An Analysis of the Recent US Countercyclical Monetary Policy

Chu V. Nguyen[1]

Susan M. Henney[2]

Abstract

The inverse relationships between the narrowest money multiplier and cash holding by the public and reserve held by banks as well as the positive causality between multiplier and transaction deposits are algebraically illustrated. Also, data from the Board of Governors of the Federal Reserve System (Fed) is used to assess the current state of the US banking sector. Given the current state of the US banking system, pursuing contractionary policy would incur large losses leading to a significant reduction in the Fed's financial contributions to the Treasury. This, in turn, will increase US borrowings and create a heavier burden on the US government and taxpayers.

Key Words: Countercyclical monetary policy; quantitative easing; money multiplier; narrowest money supply; quantity equation

JEL classificationcodes:E51; E58; E47.

I. Introduction

The impact of the recent US countercyclical monetary policy is a splendid, but incomplete, story. The US financial landscape in the 21st century is marked by two critically important events: (i) the countercyclical monetary actions starting in 2001 which fueled the housing market in the face of the 2001-2002 rescession, and (ii) the unprecedented expansionary monetary policy. The latter has been evidenced by the rigorous Federal Open Market Operations on the short spectrum of interest rates and the series quantitative easings—QE1, QE2, QE3 as well as other policy measures—to hold down long-term rates in the Fed's efforts to restore the housing market. Given the current state of the banking sector, unsustainable fiscal policy or improvement in the economy could result in a large increase in the inflation risk premium for U.S. government debt, leading to a higher rate environment and possible substantial losses on the Fed's balance sheet. This could further feed back into rising longer-term inflation expectations, raising the risk of an unwelcome surge in inflation, which may lead to devaluating the dollar and the attendant consequences. The surge in inflation would also significantly complicate the choices for monetary policy makers.

Under the aforementioned conditions, pursuing contractionary monetary policy would increase the debt servicing burden of the US government and incur significant losses in Federal Open Market Operations selling long-term, fixed-income financial instruments, accumulated on the Fed's balance sheet from recent efforts to restore the real estate market in a much lower rate environment. Given the quantity of these instruments on its balance sheet, these losses would significantly reduce the financial contributions from the Fed to the Treasury, which increases US borrowing and creates a heavier burden on the US government and eventually US taxpayers. On the other hand, with the current excess reserves in the banking sector, restraining from aggressive contractionary monetary policy measures would result in unacceptable inflation in the economy.

[1] FACIS Department, University of Houston-Downtown, 320 North Main St., Suite 422, Houston, Texas 77002

[2] Department of Social Sciences, University of Houston-Downtown, One Main St., Houston, Texas 77002

The objective of this study is threefold: (i) to derive the equation relating the money supply to the monetary base and introduce the quantity theory equation; (ii) using these two equations to articulate that US inflation has not significantly increased, as predicted by economic theory, in the face of the historically unprecedented expansionary monetary policy since 2008, because of the low interest rate environment and the payment of interest on the balances of accounts of commercial banks at the Federal Reserve System (Fed); and (iii) to argue that the current state of the US banking system will complicate significantly the choices for monetary policy makers.

The remainder of this paper is organized as follows: the next section summarizes the salient characteristics of the recent US countercyclical economic policies; the section that follows empirically characterizes the current state of the US banking system; and the final section discusses the potential consequences of the recent countercyclical monetary policy of the Federal Reserve System.

II. Salient Characteristics of the Recent US Countercyclical Economic policies

Before exploring the impact of the recent US countercyclical monetary policy actions further, it is useful to consider several salient characteristics of the US countercyclical fiscal and monetary policies.

A. Countercyclical Economic Policies

Since the late 1930s, Keynesian fiscal policy has played a critical role in macroeconomic management in market economies. Beginning in the 1960s, changes in international economic conditions resulted in persistently large government budget deficits in economies around the world. As articulated by Mishkin (1995, p. 3), partly because of concern over persistent budget shortfalls resulting in large public debts and partly because of doubt about the political system's ability to utilize the fiscal policy instrument in a timely and effective manner to achieve the desirable stabilization outcome, fiscal policy has thereby lost its luster. Consequently, the stabilization of output and inflation has been left largely to monetary policy.

