The Federal Reserve's Quantitative Easing - Promises and Outcomes in the Wake of the Great Recession

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This document represents part of the author's study programme while at the Institute of Social Studies. The views stated therein are those of the author and not necessarily those of the Institute.

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Dedication

I dedicate this study to my grandmother, Alla Metelitsa, who first taught me about the nature of dedication and the blessing of education and truth-seeking.

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List of Acronyms

BOE	Central Bank of England
BOJ	Central Bank of Japan
DC	Developing Country
ECB	Central Bank of the Eurozone (European Central Bank)
FOMC	Federal Open Market Committee
FRB	Federal Reserve Bank
FRS	Federal Reserve System
GDP	Gross Domestic Product
GR	Great Recession
MBS	Mortgage Backed Securities
PBOC	The People's Central Bank of China
QE	Quantitative Easing
QE1	First wave of QE (Nov 2008 – Jan 2010)
QE2	Second wave of QE (Nov 2010 – Jun 2011)
QE3	Third wave of QE (Sept 2012 – Oct 2014)
SME	Small and Medium Sized Businesses

Abstract

This study focuses on the Federal Reserve's policy of quantitative easing which was implemented in response to the financial crisis of 2007-8 and the subsequent Great Recession. The policy was intended to stimulate investment, fight deflation and boost household and business net worth to achieve the mandated aims of low unemployment and low, stable inflation. The policy involves trillions of dollars of liquidity generated and distributed by the Federal Reserve via purchases of Treasury securities, mortgage-backed securities and agency debt.

This analysis of QE presents a critical review of existing theoretical and empirical literature and an exploratory data analysis in an attempt to answer the question of whether the Fed achieved its aims with the policy and what other impacts it may have had on the U.S. economy. The findings show that QE, despite being useful to calm initial market panic, did not have a strong impact on the real economy and is not a sustainable solution to bring the U.S. economy to stability and growth.

Relevance to Development Studies

An analysis of the transmission channels and outcomes of U.S. QE is important in light of developing countries using or considering using elements of QE in their own monetary policies. In addition, by examining the theoretical logic and empirical outcomes of the suggested relationship between expansionary monetary policy and price levels this research is relevant in assessing prevailing advice given to developing countries by multilateral donor and financial organizations.

Keywords

Quantitative easing, financial crisis, Federal Reserve, monetary policy, large scale asset purchases

Chapter 1 – Introduction

This chapter is an overview of the research topic, problem statement and research questions. This chapter will also provide a description and justification of the chosen methodology, the relevance of this research for development studies, its scope and limitations as well as the study design.

1.1 – Background

This research will examine the large-scale asset purchase (LSAP, thereafter) program referred to as 'quantitative easing' (QE, thereafter), a policy taken up by the U.S. Federal Reserve central bank (the Fed, thereafter) in response to the financial crisis which began in 2007-8 and the subsequent 'Great Recession' (GR, thereafter). Deteriorating economic conditions in both the real and financial sectors prompted this unconventional monetary policy from the Fed in order to fulfill its Congressional dual mandate of promoting low unemployment and low, stable inflation. By building market confidence with this large and unprecedented policy, the Fed aimed to change the lending behavior of banks and the spending and investment behavior of businesses and households. According to the Fed's then-chairman Ben Bernanke, the policy was aimed to "encourage investment, boost consumer wealth" (Bernanke 2010) and fight deflation in order to create "easier financial conditions (to) promote economic growth" (ibid.).

The Federal Reserve has downplayed the experimental nature of QE, citing necessity due to the severe financial crisis and subsequent recession. However, QE may be the most important experiment of monetary policy in the last century and evaluation of this experiment is necessary. Different from the Fed's typical short-term asset purchases, quantitative easing represents a vast increase in the monetary base of the U.S. economy, fuelled by money creation to fund the LSAPs. To put it into perspective, "no investor public or private has ever accumulated such a large amount of securities in such a short period of time" (Gagnon et al. 2011: 9). Figure 1 shows increases in the asset side of the Fed's balance sheet as a result of QE, coming to a total of almost $4 trillion at the end of 2013.

Figure 1 – Assets Held by the Federal Reserve System
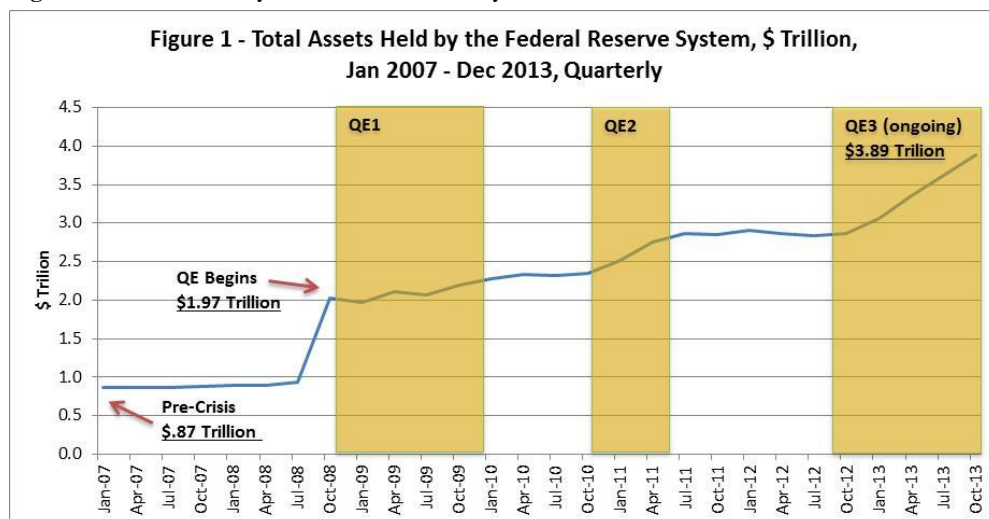
Source: FRB of St. Louis, FRED® database. Accessed 09/03/2014.

1.2 – Problem Statement

The goal of this research will be to examine the aims, rationales and outcomes of the Federal Reserve's quantitative easing policy in the wake of the recent financial crisis and the GR.

There is doubt about whether the Federal Reserve's QE policy is achieving an appropriate impact on the Fed's mandated targets of low employment and stable inflation. These goals have been difficult to achieve, making an unconventional monetary policy like QE a risky manoeuvre (Krugman 2010). The problem lies in reconciling the Fed's aims and rationales with conflicting empirical evidence of impact on policy targets. There is also an issue with the Fed changing its aims and rationales but continuing to employ the same policy.

1.3 – Research Questions

Main Question - What are the outcomes of the Federal Reserve's quantitative easing policy in terms of inflation and fixed investment?

Sub-Question – What other impacts has the quantitative easing policy had on the U.S. economy?

1.4 – Methodological Justification

The methods adopted in this study are two-fold. First is a critical review of existing theoretical and empirical literature on the rationales and outcomes of the QE policy. Empirical studies will be compared in terms of data, methodologies and results. Second is an exploratory data analysis to assess the rationales and outcomes of the policy. The analysis will be done using data on macroeconomic variables of the U.S. economy as well as financial and real sector assets and will also include lending and investment from periods in which QE was in operation. All of the data comes from the Federal Reserve System (FRS, thereafter). Exploratory data analysis has been chosen in lieu of econometrics due to a small time window to measure policy impact, the previous use of exploratory data analysis by central bank studies and a lack of such methods in analysing QE in the econometric studies surveyed in the literature review.

Fixed capital formation, as opposed to working capital or inventories, is chosen as the variable to represent growth in business investment. Fixed capital formation is the largest component of overall business investment, representing on average over 30% of gross private domestic investment in the last 10 years.[1] It is also considered to be an important indicator of longer-term economic growth which leads to growth in output and employment. Volatility of fixed investment spending is a prime contributor to cyclical fluctuations in aggregate output (Chatelain et al. 2003: 1-2, Chirinko 1993: 1).

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[1] Calculated by author. Data from the FRB of St. Louis, FRED® database. Accessed 10/29/2014.

1.5 – Relevance of Research for Developing Countries

An analysis of the transmission channels and outcomes of U.S. QE is important in light of developing countries (DCs, thereafter) using or considering using elements of QE in their own monetary policies. Although not comparable in size and breadth, several developing and emerging economy central banks have adopted policies following the crisis whose aims and rationales are parallel to those of QE. Many of these policies involve increases in the monetary base in order to boost and sustain economic growth when faced with sluggish economic conditions. The QE policy is thus not exclusive or unique to the U.S. or only to developed countries. Similar justifications have been given for such programs in DCs, making this study relevant for all countries embarking on or considering policies which employ features of QE.

Furthermore, prevailing monetary policy advice given to DCs by multilateral donor and financial organizations is based on the economic relationships underlying the rationales for QE. For example, the International Monetary Fund in its advice to Vietnam in its 2012 Country Report stressed that the State Bank of Vietnam needed to curtail interest rate cuts to prevent renewed pressure on prices leading to inflation (International Monetary Fund 2012: 10). The IMF was suggesting that by keeping interest rates high and money supply low the central bank would prevent inflation. By examining the theoretical logic and empirical outcomes of the suggested relationship between expansionary monetary policy and price levels this research is relevant for DCs in formulating their own monetary policies. It is important for developing economies because orthodox inflation targeting presents a trade-off between price stability and growth (Nicholas 2008). The Fed's QE activities, by pumping excess liquidity into financial markets, stand against advice given to DCs by the IMF to limit the money supply and engage in monetary tightening during times of financial distress.

1.6 – Scope and Limitations

One of the Fed's Congressional mandates is to promote low unemployment. Research coming from the Federal Reserve Bank (FRB, thereafter) of St. Louis admits a lack of theoretical and empirical backing for the ability of the Fed to directly influence long-term conditions in the labor market (Williamson 2014: 120). As such, the QE policy aims to impact business investment levels which have a bearing on aggregate output and economic growth in an effort to indirectly influence employment. Therefore, when assessing the impact of the QE policy on unemployment I consider fixed investment as a proxy variable for output and employment. Determining the actual impact of QE on unemployment would involve expanding on the trends and determinants of unemployment in the U.S. which is beyond the scope of this research.

It is not within the scope of this study to construct a counterfactual model which will allow for an estimation of inflation and investment if the policy of quantitative easing was not carried out or whether alternative policies were employed.

Depending on the theoretical framework underlying the policy rationale, the effects of the most recent wave of quantitative easing (QE3) may have a lag with which they impact policy targets. Due to QE3 commencing in September 2012 and concluding in October 2014 it is not possible to measure lagged impacts. Thus, the anal-

ysis of QE3 is provided as a supplement to analyses of earlier waves of QE. This research uses data on QE activities up until the end of 2013.

I have chosen to focus on the Fed's QE policy although there are several other central banks in both developed and developing countries who adopted similar programs in response to the GR. This choice is justified due to the greater scope and size of the QE program in the U.S. versus other countries as well as more detailed policy information issued by the Federal Reserve. Although this research is important for countries doing or considering QE policies, I am unable to analyze the outcomes of such policies by other central banks. In order to evaluate the economic impact of these policies I would need to examine the specific country context which goes beyond the scope available. Furthermore, we know there are some lessons to be learned from QE in terms of international trade and global monetary conditions but this would also require a review of specific country circumstances which limited by scope.

1.7 – Study Design

The study will proceed as follows. Chapter 2 will describe QE in detail and place it within its historical and institutional context. This chapter will also establish the aims and rationales of the policy. Chapter 3 will present a literature review of the theoretical and empirical underpinnings of QE. Different theoretical rationales behind the policy will be reviewed and relevant theoretical and empirical debates will be discussed. This chapter will also review existing empirical studies on the impact of QE on its policy targets. Chapter 4 will present the author's own empirical analysis and argumentation to bear on the theoretical rationales and outcomes of the quantitative easing policy. Chapter 5 will conclude by summarizing and evaluating the results of the analyses in order to put forward the main arguments with respect to the research questions.

Chapter 2 – Background of QE

2.1 – Pre-QE U.S. Monetary Policy

There is a precedent of consistently accommodative monetary policy by the Federal Reserve that can be traced back as far as the 'Black Monday' stock market crash of 1987 to which the Fed responded with increases in its securities holdings in order to depress interest rates and provide additional liquidity to the market (Carlson 2007). Commonly referred to as the 'Greenspan put' the Fed policy stance in the period from 1987-2006 as led by then-chairman Alan Greenspan was characterized by cuts in the federal funds rate in response to recessions, such as those of 1990-91 and 2001. In each case, the policy's aim was to avoid further deterioration in asset markets by providing additional liquidity which may have encouraged expectations that fed higher asset valuations and narrower credit spreads, fuelling excessive risk taking (Despeignes 2000).

An important developing during this time was the dot-com bubble, a speculative stock market bubble related to the Internet sector that formed during 1997-2000 and burst in the second half of 2000 with a stock market crash. The Fed quickly responded with a succession of rate cuts that continued further due to the second stock market crash following the September 11th, 2001 attacks on the U.S. The federal funds rate bottomed out at 1% between 2003-4 and never rose above its pre-2001 6% peak[2] in subsequent years. Bank reserves also jumped up following the dot-com and 9/11 crises, setting a precedent for post-crisis reserve accumulation. Ongoing monetary easing, coupled with an influx of surplus capital from Asian economies and trends in financial deregulation that had begun in 1980 contributed to a period of heightened liquidity and credit in the U.S. economy leading up to the financial crisis of 2007-8.

J. Taylor (2014) highlights the role that previous monetary policy may have played in causing the financial crisis by looking at how it shifted five years prior to the crisis. He shows how monetary policies, along with regulatory and fiscal policies, became more discretionary and interventionist during this time and the Fed moved away from its typical reaction function (J. Taylor 2014: 3). Taylor criticizes the Fed for its lack of predictability and rule-based behaviour during this period. The interest rate cuts the Fed embarked on in the new millennium were unusually low compared with the previous twenty years, creating a trend of the federal funds rate being below the inflation rate. This fuelled the housing boom and encouraged risk taking which may have led to the proliferation of toxic assets in balance sheets and bank failures as seen in the crisis (ibid.).

2.2 – Birth of U.S. QE

As the central banking system of the U.S., The Federal Reserve is charged with taking action in times of financial crisis. The Fed's role in response to financial crisis as stipulated in its founding charter of 1913 is to act as a 'lender of last resort', creating a backstop against bank runs and keeping the commercial banking system intact.

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2 Data from FRB of St. Louis - FRED® database. Accessed 11/10/2014.

As such, the Fed offers emergency liquidity facilities for member banks via its discount lending window and sets the base money market interest rate, called the federal funds rate, which conditions the level of interbank credit in the financial system and influences other interest rates in the repo and government bond markets. The Fed also attempts to control the money supply directly via open market operations where it engages in the purchase and sale of government debt. These traditional monetary policy tools have often been used by the Fed in response to financial stability concerns both in times of economic slumps and booms.

The adoption of QE by the Fed was initially undertaken in response to the financial crisis of 2007-8. Turbulence emanating from the collapse of the United States sub-prime mortgage market led to widespread financial and economic crisis. The trigger of the crisis was the busting of the U.S. housing bubble which had developed as property values soared during the early 2000s and households took on unprecedented levels of mortgage debt. As part of the housing and credit boom, financial instruments such as Mortgage-Backed Securities (MBS, thereafter) and related derivatives with underlying values tied to mortgage payments and housing prices were developed and widely used as investment vehicles around the world. When mortgage default rates accelerated, the value of these securities plummeted and systematically important global financial institutions, many of which were highly leveraged, were inadequately capitalized to handle the losses, leading to widespread financial crisis. Asset markets plummeted and there was a sharp contraction of liquidity and credit in financial markets, leading to a large spike in interest rates. The financial crisis subsequently led to a loss of productive activity in terms of bankruptcies and unemployment and world GDP experienced negative annual growth of -7% between late 2008 and early 2009, with global trade flows falling even further (White House Council of Economic Advisors 2010: 81).

The lack of liquidity and high contagion risk brought about by the financial crisis meant that banks were either unwilling or unable to lend to each other and the costs of financing soared resulting in a general credit shortage. As early as Q3 2007, the Fed's Federal Open Market Committee (FOMC, thereafter) had begun cutting its target federal funds rate in response to tightening liquidity conditions in U.S. financial markets. The federal funds rate was subsequently cut ten times until it neared zero at 0-0.25% (Federal Reserve Bank of New York n.d.). The federal funds rate is closely related to the repo rate at which the Fed offers liquidity in money markets and along with the closely related interbank and government bond rates these represent the basis for various other interest rates in the economy. The Fed's rate cuts aimed to boost the availability of liquidity in the system which was intended to restore order to financial markets and boost investor confidence in financial institutions. As part of its response the Fed also engaged in typical FOMC purchases of short-term Treasury securities in order to set the basis T-bill rate close to zero to depress short-term market interest rates which derive from the T-bill rate.

In addition to traditional expansionary monetary policies, the FOMC felt that something further had to be done to stimulate the economy and alleviate financial market distress. In the fall of 2008 the Fed launched an unprecedented policy in both scope and size which it felt was necessary to lower the cost of credit and spur economic growth. The program involved long-term securities purchases and was originally called 'credit easing' by the Fed (Bernanke 2009a). This program would come to represent trillions of dollars of liquidity generated and distributed by the FRS with a concomitant swelling of its asset holdings due to direct purchases of financial assets such as U.S. Treasury securities, MBS and related debt from commercial banks and

other private institutions. By buying these assets the Fed aimed to raise their price and lower their yield in an attempt to reduce long-term interest rates that derive from Treasuries and to prop up the housing, mortgage and other asset markets. Lower interest rates and higher borrower net worth due to appreciating assets were intended to stimulate bank lending for business investment, boosting growth and employment. Quantitative easing represents a vast increase in the monetary base of the U.S. economy as the Fed's purchases are financed with newly created money distributed to the banking system. This is intended to fight deflation by augmenting the money supply in order to generate a stable rise in the price level. The banks are expected to use QE money to buy assets and make new loans, increasing the money supply which should lead to inflation, further boosting growth and employment.

