0.0513)
OT1	-0.104**	-0.128***	0.0214	0.0110	-0.0243	-0.0947**	-0.160***	-0.0971**	-0.190***	-0.0761	-0.0615
	(0.0461)	(0.0446)	(0.0195)	(0.0338)	(0.0416)	(0.0458)	(0.0450)	(0.0491)	(0.0509)	(0.0490)	(0.135)
OT2	-0.0290	-0.0332	0.00645	0.0160	0.0107	-0.00468	-0.00468	-0.00260	0.0123	0.00257	0.0133
	(0.0461)	(0.0446)	(0.0195)	(0.0338)	(0.0416)	(0.0458)	(0.0450)	(0.0491)	(0.0509)	(0.0490)	(0.135)
Constant	-0.00101	-0.00179	-0.00145**	-0.00103	-0.000703	-0.000323	-0.000323	-0.00134	-0.000988	-0.00163	-0.00136
	(0.00173)	(0.00167)	(0.000732)	(0.00127)	(0.00156)	(0.00171)	(0.00169)	(0.00184)	(0.00191)	(0.00183)	(0.00507)
Observations	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.015	0.017	0.055	0.039	0.041	0.040	0.028	0.017	0.025	0.013	0.002
F-stat	20.67***	24.20***	72.04***	52.41***	56.11***	53.22***	38.43***	23.37***	34.39***	17.84***	2.79

*** p<0.01, ** p<0.05, * p<0.1

4.2. Robustness Check One-Day and Two-Day Event Windows Regressions

A robustness check regression is also performed, which included more QE1 and QE2 dates, all of those dates are official press releases by the FOMC that Krishnamurthy & Vissing-Jorgensen (2011) omitted. See Table 1 for the list of complete dates in these regressions. Regression results are reported in Tables 6 – 7. Robustness check show similar results as the original regressions, with positive effects on equity returns with statistically significant results, and negative effects on fixed-income yields, also with mostly statistically significant results. Hypothesis tests on whether the different rounds of QE have the same effects are also performed. In most cases, the null hypothesis is rejected, thereby affirming that different rounds of QEs are different in impact.

Table 6. Panel A. *Robustness Check Regression with 1-Day Event Window*

	SPY	MDY	IWM	GLD	EUR	GBP	YEN	CHF	1Y T-Bill	3Y T-Note	5Y T-Note	10Y T-Note	30Y T-Bond
QE1	0.633*	0.865*	0.936*	0.0767	0.583***	0.452***	0.368*	0.481**	-0.0212***	-0.0438***	-0.0589***	-0.0601***	-0.0278*
	(0.391)	(0.457)	(0.486)	(0.340)	(0.182)	(0.174)	(0.189)	(0.199)	(0.00616)	(0.0123)	(0.0160)	(0.0171)	(0.0166)
QE2	-0.166	-0.183	-0.252	0.171	0.353	-0.00284	0.0931	0.470*	-0.000337	0.00424	0.00668	0.0256	0.0445**
	(0.516)	(0.604)	(0.642)	(0.449)	(0.241)	(0.230)	(0.249)	(0.263)	(0.00813)	(0.0162)	(0.0212)	(0.0226)	(0.0220)
QE3	-0.0375	-0.244	-0.421	0.349	0.300	0.176	-0.177	0.329	-0.00309	-0.00651	-0.00857	0.000606	0.0108
	(0.462)	(0.540)	(0.574)	(0.401)	(0.216)	(0.206)	(0.223)	(0.235)	(0.00728)	(0.0145)	(0.0189)	(0.0203)	(0.0197)
Tapering	0.0289	-0.181	-0.116	-0.426	-0.146	-0.00107	-0.351	-0.270	0.000913	0.0133	0.0261	0.0235	0.0194
	(0.552)	(0.645)	(0.686)	(0.479)	(0.257)	(0.246)	(0.266)	(0.281)	(0.00869)	(0.0173)	(0.0226)	(0.0242)	(0.0235)
OT1	-2.991**	-3.595**	-3.755**	-1.278	-0.931	-1.499**	-0.00291	-1.376*	0.0209	0.0705	0.0304	-0.0694	-0.169***
	(1.456)	(1.703)	(1.811)	(1.265)	(0.680)	(0.649)	(0.702)	(0.742)	(0.0229)	(0.0457)	(0.0597)	(0.0639)	(0.0620)
OT2	-0.207	-0.129	-0.205	-0.789	0.184	-0.0379	-0.761	0.142	0.0209	0.0205	0.0304	0.0106	-0.00921
	(1.456)	(1.703)	(1.811)	(1.265)	(0.680)	(0.649)	(0.702)	(0.742)	(0.0229)	(0.0457)	(0.0597)	(0.0639)	(0.0620)
Constant	0.0449	0.0589	0.0526	0.0322	-0.0103	-0.00664	0.00291	0.00936	-0.000913	-0.000488	-0.000425	-0.000606	-0.000787
	(0.0384)	(0.0450)	(0.0478)	(0.0334)	(0.0179)	(0.0171)	(0.0185)	(0.0196)	(0.000605)	(0.00121)	(0.00158)	(0.00169)	(0.00164)
Observations	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.005	0.006	0.006	0.002	0.011	0.009	0.005	0.010	0.009	0.011	0.011	0.011	0.010
F-stat	6.80	8.36	8.75	3.15	8.80	10.42*	7.51	10.44*	10.51*	13.83**	13.22**	14.21**	15.42***

