LOOSENING THE BELT: A CRITICAL ASSESSMENT OF THE U.S. FEDERAL RESERVE'S LARGE-SCALE ASSET PURCHASES

Economic Theory

by Ryan Peacock

4585915

Major Paper presented to the
Department of Economics of the University of Ottawa
in partial fulfillment of the requirements of the M.A. Degree
Supervisor: Professor Mario Seccareccia

ECO 6999

Ottawa, Ontario
August 2016

Abstract

In response to the 2008 financial crisis, the U.S. Federal Reserve moved away from conventional monetary policy, instead carrying out credit and quantitative easing through a series of large-scale asset purchases. This paper discusses the effect of the unconventional strategies employed, as they relate to various macroeconomic variables. It seeks to provide clarity on the unconventional monetary policy itself, but also the Federal Reserve's objectives behind its use. To this end, it will assess the impacts of the U.S. experience empirically.

Table of Contents

1. Introduction

At the heart of the Great Depression, the U.S. government was desperate for a solution to the rampant level of unemployment and the economy's overall despondent state. Troubled by some of the policies being advocated, John Maynard Keynes wrote an open letter to then President Roosevelt, published in the New York Times on December 31, 1933. Among other concerns, Keynes warns against the belief that increasing the money supply would raise output and income, stating that "this is like trying to get fat by buying a larger belt." He extends this metaphor, emphasizing to the President that "in the United States to-day your belt is plenty big enough for your belly" (Keynes, 1933).

Fast-forward to the fall of 2008, the beginning of the worst financial crisis since the Great Depression, and the U.S. government was facing a similar fate. With interest rates nearing the floor, the standard monetary policy instruments employed by the U.S. Federal Reserve Bank (the Fed) and the central banks of the most advanced economies were rendered ineffective. Confronted with the prospect of a crumbling financial system, the Federal Open Market Committee (FOMC)[1] turned to unconventional monetary policy instruments. In particular, it engaged in credit and quantitative easing (QE) schemes through its Large-Scale Asset Purchase (LSAP) program.

Assuming credit and quantitative easing were not intended to directly increase output and incomes, a belief which Keynes suggested seventy-five year prior was fallacy, what was the purpose of these unconventional policies? Besides, what is unconventional monetary policy anyway? This paper aims to answer these questions by offering a critical assessment of the credit and quantitative easing policies implemented by the Fed. It will commence with a thorough exposition of unconventional monetary policy, covering both the Fed's specific actions and the

[1] FOMC is the branch of the Fed responsible for open market operations and the direction of monetary policy.

economic context in which they were taken. Building on this foundation, it will conduct an empirical investigation on the impacts of the LSAP program as they relate to the Fed's stated objectives and other prominent claims associated with credit and quantitative easing. Indeed, it will touch on the LSAPs' effects on bank lending, unemployment and inflation, though the primary focus will be each round's influence on the yields of various long-term securities.

2. Economic Conditions

To appreciate the motivation behind the policies pursued by the Fed and other central banks, an understanding of the economic context is warranted. Before delving into unconventional monetary policy, this section will provide a brief overview of the events that helped shape the Fed's response.

Financial pressures had been mounting since August 2007, as some European banks became increasingly concerned with the U.S. subprime housing market. As financial institutions recognized the industry's exposure to subprime mortgage-backed securities (MBSs), credit markets began to seize. With banks unwilling to lend to one another, the Fed was forced to step in, injecting liquidity into the financial system through the use of its lending facility. Meanwhile, it also initiated cuts to the federal funds rate. By December 2007, the Fed was extending $15.4 billion in credit to banks, accepting long-term bonds and private assets as collateral; this amount would balloon to almost $700 billion over the next year. It had also lowered the federal funds rate from 5.26% in July of that year to 4.24%. To stave off concerns related to inflation, the increase in reserves was offset by the sale of U.S. Treasury bills. Financial conditions continued to deteriorate into 2008, starting with J.P. Morgan and Chase acquiring the U.S. investment bank, Bear Sterns—a deal brokered and backed by the Fed. This was followed by the nationalization of

U.S. mortgage underwriting agencies Fannie Mae and Freddie Mac, and the sale of Merrill Lynch to Bank of America.

On September 15th, 2008, the financial services firm Lehman Brothers filed for chapter eleven bankruptcy. This event and the subsequent bail-out of American International Group (AIG) are now commonly recognized as the beginning of the worst financial crisis since the Great Depression. Up until then, the Fed had effectively maintained the federal funds rate near its target, which at this point had decreased to 2%. It also had managed to offset or sterilize the increase in reserves through the sale of treasury bills. However, as interbank lending all but ceased entirely, the Fed was forced to extend even more liquidity to banks and even AIG, which required a complete bailout. By now, the balance sheet of the Fed began to swell and any previous attempts at maintaining a constant level of reserves were abandoned. Not surprisingly, as the demand for reserves continued to increase, the Fed was unable to achieve the target and lost its ability to set interest rates (Lavoie M. , 2015).

In the months that follow, the Fed attempted to regain control of the federal funds target interest rate, by initially introducing a corridor system, bounded by the discount rate at the ceiling and the interest rate on reserves at the floor. When this approach proved unsuccessful, the Fed instead implemented a floor system, by intentionally supplying excess reserves to the system and effectively reducing the federal funds target rate to the interest rate on reserves. Essentially, any bank in need of liquidity could now acquire it from the Fed (Lavoie M. , 2015). Citigroup was no exception to this rule, and in late November, it too had to be rescued. By December 2008, the federal funds rate virtually hit rock bottom at 0.16%, a region in which it remained thereafter. As economic conditions continued to worsen, the Fed, given the futility of its previous interventions, opts to take an alternate approach to monetary policy.

3. Review of the Literature

The 2008 financial crisis spawned an extensive body of literature. Though a number of works seem to concentrate more on the causes rather than the remedies, given its recent conclusion, the Fed's LSAP program remains a growing area of research. Driving the majority of these studies are not only universities, but also the Fed itself. The following section will summarize some of the influential works that discuss the Fed's LSAP program.

Gagnon et al. (2011) conducts one of the first studies of the Fed's LSAP program. It employs an event study to examine the reaction of interest rates to each major Fed announcement through to March 2010. Moreover, using a time series regression model, borrowed from Backus and Wright (2007), it measures the impact of the Fed LSAPs on the ten-year term premium, finding an associated reduction between 30 and 100 basis points. Swanson (2011) takes a similar approach to examine the impact of the maturity extension program, finding the intervention to have reduced longer-term treasury yields by 15 basis point. Krishnamurthy and Vissing-Jorgensen (2011) too perform an event study; however, it focuses on the channels through which QE affects interest rates, but overall draws similar conclusions. Wright (2012) conducts a similar study using a structural vector autoregression (VAR), concluding that LSAPs purchases did in fact reduce interest rates. Thornton (2013) criticises the approach of using announcement effects to assess the efficacy of LSAPs, claiming that evidence derived from such studies offers modest evidence that QE reduces long-term yields.

Other works such as, Gertler and Karadi (2012) and Chen *et al* (2012) analyze the impact of the Fed's LSAPs by employing macroeconomic modelling techniques. Despite using this different approach, the results are generally consistent with the previous studies. Joyce *et al.* (2012) offers a thorough review of the literature demonstrating that the overall consensus

appears to be that the Fed LSAPs did lower interest rates, which is thought to have helped stimulate economic activity.

4. Unconventional Monetary Policy

Generally speaking, conventional monetary policy refers to interest rate setting by the central bank to achieve inflation targets. The U.S. casts a wider net and includes maximum employment as part of the Fed's mandate. With interest rates hovering near 0%, the oft-described lower bound, conventional monetary policy is rendered ineffective. At this threshold, economic activity cannot be stimulated through further rate reductions. As a result, the Fed and other central banks reverted to unconventional monetary policy tools.

Unconventional monetary policy is commonly used to describe a broad range of instruments. By some definitions, this includes both the floor system that was alluded to previously, the bailouts and even the Troubled Asset Relief Program (TARP) adopted by the U.S. Treasury, blurring the line between fiscal and monetary policy. To be precise, this paper will explore the credit and quantitative easing measures put forth by the Fed. Thus, any further reference to unconventional monetary policy in this work will embody these instruments only.

4.1. Credit versus Quantitative Easing

Throughout the financial crisis, arguably no two terms were more conflated than credit easing and quantitative easing. More often than not, regular news outlets would draw an analogy to a money printing press as a catchall for both. Obviously, the real explanation is more sophisticated than that. In fact, the concept for both resembles the antiquated quantity theory of

money and its explanation of "conventional" monetary policy, still found in several undergraduate economics textbooks today.

Credit easing, like quantitative easing, describes an unconventional monetary policy tool used to provide liquidity to the financial system. In general, this is achieved through the central bank's purchase of illiquid private sector or long-term government securities. In the case of credit easing, such a purchase is offset or sterilized through the sale of safe, liquid government assets, i.e. treasury bills, thus preserving the total amount of reserves in the financial system. Effectively, this series of transactions is tantamount to a swap between short-term, safe, government securities, and longer-term, illiquid, private-sector securities, otherwise held by commercial banks. Using this definition, quantitative easing can be simply understood as credit easing without sterilization (Lavoie M. , 2014). This subtle difference implies that the amount of reserves in the system is no longer held constant. From the perspective of the central bank, which treats reserves as a liability, quantitative easing will cause the balance sheet to expand (Lavoie M. , 2015), while credit easing leaves it unchanged.

4.2. U.S. Federal Reserve Large-Scale Asset Purchases

The Fed's most recent foray into unconventional monetary policy began in the fall of 2008. Between November 2008 and October 2014, it engaged in three rounds of quantitative easing and one round of credit easing, by carrying out Large-Scale Asset Purchases (LSAPs). Chronologically, each round was commonly referred to as QE1, QE2 and QE3. They primarily involved large-scale purchases of long-term treasury notes and bonds, and mortgage backed securities (MBS) (Engen, Laubach, & Reifschneider, 2015). In total, the Fed accumulated roughly $3.5 trillion worth of these assets through quantitative easing, drastically increasing the

left side of its balance sheet. For the most part, the proceeds from these purchases remained in the form of bank reserves, a liability on the balance sheet from the Fed's perspective. Furthermore, the Fed actively pursued credit easing, by exchanging long-term treasury notes and bonds for an equivalent proportion of bills. While the more obvious of these included the Maturity Extension Program (commonly referred to as Operation Twist), similar schemes were even adopted, albeit less formally, leading up to September 2008 (Lavoie M. , 2015).

QE1 commenced following the Fed's November 25, 2008 announcement that, over several quarters, it would purchase up-to $500 billion in MBS and $100 billion in direct obligations owned by Government-Sponsored Enterprises (GSE), Fannie Mae, Freddie Mac, and the Federal Home Loan Banks (Federal Open Market Committee, 2008). These purchases were initially aimed at improving housing market conditions, by increasing the availability and reducing the cost of mortgages. By March 18, 2009, this strategy was revised to include the purchase of up-to an additional $100 billion in GSE direct obligations and $750 billion in MBS, but also $300 billion in longer-term treasury securities through to the end of the year (Federal Open Market Committee, 2009). The Fed justified this expansion by claiming to also be targeting conditions in private credit markets.