2.3 – Technical Information on U.S. QE

Magnitudes and Dates

QE1

Prior to the start of quantitative easing the Federal Reserve already held $700-800 billion of short-term Treasury securities on its balance sheet as a result of ongoing open market operations. The initial QE policy announcement was made on November 25th, 2008 when the FOMC indicated that they intended to purchase up to $500 billion of MBS and $100 billion of associated debts of major government-sponsored mortgage underwriter agencies like Fannie Mae and Freddie Mac (Federal Reserve System 2008b). On March 18th, 2009 the FOMC indicated plans to increase the Fed's balance sheet further by purchasing an additional $750 billion of MBS and $100 billion of agency debt plus $300 billion of longer-term Treasury securities (Federal Reserve System 2009). Later the total agency debt would be reduced to $175 billion versus the original $200 billion committed to. This brings the total magnitude of QE1 to $1.725 trillion. When QE1 completed at the beginning of the first quarter of 2010 the Fed balance sheet was equivalent to 16% of U.S. GDP (Ashworth 2013: 4).

QE2

Due to continuing high unemployment and low, declining inflation the FOMC announced plans on November 3rd, 2010 to purchase a further $600 billion of longer-term Treasury securities by Q2 2011 at a structured pace of $75 billion per month (Federal Reserve System 2010). The second wave of quantitative easing concluded as planned in June 2011.

QE3

Citing the need to continue supporting weak economic conditions and slow employment growth, on September 13th, 2012 the FOMC announced a further round of quantitative easing involving the ongoing purchase of $40 billion of MBS per month without a target end date (Federal Reserve System 2012a). It should be noted that through ongoing reinvestment of maturing assets on the Fed's balance sheet the actual monthly investment in long-term securities was to be about $85 billion per month through the end of 2012 (ibid.). On December 12th, 2012 this round of quantitative easing was further augmented with plans to purchase $45 billion per month of longer-term Treasury securities beginning in 2013 (Federal Reserve System 2012b).

Figure 2 shows the evolution of the asset side of the Fed's balance sheet from prior to the crisis in January 2007 to just before the launch of QE3 in April 2012, broken down by type of asset.

Figure 2 – Breakdown of Federal Reserve Balance Sheet
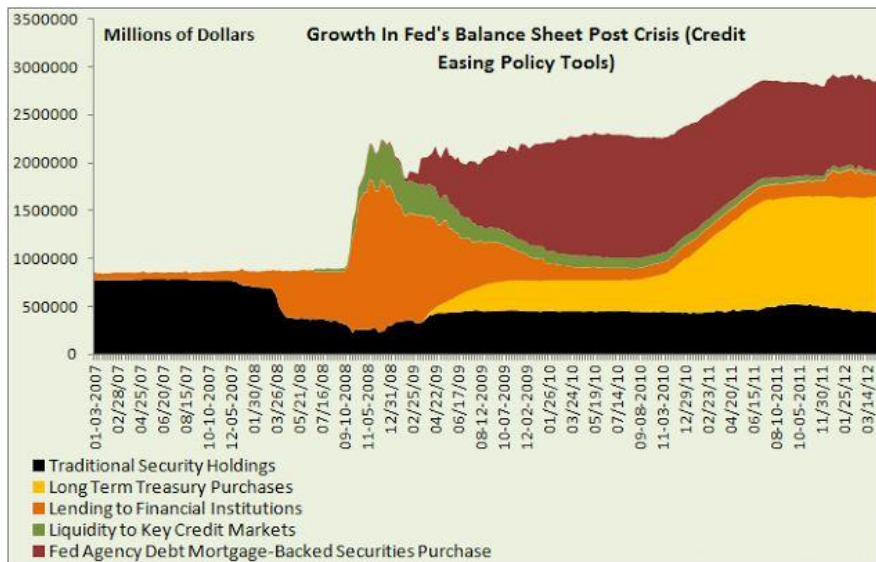
Source: Economics and Finance Fanatic (2012), author uses data from FRB of Cleveland. Accessed 11/06/2014.

2.4 – Rationales Behind QE

When the first wave of quantitative easing was announced by the FOMC, the rationale for the policy 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" (Federal Reserve System 2008b). When this wave of QE was augmented a few months later to include purchases of Treasuries the rationale was expanded to "improve conditions in (overall) private credit markets" (Federal Reserve System 2009) in order to stimulate real economic growth. Essentially this involved fixing bank balance sheets in order to stimulate lending for investment. The intermediate policy targets of the first round of QE were long term interest rates, on mortgages and on bank credit for private sector investment.

An additional goal of QE made explicit at the launch of the second and third waves was that of preventing "inflation over the medium term (that) would run at or below its 2 percent objective" (Federal Reserve System 2012a) to further support growth and bring about "sustained improvement in labor market conditions" (ibid.). Low inflation levels during the GR indicated to the Fed that the economy still had spare capacity that could be stimulated by monetary policy (Bernanke 2010). The Fed does not elaborate on the specific determinants of the 2% target, only that it is consistent in the long run with its price stability objective in terms of preventing inflation from getting too high while maintaining a small level of inflation to "make it less likely that the economy will experience harmful deflation if economic conditions worsen" (Federal Reserve System 2013). Faced with poor economic conditions and unable to depress money market rates any further with the policy rate, the Fed turned to asset purchases to inject money into the system.

As early as 2002 the future Fed chairman Ben Bernanke had stated that when faced with the threat of deflation under a zero-bound policy rate the U.S. government "by increasing the number of U.S. dollars in circulation, or even by credibly threatening to do so … can reduce the value of a dollar in terms of goods and services" thereby causing inflation (Bernanke 2002a). Deflation is considered harmful for economic growth because price declines affect the expected rates of return on monetary and physical assets making the usefulness of holding on to money balances stronger than that of investment in or consumption of physical assets. The danger of very low or zero inflation leading to deflation, as in the case of Japan, can lead to prolonged recession, high unemployment and financial stress (Bernanke 2002a). The goal of QE is to prevent deflation before it can set in because stopping deflation that has already set in is much more challenging (ibid.).

The intermediate policy targets of the second and third waves of quantitative easing were excess money supply and higher asset prices. More money in the system is supposed to increase nominal income leading to an increased inflation rate and stable inflation expectations. Higher asset prices are supposed to lead a "virtuous circle (to) further support economic expansion" (Bernanke 2010), essentially a 'wealth effect' to stimulate consumer spending and business investment.

2.5 – Precedents and Contemporaries of U.S. QE

Japan

The closest precedent to the Fed's quantitative easing was originally adopted by the central Bank of Japan (BoJ, thereafter). Between 1986 and 1991 the Japanese economy had developed a real estate and stock market bubble, fuelled by easy monetary policy (Demaestri and Masci 2003: 15). Overconfidence and speculative activity in asset markets led to rapidly increasing asset prices. The BoJ began monetary tightening in early 1990 and by the end of 1991 asset prices began to collapse. Japanese lenders began experiencing growing numbers of Non-Performing Loans (NPLs, thereafter) related to the falling asset markets, which eventually led to a banking crisis in 1997 (Nelson and Tanaka 2014: 39).

The BoJ initially took no action but eventually cut the basis interest rate, which fell to below 0.5% in the mid-1990s. At this point the Japanese economy was already embroiled a long period of economic stagnation referred to as the 'lost decade'. Lack of consumer confidence choked off spending and deflation took hold, bringing with it falling profits, wages, employment and production.

The BoJ launched a new policy on March 19th, 2001 in an effort to combat deflation which it called 'quantitative monetary easing'. At this point the basis interest rate had been cut to 0.1% and prices had been falling for years. The BoJ changed its operating target from the overnight bank rate to the quantity of bank reserves held with the BoJ. Japanese quantitative easing involved the purchase of government bonds from banks and the provision of loans to banks with the initial target of increasing bank reserves from ¥4 trillion to ¥5 trillion. Within two years the BoJ had increased Japan's monetary base by about 60% (Andolfatto and Li 2014: 1). The legacy of the asset price collapse was still felt in Japan as the private sector continued to deleverage and banks continued to recognize and write off NPLs in the new millennium. By 2004 the BoJ had increased the bank reserve target to ¥35 trillion and was also engaging in purchases of private debt.

Despite these efforts, according to empirical evidence and statements from BoJ officials, this policy "appears to have had little, if any, impact on inflation" (Andolfatto and Li 2014: 1). Kawai (2012: 2) mentions studies suggesting some impact of Japan's QE on long-term interest rates but minimal impact on credit growth, inflation or economic activity. Japanese authorities have attributed this to the lack of speed in implementing the policy (McCurry 2008). Other explanations credit the failure to a lack of confidence in the BoJ's commitment to increasing the inflation rate leading to expectations of a future monetary contraction, showing poor expectation management by the BoJ from 1998-2003 (Bernanke 2002a, Eggertsson 2003: 23, Ito and Mishkin 2004). These contractionary expectations became a reality when the BoJ's QE program was suddenly stopped on March 9th 2006 when the BoJ reverted to its original operating target of the overnight bank rate and partially reversed the QE program in the following years.

QE in Developed Countries Following the Crisis

Aside from the U.S., other developed country central banks responded to the financial crisis with common policies in terms of emergency liquidity provision and lowering of policy rates to near zero. Faced with continuing financial market instability, lack of real output growth and below-target inflation rates, the central banks of Japan, the United Kingdom and the Eurozone all responded with quantitative easing policies. Initially intended to reduce financial market distress, the various programs would eventually broaden their scope depending on the individual aims of each central bank. Regardless of their approach, any programs by these banks that increased the monetary base outside of normal short-term lending or sterilized asset purchases will be considered to be quantitative easing.

As previously mentioned, the Bank of Japan tapered its QE activities in March 2006. It did so by letting short-term assets on its balance sheet mature without replacing them. However, the BoJ continued with government bond purchases at a pace of ¥1.2 trillion per month, last increased in October 2002, as a legacy from the bond purchases it had initiated in the 1990s. After the impact of the financial crisis Japan decided to increase these monthly purchases to ¥1.8 trillion per month and developed various bank loan programs, increasing the monetary base in order to ease credit conditions and fight deflation, now a two-decade phenomenon in Japan. The BoJ's renewed QE policy would increase its asset position to almost ¥187 trillion by the end of 2012. The BoJ's goal with these purchases was to depress long-term interest rates, in line with the Fed. An additional goal of BoJ's QE may have been to lower the value of the yen versus the dollar (Allen 2010). The U.S. QE2 program in 2010 led to drops in the dollar viz-a-viz the yen and Japan wanted to make its exports more competitive to boost growth (ibid.). Faced with continuing deflation and under guidance from new prime minister Shinzo Abe, the Bank of Japan decided in April 2013 to further expand its QE policy more in line with the magnitude of the Fed's QE3, to a total of $1.4 trillion (¥7 trillion per month), doubling the Japanese monetary base with the aim of boosting demand and fighting the decline of prices and wages (Stewart 2014).

In response to the crisis, the central Bank of England (BoE, thereafter) made some initial private asset purchases in January 2009 with the goal of making asset markets more liquid to increase the availability of corporate credit. Because these purchases were sterilized with offsetting government gilt issuance they did not constitute true QE in terms of increasing the monetary base. In March of 2009 the BoE announced actual QE funded by money creation which involved the purchase of

government and corporate bonds from private financial actors; the permitted amount of these purchases was incrementally increased until it reached £375 billion in July 2012 (Bank of England 2012a), approximately 25% of the U.K. GDP (Ashworth 2013: 13). The main objective of these LSAPs was to boost the money supply to meet the bank's inflation target of 2%. The bank purchased primarily longer-term government bonds funded by reserve issuance, reflecting a similar strategy to that of the Fed. The BoE's goals were also similar to the Fed's: lower the cost of financing to stimulate bank lending and increase the money supply to fight deflation and achieve the inflation target (Bank of England 2011).

The Central Bank of the Eurozone (ECB, thereafter) has the least similarities in its QE program with the Fed. In late 2008 the ECB was concerned with widening spreads in the interbank lending market due to growing counterparty risk. It addressed these issues using refinancing operations for banks to access low-cost, low-conditionality repo loans in the magnitude of about €1 trillion (Traynor 2014) with net lending coming to about 5% of GDP (Ashworth 2013: 14). The ECB also purchased €100 billion in covered corporate bonds by the end of 2011. These refinancing operations and asset purchases were mainly sterilized from impacting the monetary base and thus do not constitute true QE (Fawley and Neely 2013: 72). The initial goal of the ECB's crisis policies was to address tight interbank and corporate lending conditions. When the European sovereign debt crisis intensified in 2010 the ECB adopted the additional goal of addressing it by purchasing sovereign debt in secondary markets. As of August 2012 the ECB has continued to target sterilized sovereign debt purchases. However, analysts predict that the ECB will eventually be forced to engage in more typical QE due to deflation and growth concerns (Bloomberg TV 2014).

QE in Developing Countries Following the Crisis

Elements of the Fed's QE policy have been employed by several central banks in emerging and developing countries. In addition to cuts in policy rates, which have occurred across the board in the countries discussed below (Akyuz 2010), there have been some unconventional monetary policies. Several programs in DCs have focused on injecting liquidity into financial institutions in order to stimulate bank lending for investment and have also attempted to increase the monetary base in order to prevent currency appreciation.

China is an emerging market economy considering crisis response policies which resemble the Fed's QE. The People's Central Bank of China (PBOC, thereafter) has made several cuts in the reserve requirement ratio aiming to increase the amount of liquidity in the financial system by freeing up required bank reserves that could be used for lending. In addition to cuts in the reserve requirement ratio, the PBOC may be considering a bond purchase program in order to further boost bank liquidity (Global Capital 2012). Banks, being the biggest buyers of bonds in the Chinese economy, stand to benefit directly from the cash injection which the PBOC hopes will help meet loan growth targets, a key priority for regulators (ibid.). The rationale is that the banking sector has a tight linkage with macroeconomic conditions and that increases in bank credit will boost economic recovery and growth in DCs (Krueger 2013: 17). China is not alone in these convictions. The central banks of Korea, India, Thailand and Indonesia have all embarked on crisis response programs which provide liquidity to financial institutions in order to boost investment lending, in some cases to offset reductions in external financing of exporters (Akyuz 2010: 27). In ad-

dition, the PBOC has attempted to boost mortgage lending to revive real estate demand in order to improve overall investment levels (ibid.).

Furthermore, the crisis policies of several Asian DCs aimed at preventing deflation in order to maintain export competitiveness. In the Philippines, the central bank is seeking to stem currency appreciation by limiting the use of certain high-yield investment accounts (SDAs) (Jiao 2013). The rationale is that flushing out SDA deposits into the economy will increase the money supply and prevent currency appreciation. A similar program has been launched in Malaysia where currency is being printed by the monetary authorities in order to bring down the value of the ringgit to boost exports and the overall economy (Au 2012). Coming back to China, the PBOC is withholding from sterilizing foreign currency transactions relating to its current and capital account surpluses, aiming to increase the amount of Chinese currency in circulation in order to increase credit expansion (Akyuz 2010: 27). It is evident that several rationales used for DC crisis policies are mirrored by those of the Fed's QE policy.

2.6 – Summary

Originally implemented by the Bank of Japan to fight deflation with limited results, quantitative easing is a policy that was adopted by the Federal Reserve in response to the sub-prime mortgage collapse which caused widespread financial crisis. This was preceded by some twenty years of accommodative monetary policy in the U.S. where liquidity and credit were central to the boom and bust of various asset markets. The Fed's QE policy was designed to address poorly functioning financial markets and the subsequent decline in real output and employment during the GR. The three waves of QE that have occurred from late 2008 through the end of 2013 have totalled $3.5 trillion. The initial aims of QE were to restore order and boost confidence in financial markets, namely both wholesale and retail money markets and the housing market in order to stimulate consumption and lending for business investment. Subsequent aims included generating inflation to fight a deflationary trend and to boost asset prices in order to generate an asset wealth effect to simulate investment. QE in other advanced countries had common aims and rationales to U.S. QE, but sometimes had differing mechanisms and scopes. Central banks in the developing world also engaged in some elements of QE as part of their crisis response, with similar rationales to those of the Fed.

Chapter 3 – Literature Review

The general aim of expansionary monetary policy is to impact real, inflation-adjusted interest rates and the money supply in order to make banks want to lend, businesses to invest, consumers to spend or invest in housing, all of which is meant to increase output and employment. In normal times when the federal funds rate is not zero-bound, a lowering of nominal short-term interest rates effects a lowering of real short-term interest rates. Lower real short-term rates can cause a fall in the long-term real rates because long-term real rates are an average of expected future short-term real rates.

Since the Fed is currently operating at a 25bp federal funds rate, regular monetary transmission channels do not apply. Commonly referred to as a 'liquidity trap' this is a situation in which expansionary monetary policy with nominal interest rates close to or at zero does not translate into a decrease of real interest rates or an increase in inflation (Krugman 2010). There is a lack of theoretical consensus around the possibility of stimulating the economy in the presence of a liquidity trap and what are the monetary means at the disposal of the central bank in order to do so. Quantitative easing represents an emergency response to a liquidity trap that seeks to increase the monetary base to reduce the cost of credit and generate inflation. Better credit market conditions and a moderate level of inflation are supposed to help stem the market chaos following the financial crisis and to allow the economy to recover from the GR through higher investment levels.