*** p<0.01, ** p<0.05, * p<0.1

Table 6 Panel B. *Robustness Check Regression 1-Day Event Window*

	Corp Aaa Bond	Corp Baa Bond	1Y Swap	3Y Swap	5Y Swap	10Y Swap	30Y Swap	15Y Fannie Mae	30Y Fannie Mae	15Y Freddie Mac	30Y Freddie Mac
QE1	-0.0457***	-0.0306*	-0.0262***	-0.0330**	-0.0332**	-0.0319*	-0.0256	-0.0696***	-0.0671***	-0.0731***	-0.0872*
	(0.0175)	(0.0170)	(0.00759)	(0.0130)	(0.0161)	(0.0177)	(0.0173)	(0.0187)	(0.0194)	(0.0186)	(0.0513)
QE2	0.0602***	0.0523**	-0.00581	-0.0112	-0.0201	-0.0266	-0.0254	0.0143	0.0127	0.0269	0.0110
	(0.0232)	(0.0224)	(0.0100)	(0.0172)	(0.0212)	(0.0233)	(0.0228)	(0.0247)	(0.0256)	(0.0245)	(0.0677)
QE3	0.0114	0.00926	-0.000314	0.00329	0.0161	0.0189	0.0198	-0.0201	-0.0273	-0.0205	-0.0279
	(0.0207)	(0.0201)	(0.00897)	(0.0154)	(0.0190)	(0.0209)	(0.0204)	(0.0221)	(0.0229)	(0.0219)	(0.0606)
Tapering	0.0128	0.0208	0.00311	-0.00157	-0.00603	0.000941	0.00367	0.0252	0.0294	0.0236	0.0319
	(0.0247)	(0.0240)	(0.0107)	(0.0184)	(0.0227)	(0.0249)	(0.0244)	(0.0264)	(0.0273)	(0.0262)	(0.0724)
OT1	-0.00859	-0.158**	-0.0183	-0.0287	-0.0289	-0.0391	-0.0192	-0.103	-0.245***	-0.0663	-0.249
	(0.0653)	(0.0633)	(0.0283)	(0.0486)	(0.0599)	(0.0659)	(0.0644)	(0.0696)	(0.0722)	(0.0692)	(0.191)
OT2	-0.0286	-0.0177	-0.0183	0.00129	0.0111	0.0409	0.0708	0.0487	0.0726	0.0603	0.0681
	(0.0653)	(0.0633)	(0.0283)	(0.0486)	(0.0599)	(0.0659)	(0.0644)	(0.0696)	(0.0722)	(0.0692)	(0.191)
Constant	-0.00141	-0.00226	-0.00169**	-0.00129	-0.00111	-0.000941	-0.000808	-0.00131	-0.000917	-0.00141	-0.000749
	(0.00172)	(0.00167)	(0.000746)	(0.00128)	(0.00158)	(0.00174)	(0.00170)	(0.00184)	(0.00191)	(0.00183)	(0.00504)
Observations	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.010	0.011	0.009	0.005	0.004	0.004	0.004	0.012	0.018	0.013	0.003
F-stat	14.44**	16.00***	7.60	4.08	4.40	4.96	5.26	14.35**	22.04***	16.52***	3.93