On November 3, 2010, the Fed announced its intention to engage in a second round of quantitative easing, through the purchase of an additional $600 billion in long-term treasury securities. QE2 continued until June 30, 2011, with the purpose of promoting a stronger pace of recovery (Federal Open Market Committee, 2010). Given its dual mandate, the Fed was predominantly targeting improvements to the rate of employment.

Following two rounds of monetary stimulus, the Fed changed its approach. On September 21, 2011, it announced the impending purchase of an extra $400 billion in long-term treasury

securities; however, this time the Fed offset these purchases through the sale of an equivalent amount of short-term treasury securities. This action, known as the Maturity Extension Program or Operation Twist, is consistent with the definition for credit easing discussed previously. It aimed to improve financial conditions by placing downward pressure on longer-term interest rates (Federal Open Market Committee, 2011). While only intended to last nine months, in a subsequent announcement on June 20, 2012, the Fed revealed that the program would be extended until the end of that year.

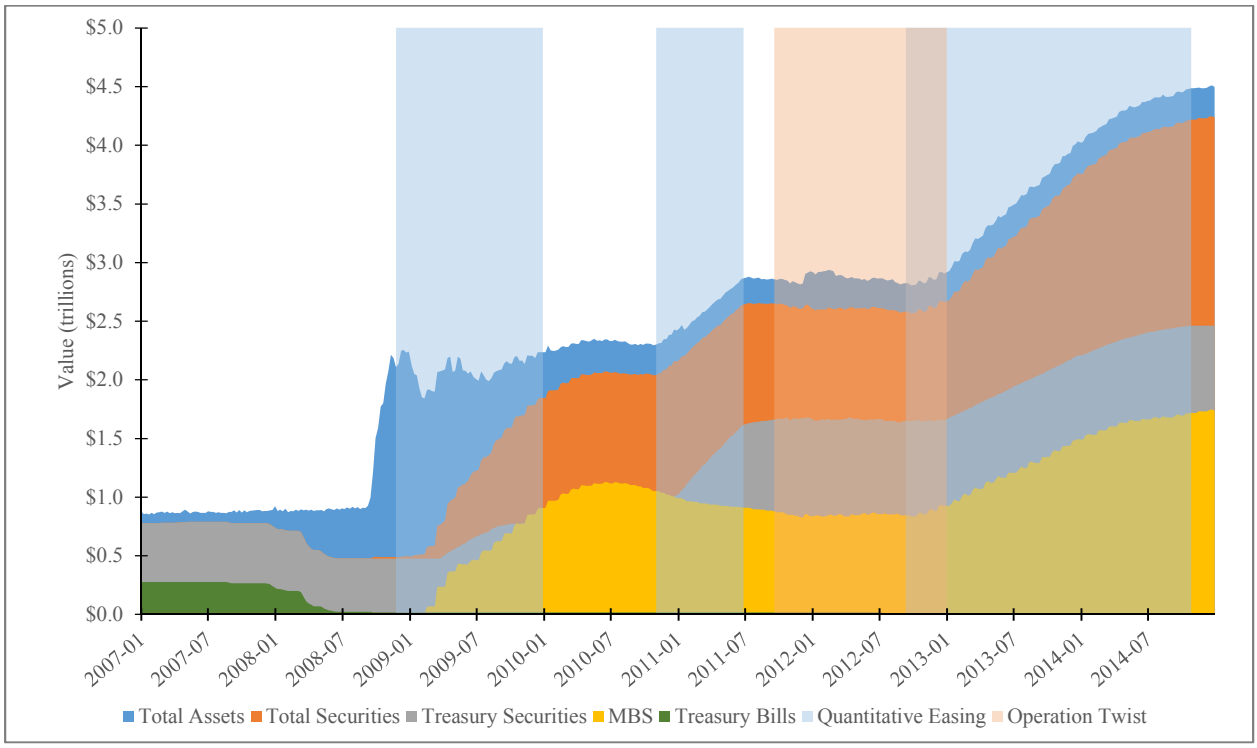
Worried about the lasting impact of its latest actions on labour market conditions and the overall recovery, the Fed quickly reverts back to its previous strategy, announcing QE3 on September 21, 2012. With Operation Twist still ongoing, the Fed committed to an open-ended purchase of $40 billion in MBSs per month (Federal Open Market Committee, 2012). Furthermore, on December 12, 2012, the Fed announced plans to extend its purchase of long-term treasury securities, following the completion of Operation Twist, increasing the pace to $45 billion a month going forward. With QE3, the Fed set a wide array of objectives, seeking to reduce longer-term interest rates, support mortgage markets, and to make broader financial conditions more accommodative (Federal Open Market Committee, 2012). Just over a year later, the Fed announced plans to begin tapering its asset purchases beginning on January 29, 2014.[2] This gradual reduction continued for most of the year and by October 29, 2014, quantitative easing ceased entirely (Federal Open Market Committee, 2014). In total, QE3 amounted to the purchase of $1.7 trillion worth of securities (Fisher, 2014).

By November 2015, the Fed's asset holdings, which initially had remained constant below the $1 trillion threshold before the financial crisis, had exploded to almost $4.5 trillion. This

[2] The Fed had previously announced plans to commence tapering on June 19, 2013, but this was quickly abandoned due a negative response in financial markets.

growth is made apparent in Figure 1, which plots the asset side of the Fed's balance sheet, during the financial crisis and recovery. The dramatic rise in total assets between September and November 2008 relate to the bail-outs discussed previously. Apart from this initial boost, each subsequent increase in the balance sheet coincides with a specific round of quantitative easing, while the period during which credit easing occurred leaves it unchanged.

Figure 1 – Federal Reserve Assets



Source: Federal Reserve Board 2016

5. *Analysis of Monetary Stimulus by the U.S. Federal Reserve*

To evaluate the monetary stimulus employed by the U.S. Federal Reserve, this analysis examines the effect of each LSAP on a series of macroeconomic variables. It will touch on the effects of the LSAPs on bank lending, unemployment and inflation, by simply plotting each variable over time and highlighting each LSAP period.

To address the impacts on long-term security yields, it will delve deeper, using econometrics to accompany the basic graphical analysis. To this end, it will regress each yield in question on the federal funds rate and series of dummy variables representing QE1, QE2, Operation Twist and QE3. After all, to isolate the effect of the Fed's unconventional LSAPs, it is necessary to control for its conventional monetary policy actions used to set interest rates. Since yields are also influenced by standard variation due to business cycle fluctuations, this too needs to be taken into account. For the treasury security yield regressions this is accomplished using the Federal Reserve's Industrial Production and Capacity Utilization Index[3] as an explanatory variable, while for private securities, core inflation was also incorporated. The idea here being that the rate of capacity utilization and core inflation, as leading indicators of economic activity, reflect the upward and downward trends experienced by the economy. Furthermore, the model takes into account uncertainty related to macroeconomic fundamentals and market volatility, each of which affect the yields of the securities in question. This is achieved by including the Chicago Board Options Exchange Ten-Year U.S. Treasury Note Volatility Index (CBOE VIX),[4] the University of Michigan's expected inflation rate and/or the TED spread.[5] The regressions pertaining to treasury-note yields will utilize the first of these two measures, whereas the Treasury bond yields and private security yield regressions discarded the CBOE VIX in favour of the TED spread. The control variables selected resemble those employed by Backus and Wright (2007). The inclusion of other variables, such as measures of the unemployment gap and consumer sentiment were considered, yet ultimately dropped on the basis of their statistical insignificance. More formally, this setup can be expressed as follows:

[3] Federal Reserve's Industrial Production and Capacity Utilization Index is a commonly used proxy for the rate of capacity utilization.
[4] CBOE VIX is a commonly used proxy for market volatility.
[5] TED Spread is considered an economic indicator of perceived credit risk, measured as the difference between the three-month LIBOR and the three-month T-bill interest rate.

$$Y_{T-Note} = \beta_0 + \beta_1 QE1 + \beta_2 QE2 + \beta_3 TWIST + \beta_4 QE3 + \beta_5 FF + \beta_6 EXPINF + \beta_7 VIX + \beta_8 IP$$

$$Y_{T-Bond} = \beta_0 + \beta_1 QE1 + \beta_2 QE2 + \beta_3 TWIST + \beta_4 QE3 + \beta_5 FF + \beta_6 EXPINF + \beta_7 IP$$

$$Y_{Corp} = \beta_0 + \beta_1 QE1 + \beta_2 QE2 + \beta_3 TWIST + \beta_4 QE3 + \beta_5 FF + \beta_6 COREINF + \beta_6 IP + \beta_7 TED$$

$$Y_{Mortg} = \beta_0 + \beta_1 QE1 + \beta_2 QE2 + \beta_3 TWIST + \beta_4 QE3 + \beta_5 FF + \beta_6 COREINF + \beta_6 IP + \beta_7 TED$$

where,

$Y =$ Security Yield

$QE1 = \begin{cases} 1 \text{ if observation occured during QE1} \\ 0 \text{ if observation occured outside QE1} \end{cases}$

$QE2 = \begin{cases} 1 \text{ if observation occured during QE2} \\ 0 \text{ if observation occured outside QE2} \end{cases}$

$TWIST = \begin{cases} 1 \text{ if observation occured during Operation Twist} \\ 0 \text{ if observation occured outside Operartion Twist} \end{cases}$

$QE3 = \begin{cases} 1 \text{ if observation occured during QE3} \\ 0 \text{ if observation occured outside QE3} \end{cases}$

$FF =$ Federal Funds Rate

$COREINF =$ Federal Reserve's measure of core inflation

$EXPINF =$ Federal Reserve's measure of expected inflation

$VIX =$ Chicago Board Options Exchange 10 year U. S. Treasury Note Volatility Index

$IP =$ Federal Reserve's Industrial Production and Capacity Utilization Index

$TED =$ TED Spread

Initially, the above equations were estimated using ordinary least squares; however, this approach gave rise to problems common to time-series data sets. Respectively, the presence of

heteroskadasticity and autocorrelation were quickly detected using White's and Durbin-Watson tests. To compensate for these issues, Heteroskedasticity and Autocorrelation Consistent Covariance (Newey-West) estimators were alternatively used. A summary of these results is available in Appendix 2, while Appendix 3 provides the detailed regression output in its entirety.

