QE Equivalence to Interest Rate Policy: Implications for Exit

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Abstract

With QE central banks have taken the role of commercial banks in providing broad money to the non-banking sector in exchange for debt. This effect of Federal Reserve QE programs is estimated to be equivalent to a negative policy (Federal funds) interest rate of about 4 percentage points. The analysis provides a quantitative framework to assess how much higher (relative to pre-QE) the interbank interest rate will have to be set during the exit, for a given central bank's balance sheet, to obtain a desired monetary policy stance.

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1. Introduction

This paper presents and estimates a monetary policy transmission framework to jointly analyze central banks (CBs)' asset purchase and interest rate policies. The negative policy interest rate equivalent to QE is estimated in a framework that accounts for the broad money supply of the CB and commercial banks. The framework characterises how standard monetary policy, setting an interbank market interest rate or interest on reserves (IOR), has to be adjusted to account for the effects of the CB's broad money injection. It provides a quantitative estimate of how much higher (relative to pre-QE) the interbank interest rate will have to be set during the exit, for a given central bank's balance sheet, to obtain a desired monetary policy stance. Or, in standard monetary policy analysis words, how many percentage points must be added to a standard Taylor rule rate for a given CB's balance sheet?

In response to the financial crisis, CBs have dramatically increased their balance sheets by buying various kinds of assets, which has resulted in strong increases in reserves that commercial banks hold at CBs. The counterpart of CBs' asset purchases has partly been the non-banking sector. This has directly increased broad money supply which, in "normal times", CBs only influence indirectly by affecting commercial banks' funding conditions, i.e. the interbank market interest rate. With QE, when the CB buys assets from the non-banking sector, commercial banks act as intermediaries. The result is like an increase in broad monetary aggregates in "normal times": the banking sector injects broad money in the non-banking sector in exchange for bonds or mortgages. With this money creation there is less need to borrow among the non-banking sector, as more money is available, and aggregate consumption can increase as more people hold money and can thus consume at the same time.

For example, households and hedge funds selling bonds to the Fed can buy corporate debt, which is an actual behavior following QE documented in Carpenter et al. (2014). This puts downward pressure on mortgage and corporate debt yields. As long as capital market yields are above zero, money injections by withdrawing longer-term or risky debt from the market should lower them even though short-term interest rates on relatively safe assets are at the zero lower bound. With QE, the CB has thus substituted for commercial banks in providing credit and broad money to the non-banking sector. It has injected broad money in the economy in exchange for debt, thus aggregate consumption can increase.

Estimating the effect of broad money supply shocks in "normal times" thus allows to quantify effects of the CB's direct money supply with QE. Estimations using only the QE period confirm the quantitative results. A 3% increase in broad money (M2M) corresponds, in terms of peak impulse-response effect on real GDP, to a 1 percentage point decrease in the Federal funds rate. With QE, banks' reserves at the Fed increased by USD 2,700 billion. As "households" (which include hedge funds, as explained in Carpenter et al.) were counterparts for about half of it, M2M increased by about USD 1,350 billion as a result, or 12% of its current amount. According to this framework, QE thus corresponds to a 4 percentage points decrease in the Federal funds rate and contributed to a 1.75 percent increase in real GDP. As a result, with its current balance sheet, the Fed would have to raise the interbank market interest rate 4 percentage points higher than pre-crisis levels to achieve a given monetary policy stance. This adjustment will depend on the evolution of Fed's direct supply of broad money.

A 4 percentage points negative interest rate is somewhat in the same order of magnitude as shadow rate estimates based on different approaches. Krippner (2015) estimates a shadow short rate of minus 5 percent at its lowest, and Wu and Xia (2014, updated by the Federal Reserve Bank of Atlanta) estimate a shadow rate around minus 3% at the end of QE3 with nonlinear term structure models. Lombardi and Zhu (2014) estimate a shadow rate at minus 5 percent at its lowest with a dynamic factor model. A difference is that the analysis of this paper indicates that it is the stock of broad money injected by the central bank, rather than flows of asset purchased, that affect economic activity, and thus QE effects remain as long as the CB's balance sheet remains higher than before the financial crisis.

Section 2 presents the conceptual framework. Section 3 displays the empirical results. Section 4 quantifies QE effects and the implications for exit, and section 5 concludes.

2. Monetary policy and banking

2.1. Conventional and unconventional policy

Figure 1(a) represents the relationship between monetary policy, money and interest rate as it implicitly is in a standard dynamic stochastic general equilibrium (DSGE) model used for monetary policy analysis. In such a model, the CB controls the interest rate relevant for consumption decisions. The money demand curve reflect the Euler equation and a cash-in-advance constraint (or money in the utility function): when the central bank decreases the interest rate, current aggregate consumption increases and thus money demand for transactions increases, which the CB accommodates.