3.1 – Rationale 1: Bank Lending

The first rationale to be analyzed is that of improved conditions in private credit markets in order to facilitate bank lending for investment. The aim is to increase liquidity in corporate debt markets and to encourage lower rates and easier credit conditions on long-term lending.

Bank Lending Channel – Theory

A theoretical framework in favour of the effectiveness of monetary policy even when nominal interest rates are zero-bound is one by Mishkin (1996) as well as Bernanke and Gertler (1995). Mishkin states that when traditional interest rate channels of monetary policy no longer succeed in bringing about a fall in real interest rates the credit channel becomes an important policy transmission vehicle for a central bank. Bernanke and Gertler along with Mishkin suggest a credit-based channel of monetary policy transmission called the bank lending channel and stress that issues in credit markets have a direct bearing on the real economy. The credit-channel exists because banks are in a unique position to solve asymmetric information problems and other frictions in credit markets, making them the center of credit intermediation (Kroszner et al. 2007: 190). The existence of substantial credit market frictions (such as those prevailing during the financial crisis) is considered by Bernanke et al. (1999) as a 'financial accelerator' which is able to greatly intensify and prolong the effects of macroeconomic shocks on investment, representing an important area in which bank credit can impact the real economy (p. 1345). Low levels of investment are thought to lead to low long-term economic growth and high unemployment (Chirinko 1993: 1875). There exists evidence of monetary policy shocks affecting fixed investment by

impacting the purchases of durable assets and production equipment (Bernanke and Gertler 1995: 28).

In the bank-lending channel, when a central bank engages in monetary expansion, either directly or indirectly targeting bank reserves, it will have the effect of increasing those reserves leading to a corresponding increase in the amount of loans the banks give to businesses who then boost aggregate output by making fixed investments and expanding production. Fluctuations in investment are theorized to be closely linked to the stance of monetary policy (Chatelain et al. 2003: 2). Businesses borrow more because the 'external finance premium', or the difference between the cost of funds raised externally and those generated internally, decreases in response to expansionary monetary policy making the cost of borrowing more attractive (Bernanke and Gertler 1995: 28). If the supply of bank loans diminishes or becomes more costly due to banks' risk-aversion or lack of liquidity the external finance premium increases which reduces real economic activity. This is because a widening external finance premium coupled with decreasing net worth of firms due to a cyclical downturn creates a 'financial accelerator' effect which feeds into itself and depresses business investment and aggregate output levels (Bernanke et al. 1999). According to this theory, all business investment is financed with either net worth or borrowing. Business net worth is derived from either profits or asset prices and higher net worth leads to increased internal financing of investment whereas lower net worth increases the importance of credit to sustain growth but also widens the external finance premium due to a higher default probability (ibid.). Adverse productivity or demand shocks lower current cash flow, reducing the ability of the firm to fund investments with retained earnings. Economic shocks lower the value of assets held by the firm, decreasing its net worth. Cyclical fluctuations in business net worth coupled with a credit crunch can intensify economic shocks and stifle crisis recovery. By attempting to lower the cost and ease the terms of credit, the QE policy aims to stimulate investment capital provision.

An assumption inherent in the bank-lending channel is that the enhanced liquidity positions of banks will lead them to lend for fixed capital formation. Furthermore, the impact of QE on lending is supposed to be stronger for credit-constrained firms with less liquid balance sheets (Bernanke et al. 1999, Kashyap and Stein 2000, Kroszner et al. 2007). Small and medium sized businesses (SMEs, thereafter) are thought to benefit from QE due to higher credit-constraints in not being able to issue equity or bonds like larger corporations in times of tight lending conditions. Therefore, in addition to large corporations this channel should also impact SMEs.

Bank Lending Channel – Theoretical and Empirical Debates

Financial sector reform in the past few decades stands in opposition to the bank-lending channel theory. Due to deregulation in the U.S. that came into effect in the mid-1980s, banks may be able to raise capital irrespective of the stance of monetary policy. For example, in a tight monetary environment banks are able to augment their capital base by issuing certificates of deposit at the market interest rate without a reserve requirement (Mishkin 1996: 10, Bernanke and Gertler 1995: 41). Since banks have more flexibility in being able to raise funds on margin due to deeper markets for bank liabilities the bank-lending channel may not be as dependent on monetary policy as theorized.

Bernanke and Gertler also describe issues with the theoretical focus on the cost of capital (1995: 27-28). They point out that empirical studies have been unable to show an impact of the cost of credit variable on interest-sensitive components of aggregate spending. Other variables such as lagged output, sales or cash flow appear to be far more important than interest rates in explaining a change in aggregate spending (ibid.). Chatelain et al. echo this by presenting evidence that shows that sales growth and cash flow, in addition to the interest rate, have a significant effect on corporate investment (2003: 9).

There is evidence against the bank-lending channel showing a lack of connection between bank loans and businesses' fixed capital investment sources. An empirical study by Corbett and Jenkinson comparing the sources and uses of funds for businesses in four of the largest developed economies[3] has found that the majority fund physical investment using internal sources like retained earnings rather than external bank financing (1997). The results show that U.S. firms' net sources of finance are comprised of 96% internal funds over the time period 1970 - 1994 (Corbett and Jenkinson 1997: 74). Especially since the 1980s, the trend for U.S. corporations has been to move towards internally generated funds and bond financing and away from bank financing.

There are trends in this study's data showing that following a recession, such as in Japan in 1994 or the UK in 1993, firms typically deleverage and decrease future borrowing in favour of internally generated funds (Corbett and Jenkinson 1997). If we examine this data for cyclical trends in the U.S. we can see that following the recession in the early 1990s the use of external finance fell very sharply and only recovered to previous levels four years later in 1994. A similar effect of lesser magnitude can be observed in the U.S. following the 1973-1975 recession. If these cyclical trends apply to the GR we can expect U.S. businesses to deleverage and turn away from additional bank or bond finance, even if it is made available at attractive terms and prices. Therefore, the recessionary environment also diminishes the benefits of QE via lower bond rates as U.S. corporations will seek less bond leverage. Additionally, we must consider the elasticity with which businesses can substitute bank credit with another type of credit on short notice. According to Kashyap and Stein, evidence of an asset wealth effect on business' net worth implicitly lessens the influence of the bank lending channel (2000: 2). If businesses benefit from expansionary monetary policy which increases their net worth, this makes them more attractive to any external investor (such as a thrift, a credit union or a venture capitalist) and not just a bank.

Goodhart (2010) proposes a theoretical framework for investment lending in which the banks only set the cost and conditions of credit and given these, the private sector determines their choice of deposits and loans. Therefore, the banking sector supply of loan and deposit facilities does not drive their expansion but rather the preferences of agents in the real economy. The timing and usage of credit is therefore demand driven, determined by borrowers according to spreads, real output, the price level, rate of inflation and interest rates on other assets (Goodhart 2010). According to this framework, a lack of demand for investment lending would render the bank-lending channel of QE impotent in stimulating the real economy.

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[3] Germany, U.S., U.K. and Japan.

Bank Lending Channel – Evidence from QE

Most empirical studies of QE relating to the bank lending theory attempt to estimate the impact of the policy on intermediate targets like government bond rates and other key long-term rates. Event studies and econometric analyses are used to determine the impact of the Fed's asset buying on various interest rates and spreads which dictate the costs and conditions in credit markets.

QE1

Studies focusing on QE1 report the strongest effects compared with later waves of QE. Gagnon et al. (2011) conduct an event study that finds a reduction by almost 1% in the yields of 10-year government bonds as a result of QE1. Event studies are carried out at a certain short time window (typically one or two days) to determine the impact of QE events such as policy announcements or actual purchases. Various other event studies structured around key policy events also find an approximately 1% reduction in long-term bond yields as a result of QE1 (Glick and Leduc 2011, Krishnamurthy and Vissing-Jorgensen 2011, Martin and Milas 2012, Neely 2010). However, Gagnon et al. do admit that empirical event studies on QE announcements are not ideal as effects from other parts of the announcement such as indicators of the Fed's economic outlook and future policy stance are hard to separate from the effects of the QE announcement itself (2011: 20).

The econometric model used by Gagnon et al. (2011) in the second part of their analysis depends on historical data to estimate the impact of QE on the interest rates of Treasuries. The model generates a slightly smaller estimate of an 80 basis-point reduction upon impact of QE1 events. Despite this fall, the study shows that on a net basis over the lifetime of QE1, interest rates on Treasuries actually increased. This means that the policy caused at best temporary falls in yields. The study concludes that QE1 was a temporary success in removing market frictions and lowering the cost of borrowing, especially in the mortgage market. It also finds reductions in the rates of various long-term securities not directly targeted by the Fed, indicating the impact of QE on the broader economy.

Another econometric study of QE1 makes use of contemporary rather than historical data and estimates a reduction of up to 50 basis points for longer term government bonds as a result of QE1 (D'Amico and King 2010). It is notable that in many of the empirical studies of QE1, the econometric model results tend to be smaller than the event study results, attributable to a strong initial response and subsequent unwind of policy effects. For example, Martin and Milas show that despite temporary falls, government bond rates rose again by the end of 2009 to their previous 2007 levels (2012: 753). Several other studies also find that the effects of QE1 on interest rates are initially large and significant but diminish greatly with time (Chung et al. 2012, Meaning and Zhu 2011).

QE2 & QE3

Subsequent waves of QE have had much weaker effects on interest rates. QE2 was twice as large as QE1 in terms of the value of Treasury securities purchased but its effects have not been as strong. Event studies find that QE2 caused at most a 10-45 basis point reduction (Ashworth 2013, Krishnamurthy and Vissing-Jorgensen 2011) and some studies find none or mixed effects on long-term government bond yields (Glick and Leduc 2011, Meaning and Zhu 2011, Szczerbowicz 2011). Likewise, econometric studies of QE2 estimate at most a 20bp reduction (Meaning and Zhu

2011) with stronger initial effects which fall to almost nothing by 2012 (Chung et al. 2012).

Analysis

The transient nature of QE's impact on interest rates is apparent in the empirical literature. Fairly strong effects of QE1 on interest rates are shown to be temporary and subsequent waves of QE don't seem to have as strong an impact as the first. It is likely that initially, QE boosted credit market confidence and removed market frictions in terms of spreads and risk perceptions thanks to its novelty and large size. But the "novelty or surprise factor associated with LSAP1 (QE1) might have waned over time as "more of the same" failed to evoke market reactions of similar magnitude" (Meaning and Zhu 2011: 4). Continuing increases in stimulus may be required to achieve the same effects (Lu 2013: 346). QE helped to alleviate serious financial market distress when it initially launched in 2009 but as these effects dissipated, longer-term effects have been difficult to achieve. In terms of supporting a theorized bank-lending channel, QE at best prevented a dysfunctional credit market and temporarily lowered interest rates. Whether this stimulated corporate investment due to a narrowing of the 'external finance premium' via the assumed relationship between bank lending and investment will be addressed in this study's empirical analysis.

The theories underlying the credit channel of monetary policy transmission lean heavily on bank lending as a conduit for recovery and growth of the real economy (Bernanke and Gertler 1995, Mishkin 1996). However, Ashworth shows that quantitative easing has not resulted in a revival of bank lending (2013: 17). This can be attributed to both supply and demand conditions in credit markets during the GR. From a supply perspective, current trends in reserve accumulation by commercial banks show that the additional money supply from QE is held in vaults instead of entering the broader economy in a phenomenon called the 'reserve trap' (Herbst et al. 2014). Banks' risk-aversion makes them unwilling to lend in the face of continuing economic stagnation. The spread between the rate the banks charge to lend and the rate they pay for savings had widened which stifles lending. In addition, QE can actually lead to lower profitability of banks as lower yields on securities they hold reduce their net interest margin, further discouraging credit provision (Ashworth 2013: 17). Faced with more stringent regulations in terms of leverage, capital and liquidity and rising riskiness of lending to the private sector, banks have tightened lending terms significantly.

A lack of credit demand is also limiting the potential effectiveness of the bank-lending channel. If we take the retail money market as primarily demand driven as per Goodhart (2010), the distinction between credit extension and credit usage is important in explaining the lack of demand for debt. If it is primarily the preferences of the private sector[4] which determine credit usage the bank can only influence credit usage via the cost and terms of credit, both of which went up during the crisis due to lower expected profitability, higher risk perceptions and higher regulatory requirements of banks (Goodhart 2010, Ashworth and Goodhart 2012). In addition, during the GR many of the largest U.S. corporations deleveraged by repaying bank borrowing and sought funds in capital markets instead (Goodhart 2010: 77). If the Federal

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[4] Determinants of which are the policy interest rate, real output, wealth, price level, inflation and rates on other assets. Liquidity and bank risk perceptions also become important determinants when in an economic crisis (Goodhart 2010: 81).

Reserve by way of QE can at best influence banks' credit extension but not the real economy's credit usage, even granted that the two have a stable relationship during normal times, it may be powerless to influence lending during a recession. Both the bank and non-bank sectors tend to engage in extensive deleveraging as a part of their crisis response which generates limited credit supply and demand.

It is notable that QE has done little to affect the interest rates facing SMEs especially on uncollateralized borrowing (Martin and Milas 2012: 758). Widening risk spreads from banks have overshadowed drops in the official policy rate. Outstanding SME loans in the U.S. have declined continuously from 2008-2011 (Herbst et al. 2014: 3). Considering that SMEs create 65% of new private sector jobs and contribute to over 50% of non-farm GDP in the U.S. (Grover and Suominen 2014: 2) the lack of impact of QE on the cost of credit for SMEs stands in opposition to the Fed's mandate of boosting output and employment. Outstanding SME loan balances[5] as of June 2013 have yet to return to pre-crisis levels, standing at almost $50 billion shy of what they were 5 years prior (ibid.). This evidence stands counter to the assumption of the bank lending theory that the QE policy is especially suited to boost lending to smaller, credit-constrained firms.

3.2 – Rationale 2: Inflation

The second rationale to be examined is that of generating inflation to prevent deflation and ensure price stability. The aim is to increase the money supply to generate higher nominal income and higher price levels.

An inflation level above zero is considered by the Fed to be an important part of their financial stability mandate with the more specific aim of preventing unwanted demand and price movements by targeting an optimal inflation rate of 2%. The mechanism the Fed uses to achieve this target is the money supply with the aim of impacting the value of the dollar in terms of real buying power for goods and services which has an effect on prices and the inflation rate. To change the money supply the Fed targets the monetary base, also referred to as 'high-powered money', which is the narrowest form of money represented by notes and coins in circulation and bank reserves.

Quantity Theory of Money

A theory of inflation supporting this mechanism and underlying a primary branch of monetary economics is the 'Quantity Theory of Money' elaborated on by Milton Friedman in 1956 which he supported with an empirical study with Anna Schwartz in 1963. The theory states that an increase in the money supply leads to higher prices of goods, services and labor. A distinction is made in the short-term between the nominal value or the currency amount of money and the real value which is the purchasing power of money in terms of goods and services. In addition to absolute measures of the quantity of money, its velocity of circulation is considered as impacting income and price levels.

The theory states that money holders are concerned with real money values and will generate nominal outflows if the real amount of money they hold is in excess. If

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[5] Commercial and industrial loans of $1 million or less.

it is assumed that prices and incomes are flexible, these attempts to spend more will increase total spending and receipts in the economy in nominal terms which has the effect of bidding up prices and increasing output. As prices rise the real value of money diminishes as more money in nominal terms is required to buy the same amount of goods and services. Inflation has the short-run effect of increasing output and decreasing unemployment according to the Phillips curve which establishes an inverse relationship between inflation and unemployment (Friedman 1987).

The theory states that the determinants of the nominal supply of money are the amount of high-powered money in the financial system, the ratio of bank deposits to bank reserves and the ratio of the public's deposits to its currency holdings. Since the supply of money is no longer tied to a commodity as it was during the gold standard, it is entirely up to the Federal Reserve and the Treasury how much fiat-based money should be supplied to the system. Friedman posits that changes in the demand for real balances are slow and gradual, whereas changes in the supply of nominal balances, such as the Fed expanding the money supply, have a strong and more immediate impact on prices and nominal income (Friedman 1987: 3). This assumes that the Fed can exercise meaningful control over the broader money supply. The income velocity and money multiplier are assumed to stay stable. The Fed's aims in increasing the nominal supply of money are not to just increase the price level but to cause a change in the rate of inflation in line with their 2% target in order to set a stable growth in the cost of holding money. They also attempt to satisfy the other part of their dual mandate, low unemployment, by inflating nominal income and output which creates a temporary boost to employment.

The real quantity of money in the system depends on how the nominal quantity of money supplied interacts with the real quantity demanded. The factors influencing demand by consumers include wealth, the division of that wealth amongst different assets and the expected rates of return on these various assets. According to Friedman's framework, when the Federal Reserve augments money balances for a set community like the U.S. all the variables determining individual demand for money adjust accordingly, including the structure of monetary institutions that respond to the preferences of money holders. The primary drivers of money balances and of inflation in this theory are therefore the monetary authorities with the rest of the economy adjusting in response to the monetary shock.