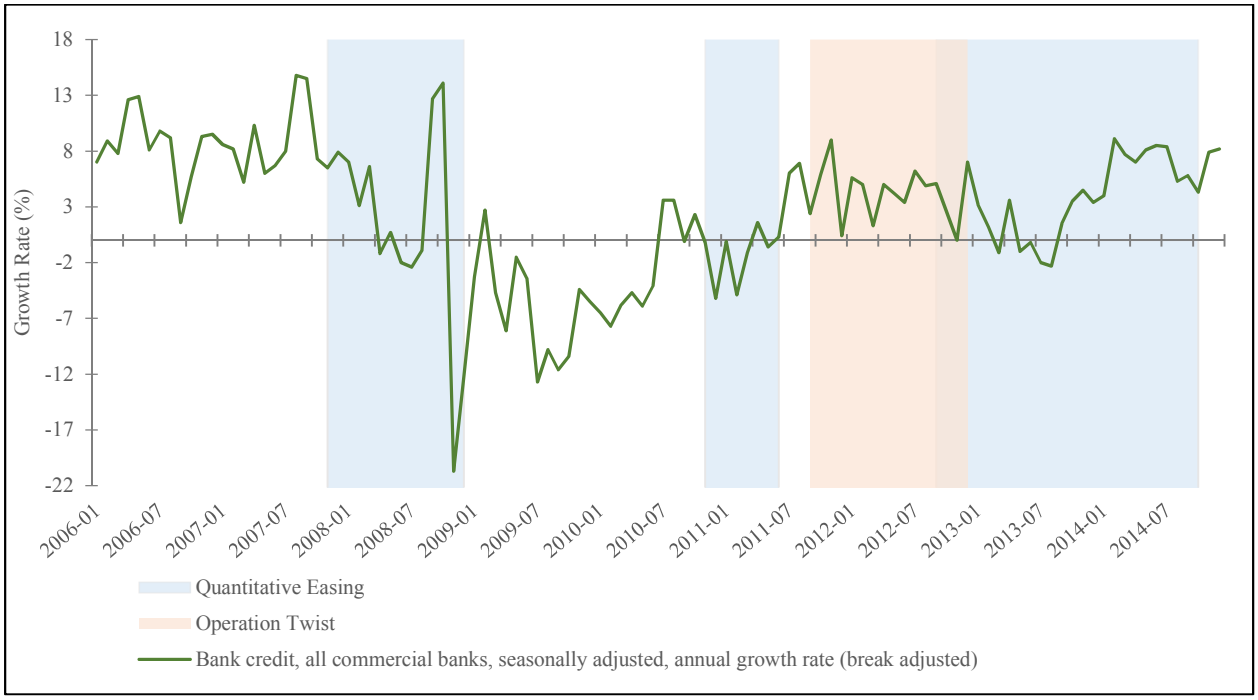
This methodology is similar to that used in Gagnon *et al*. (2011); however, it will consider the LSAP period as a whole, versus a finite window following specific announcements. It will expand on this work, by extending the study beyond March 2010 to allow for the effects of subsequent rounds of LSAPs to be captured. It assumes that the full economic impact is realized during the same window in which the purchases occurred. This assumption does align with the efficient market hypothesis, which proposes that all relevant information is contained within market prices. Thus, theory suggests that the entire change in price and yield is realized using this framework. While the same is not necessarily true for the other variables in question, this approach should provide some insight on the more immediate effects.

5.1. Effect on Credit Conditions

The FOMC, in its March 18, 2009 statement, announced that it was increasing the scope of QE1. Part of its rationale was to help improve conditions in private credit markets and to stimulate bank lending. For some, quantitative easing is thought to encourage bank lending to households and businesses. In this sense, when excess reserves are made available through quantitative easing, banks are compelled to employ this liquidity by issuing new loans. This argument is grounded in the belief that money creation is supply led, as opposed to an endogenous phenomenon driven by the demand for credit.

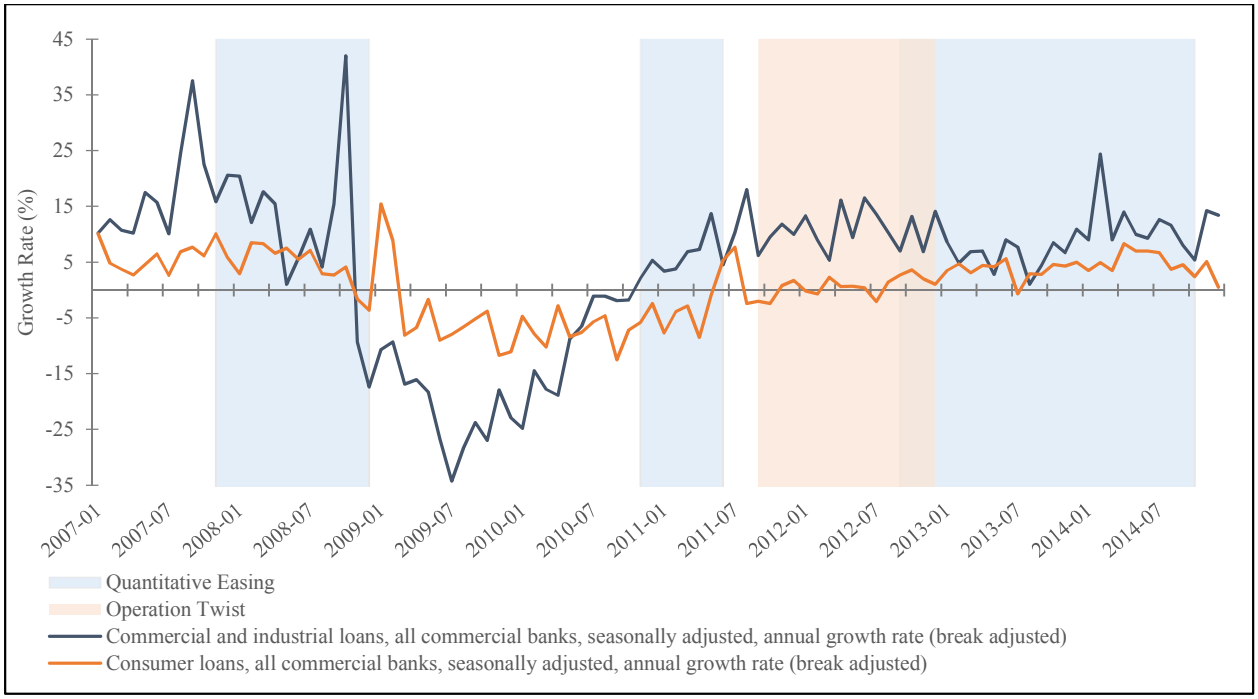
What view does the evidence support? Respectively, Figures 2 and 3 help to address this question, by plotting the annual growth in U.S. commercial bank credit, consumer loans and commercial loans over each round of quantitative easing and Operation Twist. Over the course of QE1, the annual growth in U.S. bank credit falls from approximately 6.5% to negative 12%, with the majority of the decline being explained by reductions in business loans. In the period following, bank credit improves, yet largely continues to exhibit negative growth, right through to the end of QE2. Afterwards, bank credit appears to recover with annual growth rates returning to positive territory, where it remains throughout Operation Twist. For the most part, this improvement is driven by the growth in business loans, which unlike consumer loans, remains positive over this period, peaking at approximately 18% annual growth for the period. By QE3, bank lending had evidently recovered. Apart from a minor blip in August 2013, lending seems to have recovered with the growth in bank credit firmly in the black and growth in both consumer and business loans almost returning to pre-crisis level.

Figure 2 – Annual Growth in U.S. Commercial Bank Credit



Source: Federal Reserve Board 2016

Figure 3 – Annual Growth in U.S. Consumer and Business Loans

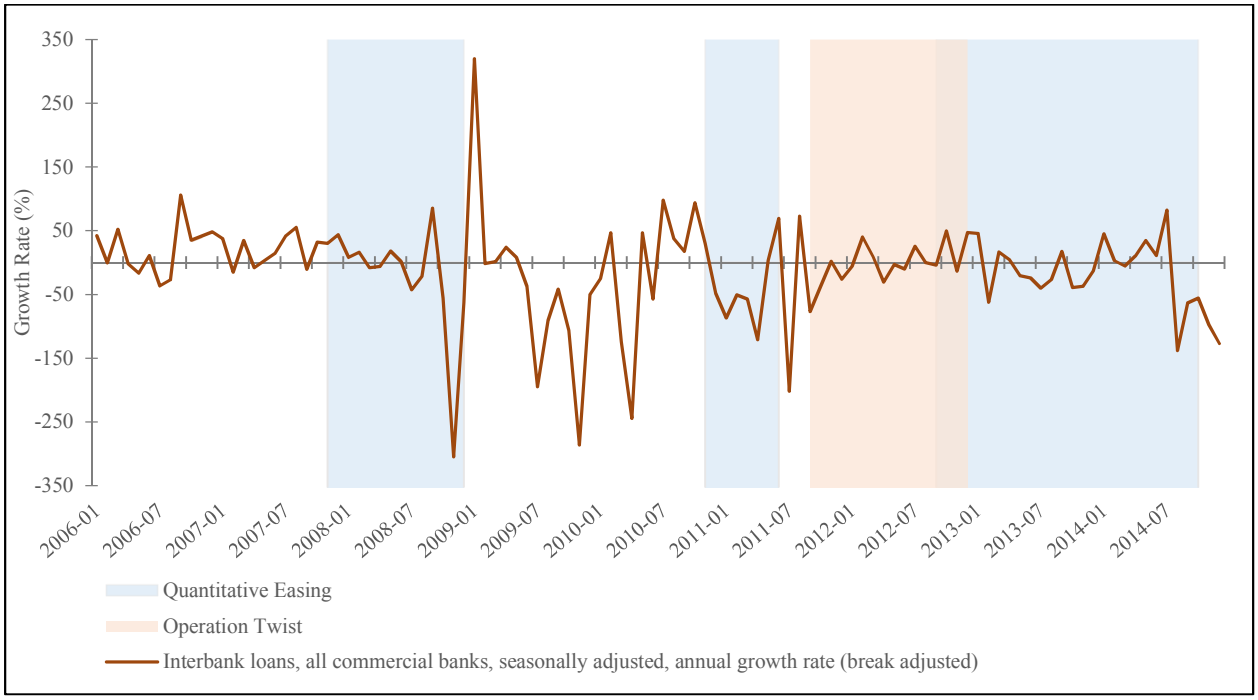


Source: Federal Reserve Board 2016

Based on this evidence, there does not appear to be a clear relationship between bank lending and credit or quantitative easing. As a whole, consumer loans, commercial loans and overall bank credit during the period sampled seems to exhibit a sharp downward trend from fall 2007 until summer 2009, followed by a gradual upward trend. This trajectory of bank lending appears to line up better with the crisis itself, which according to the National Bureau of Economic Research lasted from December 2007 to June 2009, rather than any specific periods of quantitative and credit easing.

