

EXCEEDING THE ZERO-BOUND:
INNOVATIVE MONETARY POLICY IN TIMES OF CRISES

Michael F. Sherman

DePaul University

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Dr. Timothy P. Opiela, Economics

Dr. Wayne P. Steger, Political Science

Abstract

The Federal Reserve is one of the most powerful institutions in the world, but its inner workings are complex and opaque. This paper dives into the “black box” that is monetary policy by examining various tools at the Fed’s disposal, and how those tools work through different channels to affect the real economy. Additionally, this paper examines how during the 2008 financial crisis, the tools were stretched to the limit of their effectiveness and the channels were constrained. This led to the Fed implementing unconventional monetary policy to avert an economic catastrophe.

Keywords

- Economics, Federal Reserve, monetary policy, financial crisis

Contents

I.	Introduction.....	3
II.	Central Banking Overview	4
III.	Conventional Tools.....	8
IV.	Monetary Transmission Mechanism.....	12
	Interest Rate Channel.....	12
	Credit Channel	14
	Balance Sheet Channel	15
	Bank Lending Channel	19
V.	Conducting Policy at the Zero-Bound	23
VI.	Financial Crisis	25
VII.	Unconventional Tools.....	30
	Forward Guidance.....	31
	Interest on Reserves	32
	Lending Facilities.....	33
	Quantitative Easing.....	35
	TARP	38
VIII.	Consequences.....	39
IX.	Concluding Remarks.....	44
X.	Bibliography	44

I. Introduction

The Federal Reserve is one of the most powerful institutions in the world, but its inner workings are complex and opaque. Prior to the financial crisis of 2008, the Federal Reserve largely operated off the radar screens of the national media and politicians. However, its aggressive response to the crisis thrust it into the national spotlight, and various opposition groups and members of Congress have gained fame by criticizing Fed policies and operations. Nonetheless, few individuals have a good understanding of the function and tools of the Federal Reserve. This paper seeks to address this gap.

First, the paper addresses what central banks are, what their responsibilities are, and how they function. Moving to the Federal Reserve specifically, the paper explains the conventional tools of monetary policy used by the Fed and the means through which these tools affect the real economy and regular households and businesses from a theoretical perspective. This process is known as the monetary transmission mechanism and has been dubbed the “black box” because the way in which a Fed decision impacts the real economy is debated and not definitively known.

The theory is then applied to the financial crisis and its aftermath. During this time, the Fed implemented new, unconventional tools to help stabilize the economy. The tools implemented and their objectives can be traced to the monetary transmission mechanism and the dual mandate, price stability and maximum employment, of the Federal Reserve. The final part of the paper reflects on the consequences of the actions taken by the Fed.

This paper is neither a textbook nor a pure historical account of the 2008 financial crisis. Rather, the goal is to shed light on the modus operandi of the Federal Reserve by looking at the theories surrounding central banks and monetary policy, and then applying those theories to the crisis and its aftermath.

II. Central Banking Overview

Traditionally, a central bank or monetary authority is the institution that issues currency and regulates the financial system to achieve goals consistent with their mandate. For example, the Bank of Canada serves as the central bank of Canada and issues the Canadian dollar. For the Eurozone, a supranational organization, the European Central Bank (ECB) acts as the monetary authority for all member-states. Central banks are tasked with overseeing the macroeconomy of their respective country or countries. Economies are usually measured by gross domestic product (GDP), which is equal to the total value of final goods produced and services provided by an economy in a given period, i.e. a year. The main goal of most central banks is to ensure that GDP grows stably and steadily by promoting a small, stable inflation rate.

The Federal Reserve is the central bank of the United States¹. Founded in 1913, the Fed was established by the Federal Reserve Act, and the institution continues to play various roles in the economy. It is comprised of the Board of Governors in Washington D.C. and twelve regional banks found throughout the United States. Members of the Board of Governors are appointed by the president of the United States to a fourteen-year term and are confirmed by the Senate. The Board is led by a chair and a vice-chair, who serve four-year terms. Reserve Bank presidents are selected locally, subject to approval by the Board of Governors. The aim of this structure was to both decentralize the power of the Fed and to ensure regional interests are represented. Another example of regional representation is that multiple governors from the same district may not serve on the Board simultaneously, e.g., if there is a governor from the New York district, then no one else may serve from that district until the initial New Yorker vacates his or her post.

¹ “Structure of the Federal Reserve System,” 2017

In some countries, central banks play a role in regulating the payments system. For example, in the United States, the Fed, along with the Electronic Payments Network, oversee the automated clearinghouse (ACH) system², which is a nationwide network through which depository institutions send each other batches of electronic funds. Direct deposit of payroll and social security benefits, as well as direct debiting of mortgages and utility bills are typical examples of ACH transactions. The Fed clears any and all transactions that make their way through the ACH system. In other words, they ensure that when funds are transferred from one account to the other, the initial account has the requisite funds needed to transfer. For example, an account with only \$1,000 cannot transfer \$5,000. Similar systems appear in other countries, and central banks tend to have a hand in ensuring the safety and efficiency of these systems.

The Fed additionally serves as the main regulator of bank holding companies, which are the parent companies of connected commercial banks, investment banks, money managers, and other forms of financial institutions. This role has evolved over time and can be traced to the 1930s. During that time, Congress passed legislation known as Glass-Steagall, which gave the Fed greater regulatory power over commercial banks. In this capacity, the Fed can enact various regulations governing institutions similar to how the Federal Aviation Administration can enact regulations related to airlines, airplanes, and flying. Some regulations are created directly by the Fed, and others come from Congress. These regulations, such as the ones borne from the Dodd-Frank law, are carried out by the Federal Reserve. Two of the more consequential regulations to come out of Dodd-Frank are bank stress tests and the Volcker Rule³. Stress tests are carried out by the Federal Reserve, and their goal is to ensure that large financial institutions are properly capitalized and will remain solvent in the event of a financial crisis. The Volcker Rule, named after former Fed

² “Automated Clearinghouse Services,” 2018

³ Tropeano, 2011

chair Paul Volcker who proposed it, is enforced by the Fed, and it prevents large financial intuitions from making certain kinds of speculative investments that do not benefit their customers. There are many other regulations put in place by the Fed as well as other central banks throughout the world that intended to make financial institutions safer while still allowing for risk-taking and profitability.

Central banks also act as a lender of last resort and can lend to member banks who are experiencing low liquidity; however, the bank must still be solvent. Otherwise, central banks would just be pumping money into an institution that will fail eventually. An illiquid institution, on the other hand, can remain in operation since its assets will produce sufficient funds. Originally, this was the primary purpose of central banks and was defined in Walter Bagehot's *Lombard Street*, a treatise on finance and money published in 1873 that is still consulted by central bankers. The Fed, for example, can lend to any member-banks such as Wintrust or Wells Fargo. These loans are not free and carry an interest rate known as the "discount rate." Thus, banks must pay back any monies borrowed from the Fed plus interest. These types of loans are not meant to be used frequently and are designed to protect banks from short-term liquidity issues, as a bulwark against a run on deposits. In such cases, the Fed has the capital necessary to secure the financial position of the troubled bank and contain the liquidity shortfall to that one bank. Similarly, other central banks can also lend to troubled financial institutions in times of crises.

The final function of the Fed is to conduct monetary policy, which is arguably the most important role of a central bank, and will be the focus of the rest of this paper. Monetary policy is the way through which a central bank controls the money supply and interest rates. The Federal Open Markets Committee (FOMC) is the twelve-person body within the Fed that implements monetary policy. It is comprised of the Fed Board of Governors, the New York Fed President, and

a rotation of the other regional presidents. The goals of monetary policy come from a Congressional amendment in 1977 to the 1913 Federal Reserve Act⁴. These goals are known as the dual mandate of the Federal Reserve and refer to price stability and maximum employment. This translates into ensuring that prices remain steady and that the economy is at the full employment rate of unemployment. It is important to note that pursuing both goals simultaneously is rarely feasible, as full employment tends to lead to higher inflation. Thus, the Fed seeks a balance between the two; however, policymakers tend to emphasize one-half of the dual mandate. Therefore, the philosophy of who gets appointed to the regional banks or the Board of Governors can drastically alter the policy stance of the Fed. Nonetheless, the Fed is accountable to Congress for meeting its statutory objectives. Per its website, the goal of the Federal Reserve is to “[provide] the nation with a safe, flexible, and stable monetary and financial system.”