*** p<0.01, ** p<0.05, * p<0.1

Table 7 Panel A. *Robustness Check Regression with 2-Day Event Window*

	SPY	MDY	IWM	GLD	EUR	GBP	YEN	CHF	1Y T-Bill	3Y T-Note	5Y T-Note	10Y T-Note	30Y T-Bond
QE1	0.490*	0.829**	0.844**	0.0578	0.295**	0.244**	0.274**	0.339**	-0.0149***	-0.0268***	-0.0369***	-0.0418***	-0.0264**
	(0.277)	(0.324)	(0.345)	(0.241)	(0.130)	(0.124)	(0.134)	(0.142)	(0.00438)	(0.00873)	(0.0114)	(0.0122)	(0.0118)
QE2	-0.319	-0.339	-0.325	-0.0481	-0.0163	-0.126	0.141	0.293	-0.00360	-0.0159	-0.0222	-0.0178	0.00292
	(0.365)	(0.427)	(0.454)	(0.317)	(0.171)	(0.163)	(0.176)	(0.186)	(0.00577)	(0.0115)	(0.0150)	(0.0160)	(0.0155)
QE3	-0.138	-0.133	-0.230	-0.221	0.0204	0.102	-0.403**	0.0758	-0.000225	0.00532	0.0168	0.0253*	0.0244*
	(0.327)	(0.382)	(0.407)	(0.284)	(0.153)	(0.146)	(0.158)	(0.167)	(0.00517)	(0.0103)	(0.0134)	(0.0143)	(0.0139)
Tapering	-0.0573	-0.205	-0.172	-0.293	-0.124	-0.0151	-0.140	-0.174	-0.00208	0.00889	0.0167	0.0175	0.0119
	(0.390)	(0.456)	(0.485)	(0.339)	(0.183)	(0.174)	(0.188)	(0.199)	(0.00616)	(0.0123)	(0.0160)	(0.0171)	(0.0165)
OT1	-3.139***	-3.630***	-3.300***	-1.974**	-0.864*	-1.255***	0.137	-1.170**	0.00577	0.0203	-0.0297	-0.115**	-0.210***
	(1.027)	(1.201)	(1.278)	(0.893)	(0.482)	(0.459)	(0.495)	(0.525)	(0.0162)	(0.0324)	(0.0422)	(0.0450)	(0.0436)
OT2	-1.253	-1.405	-1.345	-1.689*	-0.566	-0.419	-0.841*	-0.577	0.00577	0.0103	0.0103	-0.00468	-0.0246
	(1.027)	(1.201)	(1.278)	(0.893)	(0.482)	(0.459)	(0.495)	(0.525)	(0.0162)	(0.0324)	(0.0422)	(0.0450)	(0.0436)
Constant	0.0503	0.0596	0.0526	0.0430	-0.00462	-0.00445	0.00454	0.00996	-0.000775	-0.000316	-0.000258	-0.000323	-0.000423
	(0.0389)	(0.0455)	(0.0484)	(0.0338)	(0.0182)	(0.0174)	(0.0188)	(0.0199)	(0.000615)	(0.00123)	(0.00160)	(0.00171)	(0.00165)
Observations	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.010	0.012	0.010	0.007	0.007	0.009	0.010	0.010	0.008	0.009	0.011	0.016	0.021
F-stat	14.93*	18.14***	14.84**	8.20	9.95*	13.07**	15.00**	13.40**	7.15	9.89*	13.62**	21.37***	31.48***