Bernanke and Gertler (1995, p. 27) pointed out that monetary policy, at least in the short run, can affect the real economy. This is reflected in the empirical research (Romer and Romer, 1990; Bernanke and Blinder, 1992; Christiano, Eichenbaum, and Evans, 1994), which has confirmed earlier findings by Friedman and Schwartz (1963) that monetary policy actions affected the real output of the economy for the succeeding two years or more. Certainly, monetary policy is a powerful tool; however, Mishkin (1995, p. 4) argued that this instrument has unintended consequences. Therefore, to conduct monetary policy successfully, the monetary authorities must have accurate knowledge of the status and implications of fiscal policy and to the timing and effect of their policy actions on the economy.

B. Fractional Banking and Recent Countercyclical Monetary Policy Measures

It is useful at this juncture to define a few terms that will be used and to introduce two necessary algebraic equations: the money supply equation and the monetarist quantity equation.

B.1. Money Supply Equation

"Fractional-reserve banking" is a banking system in which banks keep only some of their deposit on reserve. At any moment, *t*, the monetary base (sometimes called "high-power money"), denoted by B_t, is the total number of dollars held by the public (including businesses) as currency, denoted by c_t, and by banks as reserve, denoted by r_t. B_t is controlled by the Federal Reserve System. The demand deposits in the economy is denoted by d_t.The cash holdings by the public to deposit ratio, denoted by c_t/d_t, is a fraction of deposits that the public holds as a fraction of their holdings of demand deposits, d_t. This ratio indicates the preferences of households about the form of money they wish to hold. Finally, the reserve to deposit ratio, denoted by r_t/d_t, is the fraction of deposits that banks actually hold in reserve. It is determined by the business policies of banks and the laws that regulate them.

Given these aforementioned exogenous variables and definitions, the most liquid or narrowest money supply at time t, $M_{1,t}$ is the sum of currency and demand deposits:

$$M_{1,t} = c_t + d_t \qquad (1)$$

and high power money at time *t*, B_t, is the sum of currency and bank reserve:

$$B_t = c_t + r_t \qquad (2)$$

To express the most liquid or narrowest money supply, $M_{1,t}$, as a function of the aforementioned exogenous variables and the monetary base, B_t, we divide equation (1) by equation (2) to get equation (3).

$$\frac{M_{1,t}}{B_t} = \frac{c_t + d_t}{c_t + r_t} \qquad (3)$$

Dividing both the numerator and the denominator of the right-hand side of equation (3) by d_t yields:

$$\frac{M_{1,t}}{B_t} = \frac{c_t / d_t + d_t / d_t}{c_t / d_t + r_t / d_t} \qquad (4)$$

Additionally, replacing $d_t / d_t = 1$, we obtain:

$$\frac{M_{1,t}}{B_t} = \frac{c_t / d_t + 1}{c_t / d_t + r_t / d_t} \qquad (5)$$

Finally, let $m_t = (c_t / d_t + 1)/(c_t / d_t + r_t / d_t)$ and m_t is known as the money multiplier. Substituting the definition of m_t for its expression on the right-hand side of equation (5) and then multiplying both sides of the equation by B_t, we get equation (6)

$$M_{1,t} = m_t B_t \qquad (6)$$

Totally differentiating $m_t = (c_t / d_t + 1)/(c_t / d_t + r_t / d_t)$ with respect to c_t, d_t and r_t yields:

$$dm_t = \frac{\frac{1}{d_t}\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right) - \frac{1}{d_t}\left(\frac{c_t}{d_t} + 1\right)}{\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right)^2} dc_t + \frac{\frac{-c_t}{d_t^2}\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right) - \left(\frac{c_t}{d_t} + 1\right)\left(-\frac{c_t}{d_t^2} - \frac{r_t}{d_t^2}\right)}{\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right)^2} dd_t + \frac{-\frac{1}{d_t}\left(\frac{c_t}{d_t} + 1\right)}{\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right)^2} dr_t$$

Rearranging the like-terms in the expression yields:

$$dm_t = \frac{\frac{1}{d_t}\left(\frac{c_t}{d_t} + \frac{r_t}{d_t} - \frac{c_t}{d_t} - 1\right)}{\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right)^2} dc_t + \frac{\frac{-c_t}{d_t^2}\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right) + \frac{c_t}{d_t^2}\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right) + \frac{1}{d_t^2}\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right)}{\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right)^2} dd_t + \frac{-\frac{1}{d_t}\left(\frac{c_t}{d_t} + 1\right)}{\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right)^2} dr_t$$