When conducting monetary policy, most central banks target either an exchange rate or an interest rate and then manipulate the supply of money to achieve the target rate. In order to achieve its dual mandate of maximum employment and price stability, the Fed’s current policy is to target an inflation rate of two percent⁵. The Fed then manipulates the money supply and interest rates to try to achieve that target. Central banks of large, industrialized nations tend to follow a similar model and target inflation. Central banks of smaller countries tend to target an exchange rate⁶. This is especially true for countries with fixed currencies. For example, the Danish central bank acts to ensure that the Danish krone is equal to 0.13 euro. Regardless of whether the rate being targeted

⁴ Zhu, 2013

⁵ Spicer, 2012

⁶ There are two main goals of exchange rate pegging. The first is to adopt the monetary policy of the other currency. This is usually done to combat high inflation and build the credibility of the domestic central bank. The second is to keep the domestic currency undervalued to promote the export business of the economy.

is an inflation or exchange rate, central banks act to ensure that the economy tracks to the selected rate, which ensures a stable financial system.

One limitation of monetary policy is that any effects on GDP or aggregate demand, which is defined as the sum of consumption, investment, government spending, and net exports, are temporary in nature. While central banks prefer to see GDP increase stably and steadily, they can only affect inflation in the long run. Nominal GDP can be thought of as price multiplied by output, and in the short run, central banks can affect demand for goods and services because prices are sticky. This means that price remains constant and output adjusts based on the implemented monetary policy. However, in the long run, output is determined by factors such as productivity, human capital, and technological advancements, all of which are outside the control of a central bank. Thus, the only component of nominal GDP that the Federal Reserve can exert influence over in the long run is the level of prices or inflation. This limitation is critical to understanding that policy actions undertaken by the Fed are meant to smooth out short-term fluctuations in the business cycle.

III. Conventional Tools

The Federal Reserve has different tools that it has at its disposal that can be used to achieve the dual mandate of price stability and maximum employment. The use of these tools is governed by the FOMC, and the effects of using them will eventually reverberate through the real economy. Empirically, there is a six to twenty-four-month lag between a policy decision and seeing the effects of that decision on unemployment and nominal GDP⁷. This is due to the fact that once the cost of funds change, market participants do not adjust instantly. For example, banks need to assign new rates to various loans, and they need to decide if their lending practices should change.

⁷ Cagan and Gandolfi, 1969. Note that this lag differs among countries.

Additionally, firms and consumers need time to identify funding needs and decide on what to purchase, with investment and consumer durables expenditures requiring the most deliberation. The transparency of the central bank also affects the lag. If rate changes have been forecasted in advanced, then the effects of the actual changes will be felt more quickly. Unexpected fluctuations affect the real economy more gradually. Therefore, the FOMC must move incrementally so that policymakers can reverse or alter their course if the effects that occur are not what they anticipated.

One of the tools of the Fed is the reserve requirement ratio. Basically, banks must hold a certain percentage of their deposits either in their vaults or at their account with the Fed. This is to ensure that in the event of a bank run, banks are able to meet the demands of their depositors. By changing the reserve requirement, the Fed can influence the amount of funds lent out by banks relative to their deposits. This tool was rarely used historically because a small change in the ratio can lead to disproportionately large effects on the economy⁸. However, following the Great Depression, the Fed drastically increased the ratio to guard against bank runs⁹. It has since brought the ratio back down, and it currently sits at 10%¹⁰. In recent times, this tool has lost its potency due to what are known as *sweep accounts*. Some, usually large, banks can “sweep” their deposits into savings accounts overnight. Initially beginning with corporate accounts and later spreading to personal accounts, these overnight accounts do not count towards the deposits that factor into the required reserve calculation. Thus, some banks can avoid this constraint because their deposits are effectively zero, so they do not have to maintain reserves. Hence, the FOMC tends to employ other tools more frequently.

⁸ The Federal Reserve also used this tool to stabilize the demand for money, i.e. the amount of required reserves set a floor for the money demand curve. By constraining this curve, the Fed could more easily conduct set interest rates.

⁹ Feinman, 1993

¹⁰ “Reserve Requirements,” 2017

Another tool of the Fed is the discount rate. This is a statutory rate set by the FOMC, and is the amount of interest that banks must pay to borrow from the Federal Reserve. As previously mentioned, these loans are meant to be infrequent and are designed to save a bank that is on the verge of failing due to a liquidity crunch. Hence, the term “Lender of Last Resort.” The name of this rate comes from the fact that originally, banks borrowed at the Fed’s discount window. Due to the fact that the main borrowers are failing banks, there is a negative stigma associated with borrowing at the discount rate. Nevertheless, this is a tool monetary policy, in that by changing the discount rate, the Fed can encourage either more or less borrowing. In recent times, however, the Fed has tied this interest rate to the federal funds rate¹¹. Whereas the federal funds rate affects all market participants, the discount rate only affects banks’ abilities to borrow from the Fed, so it has a more limited macroeconomic effect.

The federal funds rate is the main and most frequently used instrument in the Federal Reserve’s toolbox. Also known as the interbank market rate, this is the interest rate at which depository institutions lend reserve balances to other depository institutions overnight. Based on current and projected economic conditions, the FOMC will target a specific federal funds rate that is commensurate with those conditions. Once a target federal funds rate has been selected, the Federal Reserve Bank of New York will conduct open market operations (OMO) to move the federal funds rate to its target in a process known as interest rate targeting. “Under interest rate targeting, the central bank determines what level of the overnight interest rate is consistent with its inflation and growth objectives and then supplies the necessary amount of reserves to achieve

¹¹ The discount rate has an interesting history over the last few decades. Initially, it was set below the federal funds rate. To discourage its usage, the Fed said that banks that borrow too frequently through the discount window will face an audit. Under Chairman Greenspan, movement in the discount rate was used as a signaling device for future movements in the federal funds rate. Under Chairman Bernanke through today, it is set as a cost over the federal funds rate. This is consistent with Bagehot, who said that banks should pay a premium to borrow from the central bank as opposed to other banks.

this target interest rate. In this approach to implementing monetary policy, policy is eased or tightened by lowering or raising the target interest rate¹².” When conducting OMO, the New York Fed buys and/or sells U.S. Treasury securities to change the monetary base, which acts as the supply curve in the market for interbank funds. The federal funds rate is thus derived from the intersection of this curve with the money demand curve. Buying Treasuries off of banks’ balance sheets increases the monetary base, which causes the federal funds rate to decline. Selling Treasuries to banks forces them to give up cash, which reduces the monetary base and causes the federal funds rate to increase.

Historically, economists infer that the Fed targeted a specific money supply quantity, but that relationship has broken down due to deregulation and changes in what constitutes money supply. Due to various interest-bearing instruments being included in money supply definitions, there is no longer perfect substitutability between the various factors that make up the money supply. Thus, this measure is no longer a reliable means of regulating the macroeconomy. Instead of choosing a money supply quantity regardless of what the corresponding federal funds rate will be, the Fed now adjusts the monetary base to achieve their interest rate target.

Some of the economic indicators used by the FOMC when determining the interest rate target are unemployment rates, consumer confidence levels, housing prices, and others. The main indicators that the Fed looks at are inflation and expected inflation rates. This is consistent with the fact that they target a two percent inflation rate. The Fed also has teams of econometricians who build models based on these data points to predict future economic conditions. In addition to the inherent difficulty in forecasting future economic conditions, the Fed also faces a shifting current economic landscape. Various economic measures such as GDP growth and unemployment

¹² Sellon, 2003

figures are revised over time, which increases errors in short-term forecasts. These revisions can have profound effects: GDP was projected to have grown at 4.2 percent in the fourth quarter of 1977, but was later revised to show a contraction of 0.1 percent. Due to the unreliability of future forecasts, current conditions, and the lag between policy decisions and macroeconomic effects, the Fed incrementally adjusts the federal funds rate, usually at a rate of twenty-five basis points. This allows the Fed to adjust their forecasts and target rate as the macroeconomic effects materialize or if economic conditions change unexpectedly.

Overall, the Federal Reserve's workhorse is the federal funds rate. It is adjusted as necessary to maintain price stability and keep the economy at full employment. Though other tools exist, they are implemented much less frequently. However, over the course of the financial crisis, the Fed created new, unconventional tools to conduct monetary policy because the federal funds rate was no longer effective. These new tools will be discussed later on in the paper.

IV. Monetary Transmission Mechanism

The monetary transmission mechanism refers to how monetary policy decisions eventually impact unemployment, nominal GDP, and the wider macroeconomy. In other words, the mechanism answers the question, "How do FOMC decisions regarding the exercise of the aforementioned tools help to achieve the dual mandate?" The short answer is that economists do not know for sure. Hence, the transmission mechanism is also known as the "black box." Economists come up with various theories or channels to help explain how monetary policy impacts the real economy.