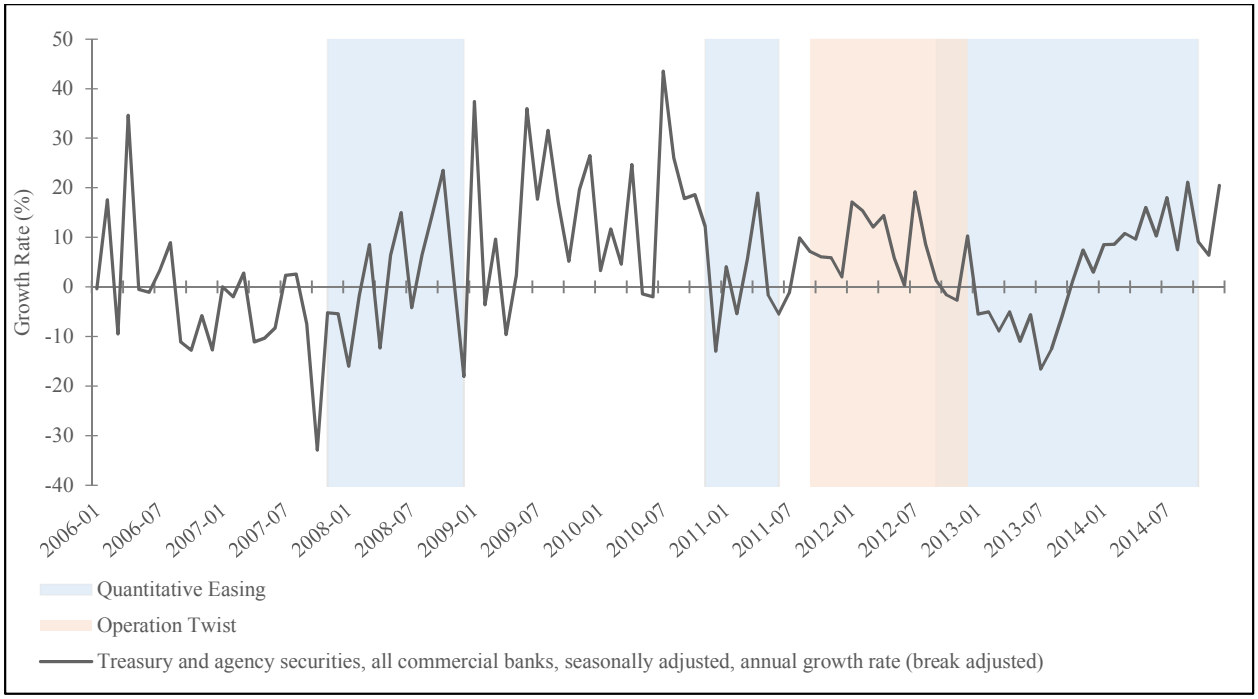
Given that during normal times banks also lend to one-another, the previous analysis only addresses part of the story. Some argued that credit and quantitative easing would allow interbank lending to recover, by replacing much of the MBS and long-term securities held by banks with treasury bills, providing an acceptable form of collateral to secure interbank loans. Figure 4 details the annual growth in U.S. interbank loans, highlighting each round of quantitative easing as well as Operation Twist, whereas Figure 5 shows the treasury and agency holding of U.S. commercial banks. Compared to consumer and business loans, the growth rate of interbank loans experienced far more volatility during the financial crisis. As expected, bank holdings of treasury and agency securities did rise in relation to quantitative and credit easing. However, with the exception of a sharp increase in its growth following the completion of QE1, the evidence does not ostensibly support a positive relationship between interbank lending rates and quantitative or credit easing. Instead, during the worst months of the financial crisis, the growth of interbank loans declines. Not surprisingly, with the Fed providing excess reserves to the financial system through its lending facilities, there is little need for an interbank loan market.

Figure 4 – Annual Growth in U.S. Interbank Loans



Source: Federal Reserve Board 2016

Figure 5 – Annual Growth in Treasury and Agency Securities holdings by U.S. Commercial Banks



Source: Federal Reserve Board 2016

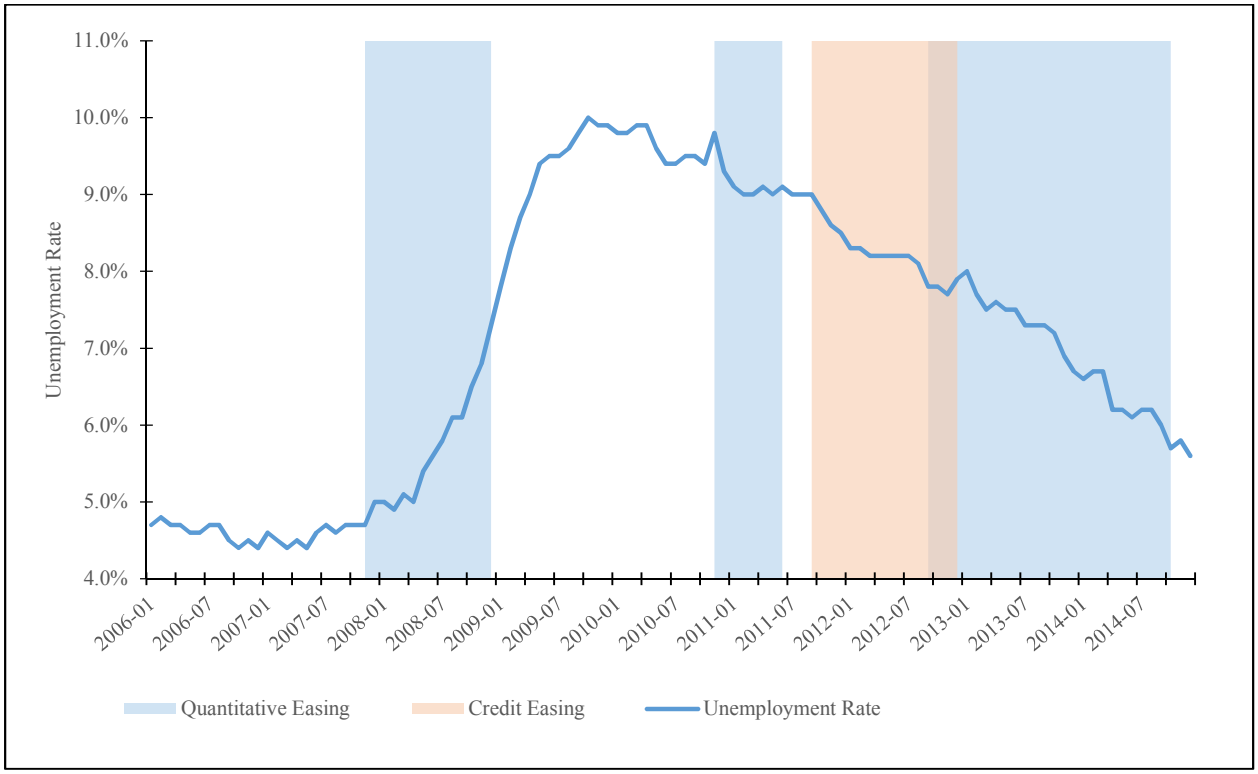
The evidence presented above does not appear to be consistent with the view that the LSAP program directly strengthened bank lending. As such, it is likely that this was not the mechanism through which credit and quantitative easing were intended to improve the economy.

5.2. Effect on Unemployment

During the economic crisis, the unemployment rate rose considerably, peaking at 9.9%, more than double its pre-crisis levels. With each round of stimulus, the Fed affirms its ambitions to improve labour market conditions, which constitutes half of its overall mandate. Was the Fed simply providing lip service or was this a realistic aspiration of the LSAP program? Like any single employer, the Fed obviously does not directly affect the unemployment rate, yet by improving overall financial conditions, it is thought to have an indirect impact on the labour market, by spurring business investment and housing starts. Aided by use of graphs, this paper will attempt to glean some insight into the relationship between credit and quantitative easing and the unemployment rate.

Figure 6 below charts the U.S. unemployment rate through four rounds of LSAP. Up until the end of 2007, the unemployment rate remained stable, hovering below 4.8%. Beginning in 2008 this reality rapidly changes and by the year's end, the unemployment rate had risen by 2.7%, in spite of QE1 taking place concurrently. This sharp increase continued until November 2009, when it reached its aforementioned peak. This was succeeded by a gradual and steady decline through three round of LSAPs. By December 2014, the unemployment rate had fallen to 5.6%: an improvement, but still above pre-crisis levels.

Figure 6 – U.S. Unemployment Rate



Source: U.S. Bureau of Labor Statistics 2016

Admittedly, without a large-scale macro model of the U.S. economy, it is difficult to accurately disentangle the effect on the unemployment rate caused by monetary stimulus versus the economic conditions as a whole. While on the surface, it appears that the unemployment rate was attenuated due to QE2, Operation Twist and QE3, making such a leap would concede the possibility that QE1 had the opposite effect—a view that lacks a coherent theoretical basis. Upon further introspection, it is conceivable that the effects on the unemployment rate simply lagged each LSAP period; labour markets are known to be rigid and therefore react more slowly than financial markets to economic pressures. Consequently, the employment impacts caused by QE1 and the ensuing LSAPs were only realized well after each round had concluded. Of course, this contention relies on the theory that credit and quantitative easing, by sufficiently lowering

interest rates and borrowing costs for households and firms, promotes job growth. Although this provides a compelling narrative, the proximate analysis on corporate bond and MBS yields will challenge this very idea, suggesting that these reductions were perhaps inadequate. Alternatively, a more credible explanation vies that the unemployment rate largely followed the same trajectory as the financial crisis, irrespective of the Fed's intervention. Job losses rose considerably beginning in December 2007, the official start of the recession, then peaked and gradually declined following its official end in June 2009. From this standpoint, if the Fed's LSAP program did affect the unemployment rate, suffice it to say that the degree was fairly trivial relative to the prevailing economic conditions.

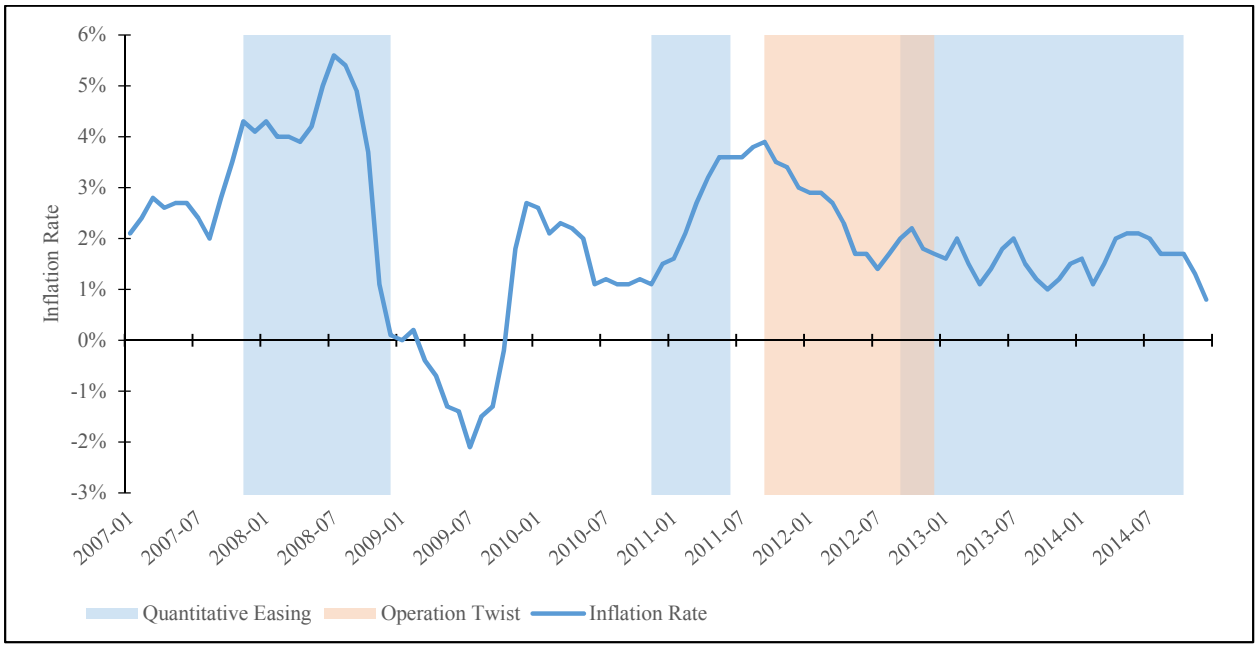
5.3. Effect on Inflation

Introductory macroeconomics warns of the inflationary pressures associated with increasing the level of base money in an economy. Starting from the first quantitative easing announcement, this remained a concern, not only for the central banks that were still trying to adhere to a 2% inflation target, but also right-wing pundits, who continually admonished the practice, citing an imminent threat of hyperinflation. These fears remained part of the ethos for the better part of the crisis in the U.S., but also in countries such as Germany, given their historical experience with the destabilizing consequences of high inflation rates during the pre-Nazi era of the Weimar republic.