In their empirical survey of monetary trends in the U.S., Friedman and Schwartz present evidence that real income, interest rates and income velocity explain historical variation in money holdings (Laidler 1982: 297). They find that the real economy reacts and adjusts to monetary impulses over several business cycles and conjecture that long-term monetary effects are what cause long swings in economic growth. Friedman and Schwartz's empirical analysis attempts to show that changes in money supply impact prices and output rather than money supply passively reacting to changes in the economy. They do so by examining certain historical episodes where changes in the money supply caused shifts in prices and output unrelated to economic conditions (Bernanke 2002b). The most notable finding from their study is a criticism of the Federal Reserve for its response to the Great Depression in which it focused on easing interest rates rather than expanding the money supply. The authors suggest that the Fed should have injected more high-powered money into the banking system to prevent large drops in the money multiplier and tight money supply prevalent during the years of deflation in the 1930s (Ashworth 2013). Ben Bernanke supported the theory of Friedman by promising that "we won't make the same mistakes again" (Bernanke 2002b).

Empirical studies of the quantity theory show that the initial impact of a change in the money supply affects per capita income, output and interest rates about six to nine months after the monetary growth with effects on the price level only about one to two years after (Friedman 1987). According to the 'theory of money neutrality' in the long-run the effects of monetary expansion on the real economy dissipate but inflation is shown to persist, leading the Monetarists to stress stable monetary supply rules.

Quantity Theory of Money – Theoretical and Empirical Debates

Goodhart (2010) criticizes the monetarist approach by investigating the analytical framework of the money multiplier. According to the quantity theory, the central bank changes the amount of high-powered money and the money supply becomes a multiple of this change, with interest rates adjusting to equate the demand with the supply of money. Goodhart points out that during normal open market operations at the Fed quite the opposite is happening because it no longer operates by targeting the money supply (2010: 74-75). Instead of setting the monetary base, the Fed sets the official interest rate and given this rate the behaviour of banks and the private sector determines the money supply which then dictates the level of high-powered money necessary to maintain the target interest rate. Therefore the money multiplier is really a monetary divisor which determines the amount of monetary base the Fed has to provide in order to make its official rate effective (ibid.). The banks and private sector determine their levels of reserves and currency holdings endogenously, not dependent on the money supply as the quantity equation implies.

If the Fed actually allowed the interest rate to be market determined as the monetarist model implies, it would be creating serious interest rate volatility ala the Volker years in the 1970s-80s. During this time the Fed experimented with a monetarist operating model which was met with limited success and large market volatility (Greider 1987). The Fed has since changed back to its interest rate targeting to facilitate a smooth operation of banking and financial systems (Goodhart 2010: 76). Furthermore, there is doubt about how much control a central bank has over broad money, limiting its ability to implement monetarist-informed policies, especially in light of increasing financial innovation and changing financial structures which influence monetary conditions. Broad money may be greatly distorted by supply-side conditions of banks as well as large shifts of money between banks and their shadow bank counterparts (Goodhart 2010: 81). No empirical studies of QE by FRB research departments model how increases in monetary aggregates, rather than decreases in interest rates, impact the policy targets of QE. This is because the Fed has continued to function based on an interest rate and not a monetary operating target throughout the crisis. Employing a monetary target would be more in line with the monetarist view of inflation being primarily driven by the money supply rather than interest rates.

Another criticism of Friedman's theory is a lack of insight into the transmission mechanism between an expansion of the money supply and changes in prices and quantities. According to the theory, the mechanism follows the logic of a classical demand/supply analysis whereby the demand function is a sum of individual demand functions determined by preferences and tastes and the supply function is a sum of individual supply functions determined by production possibilities and institutions. The logic is that a shift in either demand or supply of money creates a discrepancy that leads price levels to adjust in response. However, credit and money markets actively affect the price of money and do not just passively respond to the activities of

the monetary authorities. If the preferences of banks are endogenously determined there may not be a causal link between the supply of money to the banking system and price levels. An originator of the quantity theory, John Stuart Mill, posited that if the government's newly added money is spent in the economy it will increase demand but if it's held as a buffer stock it would have no immediate effect on demand (Friedman 1987: 15). Friedman's theory assumes that when the central bank increases the monetary base it gets into the hands of individuals who then spend it in the real economy. One may question the validity of the quantity theory in the context of QE if banks simply do not lend or otherwise release their reserves of high-powered money into the economy, creating a disconnect between monetary policy and the money supply (Goodhart 2010, Krugman 1998, Lu 2013).

Scholars have criticized the use of QE to combat the GR by pointing out the 'theory of money neutrality' which states that the impact of an increase in the nominal quantity of money and rising prices on output and employment is neutral in the long-run, making a multi-trillion policy like QE a risky move for only short-term gains (Ashworth and Goodhart 2012, Lu 2013). Furthermore, the stimulative effects of QE are likely to decrease over time as 'inflation tolerance' sets in, informed by rational expectations (Friedman 1987).

Quantity Theory of Money – Evidence from QE

The QE policy aims to impact the money supply by injecting high-powered money into banks who then theoretically distribute the excess balances to the real economy, generating a large increase in the money supply via the money multiplier, ultimately leading to inflation. A few empirical studies of QE attempt to estimate increases in the money supply which they plug into macroeconomic models of the economy in order to estimate impact on the final policy targets of inflation, output and employment. Several of these econometric studies make use of counterfactuals to estimate economic conditions if QE has not been implemented. One such study by FRB researchers finds that the first two waves of QE prevented large drops in output and inflation, creating a boost in GDP by 3% and a fall in the unemployment rate by 1.5% by the second half of 2012 (Chung et al. 2012). This study also estimates that inflation would have been 1% lower without QE, pushing the price level into negative deflationary territory. Another study looking at the impacts of asset purchases in eight advanced countries shows a temporary rise in economic activity and consumer prices which diminish after 6 months (Gambacorta et al. 2014). Furthermore, this study finds that the output effects are similar in magnitude to traditional monetary policy whereas the price level effects are weaker and less persistent (2014: 617). The authors credit the downward rigidity of nominal wages and prices which normally occurs during recessions as explaining the lack of impact of QE on prices.

Another study uses a model that estimates the effect of a 60bp fall in long-term Treasury yields on output and inflation for the four major QE economies[6] (Baumeister and Benati 2010). Their counterfactual finds that GDP growth would have been -10% rather than the -3% it actually was at the height of the crisis in the first quarter of 2009 and that it was boosted by an additional 1.3% at the end of 2009 and an additional 1.9% in the third quarter of 2010. The study also finds that inflation would have been negative in 2009 with QE helping it to stay above zero with a 0.3% in-

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[6] Eurozone, United States, Japan and the United Kingdom

crease by the end of 2009 and another increase of 1.1% in 2010. The study finds that QE prevented deflation and output collapses similar in magnitude to those that occurred during the Great Depression. Chung et al (2012) find a more modest boost to GDP growth due to QE2, in the arena of 1% while Lu (2013) finds a 1.5% decrease in unemployment by mid-2012. However, Lu attributes this increase in employment primarily to the service sector, with parallel decreases in the manufacturing sector (2013: 345). The latter study does show some gains in the inflation rate between early and mid-2011 but inflation begins falling below target again by the end of 2012.

Analysis

When looking at econometric analyses of QE's policy targets of employment and inflation, a number of conclusions arise. The lack of precedent to the policy, its scale, the limitations imposed by a 'liquidity trap' environment and generally depressed market conditions complicate the analysis. Counterfactual studies are only as valid as the assumptions they feed into their models and the permanence of the effects they estimate. Analyses seeking estimates of output and inflation which are dependent on models of the economy informed by historical data run on the strong assumption that the crisis has not altered key relationships between these variables (Martin and Milas 2012).

Williamson (2014), in a paper prepared for the St. Louis Fed, says that both theory and empirical evidence do not support the ability of the Fed to influence long-run goals like labor force participation and the employment to population ratio. He attributes this to research by Bullard (2010) who shows that low nominal interest rates typically lead to low inflation over the long run, negating the initial boost to employment. Williamson also makes reference to the Japanese QE experiment in which a zero-bound policy interest rate over several years was not effective in fixing structural labor market issues that caused persistent unemployment (2014: 120).

The relationship between the monetary base and money supply as modelled by the quantity theory has been empirically invalidated by questioning the analytical focus on the money multiplier (Goodhart 2010). By keeping a large portion of their assets in the form of reserves banks may be creating a decline in the money multiplier and the income velocity of money (Goodhart and Ashworth 2012, Ashworth 2013). As the ratio of reserves to deposits grows, the denominator of the classic quantity equation becomes bigger, resulting in a smaller multiplier for high powered money to translate into broader money supply. Goodhart (2010) calculates that the money multiplier at the time of the crisis should have been around 8 or 9 according to the identity function. He then examines the actual multipliers present between broad and narrow monetary aggregates and finds that the multiplier had collapsed to near zero, despite over $1 trillion expansion in the monetary base during QE1 (Goodhart 2010: 74). Although the Fed forced the banks to accept these vast quantities of high-powered money, this did not translate into money multiplying across the economy. Counterfactual models can only speculate on how much QE prevented a contraction of credit by measuring increases in high-powered money and drops in interest rates, using models that rely on the money multiplier approach which have not been shown to hold up during the recent crisis. Therefore the results of these models which estimate positive impacts of QE on output, employment and inflation are called into question.

The QE experiment represents a breakdown of what is considered by the economic mainstream as a chief relationship governing the money supply, reducing prior monetary trends such as those observed by Friedman and Schwartz into more of a

statistical regularity then a real explanation of the determinants of money. Bank preferences and credit market conditions during the GR are preventing Friedman's monetary mechanics from operating as theorized because the banks are not buying financial assets or making new loans. The Federal Reserve has impacted bank preferences by paying interest on bank reserves held with the FRS, even those in excess of regulatory requirements. Scholarship coming from the St. Louis Fed states that paying of interest on reserves is preventing the banks from being forced to use this money for something other than reserves (Ricketts 2011). Banks are shying away from increasing their loan portfolios or purchasing public sector debt because the interest they are receiving on their reserve holdings is a sufficient enough return for a riskless asset. Although they carry a slightly higher interest rate than reserves, Treasuries may not appeal to the banks due to heightened sovereign risk concerns (Goodhart 2010). The Fed paying of interest on bank reserves "dovetails nicely with the risk aversion adopted by the banks and takes away incentive for the banks to extend credit to business" (Herbst et al. 2014: 2). Therefore the paying of interest on reserves, although helping to prevent runaway inflation, may also be promoting deflation. Another counterproductive aspect of QE may be its ad-hoc and unpredictable nature, eschewing normal 'rule-based' central bank behaviour in favour of frequent changes and discretionary interventions that may have created more uncertainty than necessary about future inflation (J. Taylor 2014).

Despite a lack of evidence for the monetary base being able to influence money supply and nominal income via the money multiplier there may be another channel through which QE can impact inflation levels. A study of low inflation levels in the U.S. during the last two decades of the 20th century shows that declines in inflation rates were due to "falling import prices caused by … exchange rate effects" (Perry and Cline 2013: 1). The study points to exchange rate effects as lowering import costs and oil prices leading to a decline in inflation. They employ a cost-oriented framework that looks to commodity and import prices as driving inflation rather than monetary factors. Extending this framework to QE creates an additional avenue for the asset purchases to be able to impact price levels.

Several event studies of QE1 found that it depreciated the US dollar against major currencies in the range of 3-11% (Glick and Leduc 2011, Meaning and Zhu 2011, Neely 2010) with minimal effects in subsequent waves, although Lu (2013) does note continuing weakness in the USD versus the RMB, of about 8-10% during QE2 and QE3. This currency depreciation can increase the cost of imports and may lead to higher inflation to meet the Fed's 2% inflation target even in a reserve trap (Herbst et al. 2014). Unsurprisingly, due to its controversial nature, officials from the Fed have tried to downplay the external trade and currency effects of QE (Ashworth and Goodhart 2012).

3.3 – Rationale 3: Asset Wealth Effect

The third rationale to be examined is that of boosting asset values to create a 'wealth effect' to stimulate business investment and consumer spending.

Aside from yields on Treasuries and MBS the Fed aimed to influence other asset yields and prices. The rationale for this has been referred to by then-chairman Ben Bernanke as creating an asset wealth effect leading to a 'virtuous circle' of spending and investment creating higher incomes and profits which further boost aggregate

demand (2010). Higher stock and bond prices are thought to stimulate lending for productive business investment and are also supposed to boost consumer wealth resulting in increased consumption.

Balance Sheet Channel – Theory

A second credit-channel of monetary policy transmission mentioned in the literature is the balance sheet channel which concerns the impact of expansionary monetary policy on the net worth of businesses and how that interacts with bank lending (Bernanke and Gertler 1995, Mishkin 1996). The net worth of an entity informs the adverse selection or moral hazard risk that lenders assign to them. It is theorized that an increase in borrower net worth decreases lenders' risk expectations and encourages lending. QE positively affects borrowers' balance sheets and income statements by bringing about higher asset valuations and decreased interest rate obligations. Higher values of corporate equity or bonds increase the capital available to that entity in order to make fixed investments or use as collateral for debt (Bernanke et al. 1999: 1370). Assuming that an increase in the monetary base leads to inflation, the value of debt obligations decrease because they are fixed in nominal terms. These effects increase borrower net worth, cash flow and liquidity making them more attractive to lenders. It is then assumed that lenders will lend more for investment purposes, boosting aggregate demand.

Balance Sheet Channel – Theoretical and Empirical Debates

The main assumption behind the asset wealth effect is that the proportion of businesses and households whose capital position actually benefits from higher asset prices justifies the use of the QE policy. The household utility function employed by the theory assumes that households in poor liquidity situations have access to the types of financial assets that would provide them with additional income during monetary expansion. However, it is clear that higher asset valuations increase the net worth only of households or firms holding or issuing equities or bonds. Household wealth distribution and composition are significant determinants of the effects of asset prices on household wealth. Upon examination, "only a small percentage of the U.S. population holds stocks at meaningful levels, especially outside of retirement accounts that generally have high use costs associated with taxes" (Guo and Hardin 2014: 225). Therefore, the theory must be considered only in terms of the benefits QE brings to large publicly traded firms and the wealthiest cohorts of society who have access to these assets.

Another assumption of the theory is that the improved net worth position of corporates creates an increase in fixed investment as opposed to purely financial or speculative activities. There is evidence that corporate bond and share issuance following increasing trends of financialization starting in the 1980s is no longer primarily used to fund fixed investment but rather M&A and equity buybacks (Corbett and Jenkinson 1997, Henwood 1998, Ingham 2011). As previously outlined in section 3.1 a more typical source of corporate fixed investment has been the retained earnings component rather than the asset component of corporate net worth.

Balance Sheet Channel – Evidence from QE

The impact of QE on assets not directly purchased has been strongest in equity markets with studies showing large gains, for example up to a 75% recovery in the

S&P 500 (Ashworth 2013: 7-8) and a 20% recovery in the NASDAQ (Lu 2013: 344) in the year following QE1. There is also evidence of impact on corporate bonds with event studies of both investment and sub-investment grade corporate bond rates showing sharp drops of 40-100 basis points in response to QE1 (Ashworth 2013, Krishnamurthy and Vissing-Jorgensen 2011, Meaning and Zhu 2011, Neely 2010). However, there is negligible impact of QE2 on corporate bonds but it succeeds once again in stimulating the stock market, showing positive impacts on the S&P 500 of around 24% (Lu 2013: 345).

It is notable that the strongest and most persistent impact of quantitative easing on private assets has been felt in the equity markets. While the mortgage market is estimated to have received a boost via interest rate drops during QE1 and QE2, evidence from 2013 shows that the housing market is still 20% below its previous peak and high mortgage rates have returned after falling temporarily after the launch of QE2 (Gayed 2013). In contrast, the equity markets have enjoyed a much more robust and long-lasting recovery with Smithers (2014) estimating as much as a 70% overvaluation of the U.S. stock market as of the beginning of 2014.

If only "the highest cohorts of wealth show a stock wealth effect" (Guo and Hardin 2014: 234) then the primary benefactors of the stock boosts have been the most affluent sectors of society, contributing to rising inequality. Households with a lower percentage of financial wealth are more vulnerable to income shocks (ibid) such as the loss of a job but are unable to benefit from QE. The Bank of England conducted a study on the distributional effects of its QE asset purchases which found that the policy "boosted the value of household financial wealth held outside pension funds, but holdings are heavily skewed with the top 5% of households holding 40% of these assets" (Bank of England 2012b: 1). When measuring impact of the Fed's QE on household wealth via the balance sheet channel it is important to keep in mind the redistributive impact of the policy based on the existing composition of household net worth in the U.S.

3.4 – Summary

A theoretical pretext for employing QE is that of a 'liquidity trap' in which a zero-bound policy rate precludes typical monetary policy tools from being able to influence the cost and terms of credit and the inflation level. QE attempts to circumvent this by directly altering the money supply. One rationale for QE was to improve conditions in credit markets to stimulate bank lending for long-term investment via a theorized bank-lending channel of monetary policy transmission. This channel targets bank reserves in order to lessen credit market frictions which can behave as a 'financial accelerator', worsening the effects of economic shocks on business investment. Empirical studies of the credit-channel of QE show temporary interest rate drops with diminishing effects over time. An additional rationale of QE is to achieve the Fed's inflation target in order to prevent deflation, based on the quantity theory of money connecting increases in the money supply with higher price levels. Econometric counterfactuals show some impact of QE on inflation but are subject to the accuracy of underlying models. Evidence shows the money multiplier collapsing during the crisis, invalidating models relying on the money multiplier. A third rationale for QE was to support asset markets in order to generate a 'wealth effect' to stimulate investment. Studies show strong effects of QE on equity markets but limited boosts to bond and housing markets.