Interest Rate Channel

For many decades, the main channel that explained monetary policy was the interest rate/money supply channel. A major assumption of this theory is that the cost of borrowing, i.e. the interest rate, is the only factor that affects the decision to borrow. This channel starts with a

change in monetary policy, which usually occurs when the New York Fed conducts open market operations. For illustrative purposes, suppose the Fed raises interest rates. Note that if the Fed were to lower interest rates instead, then the opposite actions would take place. To raise the federal funds rate, the Fed would need to sell Treasuries and decrease the monetary base. Higher interest rates would cause consumption and investment to decrease because the cost of borrowing is higher; however, the federal funds rate is a short-term interest rate. In fact, it has one of the shortest maturities in the market since it is an overnight rate. This means that the federal funds rate cannot explain changes in investment and consumption because long-term rates are what drive real growth and gains in productivity. Firms create new factories by financing at the long-term rate, and households buy homes through mortgages, which are long-term financial instruments. The interest rate channel thus needs to answer how changes in the short-term federal funds rate affect long-term interest rates that drive aggregate demand.

The way in which the federal funds rate drives future rates is through the yield curve¹³, which is a graphical representation of interest rates or yields for a given maturity. Basically, the federal funds rate serves as the origin of the yield curve because its maturity is overnight or essentially zero. As the yield curve moves rightward, maturities increase, and yields tend to rise. Two possible explanations for this are interest rate risk and liquidity premiums. Interest rate risk refers to the idea that holding a financial instrument with a longer maturity is riskier because there is more time for the instrument's value to change due to fluctuations in the interest rate. In terms of liquidity, investors give up money for a longer period of time as maturity increases, and this sacrifice also warrants additional yield. When the Federal Reserve increases the origin of the yield curve, the rest of the curve tends to adjust in the same direction. The adjustment is unlikely to be

¹³ See Kozicki and Sellon, 2005 for further discussion on the yield curve and monetary policy

one-for-one: a twenty-five basis point increase in the federal funds rate does not mean that the yield on a ten-year Treasury will also increase twenty-five basis points. Note that expectations also play a role in the yield curve, so if investors believe that the Fed is only temporarily raising rates and will soon lower them again, then the yield curve is unlikely to adjust. Generally, however, when the Federal Reserve raises the federal funds rate, other, long-term interest rates also increase.

Now that interest rates of short and long-term maturities have increased, the rest of the channel explains how nominal GDP is impacted. A higher cost of borrowing will cause borrowing to decrease because some households and firms have been priced out of the market. For example, a family wants to buy a \$100,000 apartment and can afford to pay up to five percent interest. The current interest rate on a thirty-year mortgage is 4.95%, so the household opts to purchase the apartment. However, if the Federal Reserve increases the federal funds rate twenty-five basis points, and the rate of a thirty-year mortgage rises ten basis points to 5.05%, then the household can no longer afford to buy the home. If the mortgage rate had increased five basis points instead of ten, then the household would have been able to afford the apartment. The same logic applies to other loans and financial arrangements. Higher interest rates will drive some people and firms out of the market while others will be able to bear the additional cost. Market participants who have been driven out will cause investment and consumption to fall because their would-be purchases are no longer occurring. This causes aggregate demand and nominal GDP to decrease as well. Thus, this is how the interest rate channel explains how changes in monetary policy affect the real economy.

Credit Channel

Various studies, however, have shown that the interest rate channel alone does not explain empirical swings in consumption and investment. This means that there must be some other phenomenon occurring in the black box that is causing these swings. Economists have thus come

up with what is known as the credit channel. Note that the term “credit channel” is a bit of a misnomer in that it is not an independent channel. Rather, it acts as an amplifier or accelerator of the interest rate channel, whose main shortcoming is that it assumes that financial institutions are uninhibited by fluctuations in interest rates. Going back to the mortgage example, when the Federal Reserve raised the federal funds rate, the adjustment in the mortgage rate was not the only change that occurred. Both the bank issuing the mortgage and the household taking it were affected by the change in interest rates. Comprised of two parts, the credit channel, thus, seeks to explain how these effects drive changes in the ability to borrow and the ability to lend. It can be thought of as the market for credit or loans, and the two subchannels are the balance sheet channel and the bank lending channel. Together, these subchannels give the equilibrium quantity of credit. As interest rates change, the equilibrium quantity of loans changes. This causes investment and consumption to adjust as well, which in turn causes nominal GDP to adjust.

Balance Sheet Channel

The balance sheet channel looks at the demand for credit and is focused on borrowers. When banks lend to customers, they face asymmetric information problems. Prior to discussing the balance sheet channel, one must first understand how this information asymmetry affects firms’ ability to borrow. Information asymmetry occurs whenever one party has information necessary to make a decision that the other party is not privy to. In the case of lending and borrowing, banks have minimal information on their borrowers. Take a person walking into her local Chase branch to get a credit card. Initially, Chase knows nothing about this individual if she is a new customer. Her income level, employment history, loan history, and other variables used in Chase’s decision-making model are all unknown. The same occurs when businesses ask for loans or lines of credit. Their revenue figures, existing debt levels, and other factors are all unknown. Even though

borrowers know all of the pertinent information, banks do not, which leads to asymmetric information problems.

Two main problems arise from this information asymmetry: adverse selection and moral hazard. Adverse selection occurs before the loan is made and refers to the issue of identifying which firms are the best borrowers. Given that banks face a large distribution of potential borrowers and limited funds to lend out, they need to ensure that the customers that receive loans are the most likely ones to pay off the loans. The issue is that they do not know which borrowers can pay back the bank and which cannot. The second issue banks face is moral hazard, which occurs after the loan is made and refers to the possibility that the borrower could engage in risky behavior with the loaned funds. When a firm or household asks for a loan, banks have no way of knowing how the money will be spent. For example, if a small manufacturer asks for \$100,000 to buy new machinery and equipment, there is a possibility that the \$100,000 will actually be spent on a trip to Las Vegas for management. While this example is an extreme one, the misuse of borrowed funds could jeopardize the ability of the borrower to repay the bank. A more realistic example would be borrowing money to invest in speculative derivatives, commodities or other financial products. If these investments do not pan out, then borrowers will be unable to repay their creditors. Since only the borrower knows how the funds will be spent, banks need to guard against scenarios in which they are unable to collect their loans.

To minimize both the problems of adverse selection and moral hazard, banks have many tools, but the main two are information and collateral. Clearly, as the information on a client a bank has increases, information asymmetry decreases. Collateral works as a more complex solution. Before the loan is made, it acts as a screening device. If a bank asks for collateral, firms that do not have any or are unwilling to risk their assets will drop out of the market. This reduces

adverse selection problems because presumably, the firms that are unwilling to put up collateral are not good firms. Once the loan is made, collateral also acts as a deterrent to risky behavior. If a firm knows that the bank will confiscate the new machinery in the event of default, then the firm is more likely to act judiciously in order to minimize the probability of confiscation.

Asymmetrical information problems are exacerbated when dealing with small, bank-dependent firms. Large firms that are publicly traded file financial statements with the Securities and Exchange Commission (SEC). These statements can be accessed by any individual or entity, which includes banks, and the information provided in these filings reduce information asymmetry. Small firms do not file with the SEC, so they face a risk premium if their borrowed funds exceed their collateral. Real investments literature¹⁴ explains this concept. Basically, large firms are able to borrow funds at some base interest rate because so much of their information is public, which essentially eliminates asymmetric information problems. Banks do not have this same level of information on small, bank-dependent firms, which creates risk for the bank. Thus, banks assign risk premiums to firms that fall into this category to cover the additional risk that they are taking. This small firm interest rate is equal to the risk premium plus the base, large firm interest rate. However, small firms can borrow at the large firm rate if they have collateral because the collateral reduces the risk that banks face in that banks can seize and sell the collateral in the event of default. This creates a kinked supply of credit curve for small firms, where their interest rate is equal to the large firm rate while there is enough collateral. Once the firm collateralizes all of its assets, the supply curve increases to take into account the risk premium. Thus, as collateral levels fluctuate, firms' ability to borrow also fluctuates.