Finally, by simplifying the above expression, we get:

$$dm_t = \frac{\frac{1}{d_t}\left(\frac{r_t}{d_t} - 1\right)}{\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right)^2} dc_t + \frac{\left(\frac{1}{d_t^2}\right)}{\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right)} dd_t - \frac{\frac{1}{d_t}\left(\frac{c_t}{d_t} + 1\right)}{\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right)^2} dr_t$$

In a fractional banking system, r_t / d_t is strictly less than 1 and all other terms are positive, thus:

$$\frac{dm_t}{dc_t} = \frac{\frac{1}{d_t}\left(\frac{r_t}{d_t} - 1\right)}{\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right)^2} < 0; \quad \frac{dm_t}{dd_t} = \frac{\left(\frac{1}{d_t^2}\right)}{\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right)} > 0; \quad \text{and } \frac{dm_t}{dr_t} = -\frac{\frac{1}{d_t}\left(\frac{c_t}{d_t} + 1\right)}{\left(\frac{c_t}{d_t} + \frac{r_t}{d_t}\right)^2} < 0$$

These derivatives establish that m_t is negatively related to cash balance held by the public, c_t, and total reserves held by banks, r_t, but is positively related to deposits by the public, d_t. Algebraically, equation (6) may be written as:

$$M_{1,t} = m_t(\underset{-}{c_t}, \underset{+}{d_t}, \underset{-}{r_t})B_t \qquad (7)$$

B.2. The Quantity Equation

From the monetarists' perspectives, the equation of exchange may be viewed as a definition. It is a relationship between velocity of money, V_t, the quantity of money, $M_{1,t}$, in the economy, and P_tY_t, the product between the overall price level, P_t, and the real gross domestic product, Y_t. By assuming the constant velocity of money, denoted by $\overline{V_t}$, the quantity theorists transformed the aforementioned definition to a useful theory on the effects of the quantity of money supply on the overall price level in the economy as described by the quantity equation (8).

$$M_{1,t}\overline{V_t} = P_tY_t \qquad (8)$$

In addition to the assumption of constant velocity, monetarists articulate that: (i) the short-run productive resources and production technology in the economy are fixed and they determine the level of real GDP; and (ii) the money supply $M_{1,t}$, is set by the central bank and determines the value of the nominal GDP. This conclusion follows from the equation (8) and the above assumption of constant velocity of money. The price level, P_t, is then the ratio of the nominal GDP to the real GDP.

The quantity theory, expressed in equation (8), explains what happens when the central bank changes the supply of money. Since $\overline{V_t}$ is fixed, any change in the money supply, $M_{1,t}$, must result in a proportional change in the nominal GDP, P_tY_t. Because factors of production and production technology have independently determined the real GDP, Y_t, the nominal GDP, P_tY_t, can adjust only if the price level, P_t, changes. Stated differently, the quantity equation indicates that the aggregate price level is proportional to money supply.

As pointed out by Mankiw (2013, p. 106), inflation rate is the percentage change in the aggregate price level; this theory of price level is also the theory of inflation rate. The quantity equation can be rewritten in percentage-change form as:

$$\%\text{ Change in } M_{1,t} + \%\text{ change in } \overline{V_t} = \%\text{ Change in } P_t + \%\text{ change in } Y_t \qquad (9)$$

Under the assumption of constant velocity of money, equation (9) can be reduced to:

$$\%\text{ Change in } M_{1,t} = \%\text{ Change in } P_t + \%\text{ change in } Y_t \qquad (10)$$