In reality however, it is not the central bank but commercial banks which supply

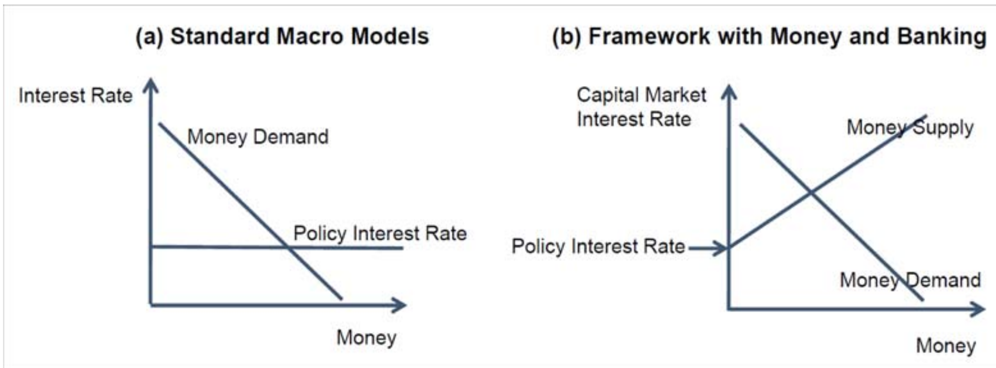

FIG. 1. Standard vs. Banking Models

money in "normal times", and the interest rate relevant for consumption decisions is the capital market rate set by commercial banks and on financial markets. Figure 1(b) represents the relationship between monetary policy, money and interest rates in a framework including banking. The money demand curve is downward sloping as a decrease in capital market rates increases the demand for current consumption and aggregate borrowing as more projects become profitable. The upward sloping supply curve represents credit supply and money creation by commercial banks, where money supply is an increasing function of capital market interest rates.

Conventional monetary policy influences the intercept of the money supply curve by setting the Federal Funds rate (FFR) or interest on reserves (IOR), i.e. the financing or opportunity cost of reserves for banks. As the aggregate amount of lending increases, monitoring and balance sheet costs as well as the risk of default increase, thus the marginal cost of loan production increases.[1] The money supply curve has thus an upward slope, and shifts with changes in FFR or IOR, lending costs, capital

[1] Bank lending and money creation can be integrated into a macroeconomic framework with a loan production function as presented in Goodfriend (2005) and Goodfriend and McCallum (2007).

requirements, banks' lending standards and profitability shocks.[2] Both the policy and market interest rates have the same maturity. As banks give mostly long-term loans, the policy interest rate in fact represent an expectation of future short-term policy rates.

Money represents a broad monetary aggregate and is defined as M2M (i.e. M2 minus time deposits) for the US in the empirical analysis. It includes cash and zero maturity deposits that can be used direclty (like cash or checks) or indirectly (immediate transfer available at par and no cost, like saving accounts) to buy goods and services. Money differs from bonds (and other assets) in that it is the only means of payment. Bonds can be sold relatively quickly in exchange for money, directly or via repo, but it is costly to do so. As a consequence, people hold USD 11 trillion of money (M2M) that earns very little interest, i.e. well below the interest paid on short-term T-bills in "normal times". Moreover, when money is exchanged among the non-banking sector via good or service transactions or is exchanged against debt, the means of transaction is transferred from one economic agent to another, thus aggregate consumption cannot increase. Only when banks or the CB create money can aggregate consumption increase (for a given velocity of money which is closely related to interest rates).

With both conventional monetary policy and QE, broad money, i.e. the means of payment, is always created against debt which the banking sector creates or buys from the non-banking sector. With conventional monetary policy, broad money is provided by the the banking sector to the non-banking sector as banks provide loans

[2] In standard DSGE models, with the assumption that the CB controls the interest rate relevant for economic decisions, monetary policy actually implicitely does QE all the time, providing broad money to target the interest rate. The problem is that the central bank in fact does not control broad money nor the interest relevant for economic decisions in "normal times", but does so with QE.

or purchase existing bonds. And with QE, broad money is provided by the CB when the latter buys bonds from the non-banking sector; the banking sector then acts as an intermediary and thus, as with conventional monetary policy, provides broad money to the non-banking sector in exchange for bonds. The only difference is that, with conventional monetary policy, the CB gets bonds for only a fraction (i.e. the reserves ratio) of broad money created through loans or banks' asset purchases, whereas with QE the CB gets bonds for the full amount of money created; this explains the strong decline in money multiplier with QE. The interbank market is just a way for the CB to control net financing conditions of banks, and thus indirectly the money supply (i.e. the intercept of the supply curve) with conventional monetary policy; with QE, the CB has a direct quantity effect.