¹⁴ See Hubbard, 1998 for further discussion on real investments

This ability to borrow is the balance sheet channel¹⁵. Fundamentally, as the Federal Reserve changes interest rates, the balance sheet of firms adjusts to reflect the new rates. The adjusted balance sheet impacts the attractiveness of a firm and its ability to borrow. Again, suppose the Fed raises interest rates. In addition to changes in the yield curve, firms' profitability, liquidity, and solvency are also affected. Assuming some of the firms' debt is floating, the interest rates will increase and interest expense will adjust as well. This drives net income downward. Additionally, asset values also decline because the discount rate applied increases, which causes the present value to decrease. If asset value declines, then the amount a firm can put up as collateral also declines, which constraints the firm's ability to borrow. Small firms that were once able to borrow at the large firm rate can no longer do so because they do not have the requisite amount of collateral, so they face a risk premium. This can be thought of as prime borrowing versus subprime borrowing. Prime borrowers face one, low interest rate, and subprime borrowers face a different, higher rate. Due to lower profitability and asset values, some firms are no longer classified as prime and are downgraded to subprime. The demand for prime loans decreases because there are less participants in that market. The demand for subprime loans increases, but this increase is less than the prime market decrease because some firms cannot bear the cost of the risk premium and are accordingly, priced out of the market. A leftward shift in the net credit demand curve causes the equilibrium quantity of credit to decline as well. Less credit causes investment and consumption to decrease, which causes nominal GDP to decline. Note that in the balance sheet channel, only the credit demand curve shifts. Firms might want to borrow more when rates increase, but they are unable to do so because they have been priced out of the market, which only affects the demand curve. In the above analysis, the supply of credit remained constant. In the real

¹⁵ See Bernanke and Gertler, 1995 for further discussion on the balance sheet channel

world, the supply of credit also shifts when interest rates change, and this shift is explained by the second credit channel subchannel: the bank lending channel.

Bank Lending Channel

While the balance sheet channel looks at firms' ability to borrow, the bank lending channel looks at how changes in interest rates affect the supply of credit and banks' ability to lend. Prior to discussing how banks lend, one must first understand the structure or balance sheet of a bank, which is distinct from other businesses. Banks have three main assets: cash, securities, and loans. Cash is money kept either at a bank's vault or at the bank's account with the Fed. These funds are made up of required and excess reserves. As previously mentioned, some banks are not constrained by the required reserve ratio due to sweep accounts. Securities are financial instruments that the bank has invested in such as Treasuries. Under various regulations, commercial banks cannot invest their money into risky assets, so Treasuries are the most common form of securities held on a bank's balance sheet. The final asset is loans, which are further divided into consumer, industrial and commercial, real estate, and interbank or federal funds loans. Of the three classes of assets, cash is the least risky and loans are the most risky. Historically, residential mortgages were considered to be the safest loans; however, this conventional wisdom was challenged in 2008. Additionally, cash and securities are considered liquid assets because cash is always liquid and securities can be sold relatively easily on the open market. A distressed loan cannot be sold off as easily as a distressed security; therefore, banks are often stuck holding bad loans due to their illiquid nature.

As with any enterprise, assets must have corresponding claims. For banks, claims consist of various forms of liabilities and equity capital. For publicly traded banks, equity capital consists of funds invested in the bank via common or preferred stock. Liabilities can be divided into core deposits and marginal sources of funds. Core deposits mainly consist of demand deposits, small

certificate of deposits, and money market deposit accounts. A bank's marginal sources of funds mainly consist of large certificate of deposits, interbank market loans, bonds, and subordinated debt. Note that core deposits are insured, up to a specified amount, by the government through the Federal Deposit Insurance Corporation (FDIC). This means that if a bank fails, depositors will be protected, whereas provider of marginal funds and equity capital will not. Because of this insurance, core deposits carry lower interest costs than marginal sources of funds. Core depositors do not face default risk because they have insurance. Providers of marginal funds do carry default risk because there is no insurance, so they charge a risk premium to the bank. Banks are able to make loans based on the amount of funds they have available. The more deposits and/or marginal funds a bank has, the more loans it can make. If a loan defaults, the asset side of the balance sheet contracts. The claim side also has to adjust, so equity capital contracts to reflect the loss on the loan. Because of this relationship between capital and loans, banks cannot make new loans if they do not have sufficient capital. This regulation comes from the Basel Accords, which were first ratified in 1998 and have since been updated periodically. Other regulations can also constrain a bank's ability to lend based on its equity capital levels.

Given banks' unique financial structure of insured and uninsured claims, economists have come up with several different theories to explain how monetary policy impacts the supply of credit. Starting with open market operations, one of the initial bank lending channel theories¹⁶ states that when the Federal Reserve increases the federal funds rate, it sells Treasury securities to depository institutions. This changes the composition of banks' assets, with cash or reserves being used to purchase the securities. Due to the required reserve constraint, deposits must also decline for the bank to remain in compliance. In order to make up for the decline in core deposits, banks

¹⁶ See Bernanke and Blinder, 1992 for further discussion on this theory

must go to marginal sources of funds. However, not every bank is able to issue bonds or large certificate of deposits. Further, marginal sources of funds carry higher interest costs for banks. This is particularly true for smaller community banks who do not have access to the capital markets and face higher risk premiums due to their size and asymmetric information problems. Thus, these institutions face a high-risk premium on marginal funds. Therefore, even though larger banks are able to perfectly substitute marginal funds for core deposits, smaller banks cause the net supply of credit to decline. A leftward shift in the supply of credit causes the equilibrium quantity of credit to decline as well. Less credit causes investment and consumption to decrease, which causes nominal GDP to decline.

However, this theory has some shortcomings that were pointed out by economists in later studies, which are outlined below. The chief shortcoming is that for many banks, the required reserve ratio is nonbinding due to “sweep” accounts, which eliminate the required reserve constraint because employing these accounts allows banks to make their deposits effectively zero. Holding no deposits means that banks do not have to hold reserves. Without that constraint, the cause and effect relationships that build off of the required reserve ratio breaks down. However, the supply of credit is nonetheless affected when interest rates change because the balance sheet of banks deteriorate. In essence, this is an application of the balance sheet channel to banks¹⁷. When interest rates increase, banks might have liquidity constraints that arise from having less cash due to higher interest costs and holding securities that have lost value. Again, when interest rates increase, the discount rate increases, which causes the present value of an asset to decline. This constrains a bank’s ability to make loans because if it does not have enough funds to pay its own bills, then the bank cannot possibly use its funds to make loans. Further, a bank’s profitability

¹⁷ See Jiminez et al, 2012 for further discussion on the bank balance sheet channel

declines due to higher interest costs and losses on investments currently held by the bank, which causes equity capital to decline to absorb that loss. Low equity capital constrains the bank's ability to make loans due to the Basel Accords. This decline in the supply of credit is unrelated to the required reserve constraint. Nonetheless, it causes investment, consumption, and nominal GDP to decline.

In addition to the two theories outlined above, the risk-pricing channel¹⁸ also explains how changes in monetary policy impact the supply of credit. Borrowing from the bank balance sheet channel, an increase in the federal funds rate causes other interest rates to increase, which causes banks' balance sheets to worsen. When a bank's financial position deteriorates, its default risk increases, which causes investors to raise their risk premiums accordingly. This means that depositors and lenders of marginal funds will demand a higher return for keeping their funds at the bank to compensate for the additional risk that they are carrying. Banks that are able to bear this higher cost will be able to get additional funds and make new loans. Banks that are unable to bear this cost will be priced out of the market and lose some of their funding. The net effect of this is that the supply of credit declines, which causes investment, consumption, and nominal GDP to decline. Note that this cause and effect relationship also does not rely on the required reserve constraint.

Regardless of which theory is employed, the bank lending channel explains how a change in interest rates causes the supply of credit to adjust as well. Further, the health of a bank's balance sheet and its ability to substitute marginal funds for core deposits play an important role in determining the supply of credit. Note that the bank lending channel only reflects the bank's ability to make loans, and that it does not discuss the demand for credit, which is explained by the balance

¹⁸ See Kishan and Opiela, 2012 for further discussion on the risk-pricing channel

sheet channel. Taken together, the balance sheet and bank lending subchannels explain how monetary policy impacts the market for credit. When interest rates increase, both the supply of and demand for credit decrease. This causes the equilibrium quantity of credit to decrease, which causes investment, consumption, and nominal GDP to decline. There is an issue of simultaneity in that when the equilibrium quantity declines, the relative declines caused by supply and demand are difficult to separate. Nonetheless, the credit channel helps explain swings seen in consumption and investment that cannot be explained solely by the interest rate channel. Thus, the credit channel amplifies the effects of the interest rate channel, and together, they explain how monetary policy is able to affect the real economy through the monetary transmission mechanism¹⁹.