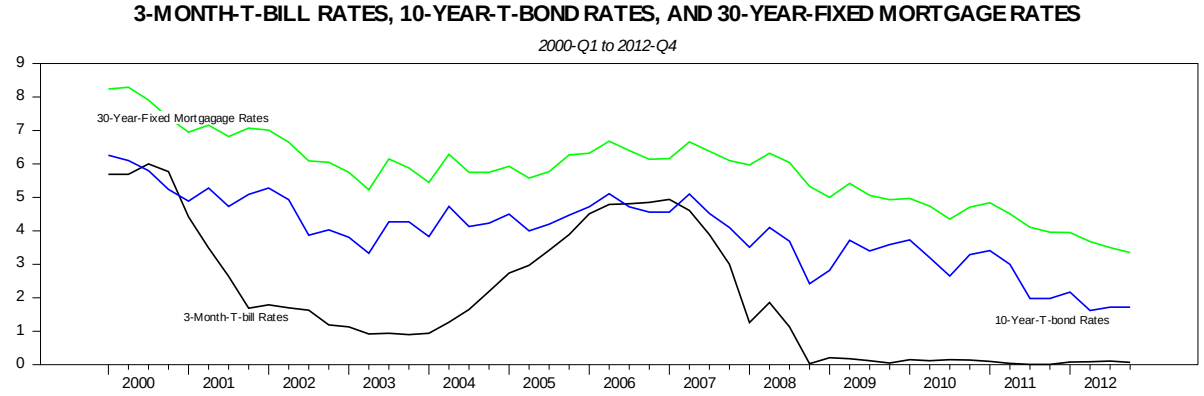
As expressed in equation (10), the quantity theory of money states if the money supply is stable, the price level will be stable. If the money supply increases rapidly, the price level will rise rapidly.

III. The Current State of the US Banking Industry

This section uses data from the Board of Governors of the Federal Reserve System to empirically assess the state of the US banking sector over the 21st century.

A. New Developments in the US Banking Sector since 2000

After recovering from the dot.com stock crash, the US economy headed to the 2001-2002 recession; the Fed began to pursue an expansionary monetary policy which resulted in declines of the 3-month T-bill rate from 5.69 percent to 2.64 percent, the 10-year T-bond rate from 6.26 percent to 5.09 percent, and the 30-year fixed mortgage rate from 8.24 percent to 6.82 percent from the first quarter of 2000 to the third quarter of 2001.

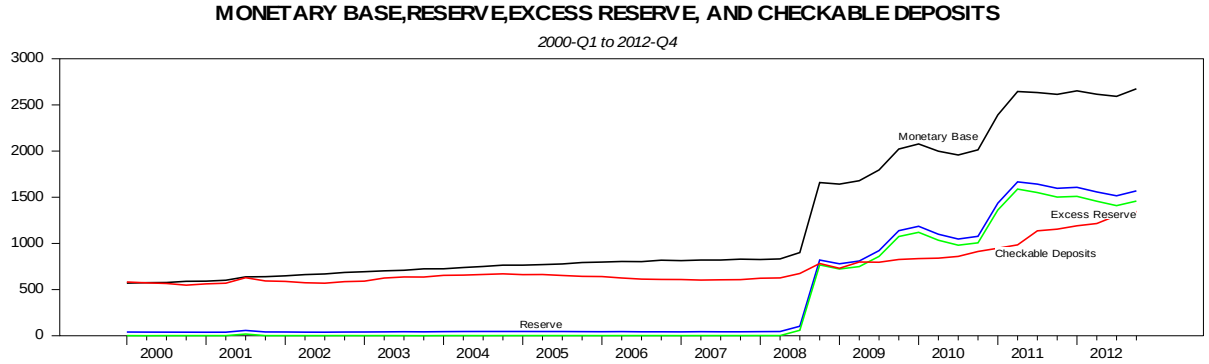


Source: Board of Governors of the Federal Reserve System.

Figure 1

As indicated in Figure 1 and Table 1, after stabilizing from the third quarter of 2001 to the end of 2003, these rates gradually oscillated around their upward trends until the first quarter of 2007. Beginning in the second quarter of 2007, with the financial markets in turmoil, the Fed pursued its original function as the lender of last resort with a historically unprecedented rigor, leading to sharp drops in the aforementioned rates over the span from the second quarter of 2007 to the third quarter of 2008. Since then, these rates have oscillated around their downward trends.

Additionally, a new expansionary countercyclical monetary policy began in December 2008 (with QE1) when the Fed started to buy large quantities of mortgage-backed securities, aiming at restoring order to the mortgage market so that would-be homeowners could borrow. Subsequently, the Fed pursued a policy of buying long-term government bonds to keep their prices up and long-term interest rates down. This policy is better known as ***quantitative easing*** (abbreviated as $QE_{k,}$ where k is the identity number of the program; so far the Fed has launched QE_1, QE_2 and QE_3), which is a type of open-market operation. However, rather than buying short-term T-bills, as the Fed normally does in an open-market operation, it bought longer-term and somewhat riskier securities. These open-market acquisitions led to the substantial increases in the monetary base as illustrated in Figure 2 and Table 1.