Chapter 4 – Empirical Analysis

4.1 – Bank Lending

The bank-lending channel of QE is supposed to affect business investment by injecting capital into the banking system. The intermediate policy targets are long-term interest rates, bank reserves, bank lending for investment and fixed capital formation.

Bank Reserves and Lending for Investment

This analysis considers QE as only being able to affect bank reserves with bank deposits being demand determined, in line with Goodhart (2010). Figure 3 examines the total reserve balances held in bank vaults or maintained with the Federal Reserve System by commercial banks and the total commercial and industrial (C&I, thereafter) loans extended by those banks. An index is used here rather than annual rates of change as reserves grew much more in absolute terms than C&I lending.

**Figure 3 - Bank Reserves and Commercial & Industrial Lending**
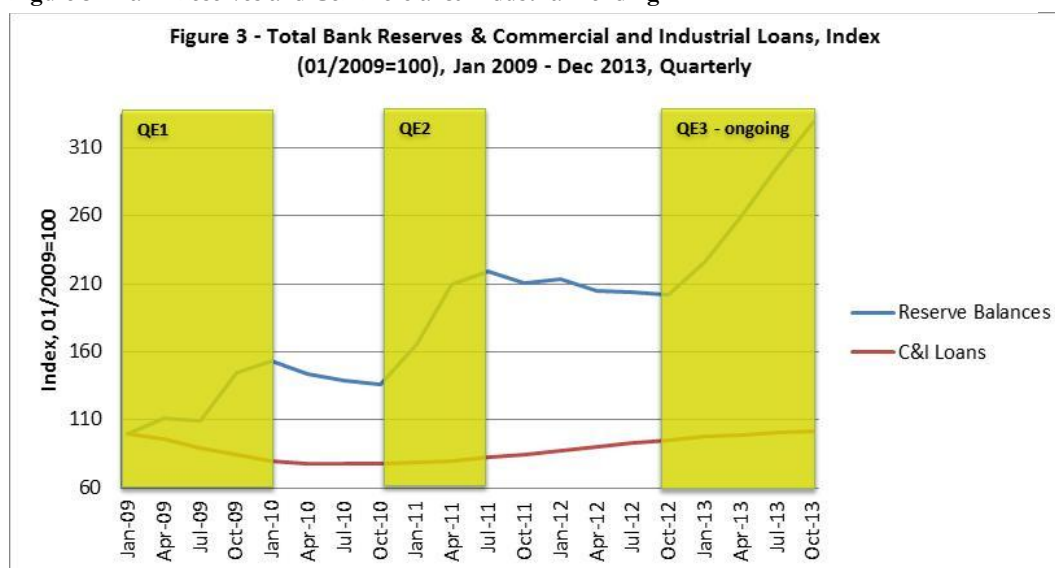
Source: FRB of St. Louis, FRED® database. Accessed 10/13/2014.

Figure 3 shows that during periods of QE when bank reserves increased, C&I loans did not experience the same. Significant increases in reserves did not impact lending for business investment. This is consistent with the 'reserve trap' theory (Goodhart 2010, Herbst et al. 2014) in which banks are hoarding reserves and not extending loans. Looking at the average terms for all commercial and industrial loans extended during this period[7], the average effective loan rate was 2.5%, representing a 2.25% spread from the target federal funds rate. Furthermore, the average loan maturity was 520 days or about 1½ years, not indicative of long-term fixed investment lending.

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[7] From the FRS annual E.2 release 'Survey of Terms of Business Lending'

If banks are extending loans to businesses, in order for these loans to impact investment levels they must be used for fixed capital formation and not just for short-term purposes like working capital or inventories. Figure 4 trends bank reserves with the longer-term component of C&I lending, considering all loans with higher than a one year maturity as serving medium to long-term fixed capital needs. On average, the maturity of these loans is 4 years. The average effective long-term loan rate is 4%, 1.5% higher than all C&I loans and a significant 3.75% spread from the federal target rate.[8] The graph shows that reserves and long-term lending moved in opposite directions in QE1 and the only time period in which a relationship between bank reserves and long-term lending existed as theorized was during QE2. Immediately following QE2 the levels of long-term C&I lending plummeted and have remained far below pre-crisis levels ever since, indicating that QE's reserve boosts are unlikely to be long-term drivers of investment lending. It is also important to keep in mind that such long-term lending represents just 0.3% of all C&I loans during this period, contrary to the assumption that banks lend for long-term investment at significant levels.

**Figure 4 - Bank Reserves and Long-Term Commercial & Industrial Lending**
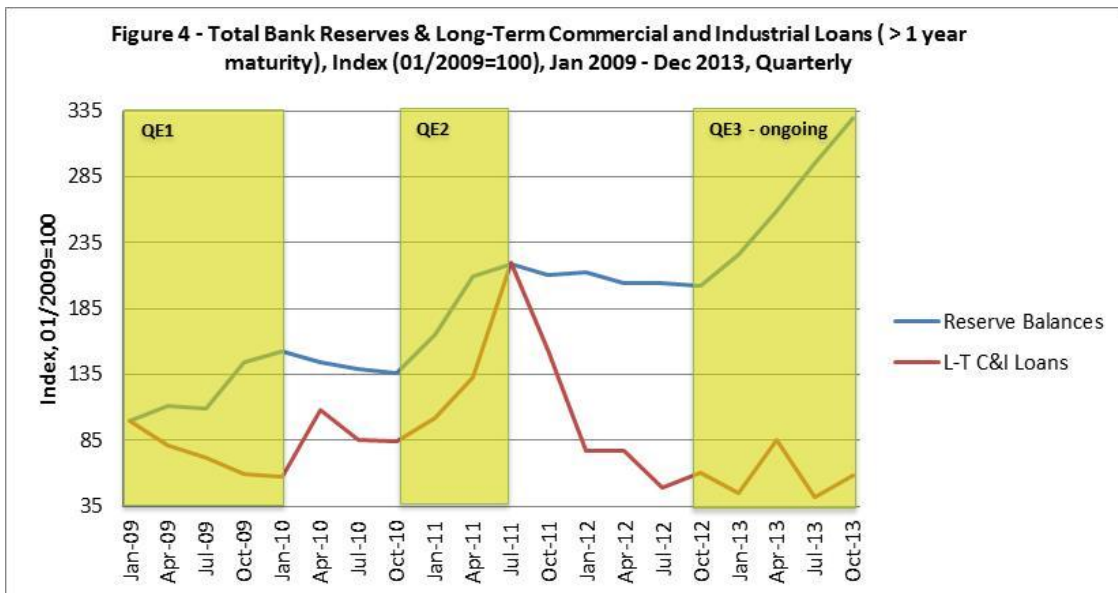
Source: FRB of St. Louis, FRED® database and the FRS Release E.2. Accessed 10/13/2014.

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[8] 4% is also the average effective loan rate for C&I loans during this period with value under $1 million, making it the rate SMEs would have likely faced. For more see the Appendix – Figure 1.

Excess Reserve Holdings

Next is an analysis of the evidence behind the 'reserve trap' theory (Goodhart 2010, Herbst et al. 2014) which may explain why bank lending has been low despite favourable liquidity positions of banks. Figure 5 looks at total bank reserves in bank vaults or maintained with the Federal Reserve System, paying attention to the excess reserve component[9] of total bank reserves. All reserve levels are deflated using the GDP Deflator (Index 2009=100) in order to rule out potential inflationary effects since the outset of the policy.

Figure 5 - Total and Excess Bank Reserves
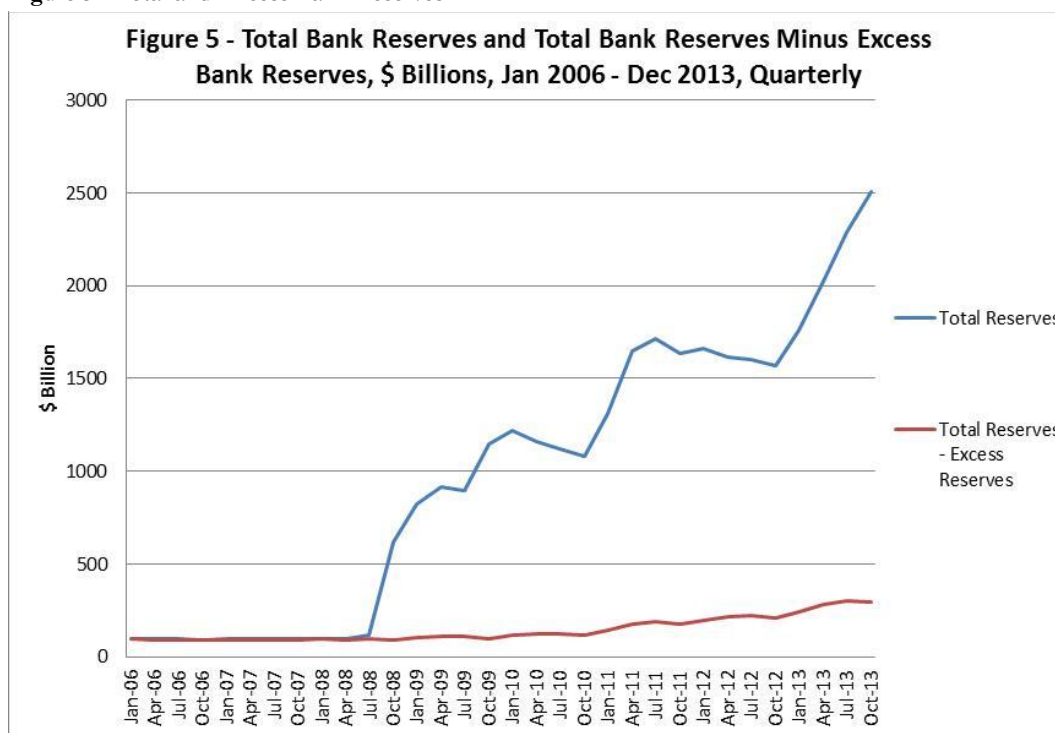
The results show that the growth in reserves since QE has started in 2009 has been primarily in excess reserves and not due to higher reserve requirements. By subtracting the excess reserve component from total reserves the figure shows a relatively neutral trajectory for total reserves, representing what reserves would have been absent the QE policy and banks' reserve hoarding. The implication is that the 'reserve trap' is precluding a potential bank lending impact of QE because banks are not releasing the money in the real economy, perhaps also due to the Fed's policy of paying interest on bank reserves, even those in excess of regulatory requirements.

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[9] Reserve balances maintained in excess of regulatory requirements

Bank Lending and Capital Expenditures

Henwood (1998: 75) provides an analysis of the sources of investment financing for non-financial corporations. The analysis looks at capital expenditures of corporates (Capex, thereafter) and looks to see how much of Capex is funded using internal versus external funds. The financing gap represents the difference between internal funds and Capex needs. Table 1 extends Henwood's analysis to cover the years leading up to and during QE.

Table 1 - Sources of Capex for Corporates

Table 1 - Sources of Capex for U.S. Non-Financial Corporations, 1952-2013, Yearly			
	capex	internal	financing gap	
	% of	funds, %	% of	% of
	GDP	of capex	capex	GDP
1952-54	9.1%	93.9%	6.1%	0.5%
1955-59	8.9%	94.5%	5.5%	0.5%
1960-64	7.8%	100.5%	-0.5%	0.0%
1965-69	8.3%	87.1%	12.9%	1.1%
1970-74	6.4%	76.6%	23.4%	2.0%
1975-79	7.5%	86.7%	13.3%	1.2%
1980-84	5.2%	85.6%	14.4%	1.3%
1985-89	4.3%	98.1%	1.9%	0.2%
1990-94	4.5%	99.7%	0.3%	0.0%
1995-97	6.2%	94.5%	5.5%	0.4%
1998-00	10.9%	76.8%	23.2%	2.5%
2001-04	8.8%	93.5%	6.5%	0.6%
2005-08	9.4%	93.6%	6.4%	0.6%
2009	7.0%	126.8%	-26.8%	-1.9%
2010	8.3%	119.0%	-19.0%	-1.6%
2011	8.6%	116.5%	-16.5%	-1.4%
2012	9.3%	107.7%	-7.7%	-0.7%
2013	9.3%	108.8%	-8.8%	-0.8%
Average	**7.8%**	**98%**	**2%**	**0.3%**

The data shows that in the years leading up to the crisis (2005-08), 94% of Capex came from internal funds and 6% came from external funds. In fact, the average in the last 60 years has been for 98% of Capex to be funded internally. During the years in which QE was in operation there is actually over 100% of Capex funding available from retained internal funds. It would appear that external sources of investment financing like bank lending are only marginally important, especially during the recent crisis. The theoretical focus on the 'external finance premium' when evaluating the impact of QE is misguided as the cost between external and internal funds is irrelevant when the financing gap is negative. The negative financing gaps are indicative of cash hoarding by corporations. Instead of facing a financing gap between internally generated funds and Capex outlays, the corporations are aflush in cash with which they could finance fixed investment.

This is evident when examining how much cash and near-cash assets non-financial corporations[10] are holding on their balance sheets since the outset of QE, shown in Figure 6. To rule out any other effects on cash holdings such as inflation, economic growth and firm size the figure looks at the percentage of total balance sheet assets held in the form of cash.

Figure 6 - Percent of Corporate Assets Held as Cash
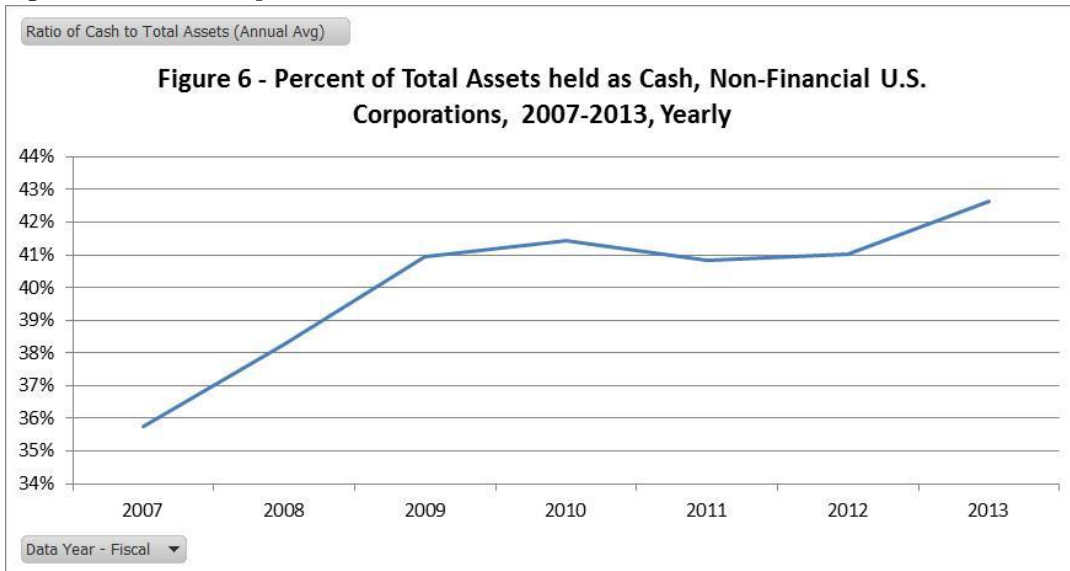
Source: Compustat North America, from Wharton Research Data Services. Accessed 08/29/2014.

The ratio of cash to total assets has risen by almost 20% from 2007 to 2013, indicating a large swell in the cash holdings of corporations. Or put another way, corporations are now holding eight times the level of cash reserves they had in 2007 (see Appendix - Figure A.2). This points to a greatly diminished relevance of the bank lending channel considering that external finance is always more costly than internal finance (Bernanke et al. 1999) and corporations have more than enough cash on their books to finance potential capital investments.

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[10] This sample of businesses is comprised of publicly traded firms required to report their financials. For evidence of impact of QE on SMEs see the 'Bank Lending Channel – Evidence from QE' section of Chapter 3.

4.2 – Inflation

According to the Monetarist view, inflation is prima facie driven by an augmentation in the money supply, starting with the monetary base, flowing through the rest of the monetary aggregates powered by the velocity of money. The intermediate policy targets are broad money supply, nominal income and price levels.

Monetary Base and Money Supply

First we must examine how the monetary base has translated into broader money supply in the economy. M2 is chosen as the primary measure of the broader money supply, in line with the analysis of Friedman and Schwartz in *Monetary Trends* (Trescott 1964). Figure 7 compares year-over-year growth rates in high-powered money and M2.