V. Conducting Policy at the Zero-Bound

Conventionally, open market operations fully impact the real economy after six months to two years. Changes in the federal funds rate flow through various channels that make up the monetary transmission mechanism to influence nominal GDP, unemployment, and other macroeconomic variables. However, this conventional approach to monetary policy has a major limitation in that the federal funds rate faces a zero-bound. Theoretically, the federal funds rate has no upper-bound and can rise to whatever level is deemed appropriate by the FOMC. In the early 1980s for example, Paul Volcker, who was the chair at the time, allowed the federal funds rate to approach twenty percent. While the federal funds rate has never exceeded twenty percent, it theoretically could. At the opposite end of the spectrum, the federal funds rate cannot dip below zero because negative nominal rates do not exist²⁰. This constraint on monetary policy is known as the zero-bound.

¹⁹ Note that there are other channels that also seek to explain how monetary policy affects the real economy. The exchange rate channel and the wealth channel are two notable examples.

²⁰ Note that some countries, notably Japan, are experimenting with negative rates. The effectiveness of these policies remains an open question.

However, the Fed has ways to work around this particular limitation. In other words, monetary policy does not become impotent once the federal funds rate hits zero. Various economists have written theoretical workarounds²¹ to the zero-bound problem. The most frequently discussed approach involves changes the composition of the balance sheet of the Federal Reserve. Composition refers to changing the makeup of the balance sheet. Most central banks' balance sheets are similar in nature. Their main assets are securities, loans to banks, foreign currency holdings, and other assets such as gold. For the Fed, prior to the financial crisis, most securities were short-term U.S. Treasuries. The liability side of the Fed's balance sheet consists mainly of currency in circulation and member-banks' reserves. When conducting open market operations, the Fed either increases its security holdings and liabilities by buying Treasuries in exchange for currency, or it decreases its holdings and liabilities by selling Treasuries in exchange for currency. By buying and selling short-term instruments, the Federal Reserve can affect the short-term federal funds rate. However, the Fed could theoretically buy and sell long-term securities instead of short-term one if the federal funds rate is at zero. This would change the composition of the Federal Reserve's balance sheet from short-term assets to long-term assets. Additionally, the Fed could purchase non-Treasury securities to target specific segments of the economy. The liabilities side would not change, but the Fed can adjust the asset side of their balance sheet to accommodate zero-bound monetary policy.

An additional important consideration of zero-bound monetary policy is that it starts to occur before the federal funds rate reaches zero. Per the interest rate channel, the Fed changes short-term rates, and then long-term rates adjust through the yield curve. There are diminishing marginal effects to lowering the federal funds rate, e.g. decreasing the fed funds rate by 25 basis

²¹ See Sellon, 2003 for further discussion on these workarounds

points when it is at five percent has a larger impact on long-term rates relative to a fed funds rate of two percent. Thus, as the fed funds rate approaches zero, the Federal Reserve needs to start changing the composition of its balance sheet or employing some other unconventional tool.

Ultimately, the zero-bound does not spell the end of effective monetary policy. Rather, it spells the end of conventional monetary policy. The Fed can continue to operate and influence the economy even if the federal funds rate is at zero. However, the policies undertaken by the Fed in such a situation are unconventional in nature and have little empirical studies analyzing them. In the face of the financial crisis of 2008, the Federal Reserve employed various unconventional approaches aimed at stabilizing the financial system and the broader economy.

VI. Financial Crisis

The Great Recession or the financial crisis of 2008 is arguably the single most significant macroeconomic event since the Great Depression. Per the U.S. National Bureau of Economic Research, the recession began in December 2007 and ended in June 2009. However, the beginnings of the crisis can be traced to the collapse of the housing market in 2006. The unemployment rate grew from 5.0% in December 2007 to 9.5% in June 2009 and then peaked after the end of the recession at 10.0% in October 2009²². GDP contracted sharply during the crisis, and the true cost continues to be debated and analyzed.

The causes of the financial crisis are many and varied. Books and academic articles²³ have been and will continue to be written about what led to the crisis and how it could have been avoided. For the purposes of this paper, a basic understanding of the key causes and their effects on financial institutions and the monetary transmission mechanism is necessary. Broadly speaking, the main causes of the crisis were bad mortgages and new financial instruments. These new

²² All economic data is aggregated by the St. Louis Fed's Federal Reserve Economic Data (FRED)

²³ See Brunnermeier, 2009 for further discussion on the causes of the crisis

instruments consisted of mortgage-backed securities (MBS) and credit default swaps. An MBS works by taking a mortgage and slicing and dicing it into a thousand pieces. This process is repeated with several thousand mortgages, and different pieces of different mortgages are then put together into one MBS. This one security consists of several thousand mortgages and is divided into tranches based on riskiness. Investors can then buy whichever tranche appeals to them, with higher tranches consisting of less risky (i.e. prime) mortgages and lower tranches consisting of riskier (i.e. subprime) mortgages. Since MBS securities consisted of so many different mortgages, they were thought to be very safe investments. In fact, ratings agencies such as Standard and Poor's and Moody's gave mortgage-backed securities AAA ratings, which is the same rating that U.S. Treasuries carry and translates into a risk-free financial instrument. In other words, ratings agencies believed that investing in an MBS was just as safe as investing in the U.S. government.

The second new instrument, a credit default swap, worked similarly to an insurance policy. Basically, if an MBS was not paying interest because a mortgage-holder defaulted, then the issuer of the credit default swap would pay. Together, these instruments relied on a simple premise: that housing prices would continue to rise. As long as the value of homes grew, then homeowners could refinance their mortgages, or in a worst-case scenario, the bank could foreclose the home and resell it at a higher value. Additionally, since these instruments were relatively new, there were few laws regulating them. This perfect storm led to banks and other mortgage-originators underwriting as many mortgages as possible to generate transactional fees. This process was known as "originate to distribute." In other words, underwriters would create or originate as many mortgages as possible and then sell or distribute them to other parties. Banks were no longer keeping mortgages on their balance sheets, and mortgages that did remain on the balance sheet were guaranteed with a credit default swap. This meant that banks did not have to be stringent with credit, and many

unqualified individuals received mortgages. In this case, unqualified refers to the fact that some mortgage-holders bought homes that were considerably out of their price range. However, as long as housing prices continued to rise, this would not be a problem.

However, like all bubbles, the housing bubble burst. The Federal Reserve increased the federal funds rate in 2006, which caused other interest rates, such as mortgage rates, to similarly adjust upward. Homeowners that had taken adjustable-rate mortgages saw their interest rates increase, and their new monthly payments became too much to bear, so they defaulted. Throughout the country, many holders of these mortgages defaulted, which caused the value of mortgage-backed securities to plummet. These instruments were incredibly complex so when investors saw lower tranches default, they pulled all of their money. Initially, investors bought MBS securities based solely on the credit ratings furnished by Moody's and others. They did not do their own due diligence, so they were unfamiliar with the intricacies of these instruments, so when subprime tranches defaulted, positions in prime tranches were also liquidated even though these tranches were not at risk.

Credit default swaps should have stemmed the bleeding, because they were designed to pay MBS security holders in the event of mortgage default. This did not occur because issuers did not set aside enough money to cover all of the losses. The most famous example of this is American International Group or AIG. A small division of AIG wrote credit default swaps and sold these instruments to various financial institutions. Since there was little regulation in this area, AIG did not have to set aside money to cover potential losses like it does with other insurance policies. For example, when AIG underwrites a car insurance policy, they must reserve some money in the event that the car is totaled or otherwise damaged. The amount of money that needs to be set aside depends on the car and policy. When writing credit default swaps, AIG and other underwriters did

not follow this practice. As credit default swap holders demanded their money, AIG and other issuers could not meet their demands and, consequently, faced liquidity problems which exacerbated the financial crisis.

Another feature of the crisis that was specific to financial institutions was investment vehicles. These vehicles were separate corporations that were run and guaranteed by the parent company; however, their liabilities and losses did not appear on the parent's balance sheet; only profits flowed through. Many of these vehicles invested in mortgage-backed securities, so when the housing market crashed, they began to experience heavy losses. Financial institutions could either let them fail or reincorporate them. Failure would have resulted in a tarnished reputation, so most institutions put these previously off-balance-sheet vehicles onto the balance sheet. This action further eroded the financial position and liquidity of the financial system.

With regard to the broader economy, the Fed began to lower the federal funds rate over the course of the crisis. By the end of 2008, the federal funds rate was effectively zero, and it remained at that level until the December 2015 FOMC meeting, in which the Fed raised it to a new target range of twenty-five to fifty basis points. This meant that for the first time in history, the Federal Reserve had hit the zero-bound. Conventional monetary policy was constrained as never before.