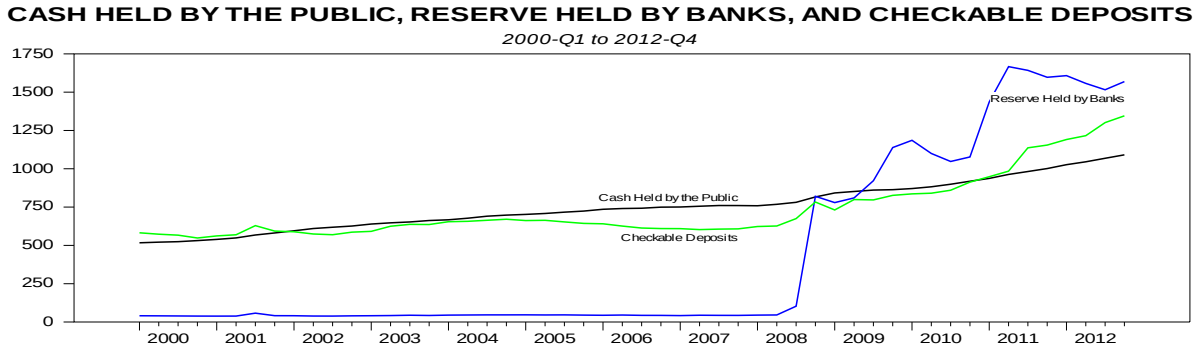
Source: Board of Governors of the Federal Reserve System.

Figure 2

Another important new development in the US banking sector in this period was that, beginning in October 2008, the Fed ***started paying interest*** on the portion of reserves that banks deposit at the Fed. Similar to the beginnings of other monetary policy instruments (i.e., the Fed just stumbled upon them), this change gives the Fed another tool with which to influence the economy. The higher the interest rate on reserves, the more reserves banks will choose to hold. Consequently, an increase in the interest rate on reserves will tend to increase the reserve to deposit ratio, lower the money multiplier, and lower the quantity of money supply that would be created from every dollar of the monetary base. However, this instrument has been newly discovered; it is not yet clear how important it will be in the conduct of monetary policy.

B. Responses of US Commercial Banks and the Public

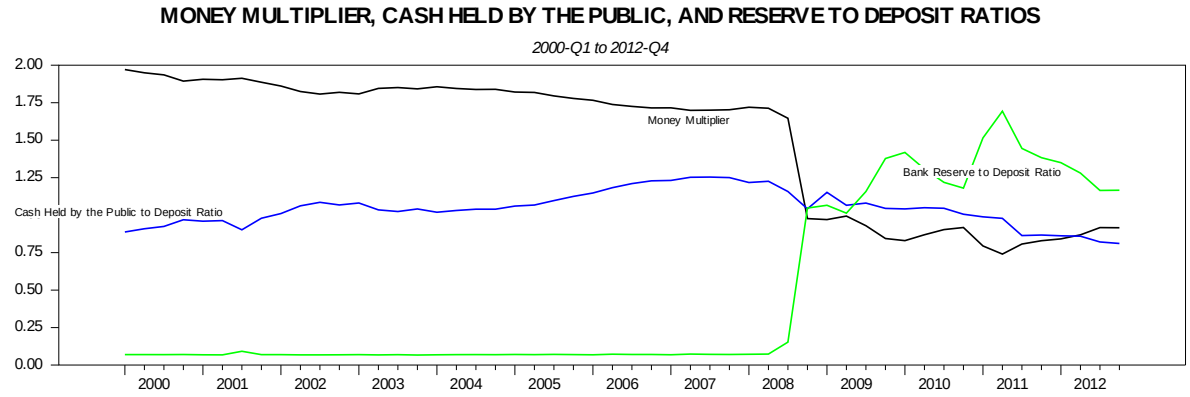
Macroeconomic theories have articulated that the opportunity cost for the public to hold cash balances is the forgone interest income and for the banks to hold excess reserve is the forgone interest income that they could have received by lending these funds. The low rate environment of the 21st century has reduced significantly the opportunity cost of holding cash balances by the public. In addition to the low rate environment, the decision to pay interest on the portion of banks' reserves held at the Fed has drastically reduced the opportunity cost of holding excess reserves by commercial banks. Due to the aforementioned and the fact that banks have made many bad loans leading up to the financial crisis of 2008, it is theoretically expected and empirically supported by data in Table 1 and Figures 2 and 3 that the public would increase their cash holdings and commercial banks would hold higher levels of excess reserves.