Figure 7 below charts the U.S. inflation rate over the course of the financial crisis. Though it is fairly obvious that quantitative easing did not induce hyperinflation, can the same be true for price levels in general? Despite the large increases in reserves brought about by quantitative easing, the inflation rate peaked around 5.6% midway through 2008, only to fall to a low of

negative 2.1% the following year. According to the Fed, this variance is largely due to increases in commodity prices, and not the expansion in reserves (Bernanke, 2009).

Figure 7 – U.S. Inflation Rate



Source: U.S. Bureau of Labor Statistics

Regardless of the motivation, the fact that the inflation rate fell and even became negative following QE1 runs counter to the argument that credit and quantitative easing would result in high inflation. It most certainly dismisses the view that they would necessitate hyperinflation. All in all, the effect on inflation is fairly inconsequential.

5.4. Effect on Long-Term Interest Rates

As communicated in each LSAP announcement, every round of stimulus sought to reduce longer-term interest rates. With the exception of mortgages rates, the Fed in typical central bank fashion, remained discrete about the specific long-term rates that were being targeted. Reading between the lines, one can reasonably assume that QE2 and Operation Twist targeted yields on

both U.S. treasury securities and ultimately corporate securities. QE1, on the other hand, focused on mortgage rates, whereas QE3 sought to affect both.

5.4.1. Treasury Securities

U.S. Treasury securities represent a class of debt instrument comprised of bills, notes and bonds that are used to finance government operations. They are sold by the U.S. Department of the Treasury to primary dealers, which in turn resell them to commercial banks or the Fed, in case of excess quantities (Lavoie M. , 2014). As an investment, treasury securities are a low risk and liquid asset with maturities ranging from a month to thirty years. To commercial banks, they remain a principal form of collateral used to secure loans on the overnight or interbank market. For this reason, the Fed buys and sells treasury securities, primarily bills during regular times, in order to influence interest rates and execute monetary policy.

As with any debt security, the price of a treasury security is inversely related to its yield, hence a higher value implies a lower yield and vice versa. In general, treasury securities serve as a benchmark for a host of other debt instruments. In this respect, by affecting the price of treasury securities through their purchase and sale, the Fed is not only able to affect their own yields, but also those of other assets. In part, the LSAP program aimed to do exactly that by extending the average maturity of its securities holdings. Save for QE1, which focused on MBS yields and mortgage rates, the objective of each ensuing round of stimulus sought to reduce yields of long-term treasury securities. For the purposes of this paper, treasury notes and bonds, i.e., those with maturities of two years or greater, will be considered long-term securities. Figures 8 and 9 below chart the yields on long-term treasury securities from the beginning of 2007 until the end of 2014. Over this period, average bond yields exhibited a gradual decline, starting just

below 500 basis points and falling to roughly 200 basis points. Meanwhile, the spread between the thirty and ten-year yields widened by as much as 106 basis points. In the case of notes, yields experienced a more abrupt decline, starting in July 2007 and lasting until January 2009. Yields completely bottomed out in September 2011, as rates on a two-year note fell to as low as 35 basis points. Like with bonds, the disparity between the seven and two-year yield grew considerably.

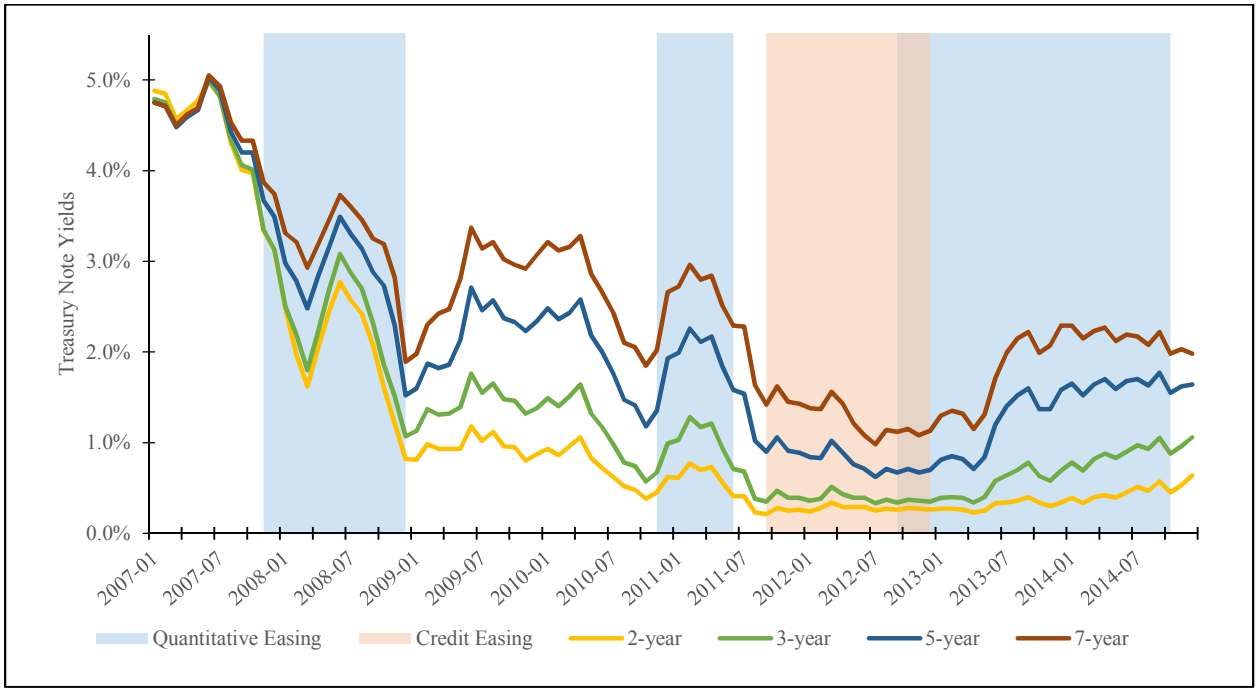
To assess the impact on long-term treasury securities, the yield for each specific maturity was regressed on every LSAP and series of control variables. Based on the results presented in Appendix 3, the effect of QE1 was fairly negligible. With the exception of the ten-year note, the yield of which was reduced by 38 (0.003806) basis points, the effect of QE1 on all other long-term treasury yields was found to be insignificant at the 5% level. This result is not entirely surprising given that QE1 specifically targeted MBS yields and mortgage rates. QE2, which was directed at long-term treasury securities, achieved roughly the same level of success, managing to reduce yields by 29 basis points (0.002945) on the three-year note. By and large, QE1 and QE2 had very little influence on long-term treasury yields, which were predominately impacted by other macroeconomic factors. Operation Twist proved considerably more effective than the previous two LSAPs. Though it failed to affect the yield of the thirty-year bond, it was significant for all remaining maturity classes. For the most part, the effect of Operation Twist rose with each security's maturity: a result that is consistent with Fed's objectives, which for this round specifically targeted long-term securities. Respectively, Operation Twist resulted 37 (0.003725), 66 (0.006622), 102 (0.010227) and 115 (0.011499) basis point reduction on two, three, five and seven-year notes. Similarly, it led to 113 (0.01128) and 110 (0.011055) basis point reductions on the ten and twenty-year bonds. Though QE3 fared better than the Fed's

previous attempts at quantitative easing, its impact on treasury securities appear to be limited to treasury-note yields. This result aligns with the Fed's, stated QE3 objectives, which among other things involved reducing yields on long-term securities. As with Operation Twist, the effect on these securities grew with their maturity. Reductions ranged from 34 (0.003414) basis point on the two-year note to 62 (0.006259) basis points on its seven-year equivalent.

Figure 8 – Treasury Bond Yields

Source: Federal Reserve Board 2016

Figure 9 – Treasury Note Yields



Source: Federal Reserve Board 2016

Overall, the evidence points to Operation Twist and QE3 as the two LSAP that managed to place downward pressure on the yields of long-term treasury securities. While QE1 and QE2 did lead to respective reductions on the yields of ten and three-year securities, these were the exception. On average, the two latter rounds of LSAP reduced yields between 34 (0.003414) and 113 (0.01128) basis points. What is yet to be determined is whether this decline translated into a reduction in the yields of private securities.

5.4.2. Corporate Securities

Corporate securities represent a class of debt instruments sold by firms to finance their operations. Compared to their treasury counterpart, they are typically thought to bare a higher risk, reflected in the risk premium they offer. Otherwise, the two instruments are near substitutes and their yields tend to move in tandem. By targeting U.S. Treasury securities, the LSAP

program attempted to exploit this relationship in order to reduce the yields of corporate securities. To be precise, the Fed was targeting interest rates on corporate bonds, which as a major component of corporate financing impacts a firm's borrowing costs. As such, a reduction in corporate bond yields is thought to stimulate investment by making financing more affordable.

A bond is a form of corporate security with a long-term maturity. Like a treasury security, its price is inversely related to its yield. Figure 10 below charts bond yields over an eight-year period beginning in 2007 and highlights each period of LSAP. It tracks the yields for both Moody's Aaa and Baa bonds to provide a wider sample. Both classes appear to grow considerably leading up to the end of 2008. Respectively, Aaa and Baa bond yields peak at 6.28% and 9.21%, before steadily declining to lows of 3.40% and 4.63% over two-and-a-half years later.

By regressing bond yields on each round of stimulus, it appears that the LSAP program, as a whole, did find some success in reducing yields on corporate bonds, albeit not nearly to the same degree as with treasury securities. The full results of this exercise are presented in Appendix 3. With the exception of QE1 and QE2, both of which were found to be insignificant beyond the 5% level for both Aaa and Baa bonds, corporate bond yields exhibited modest declines through the two latter rounds of LSAPs. Respectively, Operation Twist reduced Aaa bond yields by 73 (0.007358) basis points, yet failed to affect Baa yields. Conversely, QE3 reduced Baa bond yields by 68 (0.006814) basis points, but fell short in its effect on Aaa bonds. The inability of QE1 to affect yields can hardly be viewed as a failure, seeing as it was focused on MBS yields and mortgage rates. The same logic does not extend to QE2, which was directed at long-term securities. As for Operation Twist and QE3, the results suggest that the Fed did find some success towards this objective.