The main tool of monetary policy had thus been stretched to the limit of its effectiveness. Additionally, the channels of the monetary transmission mechanism were constrained. The interest rate channel starts with a change in the federal funds rate, so since rates could not go any lower, this channel could not stimulate the real economy: short-terms were as low as they could be. However, long-term rates were still relatively high. Lowering these rates could have stimulated the economy because most investment decisions are based on long-term rates, and lower rates would make investments more affordable. However, decades had elapsed since the Fed had last

targeted long-term rates directly. Thus, long-term rates could go further down, but there were no conventional means of achieving this objective.

The credit channel was similarly constrained. Like the interest rate channel, the starting point of the credit channel was a change in the federal funds rate. Since that rate was effectively zero, the Fed could not rely on this channel to stimulate the economy. Further, the crisis affected the credit channel similarly to contractionary monetary policy. The exogenous shock that starts the cause and effect relationships outlined in the credit channel is usually a change in monetary policy. In this case, the financial crisis was the exogenous shock. The balance sheets of businesses and households were weaker in that asset values had declined. Households, whose main asset is their home, saw their net worth plummet due to housing market crash, and individuals who lost their jobs also saw their financial positions worsen. Additionally, for businesses, profits eroded, and many companies saw net losses. Collateral that had once been able to secure a loan of \$1 million was now only worth \$800 thousand. Many borrowers saw their credit rating downgraded to subprime status, which meant that in order to continue borrowing, they would have to pay a risk premium. Under normal market conditions, this premium was high. With the crisis, the premium was even higher, and many borrowers were priced out of the market.

The excess premium was largely caused by a deterioration in the bank lending channel. This decline was caused by the financial crisis, not monetary policy. On the asset side of the banks' balance sheet, loans were in default and mortgage-backed securities saw their values plummet. The liabilities of the banks did not change substantially, so equity capital contracted to make up for the decline in asset value. Further, as losses mounted, equity capital continued to contract. With little cash and equity capital, banks could not make new loans, so they lent sparingly and only to the most qualified borrowers. Other borrowers faced the excess risk premium. On the whole, the

credit channel saw a decline in the equilibrium quantity of loans and an increase in the equilibrium price (or interest rate on) loans.

This is the opposite of what the Fed would have liked to have seen. After all, in a recession, the Fed would like to see more credit at lower rates to stimulate the economy and achieve the dual mandate. However, the tools that the Fed had at its disposal could not attain the price stability and maximum employment. Thus, the Federal Reserve developed new, unconventional tools to deal with the financial crisis.

VII. Unconventional Tools

Facing a federal funds rate that had reached its lowest possible value, an unfriendly yield curve, and financial institutions with historically weak balance sheets, the Federal Reserve was forced to abandon orthodoxy and introduced new tools to continue to stimulate the economy. The actions undertaken by the Fed at this time were not necessarily geared towards the dual mandate of price stability and maximum employment. In fact, the price stability half was sidelined as the Fed moved aggressively to first stabilize the financial system and then to lower the unemployment rate. Two of the tools, forward guidance and interest on reserves, had either already been discussed or had previously been implemented. Other approaches, such as new lending facilities, were extensions of existing programs within the Federal Reserve²⁴. These new approaches were met with relatively little controversy. The same could not be said for quantitative easing, which was and remains one of the single most controversial actions ever taken by the Federal Reserve.

²⁴ Another existing approach taken by the Fed was to set up currency swap lines with other major central banks. This was done because there was a high demand for U.S. dollars by international financial institutions who needed the currency to support their loans and investments that were denominated in dollars. Once a foreign central bank received U.S. dollars via the swap line, it could lend out the dollars to its member-banks similar to how the Fed lends money via the discount window. Absent these currency swap lines, U.S. markets would have been much more volatile because foreign banks would have come to the United States to have their demand for dollars met. Instead, they could go their central banks to have their demand met and not disrupt the U.S. economy

Forward Guidance

One new tool introduced during the crisis was not a new tool at all. Signaling had been employed by the Fed for some time. For decades, the Fed had subtly signaled where it was going to move interest rates. Various regional presidents and governors would give speeches indicating the direction in which the Fed was likely to move. Most of these talks focused on the short-term. No one was saying what would happen in the long-run, so investors were prepared for the next FOMC meeting, and they could possibly divine what the following FOMC meeting would bring. Meetings further than that, however, remained a mystery. Additionally, these talks were rarely coordinated. Two presidents could have differing speeches, and one could say that rates should go up while the other said that rates should not move. Usually, however, FOMC members were in relative agreement on monetary policy decisions.

Forward guidance, contrasted with signaling, was much more coordinated, and it had a far longer reach. The goal of this tool was to work around the constrained interest rate channel to directly target long-term rates. Under conventional monetary policy, the yield curve adjusts based on movements in the federal funds rate and expectations of future movements. Since the Fed was facing the zero-bound, it had to be more transparent with regard to where it planned on moving interest rate. This allowed investors to incorporate this transparency in their projections and plan accordingly. Under rational expectations theory, investors use any and all information available to them to project prices in the market. One application of this theory is that based on statements of FOMC members, investors can forecast where short-term rates will be in the future. Since long-term rates are built on short-term rates, knowing more information about short-term rates allows investors to make informed decisions. For example, if a governor says that the federal funds rate will remain at zero for at least a year, then investors can price that information into their projections

of long-term rates. These projections showed long-term rates that were lower compared to what they would have been without forward guidance.

Furthermore, to make forward guidance even more effective, the Fed coordinated its communications strategy. Governors and regional presidents gave similar speeches to avoid any confusion in the market. Eventually, forward guidance was incorporated into FOMC statements. For example, the December 2008 FOMC meeting moved the federal funds rate to zero, and the subsequent press release stated that weak economic conditions were "likely to warrant exceptionally low levels of the federal funds rate for some time²⁵." This coordinated transparency allowed for both more accurate projections and lower long-term interest rates. While the Federal Reserve was able to lower interest rates through forward guidance, they were still too high, so other actions were later taken.

Interest on Reserves

Stepping away from the yield curve, the Fed also faced a historically weak financial system that was drained of much of its liquidity. One approach taken by the Fed to stabilize financial institutions and the interbank loan market was to set interest on both required and excess reserves. The Fed received authorization from Congress to do this in 2006 under the Financial Services Regulatory Relief Act. Note that this authorization took place before the financial crisis. The original goal of this legislation was to move away from the required reserve ratio since it was no longer a binding constraint for many large banks. Rather than using quantity controls, the idea was to manipulate prices to control credit flows. For example, if interest on reserves is 1.0%, then a bank will not make a loan unless it can get a return higher than 1.0%. Moving the rate on reserves

²⁵ Bernanke, 2015

in tandem with the federal funds rate would allow the Fed to easier manipulate the interbank loan market. Under the 2006 law, the Fed was set to begin implementing this tool in 2011.

The financial crisis changed both the timetable and the calculus behind this tool. The Emergency Economic Stabilization Act of 2008 moved up the date of implementation to October 1, 2008. When the Fed first implemented interest on reserves, it took some time to adjust to the new regime. The quantity of reserves held at the Fed exploded, and this phenomenon interfered with monetary policy, since the Fed would have preferred the banks instead lent out these funds to stimulate the economy. Nonetheless, this instrument of monetary policy did and continues to help stabilize the federal funds market, which faced significant headwinds during the crisis.

Lending Facilities

Another means of strengthening financial institutions was the establishment of several emergency lending facilities²⁶. This harkens back to a central bank's primary duty, as defined by Walter Bagehot in *Lombard Street*, of being a lender of last resort. Traditionally, central banks would lend to member-banks that were facing liquidity problems. Since then, the banking system has evolved, and many financial institutions that are not banks perform bank-like functions such as making loans. This shadow-banking industry, with the traditional-banking industry, make up a much more complex financial system that consists of loans, securities, commercial paper, repurchase agreements, and other financial instruments and arrangements. Over the course of the financial crisis, both banks and shadow-banks faced liquidity crunches. To achieve its lender of last resort objective, the Federal Reserve would lend via the discount window; however, these funds were not available to non-lending institutions facing a liquidity crisis. Since the financial system was so incredibly interconnected, a securities dealer's liquidity crunch could quickly

²⁶ Bernanke, 2015

impact commercial banks. A crisis in the commercial paper market could bring many large corporations to their knees. Realizing this, the Federal Reserve created several lending facilities similar to the discount window. These facilities were geared towards specific sectors of the financial system. To set up these facilities, the Fed had to invoke Section 13(3) of the Federal Reserve Act, which allows the Federal Reserve, “in unusual and exigent circumstances,” to lend to “any individual, partnership, or corporation,” as long as certain requirements are met. Section 13(3) has seen limited use in history, with the last noteworthy invocation occurring during the Great Depression. The FOMC thus concluded that the financial crisis similarly met the “unusual and exigent circumstances” standard.