*** p<0.01, ** p<0.05, * p<0.1

Table 7 Panel B. *Robustness Check Regression with 2-Day Event Window*

	Corp Aaa Bond	Corp Baa Bond	1Y Swap	3Y Swap	5Y Swap	10Y Swap	30Y Swap	15Y Fannie Mae	30Y Fannie Mae	15Y Freddie Mac	30Y Freddie Mac
QE1	-0.0366***	-0.0339***	-0.0377***	-0.0452***	-0.0491***	-0.0490***	-0.0321***	-0.0476***	-0.0523***	-0.0444***	-0.0587
	(0.0125)	(0.0121)	(0.00533)	(0.00920)	(0.0113)	(0.0125)	(0.0122)	(0.0133)	(0.0138)	(0.0132)	(0.0365)
QE2	0.00342	0.00301	-0.00623	-0.0229*	-0.0351**	-0.0316*	-0.0171	-0.00985	-0.00281	-0.00687	-0.000196
	(0.0164)	(0.0159)	(0.00702)	(0.0121)	(0.0149)	(0.0164)	(0.0161)	(0.0175)	(0.0181)	(0.0174)	(0.0481)
QE3	0.0254*	0.0233	0.000270	0.00783	0.0211	0.0243*	0.0254*	0.0139	0.0168	0.0176	0.0204
	(0.0147)	(0.0142)	(0.00628)	(0.0109)	(0.0134)	(0.0147)	(0.0144)	(0.0157)	(0.0162)	(0.0156)	(0.0430)
Tapering	0.000918	0.00534	0.00341	0.0137	0.0149	0.0117	0.00466	0.0181	0.0189	0.0200	0.0188
	(0.0175)	(0.0170)	(0.00749)	(0.0129)	(0.0160)	(0.0176)	(0.0172)	(0.0187)	(0.0194)	(0.0186)	(0.0513)
OT1	-0.104**	-0.128***	0.0213	0.0108	-0.0244	-0.0947**	-0.160***	-0.0973**	-0.191***	-0.0764	-0.0619
	(0.0462)	(0.0447)	(0.0197)	(0.0341)	(0.0420)	(0.0463)	(0.0452)	(0.0492)	(0.0510)	(0.0490)	(0.135)
OT2	-0.0291	-0.0332	0.00627	0.0158	0.0106	-0.00471	-0.00463	-0.00279	0.0121	0.00233	0.0129
	(0.0462)	(0.0447)	(0.0197)	(0.0341)	(0.0420)	(0.0463)	(0.0452)	(0.0492)	(0.0510)	(0.0490)	(0.135)
Constant	-0.000918	-0.00176	-0.00127*	-0.000832	-0.000567	-0.000287	-0.000373	-0.00116	-0.000790	-0.00140	-0.000949
	(0.00175)	(0.00169)	(0.000747)	(0.00129)	(0.00159)	(0.00175)	(0.00171)	(0.00186)	(0.00193)	(0.00185)	(0.00512)
Observations	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.012	0.013	0.034	0.020	0.019	0.018	0.016	0.013	0.020	0.011	0.002
F-stat	15.91***	18.30***	36.14***	22.30***	22.32***	21.06***	21.34***	15.71***	27.10***	14.64***	2.84

*** p<0.01, ** p<0.05, * p<0.1

5. Concluding Remarks

This study is a complete and thorough study on the effects of LSAPs since the financial crisis of 2008 on all sectors of the financial market. All of the major equity and fixed income assets are included in this study, as well as major currency pairs against the U.S. dollar. The large scale purchases included in this study are the three rounds of quantitative easing, with the third round in the process of tapering, and the two rounds of operation twist. An event study approach is taken, similar to other research papers on quantitative easing.

Empirical results show that the three rounds of QE decreased yield on all long-term nominal assets, including Treasuries, Agency bonds, corporate bonds, and MBS. This was the intention of the Fed since it announced the first round of these large-scale asset purchases in 2008. Additionally, the effects of QE are larger for longer duration assets, another intended goal set out by the Fed. Evidence shows that the first round of QE was the most effective. While the second and third rounds of quantitative easing also had intended effects on most of the assets examined in this paper, the first round of quantitative easing had a larger effect, with results statistically significant.

Moreover, QE also affected other financial assets, as evidenced by the increase in the return of equity markets over the announcement periods. Lastly, QE depreciated the home currency against other major currencies.

While the first quantitative easing had the intended effects of lowering the cost and increasing 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, the impacts of subsequent rounds of quantitative easing, as well as Operation Twists, are minimal. This opens up the debate of whether the Fed should discontinue its asset purchases, instead of its current action of merely tapering off QE.

Evidence of the Fed's actions affecting other financial markets besides the intended bond market should alert policy-makers to device more prudent unconventional monetary policy in the future, since the Fed's QE actions could have caused the current stock market bubble.

At the time of this chapter's writing, the Fed's large-scale asset purchase is still ongoing, albeit at a reduced rate of $10 billion per month for agency MBS, and $20 billion per month for long-term Treasury securities[10]. A possible research suggestion in the future is to conduct a comprehensive study of the conclusion of the Fed's asset purchasing program using the same methodology as in this study.

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