Source: Board of Governors of the Federal Reserve System.

Figure 3

Algebraically, an increase in cash holdings by the public would increase the cash to deposit ratio, c_t, and an increase in banks' reserves would increase the reserve to deposit ratio, r_t. Furthermore, equation (7) stipulates that these increases will in turn reduce the money multiplier, $m_t = (c_t / d_t + 1)/(c_t / d_t + r_t / d_t)$. This theoretical conjecture is empirically supported by Figure 4 and Table 1.



Source: Board of Governors of the Federal Reserve System.

Figure 4

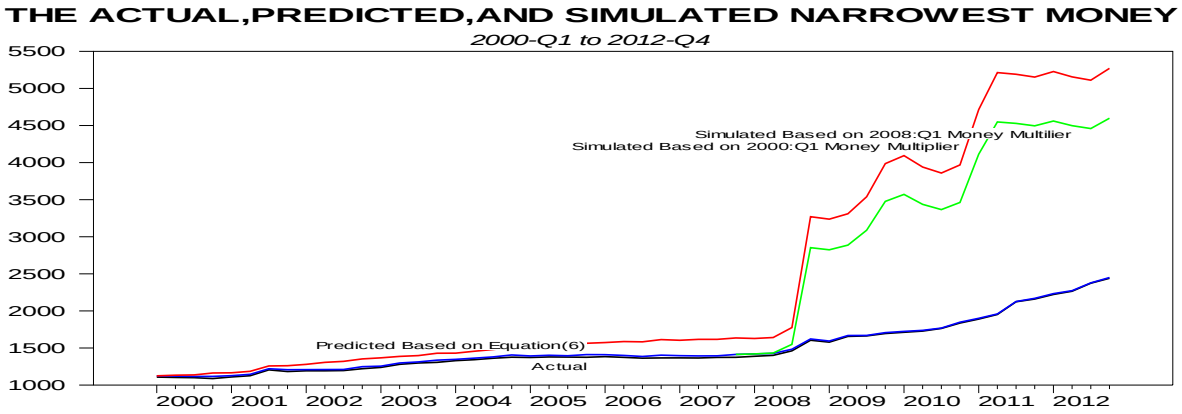
As previously mentioned, the US financial landscape in the first years of the 21st century has been marked by two critically important events: (i) the countercyclical monetary actions starting in 2001 to stimulate the housing market in the face of the 2001-2002 rescession, and (ii) the unprecedented expansionary monetary policy.

As Table 1 indicates and Figure 5 illustrates, these monetary policy actions by the Fed have inceased the US banks' reserve from $ 40.73 billion at the end of 2000:Q1 to $ 46.03 billion at the end of 2008:Q2 and $ 1,569.02 billion at the end of 2012:Q4! The corresponding figures for cash held by the public were $ 516.90 billion, $ 768.02 billion, and $ 1,090.00 billion.

As aforementioned, these increases lead to significant reductions in the money multiplier $m_t = (c_t / d_t + 1)/(c_t / d_t + r_t / d_t)$ over the sample period. Empirically, the numerical value of the money multiplier decreases from 1.97 at the end of 2000:Q1 to 1.91 at the end of 2008:Q2 and to 0.92 at the end of 2012:Q4, with the lowest value of 0.74 being at the end of 2011:Q2.

The reductions in the money multiplier explain why the reported money supply $M_{1,t}$ has increased very modestly in the face of sharp increases in the banks' reserves, cash holdings by the public, and hence the monetary base, as evidenced by Figure 5 and data in Table 1. To put the magnitude of the impact of the reduction in the money multiplier on the money supply in a proper perspective, this study simulates the money supply using equation (6) and different selected values of the money multiplier. The results are reported in Table 1 and Figure 5.