2.2. QE and Exit

Figure 2 represents the effects of QE and exit. With conventional monetary policy, when the CB lowers the interbank market rate, the financing cost of banks decrease and banks thus provide more loans or buy more bonds at a given capital market rate; thus the broad money supply curve shifts to the right. With QE, broad money directly increases by the amount of assets that the CB buys from the non-banking sector. The effect of QE on capital market interest rates corresponds to a negative interest rate on reserves (IOR), as can be seen on Figure 2, in the sense that if the CB would implement negative IOR, some banks would find it profitable to start lending at even negative market interest rates, thus the money supply curve would shift down as with QE. Moreover, the fact that with QE the supply curve is vertical at negative interest rates (as the QE supplied amount is inelastic) shows that market rates can be negative if the QE program is large relative to money (thus investment) demand. Section 3 quantifies the negative interest rate equivalent of QE.

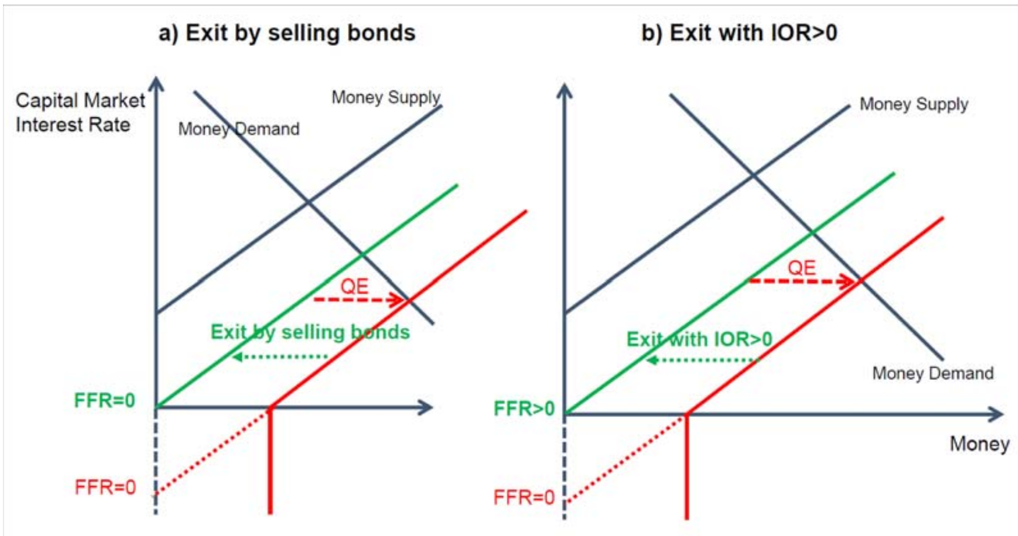

FIG. 2. Exit and Interest Rate Policy

The reason equilibrium capital market interest rates decrease with QE can be understood as follows. To get more means of payment, i.e. to increase aggregate consumption, the non-banking sector has to provide claims to the banking sector with conventional monetary policy, or to the CB with QE. Capital market rates decrease when broad money increases against bonds for the same reason as interbank market rates decrease when the CB injects reserves in exchange for collateral with conventional monetary policy. With QE, the CB increases the amount of broad money that can be lent and borrowed among the non-banking sector, thus economic agents need to borrow less on aggregate. Capital market rates should decline relative to expected policy rates as aggregate lending risk decreases with less need to borrow.

Figure 2 shows the consequences of exit. If the CB sells bonds, the pre-QE spread between capital market and interbank market interest rates will be restored. If however the CB tightens monetary policy by raising the interest on reserves, the spread will remain depressed other things equal, i.e. capital market interest rates will be lower for a given interbank rate as the CB is a provider of broad money in addition to commercial banks. The intercept of the green curve would corresponds to an interbank rate larger than zero on Figure 2(b), in contrast to Figure 2(a) where the CB would sell bonds. For a desired monetary policy stance, the CB will thus have to raise the interbank market rate higher than pre-QE to compensate for the stimulative economic effect of QE. By quantifying the correspondance between QE and conventional monetary policy, section 3 provides an estimate of the extend to which the interbank rate will have to be higher than pre-QE for a desired monetary policy stance during the exit given the broad money directly supplied by the CB.