Over the course of the crisis, the Fed developed many lending and auction facilities to increase liquidity. In essence, it acted as the lender of last resort for both banks and the broader financial system. To partake in these facilities, financial institutions had to put up collateral with the Fed to cover default risk and pay interest on borrowed funds. For example, the Primary Dealer Credit Facility was established to relieve pressure in the triparty repurchase agreement market. Left unchecked, that pressure would have placed significant stress on the broker-dealers who make up the repo market. Broker-dealers put up securities, usually U.S. Treasuries, in order to borrow funds to ensure that repurchase agreements cleared. The Commercial Paper Funding Facility was established to inject credit into the commercial paper market, which consists of short-term borrowings of large corporations. Due to the crisis, commercial paper that was previously seen as ultra-safe faced various pressures. This forced issuers to borrow from banks, who were more than happy to lend to large corporations instead of households with little net worth. The Fed’s objective was to allow the commercial paper market to function again, which would free up credit for smaller firms and households. An increase in the supply of credit would increase the equilibrium quantity

of credit. This would allow consumption, investment, and nominal GDP to grow. Additionally, all of the facilities yielded a profit for the taxpayer since the interest received exceeded the costs of the facilities.

Quantitative Easing

Despite developing many unconventional tools over the course of the financial crisis, only one was met with significant controversy and continues to be hotly debated in academic circles: quantitative easing (QE). Officially known as large-scale asset purchases and dubbed credit easing by then-Chairman Ben Bernanke, QE consisted of three rounds and injected trillions of dollars of liquidity into the financial system²⁷. The program began in late 2008 and concluded in October 2014, so it lasted far longer than the financial crisis and subsequent recession. During and after its implementation, quantitative easing faced and continues to face questions regarding its effectiveness.

The first round of quantitative easing was geared towards cleaning up the balance sheets of financial institutions. To achieve this objective, the Fed, in December 2008, began purchasing \$600 billion worth of agency mortgage-backed securities. Effectively, this meant that while conducting open market operations, the Fed purchased MBS securities in addition to the traditional U.S. Treasuries. Officially, the Fed did not purchase private-label securities, and instead, acquired Fannie Mae and Freddie Mac issued MBS securities. This was done to both stabilize Fannie and Freddie and to strengthen banks' balance sheet. The crisis caused MBS securities to plummet in value, and banks' equity capital had to absorb this loss. Banks that weathered the loss on their securities were still in a weak position because they held assets with little value and with little liquidity. QE1 replaced these bad assets with cash, which is the most liquid asset. On the bank

²⁷ Bernanke, 2015 and Team, 2015

side, this alleviated liquidity crunches, which allowed banks to remain operational and make loans. The constraints of the bank-lending channel, in other words, were softened, and banks could use the funds received via QE1 to expand the supply of credit, which theoretically led to high consumption, investment, and nominal GDP. A byproduct of this quantitative easing program was that the Federal Reserve now held \$600 billion worth of securities that were actually worth considerably more money. MBS securities were marked-down significantly over the course of the crisis even if an individual investment's default risk did not warrant a downgrade. This allowed the Fed to cheaply purchase these securities and generate a profit for taxpayers once the financial instruments matured.

The second round of quantitative easing was aimed at the yield curve, which was similar to forward guidance. Although the short-term side of the yield curve was low (the federal funds rate had not left the zero-bound), the long-term side was still, in the view of the Fed, too high. This elevated yield curve was thus in conflict with the dual mandate, and forward guidance was not doing enough. The Fed believed that by lowering long-term rates, investment and consumption would increase. This would create jobs and lower the unemployment rate, helping the Fed achieve its prioritized maximum employment objective. Therefore, in November 2010, the Fed launched QE2, which consisted of buying \$600 billion in long-term U.S. Treasuries. Instead of buying Treasury bills, the Fed began to purchase Treasury notes, which had maturities of over five years. This allowed the Fed to directly target the long-term side of the yield curve. Similar to how purchasing Treasury bills reduces short-term rates, purchasing Treasury notes reduces long-term rates. Within the interest rate channel, QE2 allowed the Fed to bypass the adjustment in the yield curve resulting from changes in the federal funds rate. The rates that critical investment and

consumption decisions are based on were now lower, which allowed for aggregate demand and nominal GDP to increase.

At the conclusion of QE2, the Fed announced the Maturity Extension Program. Prior to the crisis, as Treasury bills matured, the Federal Reserve would reinvest the principal amount into newly issued Treasuries. With the federal funds rate still at zero, the Fed decided to reinvest their security holdings into Treasury notes. This did not add new stimulus to the economy. Rather, the Fed took the proceeds from Treasury bills and ploughed them into Treasury notes. Reinvesting in Treasury notes would further bring the yield curve down by adding supplementary demand to long-term instruments.

The final round of quantitative easing was launched in September 2012. Under this QE, the Fed purchased \$40 billion of MBS securities each month. This was later expanded to \$85 billion per month in December 2012. Additionally, the Fed continued to reinvest proceeds from maturing Treasury bills into Treasury notes. This round of quantitative easing was nicknamed QE-infinity because it had no definitive end date. Instead, QE3 was tied directly to one-half of the dual mandate: maximum employment. The FOMC declared that they would continue injecting \$85 billion of credit into the economy each month until the jobs market improved for workers, and the unemployment rate declined. Additionally, the Fed hoped that by purchasing MBS securities, mortgage rates would go down, which was spur more investment. Mindful of the second half of their mandate, the FOMC also stated that they expected inflation to remain at or below the two percent target in the medium-run. Thus, they could implement QE3 with the assurance that inflation would not spike as a result.

The objective of QE3 was a continuation of the two preceding rounds. Purchasing mortgage-backed securities was aimed at relieving banks of their toxic assets and stabilizing the

housing market. Reinvesting Treasury bill proceeds into Treasury notes was aimed at further bringing down the long end of the yield curve. QE-infinity proved to be finite and concluded in October 2014. Since then, the Fed has not introduced another round of quantitative easing. Overall, the general objective of quantitative easing was to either soften or bypass constraints within the monetary transmission mechanism. Traditional monetary tools had been stretched to the limit of their effectiveness so new tools such as QE were utilized.

TARP

Despite innovations developed during and after the financial crisis, monetary policy has its limits. Namely, it cannot affect the equity section of a bank's balance sheet. This meant that most banks could still not make loans because under various regulations, banks need a requisite amount of equity capital to make new loans. Even though they had the cash to make loans from QE, that cash did not translate into equity capital. Additionally, the best way to stabilize the financial system is to raise equity capital because it provides funding that does not increase leverage, and capital is tied loan growth through various regulations. Thus, working with the Treasury Department, the Fed had to convince Congress to authorize the Troubled Asset Relief Program (TARP)²⁸. TARP was and remains highly controversial. The House of Representatives initially voted down TARP legislation. Eventually, however, the program was passed, which authorized the Treasury to invest up to \$700 billion into companies. Of that amount, the Treasury invested \$426.4 billion of equity capital into banks and other institutions across the country. Essentially, the federal government owned preferred stock in these companies. Preferred shares meant that the government had no say in the management of the companies, but they did benefit from capital appreciation. Further, the equity shares had interest associated with them. This injection of capital allowed banks to start

²⁸ Paulsen, 2011

making new loans again and further softened the constraints in the bank lending channel. The program concluded in 2014, and the government recovered funds totaling \$441.7 billion, which yielded a \$15.3 billion profit for taxpayers.

The financial crisis permanently changed the financial system of the United States in multiple ways. From a monetary policy perspective, new tools had to be introduced in order to work around the constraints within the monetary transmission mechanism caused by the crisis. The crisis caused credit to dry up, so the new tools tried to address this development. Most economists agree that these measures were relatively successful. The unconventional tools promoted economic growth and job creation, while also reducing the risk of deflation.