Figure 10 – Corporate Bond Yields

Source: Federal Reserve Board 2016

By and large, the evidence supports the viewpoint that Operation Twist and QE3 achieved small reductions in yields of long-term corporate securities. As theory suggests, such a result would in turn have a positive effect on investment and the broader economic conditions. Although the empirical analysis does not tackle this question, it is difficult to envision interest rate reductions of this scale having a profound effect on the economy. From this perspective, the LSAP did achieve one of its intended objectives, though perhaps not to the desired level.

5.4.3. Mortgage-Backed Securities and Mortgages

One of the LSAPs' goals was to improve housing market conditions. For this reason, the Fed targeted MBS as part of QE1 and QE3, purchasing a total of $1.7 trillion by October 2014.

Before discussing the impact of these purchases, a bit of background on MBS and their relationship to mortgage rates is necessary.

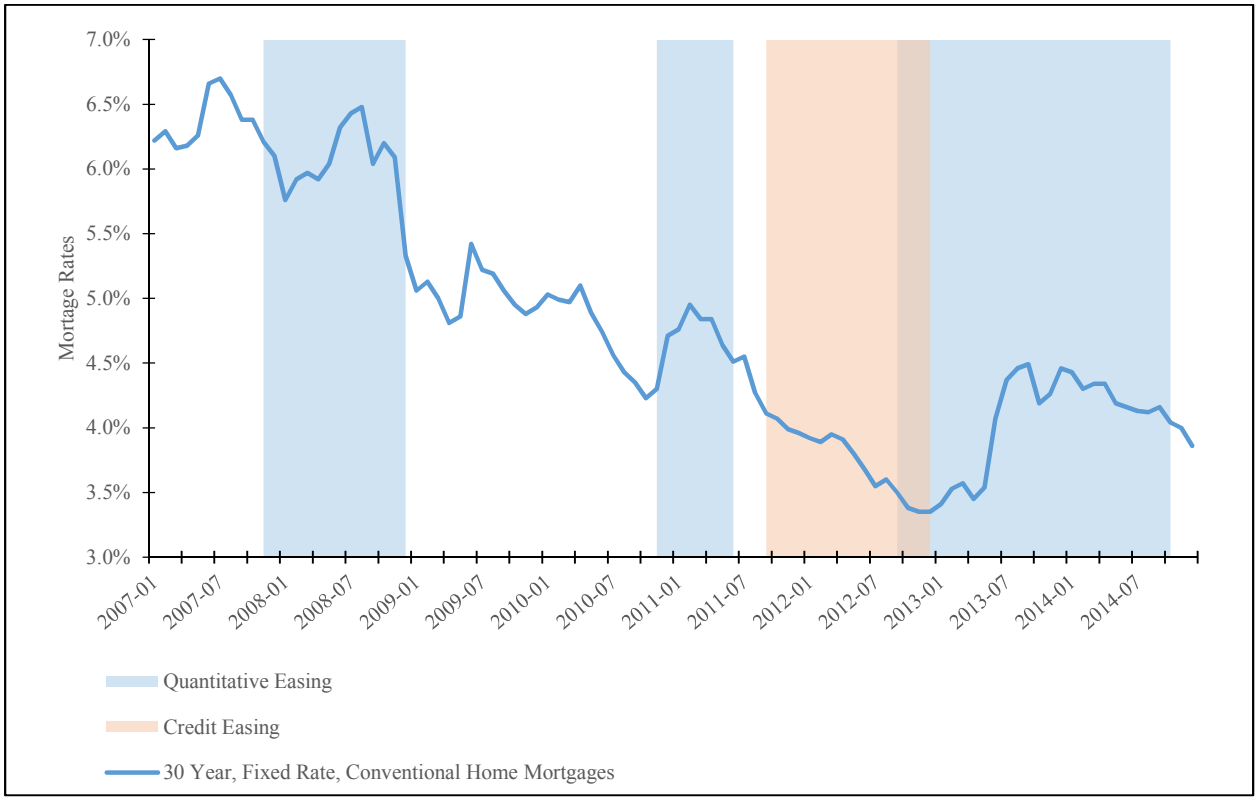
MBSs refer to a subset of the broader class of financial instrument known as an Asset-Backed Securities (ABSs). Generally speaking, ABSs provide investors with a stream of payments derived from the financing of various underlying assets. MBSs, as the name suggests, describe an investment vehicle backed or collateralized specifically by mortgages. In this sense, their value is tightly linked to mortgage rates and the real-estate markets altogether. Essentially, MBSs are created when newly-issued mortgages are bundled together and sold to investors, through a process commonly referred to as securitization. In the U.S., this process is executed primarily by the GSEs, Fannie Mae and Freddie Mac, but also privately to a lesser extent. Just like a bond, the price of a MBS is negatively correlated to its yields. Thus, lower yields on a MBS and their underlying mortgage rates imply a higher price.

Given the tight link between MBSs, mortgage rates and real-estate markets as a whole, it is not surprising that investors sought to divest in these assets, having recognized their exposure to U.S. subprime lending. As a result, the value of MBSs plunged, placing upward pressure on mortgage rates. The Fed's intervention aimed to counter this trend. By carrying out large-scale purchases of MBSs, the Fed intended to spur the demand for an otherwise failing asset, increasing its price. In turn, this was expected to reduce MBS yields and mortgage rates, helping to bolster the housing market.

Due to the limited availability of MBS yield data, the following analysis will focus solely on the impact of the LSAPs on mortgage rates. Figure 11 below plots conventional, U.S., thirty-year, mortgage rates throughout the financial crisis, highlighting each round of LSAP. The obvious downward trend indicates a sharp decline in mortgage rates over this period. At first

glance, mortgage rates do appear correlated with at least some of the Fed's interventions. Regressing mortgage rates on each LSAP period and a series of control variables, suggests that mortgage rates did decline during Operation Twist, by 67 (0.006766) basis points. Given that Operation Twist was directed toward real-estate securities, this result comes as a bit of a surprise. For all other rounds of LSAP, including QE1, which was specifically targeting MBSs and mortgage rates, the effects were found to be insignificant. The details of these results are available in Appendix 3.

Figure 11 – U.S. Mortgage Rates



Source: Federal Reserve Board 2016

Overall, the Fed seems to have found fairly limited success with its LSAP program, as it relates to mortgage rates. Based on the results, one can infer that quantitative easing was unsuccessful at reducing MBS yields and mortgage rates. Granting that the Fed's credit easing

measures did achieve a modest yield reduction, this was not their intention. Furthermore, it is unlikely that the reduction achieved through Operation Twist was to the level anticipated by Fed as it pertained to the entire LSAP program. As with corporate bonds, taking into account the scale of the reduction, whether this translated into a meaningful improvement to the economy at large remains unclear.

6. Conclusion

Though the U.S. was technically out of the red by June 2009, the pace of the ensuing recovery was gradual. By a number of accounts, overall economic conditions remained depressed well after the recession officially ended (Blake, 2014). Only as of October 29, 2014, did the Fed suspend its LSAP program indefinitely, ending what amounted to three rounds of quantitative easing and one round of credit easing. For its efforts, the Fed amassed close to $3.5 trillion in securities, drastically increasing the size of its balance sheet.

To gauge the impact of credit and quantitative easing, the effect of the Fed's LSAP program on bank lending, unemployment, inflation, and the yields of various long-term securities were examined empirically. Starting with bank lending, the evidence suggests that these unconventional policies did not stimulate credit issuance. This result runs counter to the supply-led view of money creation, which asserts that banks respond to increases in reserves by extending additional credit. Similarly, the results suggest that the LSAP program had little to no influence on the rates of unemployment and inflation, in spite of the Fed paying particular attention to these variables in each of its press releases.

Where LSAP did appear to find some success was through its effect on the yields of long-term securities—another of the Fed's stated goals. As discussed, the logic behind this objective

being that a reduction in long-term yields promotes spending by firms and households alike, by lowering borrowing costs. According to the evidence, the LSAP program had by far the largest effect on treasury notes and bonds managing to reduce yields between 34 and 113 basis points through most rounds. Although this did not correspond with an equivalent reduction in the yields of private securities, Moody's Aaa and Baa bond yields did experience minor declines between 68 and 74 basis points apiece, during Operation Twist and QE3. Likewise, mortgage rates and presumably their MBS counterparts, saw a modest 68 basis point reduction, though oddly only in response to Operation Twist. Clearly, the evidence does not indicate that the LSAP program had a profound effect on private securities. Still, given the pressures facing corporate bonds and MBSs, even a trivial reduction in their yields could be viewed as a minor feat.

In general, the practical application of credit and quantitative easing strategies, such as the Fed's LSAP program, appears to be fairly narrow in scope. Though one cannot ignore the evidence supporting their ability to reduce yields on long-term securities, to claim that the LSAP program was a resounding success would be to miss the forest for the trees. Given the scale of these reductions, it is unclear if these enhanced the broader economic outlook. Furthermore, it appeared ineffective at stimulating bank lending or reducing the unemployment rate—an area that would benefit greatly from further empirical research. In this sense, unconventional monetary policy can hardly be viewed as a panacea for all economic woes. By the same token, the LSAP program did not invariably lead to the sort of inflationary or even hyperinflationary consequences, touted by some right-wing observers.

While it may be a stretch to analogize credit and quantitative easing to gaining weight by way of a looser belt, as they pertain to economic stimulus, these serve as fairly blunt instruments at best. More often than not, their results strayed from the Fed's stated objectives. Despite these

shortcomings, with conventional monetary policy ill-equipped to tackle an impending financial crisis, it is difficult to deprecate the use of unconventional tools. Even a minor improvement likely outweighs the insignificant downside risk. In the specific case of the LSAPs, one could reasonably conclude that the program was earnestly targeting long-term interest rates, notwithstanding the Fed's more lofty objectives or other prominent claims. Taking a more cynical perspective, one could interpret the LSAP program as nothing more than a sleight of hand by the Fed; after all, to do nothing was presumably out of the question.

References

Backus, D. K., & Wright, J. H. (2007). Cracking the Conundrum. *Brookings Papers on Economic Activity*, 293.

Blake, A. (2014, September 25). *Americans think we're in a recession. They're wrong. But still….* Retrieved from Washington Post: https://www.washingtonpost.com/news/the-fix/wp/2014/09/25/americans-think-were-in-a-recession-theyre-wrong-but-still/

Board of Governors of the Federal Reserve System. (2015, June 1). *U.S. Federal Reserve*. Retrieved from Economic research and data: http://www.federalreserve.gov/datadownload/

Chen, H., Cúrdia, V., & Ferrero, A. (2012). The Macroeconomic Effects of Large-scale Asset Purchase Programmes. *Economic Journal, 122(564)*, F289-F315.

D'Amico, S., & King, T. B. (2010). Flow and stock effects of large-scale treasury purchases. *Finance and Economics Discussion Series No. 2010-52*, 18.