Figure 7 - Monetary Base and M2
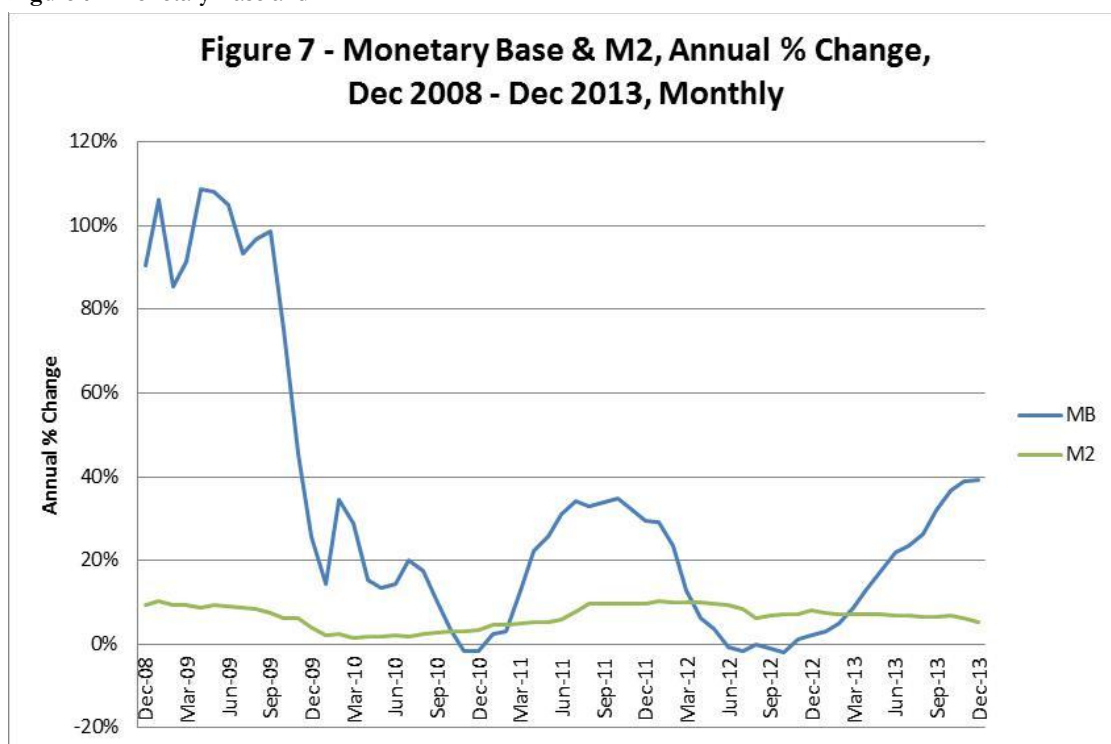
Source: FRB of St. Louis, FRED® database. Accessed 08/21/2014.

Large swings in the monetary base[11] do not translate into proportionate effects on M2. The relationship between the monetary base and M2 deteriorated at the height of the financial crisis during 2009, throughout all of 2011 and again after 2012 with a widening gap between growth in the monetary base and that of the money supply. M2 is only 25% greater now than it was in 2008 but the monetary base is 225% greater than it was in 2008 (not shown in the figure).

It is of note that the Fed database had discontinued all of its M3+ series, showing that broad money has become difficult to track, more less control, by the mone-

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[11] The large jump in the monetary base starting in 2008 through the end of 2009 can be explained by other emergency liquidity programs undertaken by the Fed to support failing money markets.

tary authorities. This goes against the assumption of the quantity theory that the central bank has a predictable influence over broad money.

Part of this assumption is a fixed relationship between the monetary base and money supply via a constant money multiplier, or the ratio of the monetary base to the money supply. A constant money multiplier allows the cash base to impact money supply in a predictable and stable manner.

Figure 8 examines annual percent changes in the monetary base compared with the M2 money multiplier.

Figure 8 - Monetary Base and M2 Money Multiplier
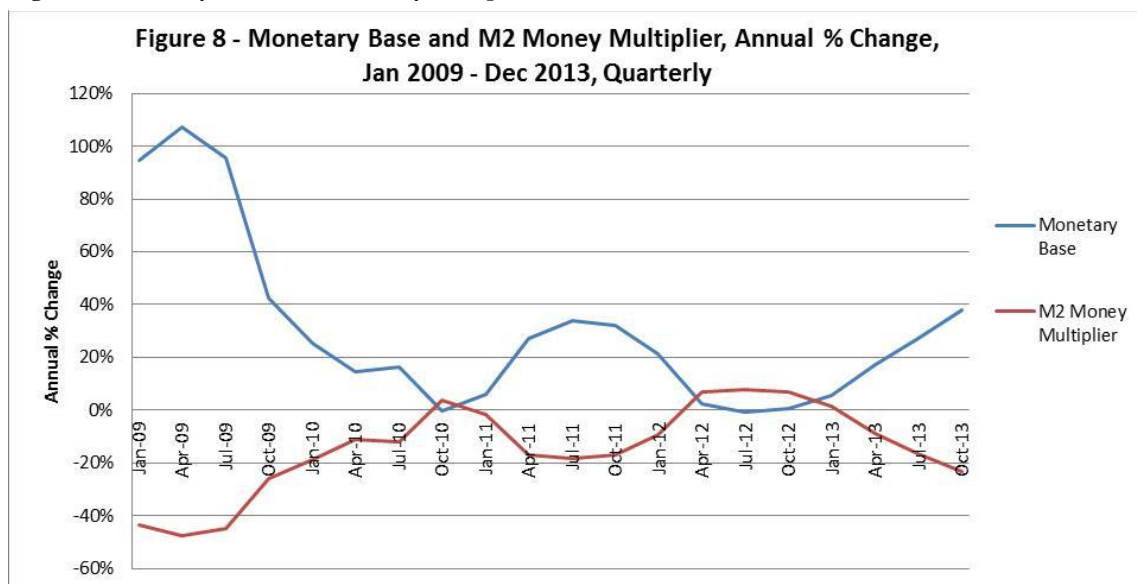
Source: FRB of St. Louis, FRED® database and own calculations. Accessed 10/14/2014.

Not only is the M2 money multiplier not constant but it appears to uniformly offset changes in the cash base during the crisis up to this present moment. When the monetary base rose during QE1, the money multiplier fell significantly and similar offsetting trends are present following QE2 and QE3. Such a significant offset by the multiplier results in a small impact on the money supply despite ever increasing injections of high powered money. This evidence brings into question the assumption of a fixed relationship between the monetary base and money supply.

## Money Supply, Nominal Income and Inflation

According to Friedman's theory, there is a fixed relationship between the money supply and nominal income whereby nominal income will increase proportionally to an increase in the money supply via a constant income velocity of circulation. If it is unstable and fluctuates[12], the velocity of circulation should only do so marginally and without offsetting changes in the money supply.

Figure 9 compares year-over-year trends in M2 with its income velocity of circulation to examine the velocity's theoretical uniformity. What is readily apparent is that the velocity has primarily experienced a negative trend during the crisis, aside from 2010. Despite positive growth in the money supply, the velocity of M2 appears to

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[12] The instability of monetary velocity was a later modification of the quantity theory.

partially offset this growth as holders of money balances refrain from engaging in transactions.

**Figure 9 - M2 and M2 Income Velocity**
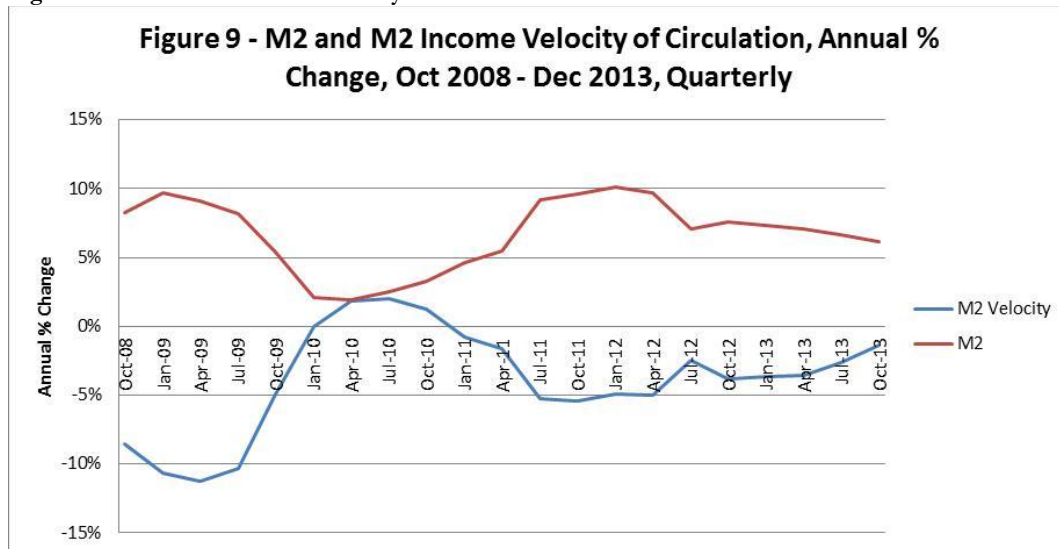
Source: FRB of St. Louis, FRED® database. Accessed 09/02/2014.

Instead of remaining stable or moving respectively with changes in M2 to create proportional changes in nominal income as theorized, the income velocity of M2 is negating these nominal income effects.

A potential reason that growth in M2 is not translating into growth in nominal income is that banks are accumulating vast amounts of excess reserves as shown earlier in Figure 5. Figures A.3 and A.4 in the Appendix explore further the link between reserve accumulation, the monetary base and the income velocity of money.

Next, Figure 10 examines the theoretical link between the money supply and inflation by comparing trends in excess M2 growth with measures of inflation including the consumer price index (CPI), the GDP deflator and the personal consumption expenditure (PCE) deflator, which is the metric the Fed focuses on when evaluating their inflation target. Excess M2 growth is calculated as the growth in M2 minus growth in real GDP to get growth in excess money balances. This is in line with the quantity theory which considers excess monetary growth above what is needed to sustain output growth as the primary cause of inflation (Friedman 1987).

Figure 10 - Excess M2 Growth and Inflation

Figure 10 - Excess M2 Growth and 1-yr Lagged Measures of Inflation, Annual % Change, Jan 2008 - Jan 2013, Quarterly
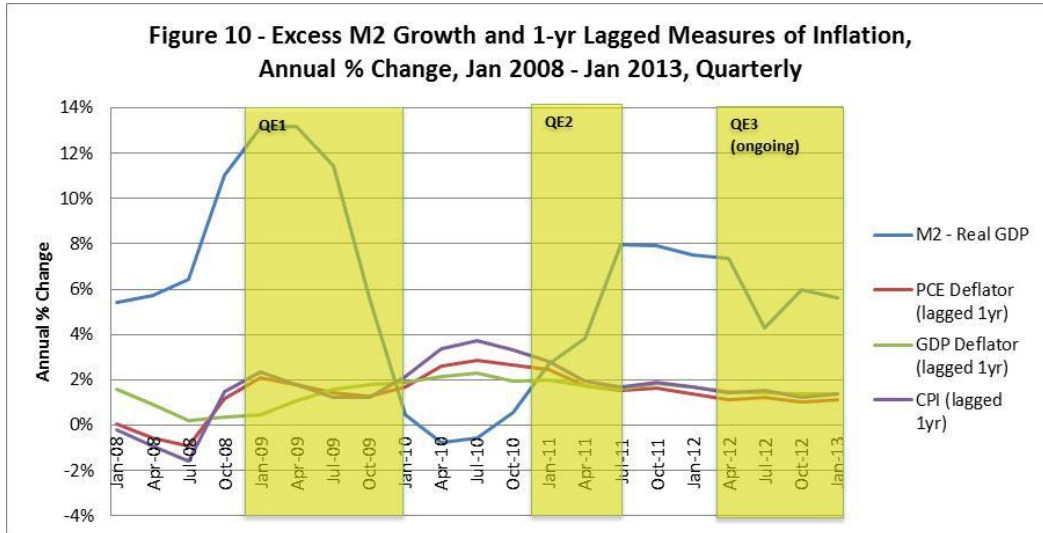
Source: FRB of St. Louis, FRED® database. Accessed 09/16/2014.

According to the theoretical literature on the quantity theory an expansion in the money supply could take anywhere between 6 months to 2 years to impact price levels. This analysis takes a rounded average of that range to specify a one year lag in the impact of money supply on prices. Figure 10 compares fluctuations in excess M2 with 1-yr lagged responses in inflation measures. There does not appear to be a strong relationship between excess money supply and inflation. For example, the effects of excess monetary expansion on inflation at the outset of QE1 show a moderate co-movement whereas the effects of QE2 and QE3 show an inverse relationship. The largest boost to inflation coincides with lower levels of excess money in between QE1 and QE2.

Overall, CPI has barely budged from its 2008 value five years later in 2013 and as of Q4 2013 the PCE deflator stood at just 0.25% as opposed to the Fed's 2% target (not shown in figure). The on-going QE experiment has failed to generate inflation according to the mechanics of Friedman's quantity theory. However, QE may be generating inflation via another channel not explicitly stated by the Fed: currency depreciation increasing the cost of imports. This is explored in the Appendix, Figures A.5 & A.6.

4.4 – Asset Wealth Effect

QE aims to affect the net worth of corporations through higher asset values. Higher valuations of corporate bonds and equities are supposed to increase business investment. The intermediate policy targets are asset values and fixed capital formation.

From the household perspective, higher valuations of consumer held housing and financial assets are supposed to boost consumption. However, evidence points to a lack of impact of QE on housing wealth (Gayed 2013, Appendix - Figure A.7 & A.8) as well as a severely unequal distribution of financial assets by household wealth percentile (Guo and Hardin 2014, Bank of England 2012). Therefore households will not be addressed in this analysis.

Equities and Investment

One of the asset classes not directly targeted by QE purchases but referred to as a rationale for QE is equities. Figure 11 shows how the S&P 500 stock market index of the leading corporations in the U.S. performed during the operation of QE policy, including impacts on volatility as measured by the CBOE S&P 500 3-month volatility index.

**Figure 11 - Equity Trends - S&P 500**
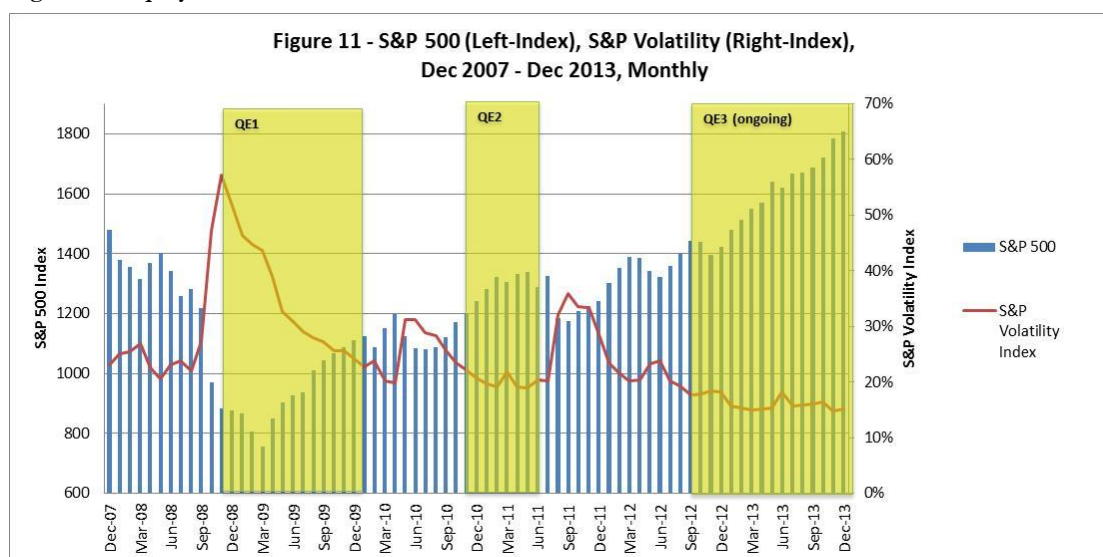
Source: FRB of St. Louis, FRED® database. Accessed 08/20/2014.

At the start of QE1, volatility was very high and the S&P was nearing its absolute crisis low. QE1 appears to have immediately calmed equity market volatility and boosted the S&P from its absolute low (~750 points) towards recovery. QE2 had similar effects on the stock market by boosting stock prices and keeping volatility stable. QE3 continued to boost equities & contributed to ~10% further fall in volatility. Major drops in stocks occurred primarily in-between waves of QE. As of the end of 2013 the stock market was at its highest level than it had ever been during the previous 5 years. The equity market's response to QE is the strongest and most long-lasting response seen across all the asset classes.

According to the 'virtuous circle' (Bernanke 2010), higher equity prices are supposed to create a rise in investment levels. Figure 12 plots the annual percentage

change in the S&P 500 stock index compared to the rate of fixed capital formation as a percentage of nominal GDP to determine how much stock market gains impacted the rate of business investment.

**Figure 12 - Equities and Fixed Capital Formation**
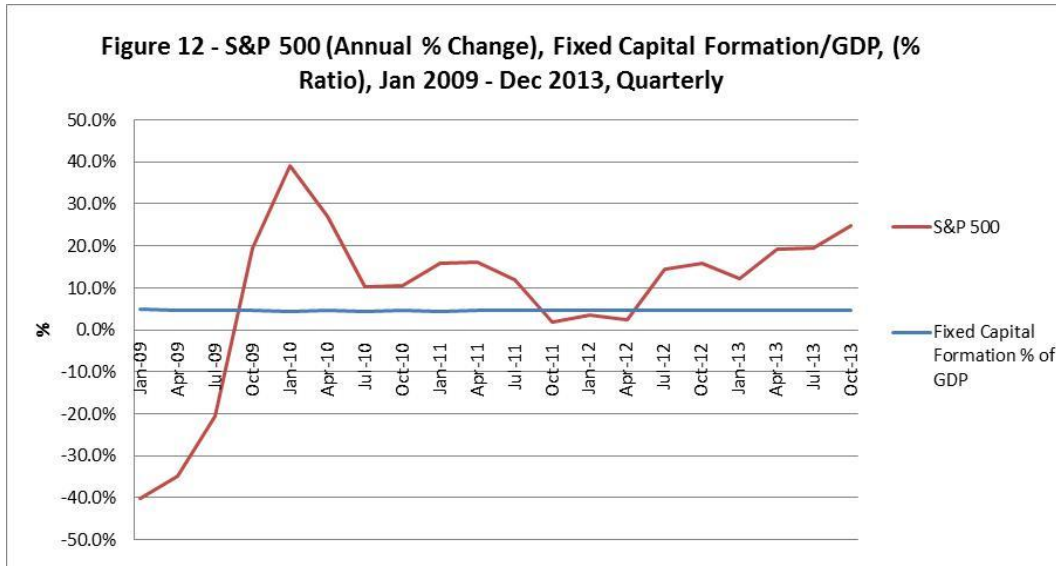
Source: FRB of St. Louis, FRED® database. Accessed 10/14/2014.