3. Empirical interest and quantity effects

This section estimates the effects of QE and compare them to the effects of conventional interest rate monetary policy according to the framework presented in section 2. To account for general equilibrium effects and endogeneity, a VAR model is estimated. The variables included are standard for a macro VAR model, except that money and an interest rate spread are included to account for QE and the banking sector transmission of monetary policy. The variables included are the log levels of the price of industrial commodities (LCOMPI), GDP price deflator (GDPDEFL), real GDP (LGDPR), M2M (LM2M), as well as the following variables in percentage points: the Baa - 10-year Treasury bond interest rate spread (BAA_TB10) and the Federal Funds rate (FF).

The Baa-treasury spread is meant to account for the interest rate spread presented in the framework of section 2, in the sense that the Baa corporate rate reflects long-term market lending rates and the 10-year Treasury rate reflects long-term expectations of the monetary policy interest rate. There are of course many capital market rates, and the mechanisms presented in this paper should affect all of them. The main results are robust when a short-term spread is used or when a VAR without a spread is estimated.

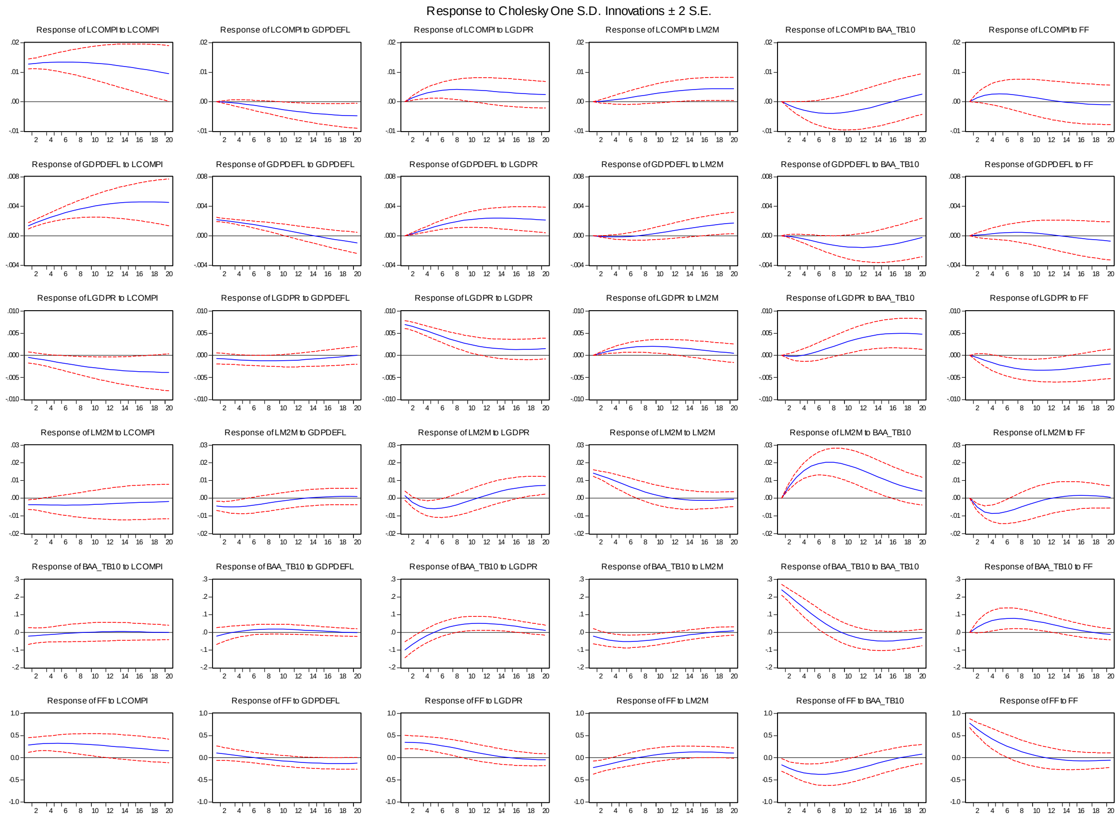

FIG. 3. Impulse-Response Function (1977-2007)

First, the estimation period 1977Q1-2007Q2 is considered, as aggregate money demand showed signs of instability prior to 1977 and has been stable since.[3] This first

[3] See Reynard (2004, 2007).

sample ends before the financial crisis. Then, the zero-lower bound period 2009Q1-2014Q3 is considered. Althought this second sample is short, estimations confirm results from the longer pre-crisis period. The VAR model includes one lag of each variable and variables are ordered according to the graph and variables' description above. Results are robust to variables' ordering, as well as generalized IR, and lag choice. Figure 3 presents impulse-response functions for the 1977Q1-2007Q2 period, with 95% standard error bands.