Engen, E. M., Laubach, T., & Reifschneider, D. (2015). *The Macroeconomic Effects of the Federal Reserve's Unconventional Monetary Policies*. Retrieved from Washington: Board of Governors of the Federal Reserve System: http://dx.doi.org/10.17016/FEDS.2015.005

Federal Open Market Committee. (2008, November 25). *Federal Reserve announces it will initiate a program to purchase the direct obligations of housing-related government-sponsored enterprises and mortgage-backed securities backed by Fannie Mae, Freddie Mac, and Ginnie Mae [Press Release]*. Retrieved from Board of Governors of the Federal Reserve System: https://www.federalreserve.gov/newsevents/press/monetary/20081125b.htm

Federal Open Market Committee. (2009, March 18). *FOMC statement [Press release]*. Retrieved from Board of Governors of the Federal Reserve System: https://www.federalreserve.gov/newsevents/press/monetary/20090318a.htm

Federal Open Market Committee. (2010, November 3). *FOMC statement [Press release]*. Retrieved from Board of Governors of the Federal Reserve System: https://www.federalreserve.gov/newsevents/press/monetary/20101103a.htm

Federal Open Market Committee. (2011, September 21). *Federal Reserve issues FOMC statement [Press release]*. Retrieved from Board of Governors of the Federal Reserve System: https://www.federalreserve.gov/newsevents/press/monetary/20110921a.htm

Federal Open Market Committee. (2012, September 13). *Federal Reserve issues FOMC statement [Press release]*. Retrieved from Board of Governors of the Federal Reserve System: https://www.federalreserve.gov/newsevents/press/monetary/20120913a.htm

Federal Open Market Committee. (2012, December 12). *Federal Reserve issues FOMC statement [Press release]*. Retrieved from Board of Governors of the Federal Reserve System: https://www.federalreserve.gov/newsevents/press/monetary/20121212a.htm

Federal Open Market Committee. (2014, January 29). *Federal Reserve issues FOMC statement [Press release]*. Retrieved from Board of Governors of the Federal Reserve System: https://www.federalreserve.gov/newsevents/press/monetary/20140129a.htm

Federal Open Market Committee. (2014, October 29). *Federal Reserve issues FOMC statement [Press release]*. Retrieved from Board of Governors of the Federal Reserve System: https://www.federalreserve.gov/newsevents/press/monetary/20141029a.htm

Federal Reserve Bank of Boston. (2015). Joint Event on Sovereign Risk and Macroeconomics. *Lessons from the U.S. Experience with QE* (p. 22). Frankfurt: Moody's Investors Service and Peterson Institute for International Economics.

Federal Reserve Bank of St. Louis. (2016, July 25). *Natural Rate of Unemployment (Long-Term)*. Retrieved from FRED: https://fred.stlouisfed.org/series/NROU

Fisher, R. W. (2014, November 3). *R.I.P. QE3… Or Will It?* Retrieved from Federal Reserve Bank of Dallas: http://www.dallasfed.org/news/speeches/fisher/2014/fs141103.cfm

Gagnon, J., Raskin, M., Remache, J., & Sack, B. (2011). Large-scale Asset Purchases by the Federal Reserve: Did They Work? *Federal Reserve Bank of New York Economic Policy Review*, 41.

Gertler, M., & Karadi, P. (2012). QE 1 vs. 2 vs. 3...A Framework for Analyzing Large Scale Asset Purchases as a Monetary Policy Tool. *Federal Reserve Board Conference*, (p. 50).

Joyce, M., Miles, D., Scott, A., & Vayanos, D. (2012). Quantitative Easing and Unconventional Monetary Policy – an Introduction. *Economic Journal, 122(564)*, F271-F288.

Keynes, J. M. (1933, December 31). *New Deal Documents.* Retrieved from An Open Letter to President Roosevelt: http://www00.unibg.it/dati/corsi/6448/24382-A%20letter%20to%20President%20FD%20Roosvelt%20by%20JM%20Keynes.pdf

Krishnamurthy, A., & Vissing-Jorgensen, A. (2011). The effects of quantitative easing on interest rates: Channels and implications for policy. *Brookings Papers on Economic Activity, 215*, 74.

Lavoie, M. (2014). *Post-Keynesian economics new foundations.* Cheltenham: Edward Elgar Pub. Ltd.

Lavoie, M. (2015, Fall). *ECO6183 - Explorations in Monetary Economics*. Lecture presented in University of Ottawa, Ottawa.

Swanson, E. (2011). Let's Twist Again: A High-Frequency Event-Study Analysis of Operation Twist and Its Implications for QE2. *Brookings Papers on Economic Activity, 2011(1)*, 151-188.

The National Bureau of Economic Research. (2012, April 23). *US Business Cycle Expansions and Contractions*. Retrieved from The National Bureau of Economic Research: http://www.nber.org/cycles/cyclesmain.html

Thornton, D. (2013). An Evaluation of Event-Study Evidence on the Effectiveness of the FOMC's LSAP Program: Are the Announcement Effects Identified? *IDEAS Working Paper Series from RePEc*, 47.

United States Department of Labour. (2016, June 9). *U.S. Bureau of Labor Statistics* . Retrieved from Databases, Tables & Calculators by Subject: http://www.bls.gov/data/

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

Appendix 1 – Summary of Large-Scale Asset Purchases

Program	Announcement Date	Targeted End Date	Targeted Total Purchase	Composition of Purchases	Program Details as Announced
Quantitative Easing 1 (QE1)	November 25, 2008	Over Several Quarters	Agency Debt: Up to $100 billion Agency MBS: Up to $500 billion	Agency Debt and Agency MBS	Purchase up to $100 billion of agency debt and up to $500 billion of agency MBS. Purchases expected to take place over several quarters.
	March 18, 2009	Treasury Securities: September 30, 2009 Agency Debt and MBS: December 31, 2009	Agency Debt: Additional $100 billion Agency MBS: Additional $750 billion Longer-Term Treasuries: $300 billion	Agency Debt, Agency MBS, and Longer-Term Treasury Securities	Total purchases of agency MBS will now be to up to $1.25 trillion, and agency debt up to $200 billion. Purchase up to $300 billion of longer-term Treasury securities over next 6 months.
Quantitative Easing 2 (QE2)	November 3, 2010	June 30, 2011	$600 billion	Longer-Term Treasury Securities	Purchase $600 billion of longer-term Treasury securities by the end of the second quarter of 2011, a pace of about $75 billion per month.
Maturity Extension Program (Operation Twist)	September 21, 2011	June 30, 2012	$400 billion	Longer-Term Treasury Securities[1]	Purchase, by the end of June 2012, $400 billion of Treasury securities with remaining maturities of 6-30 years and sell an equal amount of Treasury securities with remaining maturities of 3 years or less.
	June 20, 2012	December 31, 2012	Amount Limited by Remaining Shorter-Term Treasury Securities	Longer-Term Treasury Securities	Purchase Treasury securities with remaining maturities of 6-30 years at the current pace and sell or redeem an equal amount of Treasury securities with remaining maturities of approximately 3 years or less.
Quantitative Easing 3 (QE3)	September 13, 2012	None Given	None Given	Agency MBS and Longer-Term Treasury Securities	Purchase agency MBS at pace of $40 billion per month and continue Twist through yearend, increasing holdings of longer-term securities in aggregate by $85 billion.
	December 12, 2012	None Given	None Given	Agency MBS and Longer-Term Treasury Securities	Purchase agency MBS at a pace of $40 billion per month and longer-term Treasury securities initially at a pace of $45 billion per month after Twist ends at yearend.
	January 29, 2014	October 29, 2014	None Given	Agency MBS and Longer-Term Treasury Securities	Tapering of asset purchases at a pace of $30 billion per month for MBS, and $35 billion per month per month for Treasury securities

Source: Federal Reserve Bank of Boston, 2015

Appendix 2 – Summary of the Effects of LSAP

Security	Maturity / Class	LSAP			
		QE1	QE2	TWIST	QE3
Treasury Notes	2-year	-0.003487	-0.002249*	-0.003725***	-0.003414***
	3-year	-0.004046*	-0.002945**	-0.006622***	-0.004411***
	5-year	-0.003564*	-0.002174	-0.010227***	-0.005475**
	7-year	-0.003503*	-0.001415	-0.011499***	-0.006259**
Treasury Bonds	10-year	-0.003806**	0.0000128	-0.01128***	-0.005905*
	20-year	-0.002532	0.001771*	-0.011055***	-0.006453*
	30-year	-0.00361	0.001985	-0.009825	-0.005508
Corporation Securities	Moody's AAA	-0.000903	0.000741	-0.007358**	-0.004344***
	Moody's BAA	0.001067	0.001142	-0.003912	-0.006814***
MBS	Mortgage Rates	0.001414	-0.001758	-0.006766***	-0.00509*

***Statistically significant at the 1 percent level.

**Statistically significant at the 5 percent level.

*Statistically significant at the 10 percent level (not considered as part of the analysis)

Appendix 3 – Regression Output

Dependent Variable: _24MONTH
Method: Least Squares
Date: 07/27/16 Time: 21:37
Sample: 2006M01 2014M12
Included observations: 108
HAC standard errors & covariance (Prewhitening with lags = 4 from AIC maxlags = 4, Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002328	0.001754	1.327300	0.1875
QE1	-0.003487	0.002136	-1.632149	0.1058
QE2	-0.002249	0.001202	-1.871389	0.0642
TWIST	-0.003725	0.000692	-5.386153	0.0000
QE3	-0.003414	0.000744	-4.585814	0.0000
IP	-0.031627	0.009066	-3.488484	0.0007
EXPINF	0.149332	0.076019	1.964405	0.0523
FF	0.798745	0.026563	30.06967	0.0000
VIX	-0.002196	0.000760	-2.887508	0.0048

R-squared	0.980030	Mean dependent var	0.015927
Adjusted R-squared	0.978416	S.D. dependent var	0.017135
S.E. of regression	0.002517	Akaike info criterion	-9.051539
Sum squared resid	0.000627	Schwarz criterion	-8.828028
Log likelihood	497.7831	Hannan-Quinn criter.	-8.960914
F-statistic	607.2892	Durbin-Watson stat	0.611953
Prob(F-statistic)	0.000000	Wald F-statistic	1618.406
Prob(Wald F-statistic)	0.000000		

Dependent Variable: _36MONTH
Method: Least Squares
Date: 07/27/16 Time: 21:38
Sample: 2006M01 2014M12
Included observations: 108
HAC standard errors & covariance (Prewhitening with lags = 4 from AIC maxlags = 4, Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005531	0.001801	3.071284	0.0028
QE1	-0.004046	0.002344	-1.726298	0.0874
QE2	-0.002945	0.001466	-2.008510	0.0473
TWIST	-0.006622	0.001036	-6.392810	0.0000
QE3	-0.004411	0.001138	-3.876526	0.0002
IP	-0.034906	0.006838	-5.104782	0.0000
EXPINF	0.189798	0.074196	2.558059	0.0120
FF	0.705675	0.028314	24.92347	0.0000
VIX	-0.002443	0.000572	-4.271148	0.0000