When comparing changes in the S&P with changes in the fixed capital investment rate there does not appear to be any significant impact. According to the theory underlying the asset wealth effect, a boost to the stock market should increase the rate of fixed capital formation, measured as a percentage of output. From the data it is apparent that boosts to the stock market are not pushing up the investment rate, which has remained steady at around 4.6% of GDP.

Bonds and Investment

Another asset class not directly targeted by QE but considered important for its boost to corporate investment funding is corporate bonds. Figure 13 examines trends in prime AAA and junk BAA corporate bond yields, keeping in mind that lower yields mean higher bond values.

Figure 13 - Corporate Bond Yields

Figure 13 - Corporate Bond Yields, AAA & BBB Ratings, Bond Yield %, Dec 2008 - Dec 2013, Monthly
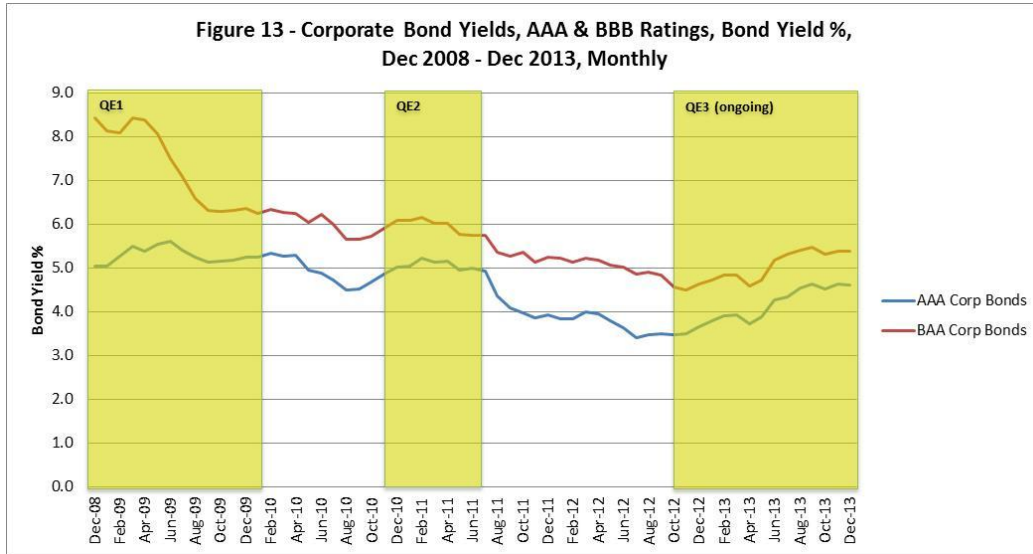
Source: St. Louis Federal Reserve Bank, FRED® database. Accessed August 21st, 2014.

Junk bond rates responded to QE1 more than prime rates. Prime rates were actually higher at the end of QE1 than at the beginning whereas junk bond rates fell ~2.3%. Both rates continued to decline during the interims between periods of QE. However, QE seemed to have lost steam in later stages as QE2 left both rates relatively unchanged, in fact they both went up at the outset of QE2. Since QE3 bond rates have begun to rise showing that gains in the bond markets seem to be short lived, especially for prime bonds which have almost as high an interest rate at the end of 2013 (~4.7%) than they did at the outset of QE (5%). Overall, the long-term impact of QE on bond rates has been negligible. We can therefore expect the effect of bond interest rates on business investment to be marginal (see Appendix – Figure A.9).

4.5 – Summary

The empirical analysis shows that boosts to bank reserves are not translating into more investment lending. Long term C&I lending remains below pre-crisis levels and average spreads are higher than those for overall C&I lending. More bank reserves have translated into excess reserve holdings, an indicator that banks are not releasing the funds into the broader economy. Further evidence of the sources of business investment financing during the crisis shows that corporations have more than enough internal cash to fund investments and have historically relied on internal rather than external funds for capital expenditures. In terms of the theorized channels of inflation, large increases in the monetary base have been offset by opposing swings in the money multiplier and are not proportionately impacting the money supply. Furthermore, increases in the money supply are being offset by negative monetary velocity, preventing them from impacting nominal income. There does not appear to be a strong relationship between excess money supply and various measures of inflation. In terms of the asset wealth effect, QE has had the most powerful effects on the stock market with negligible impacts on bonds and housing. These stock market gains have not helped to boost the rate of fixed capital formation.

Chapter 5 – Conclusion

The goal of this research on the Federal Reserve's quantitative easing policy was to determine whether its rationales were justified and whether its aims were achieved, using its own data and theoretical transmission channels to determine policy impact. The findings, aside from being important for evaluating the policies of the Federal Reserve and other developed country central banks, also shed light on justifications employed for various developing country policies.

As of late 2014, the FOMC announced the end of QE3. However, it will continue re-investing its existing asset holdings and employing highly accommodative policies (Federal Reserve 2014). In the same week the BoJ launched a new wave of QE (Mackenzie et al. 2014) and the ECB was close to embarking on its own QE program (E. Taylor 2014), all with similar rationales to the Fed. Meanwhile, the PBOC has continued to inject liquidity into Chinese banks which analysts think is an effort to boost economic growth (Jianxin and Takada 2014). And the government of Thailand is focused on boosting the stock market in order to grow its economy (Securities and Exchange Commission of Thailand 2014). This study provides a critical assessment of the rationales behind these programs and has particular relevance for current debates on monetary policy, inflation and economic growth.

The findings show that QE has not been an effective strategy to boost bank lending for fixed investment, limiting its impact on output and employment via a theorized bank-lending channel. The phenomena of cash reserve accumulation on both bank and business balance sheets coupled with risk-aversion and deleveraging have led to greatly diminished lending. Historically low levels of external borrowing to fund capital expenditures by corporations means that smaller, more cash-strapped firms should be the primary beneficiaries of QE. To incentivize loan supply, QE policies could come with conditionality obligating banks to use the injected cash to make loans for SME investment. Alternatively, asset-based reserve requirements (ABRRs) could be used to impose larger margins on riskier speculative assets like equity margin loans and small or negative margins on strategic lending for business investment (Palley 2014).

QE has not led to a significant increase in inflation according to Milton Friedman's monetary mechanics. This brings an important perspective on the nature of inflation, especially during crisis conditions. If the relationship between interest rates, the money supply and price levels can break down then the theoretical trade-off between price stability and growth facing developing countries may not apply. Further research on the determinants of inflation during financial crisis conditions is called for in order to inform future policy.

In terms of generating asset boosts, QE helped to calm panic in mortgage markets immediately following the crisis but since then the benefits of QE for housing wealth have been mixed. The strongest effects of QE have been felt in the equity markets but these gains are inaccessible to 95% of wealth-holders and also do not bring about higher levels of productive business investment. A more effective boost to household wealth and consumption could be fiscal policy in terms of wage increases and tax cuts which would more equitably benefit households across America. Furthermore, gains in the stock market do not appear to be supported with actual growth levels which may be indicative of another bubble which analysts predict may lead to a long slump in asset prices in the future (Hennigan 2014). It is just one in a
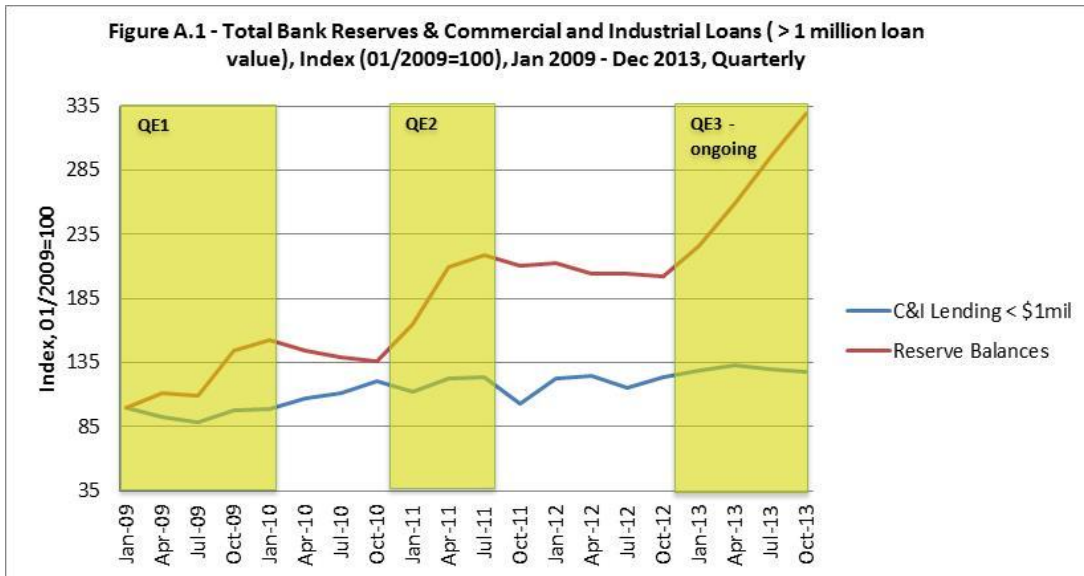
long line of examples of the cyclical tendencies of monetary easing in both fuelling bubbles and then being used to address the economic fallout when the bubble bursts.

In conclusion, while QE improved the functioning and liquidity of asset and money markets immediately following the financial crisis, it is not a sustainable solution to return the U.S. economy to stability and growth. Over 5 years of QE in the U.S. has not resulted in accelerated recovery with real GDP growth in the U.S. still hovering between 1-3%. The policy overwhelmingly benefits the financial sector with limited impact on the real economy. The primary beneficiaries of the policy appear to be commercial banks and the wealthiest segments of society which has the potential to greatly increase inequality by redistributing wealth to the top. More research on the distributional consequences of the policy is called for, especially considering that the new Fed chairwoman has expressed concern over how stock market gains have led to widening inequality while wage growth, labor market conditions and increases in housing wealth continue to stagnate (Yellen 2014).

There is no simple fix to the many structural problems and obstacles to growth in output and employment in the U.S. These barriers cannot be addressed with monetary policy alone. We saw how ineffective the several decade long Japanese QE experiment was in fixing structural labor market issues responsible for persistent unemployment in Japan (Williamson 2014) and the U.S. is no different. While QE may have saved Wall Street until the next bubble bursts, it falls short of what is needed to prevent the U.S. economy from stagnating.

Appendix

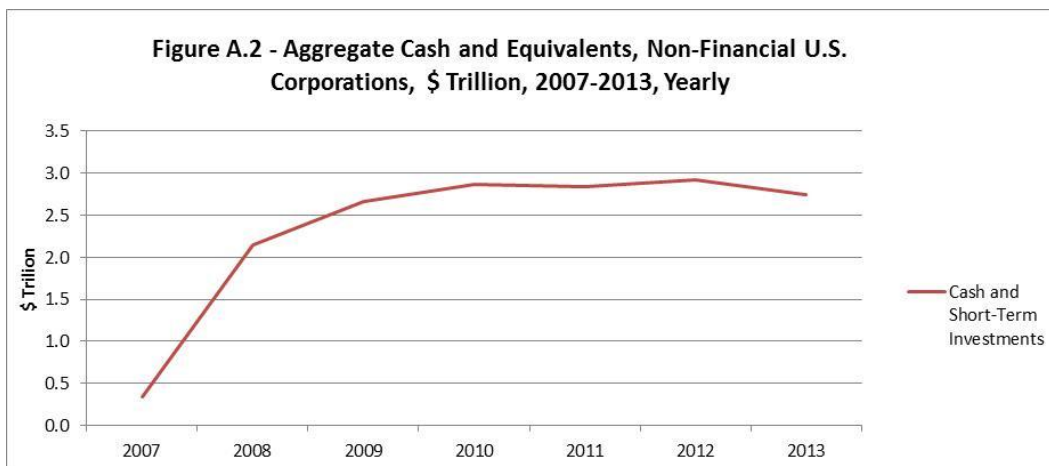**Appendix Figure 1 - Bank Reserves and Commercial & Industrial Lending (under $1 million)**

Figure A.1 - Total Bank Reserves & Commercial and Industrial Loans (> 1 million loan value), Index (01/2009=100), Jan 2009 - Dec 2013, Quarterly

As per Grover and Suominen (2014: 9) this study uses C&I loans with values of $1 million or less as a proxy for lending to small and medium enterprises and compared that with growth in bank reserves. However, unlike their study, this examines new loans extended during the period as opposed to total loan balances outstanding. The results in Figure A.1 show moderate recovery in small loans by 2010 but episodes of QE do not appear to significantly boost this lending. It is also possible that instead of productive SME investment, these small loans represent margin debt used by equity investors to engage in speculative margin trading, which is now at an all-time high (Mackenzie and Rodrigues 2014).

As a supplement to Figure 6 ('Percent of Corporate Assets Held as Cash'), Figure A.2 presents the aggregate cash & near-cash holdings of U.S. corporations to show a trend in cash accumulation during the crisis years. Asset values are deflated using the GDP Deflator (Index 2009=100) in order to rule out potential inflationary effects since the outset of the QE policy.

**Appendix Figure 2 - Corporate Assets Held as Cash**

Figure A.2 - Aggregate Cash and Equivalents, Non-Financial U.S. Corporations, $ Trillion, 2007-2013, Yearly

Similar to the results of Figure 6, this shows a steep rise in cash holdings.

Figure A.3 trends the monetary base with excess reserves, showing that the excess component of bank reserves is driving growth in the monetary base because subtracting excess reserves from the monetary base shows a much different trajectory for the monetary base. The nominal data in the following two figures (A.3 & A.4) is deflated using the GDP Deflator (Index 2009=100) in order to rule out potential inflationary effects since the outset of the QE policy.

Appendix Figure 3 - Monetary Base and Excess Reserves
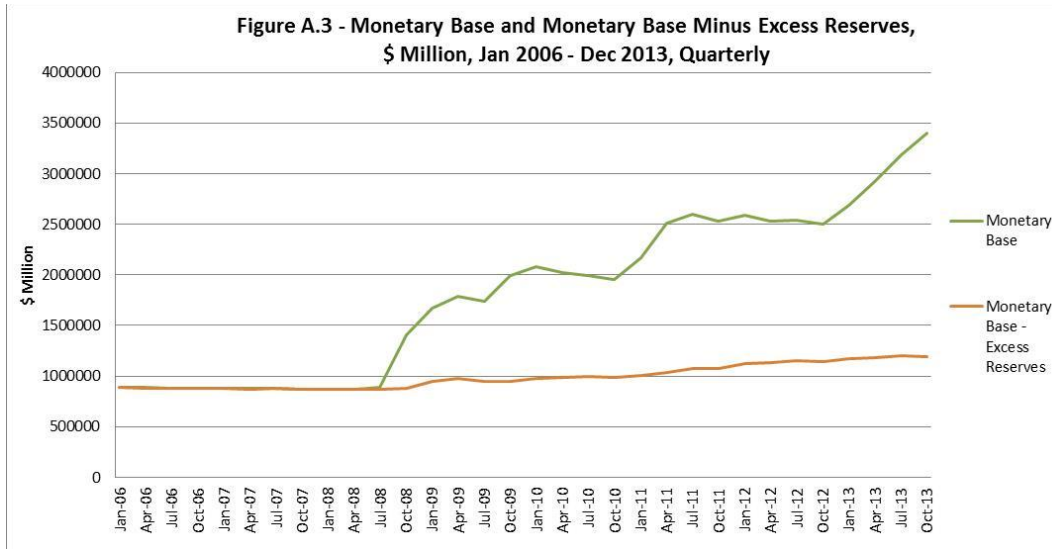
Source: FRB of St. Louis, FRED® database. Accessed 08/20/2014.

Figure A.4 shows the velocity of M2 along with trends in total bank reserves held in bank vaults or with the Federal Reserve System, distinguishing for the excess reserve component of total bank reserves.

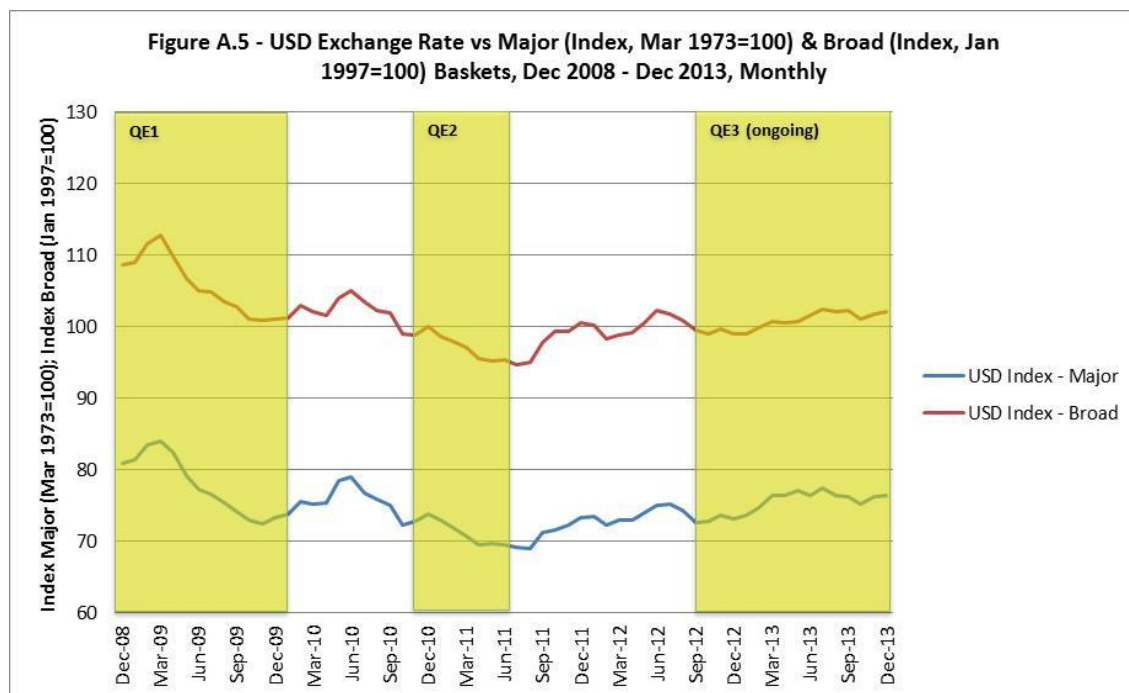**Appendix Figure 4 - Bank Reserves and M2 Income Velocity**

Source: FRB of St. Louis, FRED® database. Accessed 08/21/2014.