VIII. Consequences

Just as the crisis changed the financial system, the actions undertaken by the Federal Reserve changed the people's perception of the institution. Many questions arose regarding the power of the Federal Reserve. After all, the Fed had injected trillions of dollars into the economy over the course of the crisis through its lending facilities, quantitative easing, TARP, and other loans. In a democratic society, the fact that so much power was concentrated in a handful of people rubbed many the wrong way. Additionally, many viewed QE and TARP as bank bailouts, which were deeply unpopular. In the views of detractors, banks had caused the crisis, and then taxpayers had to bail them out even though no one was bailing out taxpayers that defaulted. This frustration with the Fed could be seen in Ben Bernanke's two confirmation votes. In 2006, before the crisis, Bernanke was confirmed by a voice vote with broad, bipartisan support. After the crisis, in 2010, he was confirmed by a vote of 70-30. This was the closest margin for a Fed chair up to that point in time. Additionally, Bernanke weathered harsh criticism during the 2012 presidential race, and this criticism ultimately caused Bernanke to change his political affiliation. The criticism,

however, is not just rhetorical. Members of Congress have since introduced several pieces of legislation aimed at curtailing the powers of the Federal Reserve, with Audit the Fed having the most fame. These bills aim at either curtailing the lending abilities of the Fed and/or the independence of monetary policy. However, there is a rich literature that indicates that an independent monetary policy is critical to economic performance. Policy that is influenced by political forces has empirically had negative consequences for the economy. To date, no significant changes have been made to the Fed's structure.

Aside from the political consequences, the Federal Reserve must now contend with a bloated balance sheet. When the Fed buys Treasury bills through open market operations, those securities are added to the Fed's balance sheet as assets. The same occurred when the Fed bought mortgage-backed securities and Treasury notes over the course of the three rounds of quantitative easing. Those purchases have caused the balance sheet to grow from less than \$2 trillion before the crisis to over \$4 trillion. According to various FOMC statements, the Fed plans to unwind the balance sheet by allowing securities to reach maturity and roll off instead of reinvesting the proceeds²⁹. The plan calls for a maximum reduction of \$30 billion in Treasuries and \$20 billion in MBS per month. Additionally, Fed officials estimate that the balance sheet will reach a new equilibrium level of \$2.5 trillion, which is significantly less than the high of \$4.5 trillion but still higher than its pre-crisis level. The goal of this policy is to minimally affect financial markets while reducing the size of the balance sheet. The success of this program remains to be seen and will be examined in the future.

A more negative consequence is that the Federal Reserve may have inadvertently created a moral hazard³⁰. Many financial institutions believe that since they were bailed out in the past,

²⁹ Timiraos, 2017

³⁰ See Afonso, 2014 for further discussion on moral hazards

they are likely to get bailed out again if the economy goes into recession. Some have taken it a step further and have reached the conclusion that the government and/or the Federal Reserve will bail them out if their financial position deteriorates even if the overall economy is healthy. For example, if a bank the size of Citibank or Bank of America were to experience financial distress, it is highly doubtful that the Fed would allow them to default. Such a shock would likely send the entire economy into a tailspin, so the Fed would act. Additionally, the Fed would likely also act if a firm in the shadow-banking industry was on the cusp of default if it is too interconnected. Some financial institutions are taking advantage of this by taking on a disproportionate amount of risk in order to achieve additional return. Historically, they would have tempered that desire for return with the fact that too much risk can lead to default. Now, with the belief in bail outs, institutions are willing to take on more and more risk because they have a safety net. Others will argue that regardless of desired returns, regulations such as the Volcker Rule prevent institutions from taking on different types of risk. Further, there is no guarantee that a bail out will occur, and the Fed did allow some institutions, such as Lehman Brothers, to default. This question, therefore, continues to be debated.

Historically, when the Fed pursued expansionary monetary policy, inflation would increase. However, over the course of the crisis and the Fed's aggressive response, inflation has remained historically low with some years seeing close to zero inflation. The reason behind this record low inflation is a mystery, and many economists are examining this question. Some argue that paying interest on reserves has incentivized financial institutions to keep their funds at the Fed instead of lending them to borrowers. Had banks made more loans, inflation would have picked up sooner. Others argue that the proceeds from Fed policies in general and QE in particular have been invested primarily in the stock market, which has caused securities to be artificially high.

These individuals also argue that stock prices continue to be artificially high, and that the stock market is, therefore, a bubble. The stock market bubble, the argument goes, is thus hiding inflation. While these theories may be correct, many more studies will need to be conducted to determine what is actually driving inflation to record lows.

The final set of consequences deals with perhaps the most interesting question: the future viability of the new, unconventional tools developed during the crisis. Paying interest on reserves appears to be a permanent fixture of the Fed's toolbox. As the Fed changes the federal funds rate, it will also adjust the interest paid on reserves to better manipulate the interbank market loan. Since this concept was introduced independently of the financial crisis, there is no reason for this practice to end unless it fails to help the Fed achieve its dual mandate. On the other hand, the various lending and auction facilities have been closed and are likely to remain closed unless a particular market (i.e. the commercial paper market) experiences significant distress. However, a regulatory development might also have minimized the need for these facilities. Traditional banks have always been able at the discount rate, so these facilities were set up for non-banks such as investment banks. In the wake of the crisis, all of the big investment banks have either closed (Lehman Brothers), been acquired (Bear Stearns), or forced to convert into bank holding companies (Goldman Sachs). Bank holding companies can borrow directly from the discount window, so these conversions in the structure of the financial system might have rendered emergency lending facilities obsolete absent a significant crisis while also allowing the Federal Reserve to more easily regulate large financial institutions.

Forward guidance continues to be used by the Federal Reserve. Most notably, the plan to unwind the balance sheet was first communicated via forward guidance and was later written out in FOMC statements. The Fed has made a push to be more transparent, and forward guidance is a

big part of this initiative. However, this tool is not without potential pitfalls. Once the Fed says that it plans on pursuing some policy, market participants will price this policy into their forecasts and decisions. Thus, when the Fed implements the policy, there is minimal market reaction. If the Fed does not follow through on the policy; however, then, markets are likely to see volatility as they try to undo the adjustments that they made in anticipation of the policy. Forward guidance allows markets to adjust to future Fed policies, but it also locks the Fed into a particular policy unless the macroeconomy changes significantly. Keeping this in mind, the Fed practiced “conditional” forward guidance. Most of their announcements were followed by statements such as “until unemployment is below six percent” or “until GDP grows by one percent.” For example, if the Fed aims to raise rates four times in a year, but the economy enters a recession in the third quarter, then they will lower rates instead. Markets will expect the Fed to change course as the economy shifts or as their conditions change. If there is no obvious macroeconomic shift, then the Fed has less leeway. Additionally, forward guidance puts the credibility of the Fed on the line. If the Fed does not follow through on its forward guidance, then market participants will be less inclined to believe the Fed the next time. A central bank’s credibility is essential to its pursuit of price stability, so the Fed must be cognizant of the consequences of not following through on a policy announcement.

Due to its controversial nature, quantitative easing is likely to only be used by the Federal Reserve in unusual and exigent circumstances such as the financial crisis. As long as the traditional tools of monetary policy as well as forward guidance and interest on reserves are able to achieve the dual mandate, the Fed is unlikely to implement another round of quantitative easing. Additionally, other central banks have experimented with different unconventional tools in the wake of the crisis. For example, the Bank of Japan has implemented negative interest rates and the

European Central Bank has purchased corporate bonds. Depending on the success of these and other programs, the Federal Reserve might borrow various ideas from their international peers in the event of a future crisis.

IX. Concluding Remarks

The Federal Reserve is the central bank of one of the most consequential economies of the world. It oversees and manages the supply of the U.S. dollar, which is the world's reserve currency. Despite strides taken to improve transparency, the inner workings of the Fed remain a mystery to many people. Nonetheless, the Fed tries to “[provide] the nation with a safe, flexible, and stable monetary and financial system.” To achieve this goal as well as its statutory dual-mandate of price stability and maximum employment, the Fed analyzes and projects economic conditions and implements monetary policy that is appropriate and consistent with the forecasted conditions and the Fed's inflation rate target. While the Fed has several tools at its disposal, changing the federal funds rate to match macroeconomic conditions is the preferred mode of operation.

Monetary policy then flows through the monetary transmission mechanism and eventually impacts consumption, investment, and nominal GDP through a variety of channels. In extreme circumstances, such as the crisis of 2008, these channels can be constrained, and the tools of monetary policy can be stretched to the limits of their effectiveness. This limitation is conceived as the zero-bound, and its name is derived from the fact that nominal interest rates cannot fall below zero percent. Therefore, once the federal funds rate, a conventional tool, has been brought to zero, it is no longer effective. In order to continue to stimulate a distressed economy, the Federal Reserve must implement unconventional monetary policy to exceed the zero-bound.

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