R-squared	0.970046	Mean dependent var	0.018272
Adjusted R-squared	0.967625	S.D. dependent var	0.015906
S.E. of regression	0.002862	Akaike info criterion	-8.794969
Sum squared resid	0.000811	Schwarz criterion	-8.571458
Log likelihood	483.9283	Hannan-Quinn criter.	-8.704344

F-statistic	400.7588	Durbin-Watson stat	0.700531
Prob(F-statistic)	0.000000	Wald F-statistic	1146.310
Prob(Wald F-statistic)	0.000000		

Dependent Variable: _60MONTH
Method: Least Squares
Date: 07/27/16 Time: 21:38
Sample: 2006M01 2014M12
Included observations: 108
HAC standard errors & covariance (Prewhitening with lags = 1 from AIC maxlags = 4, Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.012572	0.002829	4.444088	0.0000
QE1	-0.003564	0.002049	-1.739284	0.0851
QE2	-0.002174	0.001861	-1.168250	0.2455
TWIST	-0.010227	0.001983	-5.157046	0.0000
QE3	-0.005475	0.002466	-2.220107	0.0287
IP	-0.030009	0.012002	-2.500393	0.0140
EXPINF	0.223292	0.072063	3.098568	0.0025
FF	0.546172	0.039544	13.81175	0.0000
VIX	-0.002219	0.001323	-1.677471	0.0966

R-squared	0.946408	Mean dependent var	0.023537
Adjusted R-squared	0.942077	S.D. dependent var	0.013711
S.E. of regression	0.003300	Akaike info criterion	-8.510212
Sum squared resid	0.001078	Schwarz criterion	-8.286701
Log likelihood	468.5515	Hannan-Quinn criter.	-8.419587
F-statistic	218.5368	Durbin-Watson stat	0.731275
Prob(F-statistic)	0.000000	Wald F-statistic	114.7009
Prob(Wald F-statistic)	0.000000		

Dependent Variable: _84MONTH
Method: Least Squares
Date: 07/27/16 Time: 21:39
Sample: 2006M01 2014M12
Included observations: 108
HAC standard errors & covariance (Prewhitening with lags = 2 from AIC maxlags = 4, Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.019165	0.003935	4.870030	0.0000
QE1	-0.003503	0.001954	-1.792474	0.0761
QE2	-0.001415	0.002627	-0.538677	0.5913
TWIST	-0.011499	0.002317	-4.963432	0.0000
QE3	-0.006259	0.002843	-2.201487	0.0300
IP	-0.026875	0.013768	-1.951949	0.0538
EXPINF	0.214789	0.083649	2.567738	0.0117
FF	0.428236	0.042150	10.15975	0.0000
VIX	-0.002263	0.002022	-1.118793	0.2659

R-squared	0.920572	Mean dependent var	0.027904
Adjusted R-squared	0.914153	S.D. dependent var	0.011943

S.E. of regression	0.003499	Akaike info criterion	-8.392835
Sum squared resid	0.001212	Schwarz criterion	-8.169324
Log likelihood	462.2131	Hannan-Quinn criter.	-8.302209
F-statistic	143.4260	Durbin-Watson stat	0.702955
Prob(F-statistic)	0.000000	Wald F-statistic	157.1384
Prob(Wald F-statistic)	0.000000		

Dependent Variable: _120MONTH
Method: Least Squares
Date: 07/27/16 Time: 21:40
Sample: 2006M01 2014M12
Included observations: 108
HAC standard errors & covariance (Prewhitening with lags = 1 from AIC
maxlags = 4, Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.023575	0.004225	5.580010	0.0000
QE1	-0.003806	0.001839	-2.069256	0.0411
QE2	1.28E-05	0.003639	0.003523	0.9972
TWIST	-0.011280	0.003314	-3.404293	0.0010
QE3	-0.005905	0.003466	-1.703442	0.0916
IP	-0.017384	0.023499	-0.739750	0.4612
EXPINF	0.241739	0.063870	3.784839	0.0003
FF	0.326844	0.075810	4.311378	0.0000

R-squared	0.895729	Mean dependent var	0.032265
Adjusted R-squared	0.888430	S.D. dependent var	0.010227
S.E. of regression	0.003416	Akaike info criterion	-8.449406
Sum squared resid	0.001167	Schwarz criterion	-8.250730
Log likelihood	464.2679	Hannan-Quinn criter.	-8.368850
F-statistic	122.7205	Durbin-Watson stat	0.617673
Prob(F-statistic)	0.000000	Wald F-statistic	90.61231
Prob(Wald F-statistic)	0.000000		

Dependent Variable: _240MONTH
Method: Least Squares
Date: 07/27/16 Time: 21:41
Sample: 2006M01 2014M12
Included observations: 108
HAC standard errors & covariance (Prewhitening with lags = 4 from AIC
maxlags = 4, Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.031695	0.004221	7.509481	0.0000
QE1	-0.002532	0.001745	-1.451256	0.1498
QE2	0.001771	0.005386	0.328802	0.7430
TWIST	-0.011055	0.004170	-2.651287	0.0093
QE3	-0.006453	0.003589	-1.798062	0.0752
IP	-0.022653	0.022648	-1.000216	0.3196
EXPINF	0.225667	0.061719	3.656355	0.0004
FF	0.225809	0.095078	2.374995	0.0195

R-squared	0.861024	Mean dependent var	0.038621

Adjusted R-squared	0.851295	S.D. dependent var	0.008775
S.E. of regression	0.003384	Akaike info criterion	-8.468342
Sum squared resid	0.001145	Schwarz criterion	-8.269666
Log likelihood	465.2905	Hannan-Quinn criter.	-8.387786
F-statistic	88.50679	Durbin-Watson stat	0.543784
Prob(F-statistic)	0.000000	Wald F-statistic	500.6799
Prob(Wald F-statistic)	0.000000		

Dependent Variable: _360MONTH
Method: Least Squares
Date: 07/27/16 Time: 21:42
Sample: 2006M01 2014M12
Included observations: 108
HAC standard errors & covariance (Prewhitening with lags = 1 from AIC
maxlags = 4, Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.031889	0.013400	2.379726	0.0192
QE1	-0.003610	0.003423	-1.054805	0.2941
QE2	0.001985	0.014629	0.135703	0.8923
TWIST	-0.009825	0.011848	-0.829259	0.4089
QE3	-0.005508	0.010399	-0.529622	0.5975
IP	-0.006049	0.082092	-0.073682	0.9414
EXPINF	0.273482	0.087051	3.141626	0.0022
FF	0.166259	0.274528	0.605620	0.5461

R-squared	0.820793	Mean dependent var	0.039913
Adjusted R-squared	0.808249	S.D. dependent var	0.007272
S.E. of regression	0.003184	Akaike info criterion	-8.589872
Sum squared resid	0.001014	Schwarz criterion	-8.391195
Log likelihood	471.8531	Hannan-Quinn criter.	-8.509315
F-statistic	65.43069	Durbin-Watson stat	0.518270
Prob(F-statistic)	0.000000	Wald F-statistic	54.57808
Prob(Wald F-statistic)	0.000000		

Dependent Variable: MOODYS_AAA
Method: Least Squares
Date: 07/27/16 Time: 21:43
Sample: 2006M01 2014M12
Included observations: 108
HAC standard errors & covariance (Prewhitening with lags = 4 from AIC
maxlags = 4, Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.046636	0.002455	18.99553	0.0000
QE1	-0.000903	0.000835	-1.081705	0.2820
QE2	0.000741	0.003037	0.243836	0.8079
TWIST	-0.007358	0.003638	-2.022492	0.0459
QE3	-0.004344	0.002390	-1.817341	0.0722
IP	-0.041811	0.016767	-2.493679	0.0143
EXPINF	0.224142	0.038376	5.840717	0.0000
FF	0.215617	0.087258	2.471043	0.0152
TED	0.210703	0.060102	3.505752	0.0007

COREINF	-0.373776	0.132621	-2.818374	0.0058

R-squared	0.888290	Mean dependent var	0.048602
Adjusted R-squared	0.878031	S.D. dependent var	0.007425
S.E. of regression	0.002593	Akaike info criterion	-8.983973
Sum squared resid	0.000659	Schwarz criterion	-8.735628
Log likelihood	495.1346	Hannan-Quinn criter.	-8.883278
F-statistic	86.58555	Durbin-Watson stat	0.731639
Prob(F-statistic)	0.000000	Wald F-statistic	291.1802
Prob(Wald F-statistic)	0.000000		

Dependent Variable: MOODYS_BAA
Method: Least Squares
Date: 07/27/16 Time: 21:43
Sample: 2006M01 2014M12
Included observations: 108
HAC standard errors & covariance (Prewhitening with lags = 2 from AIC
maxlags = 4, Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.065567	0.003881	16.89283	0.0000
QE1	0.001067	0.002171	0.491395	0.6242
QE2	0.001142	0.002803	0.407482	0.6845
TWIST	-0.003912	0.002829	-1.382954	0.1698
QE3	-0.006814	0.001976	-3.449399	0.0008
IP	-0.093401	0.022872	-4.083696	0.0001
EXPINF	0.008815	0.109081	0.080814	0.9358
FF	0.184966	0.073050	2.532027	0.0129
TED	0.529591	0.130150	4.069071	0.0001
COREINF	-0.459381	0.218049	-2.106776	0.0377

R-squared	0.900526	Mean dependent var	0.060331
Adjusted R-squared	0.891390	S.D. dependent var	0.010301
S.E. of regression	0.003395	Akaike info criterion	-8.445071
Sum squared resid	0.001129	Schwarz criterion	-8.196725
Log likelihood	466.0338	Hannan-Quinn criter.	-8.344376
F-statistic	98.57530	Durbin-Watson stat	0.727613
Prob(F-statistic)	0.000000	Wald F-statistic	182.4874
Prob(Wald F-statistic)	0.000000		

Dependent Variable: MORTGAGE
Method: Least Squares
Date: 07/27/16 Time: 21:44
Sample: 2006M01 2014M12
Included observations: 108
HAC standard errors & covariance (Prewhitening with lags = 1 from AIC
maxlags = 4, Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.042694	0.004102	10.40817	0.0000
QE1	0.001414	0.002400	0.588892	0.5573
QE2	-0.001758	0.001799	-0.977212	0.3309
TWIST	-0.006766	0.002509	-2.697165	0.0082

QE3	-0.005090	0.002741	-1.856748	0.0664
IP	-0.035102	0.015080	-2.327747	0.0220
EXPINF	0.256498	0.084610	3.031530	0.0031
FF	0.378676	0.058578	6.464499	0.0000
TED	0.141634	0.067715	2.091612	0.0391
COREINF	-0.260531	0.167879	-1.551896	0.1239

R-squared	0.932317	Mean dependent var	0.049777
Adjusted R-squared	0.926101	S.D. dependent var	0.010291
S.E. of regression	0.002798	Akaike info criterion	-8.832066
Sum squared resid	0.000767	Schwarz criterion	-8.583720
Log likelihood	486.9316	Hannan-Quinn criter.	-8.731371
F-statistic	149.9911	Durbin-Watson stat	0.725551
Prob(F-statistic)	0.000000	Wald F-statistic	130.6826
Prob(Wald F-statistic)	0.000000		