41
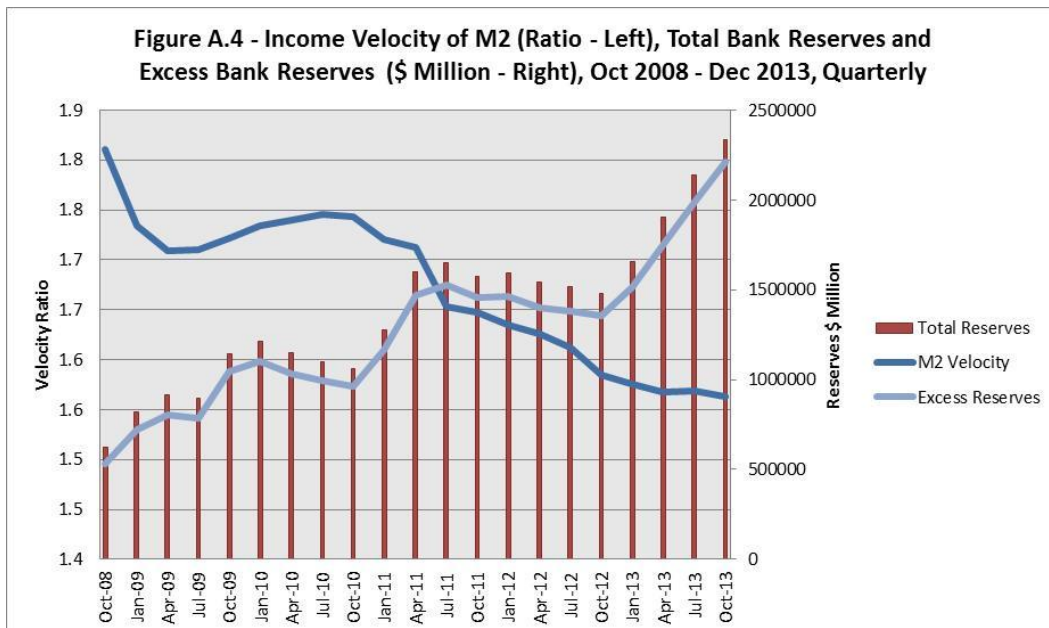
A trend of increasing reserve growth powered by excess reserves is evident. At the same time the M2 velocity is declining, most likely because the reserves are not being released into the economy to be used for transactions. The implication is that a 'reserve trap' is precluding a theorized monetary velocity from impacting nominal income.

According to the cost-based theory of inflation it is rising producer costs, especially of raw material imports, that drive inflation in the economy (Nicholas 2008). The Fed may be indirectly looking to target this channel but this remains unstated by policymakers. Zero-bound interest rates and money printing are causing currency depreciation which results in import inflation, increasing the cost of imported goods.

Figure A.5 examines trends in the USD exchange rate during the operation of the QE policy by comparing the performance of the USD against a basket of major currencies[13] along with a more broad basket of currencies, including key emerging market trading partners[14].

Appendix Figure 5 - USD Exchange Rate

Figure A.5 - USD Exchange Rate vs Major (Index, Mar 1973=100) & Broad (Index, Jan 1997=100) Baskets, Dec 2008 - Dec 2013, Monthly

Source: FRB of St. Louis, FRED® database. Accessed 08/21/2014.

Although the USD was generally appreciating during QE1a, once QE1b was announced in March 2009, the USD started falling. It fell close to its 1997 value against the broad basket of currencies and close to 70% of its 1973 value against the major basket of currencies by the end of QE1. QE2 caused further depreciation of the USD, breaching and dropping below its 1997 value against the broad basket and falling below 70% of its 1973 value against the major basket. The USD has tended to

[13] Includes the Eurozone, Canada, Japan, United Kingdom, Switzerland, Australia, and Sweden.

[14] Includes the Eurozone, Canada, Japan, Mexico, China, United Kingdom, Taiwan, Korea, Singapore, Hong Kong, Malaysia, Brazil, Switzerland, Thailand, Philippines, Australia, Indonesia, India, Israel, Saudi Arabia, Russia, Sweden, Argentina, Venezuela, Chile and Colombia

appreciate or stay stable during windows in-between waves of QE. QE3 did less to influence the value of the USD which stayed stable and appreciated slightly. However, the impacts of QE1/2 on the exchange rate are the second strongest and most long-lasting impacts of the policy on assets next to equities.

Figure A.6 shows the inflationary impact of USD depreciation by comparing trends in the broad and major USD indices with measures of inflation.

**Appendix Figure 6 - USD Exchange Rate and Inflation**
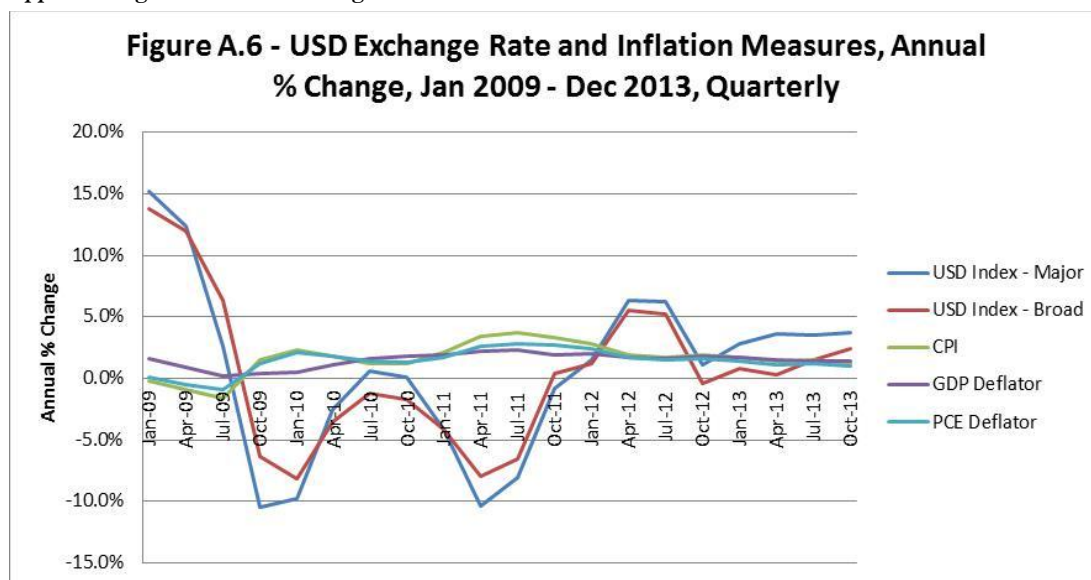
Source: FRB of St. Louis, FRED® database. Accessed 09/10/2014.

The impact of QE on the USD exchange rate appears to have some influence on inflation. Looking at the two major devaluations of the USD, from Q2 2009 to Q2 2010 and again from Q4 2010 to Q4 2011, they are both correlated with appreciable boosts to the inflation measures. Conversely, when the USD appreciated from Q1 2012 to Q4 2012, the inflation measures stagnated or dropped slightly. It is possible that an ulterior goal of the QE policy is to meet the inflation target via import inflation by devaluing the dollar.

When the Fed bought MBS it aimed to generate a boost to the mortgage and housing markets via lower mortgage rates, intended to increase the value of houses. Increased household net worth in terms of higher home equity was supposed to stimulate lending to the household sector to invest in housing, durables and to increase consumption.

Figure A.7 looks at trends in the S&P Case-Shiller 20-City Home Price Index to see how housing prices performed during QE.

Appendix Figure 7 - Housing Prices

Figure A.7 - S&P Case-Shiller 20-City Home Price Index©,
Oct 2008 - Dec 2013, Quarterly
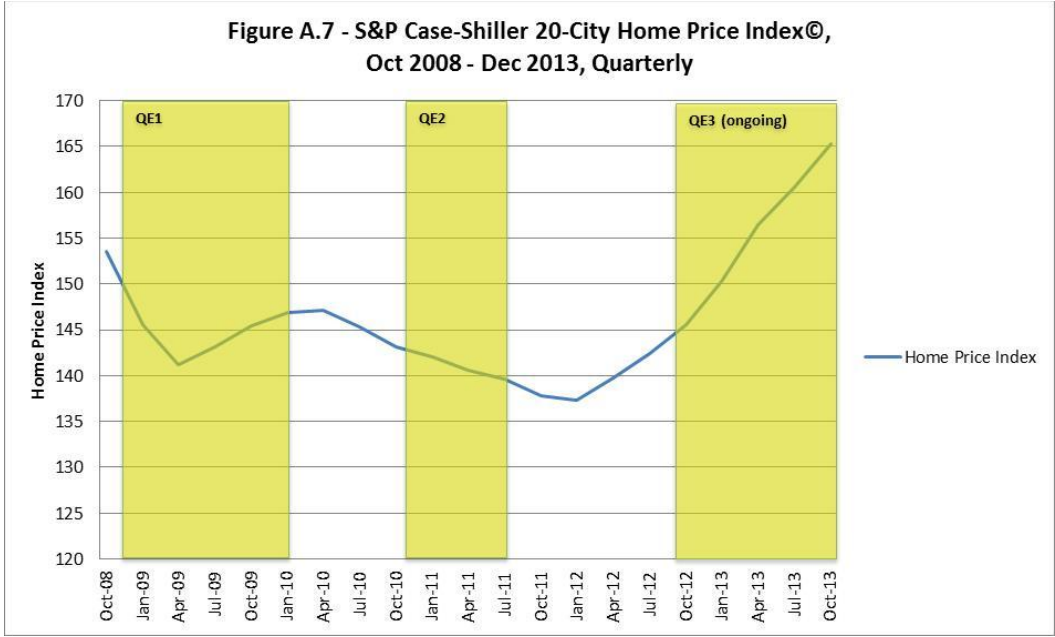
QE1 and QE2 do not appear to have a significant effect on housing prices. QE1 fails to boost housing prices to pre-crisis levels and after QE2 they sink even further past their previous low. In 2012 housing prices begin a sustained rise and continue to recover after QE3 is put in place, recovering fully to pre-crisis levels in 2013. Was QE3 responsible for this recovery? In order for the Fed's MBS purchases to impact home equity, there must be a link between falling mortgage rates and rising housing prices.

To examine the link between mortgage rates and housing prices, Figure A.8 compares trends in the average 30 year fixed mortgage rates in the U.S. and the S&P Case-Shiller 20-City Home Price Index.

**Appendix Figure 8 - Mortgage Rates and Housing Prices**

Figure A.8 - 30-yr Mortgage Rates (Left) and S&P Case-Shiller 20-City Home Price Index© (Right), Annual % Change, Oct 2008 - Dec 2013, Quarterly
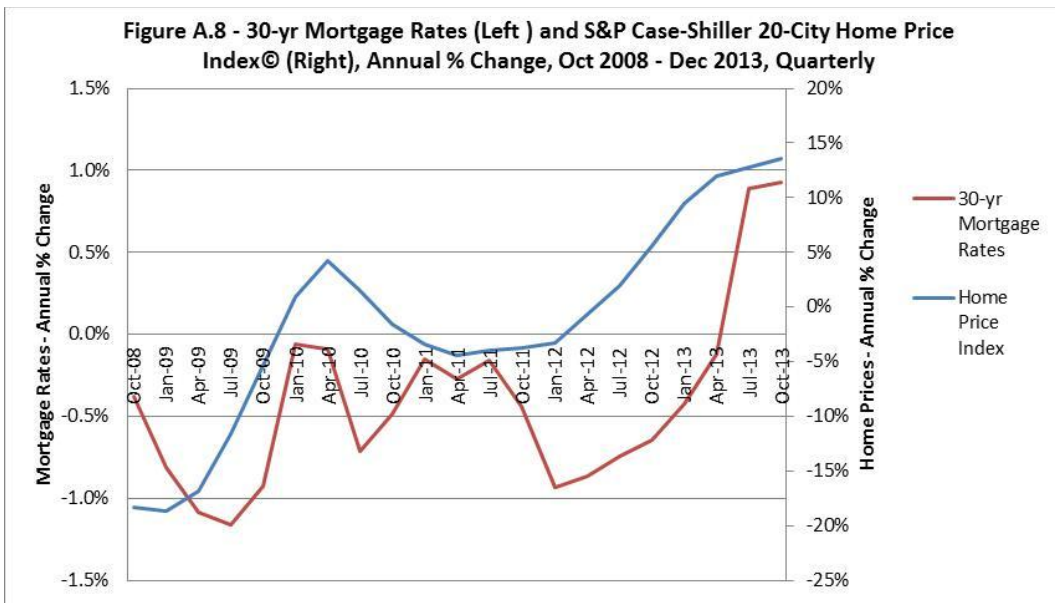
For the most part, recoveries in the housing market are actually accompanied by increases in mortgage rates. For example, the rise in mortgage rates starting in Q3 2009 was followed by a rise in home prices. Alternatively, a drop in mortgage rates at the start of Q2 2010 was followed by a drop in housing prices. Since Q1 2012 the two measures have followed each other on an upward trend which is not what should theoretically be the case as falling, not rising, mortgage rates are supposed to boost housing prices according to the Fed's rationale. Therefore, it is unclear whether the housing market recovery in 2012 was due to QE3 as in Figure A.7 because it is shown in Figure A.8 that these gains have coincided with rising, not falling, mortgage rates.

As mentioned in Chapter 3, QE indirectly targeted corporate bond yields in an effort to boost corporate investment. The intermediate target of bond interest rates is supposed to impact the final target of business investment. Lower bond financing costs are supposed to encourage fixed capital formation. Figure A.9 compares bond yields with the rate of fixed capital formation, measured as a percentage of nominal GDP in order to determine how much bond financing impacted the rate of business investment.

Appendix Figure 9 - Bond Yields and Fixed Capital Formation
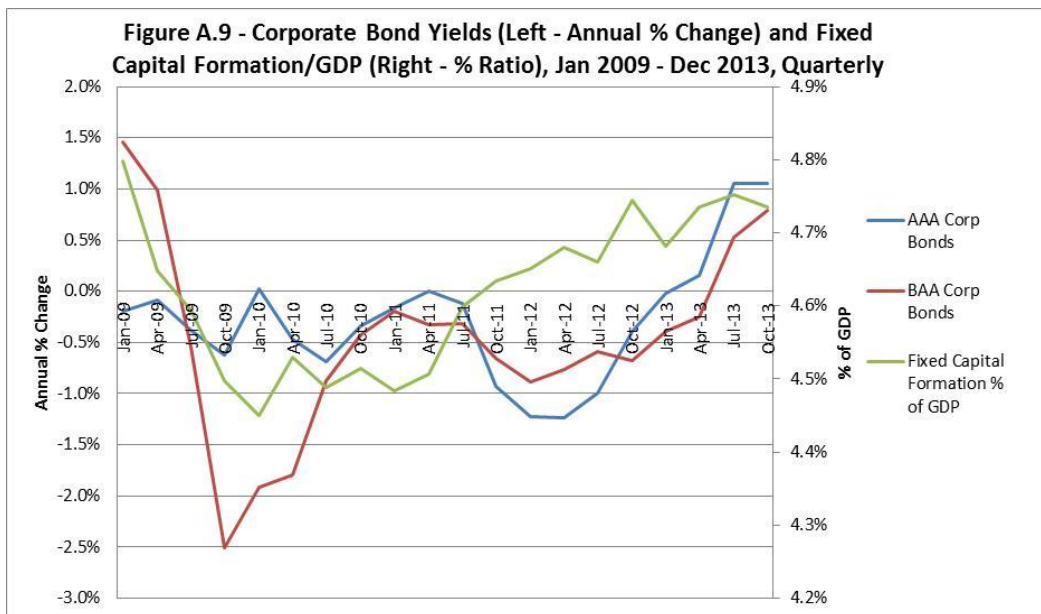
Source: FRB of St. Louis, FRED® database. Accessed 09/16/2014.

Bond yields (on the left scale) have tended to have an unclear relationship with the fixed investment rate (on the right scale). Movements in the bond rates show mixed effects on fixed capital formation. At times they move in the same direction, such as during all of 2009 and 2010, which is the opposite of the theorized relationship of lower bond rates leading to higher investment levels. At other times the relationship between the variables is as expected, for example from mid-2011 to mid-2012. Granted the inconclusive patterns, there may be other factors besides bond yields that impact the rate of fixed business investment.

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