Impulse-response functions are in line with standard results from macro VAR models. There are additional insights from including an interest rate spread which support the framework presented in section 2. First, as implied by a money and loan supply function, money supply increases after a positive spread shock: it becomes more profitable for banks to lend money as capital market rates increase relative to the monetary policy interest rate. The spread shock could be identified as a productivity or capital demand shock, as it is followed by increasing real GDP. Note that the CB accomodates this shock as the FF decreases. Moreover, money supply decreases with an increase in the FF, as we would expect from higher banks' financing costs. And the positive response of the spread to a FF shock reflects the financial accelerator mechanisms.

A positive money shock decreases the spread, as implied from the analysis of section 2, and increases real GDP. Comparing the peak response of real GDP to money and FF shocks leads to the following equivalence: a 3% increase in broad money corresponds to a 100bp decrease in the FF. Similar results are obtained when the spread is not included in the VAR model.

To check whether the results are representative of QE, a VAR when the policy rate was at the ZLB is estimated. The FF and spread are not included as there was no movement in the policy rate. Results are presented on Figure 4. The sample period 2009Q1-2014Q3 is short but leads to similar quantitative results.

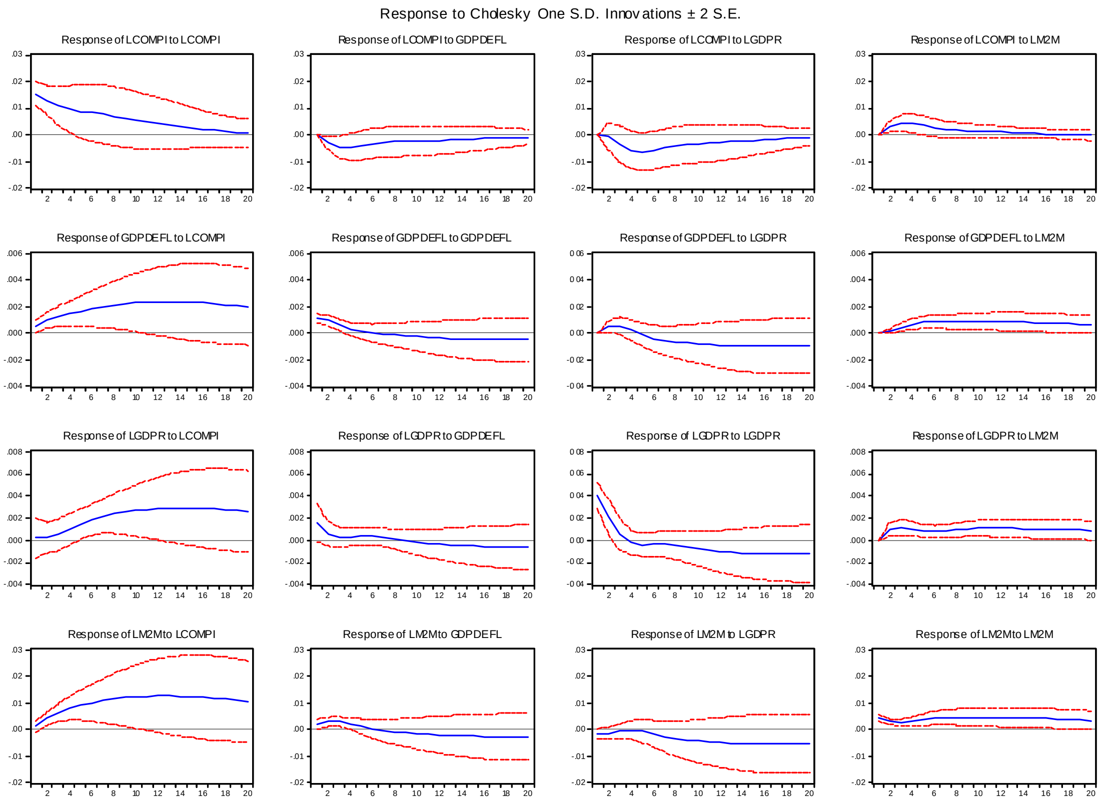

FIG. 4. Impulse-Response Functions (ZLB)

4. QE effects and implications for exit

With QE, commercial banks' reserves at the Federal Reserve increased by USD 2,700 billion. As "households" (which include hedge funds) were counterparts for about half of it (se Carpenter et al.), M2M increased by about USD 1,350 billion as a result, or 12% of its current amount. QE thus corresponds to a 4 percentage points decrease in the FF, and contributed to a 1.75% increase in real GDP.

5. Conclusions

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