The series labeled "Predicted Based on Equation (6)" is obtained by multiplying the end-of-period value of the monetary base by the calculated periodic money multipliers, using $m_t = (c_t / d_t + 1)/(c_t / d_t + r_t / d_t)$. The series labeled "Simulated Based on 2008:Q1 Money Multiplier" is simulated by multiplying the end-of-period value of the monetary base by the value of the money multiplier at the end of 2008:Q1, which was 1.72. This simulated series is to illustrate the level of money supply over time given the values of the monetary base as the sum of reserves held by banks and the cash held by the public, and using the money multiplier at its value at the end of 2008:Q1. Finally, the series labeled "Simulated Based on 2000:Q1 Money Multiplier" is derived by multiplying the end-of-period value of the monetary base by the value of the money multiplier at the end of 2000:Q1, which was 1.97. Again, this simulated series is to illustrate the level of money supply over time given the values of the monetary base as the sum of reserves held by banks and the cash held by the public, and using the money multiplier at its value at the end of 2000:Q1. Clearly, the last two simulated time series of the money supply suggest that the Fed's unprecedented expansionary monetary policy measures would result in explosive growth in the money supply, $M_{1,t}$, if the money multiplier has not been reduced by the low rate environment. Additionally, the explosive growth in money supply would in turn push US inflation much higher than reported levels in the first years of the 21st century, especially in the last five years, as suggested by equation (9).



Source: Board of Governors of the Federal Reserve System and simulations by the authors.

Figure 5

IV. Implications for the Future

Countercyclical economic policy is an essential trade-off between unemployment and inflation. More specifically, an expansionary countercyclical monetary policy action—increasing the quantity of money in the economy—to curtail unemployment and to bring the gross national product to its long-run equilibrium would consequently build inflationary pressure in the economy. A contractionary countercyclical monetary policy action—decreasing the quantity of money in the economy—to contain inflation would lead to an increase in unemployment and hence a slowdown in the economy. Moreover, as pointed out by Greenlaw et al. (2013) and Carpenter et al. (2013), recent sovereign debt crises among advanced economies suggest that countries with debt above 80% of GDP and persistent current-account deficits are vulnerable to rapid fiscal deteriorations.

Currently the US national debt to GDP ratio is a little over 100%. The danger of a fiscal crisis raises issues about the appropriate response of monetary policy.

The recent rigorous Federal Open Market Operations on the short spectrum of interest rates and other efforts to restore the housing market, such as the quantitative easings QE1, QE2, QE3 and others, to hold down long-term rates have led to a cumulation of long-term, fixed income securities on the Fed's balance sheet, high levels of cash holdings by the public, and excess reserves held by banks. Prices of fixed-income, long-term securities are much more sensitive to changes in market interest rates. Additionally, the US economy has experienced twin deficits. Given the current state of the banking sector, unsustainable fiscal policy or improvement in the economy could result in a large increase in the inflation risk premium for U.S. government debt, leading to a higher rate environment. This could further feed back into rising longer-term inflation expectations. This in turn will raise the risk of an unwelcome surge in inflation, which may lead to devaluating the dollar and the attendant consequences.

This conjecture may contradict Glenn and Samad's (2012, p. 62) report that currently the Federal Reserve is not in a position to influence the government's deficit pathway in the United States, but rather simply manages the debt as generated by the deficit, indicating that fiscal authorities constrain monetary authority. These authors posit that under this coordination scheme, the current quantitative easing meant to fight the recession/slow-growing economy/financial crisis should lead to lower future inflation according to Sargent and Wallace (1986). They specifically articulate that, adjusting for the money supply, there should be a positive long-run relationship between interest rate and the price level, whereby a lower interest rate (an easy monetary policy) leads to higher inflation during the short run, but leads to a lower price over the long run. Glenn and Samad (2012 , pp. 62-63) argue that if Sargent and Wallace's (1986) position holds and under the above conditions a tight current monetary policy to fight inflation leads to higher future inflation, the reverse should also be true.

Using US quarterly data for the period of 1973:Q1-2011:Q3, Glenn and Samad (2012, p. 58) find that Sargent and Wallace's view that an easy monetary policy today will result in a lower price level over the long run when debt and deficit exist is true for the United Sates. Interestingly, these authors also find that over the long run, a higher real exchange rate, government expenditures, deficit per GDP as well as debt per GDP lead to a higher price level.

It should be noted here that the sample period investigated by Glenn and Samad is fairly long; however, it contains very few periods of rigorous, unprecedented expansionary countercyclical monetary policy actions by the Fed, such as purchasing long-term and "unconventional" securities in the post-2008 period. As previously articulated, the money multiplier has been very low due to historically low interest rates of unprecedented duration. In fact, as indicated in Table 1, at the end of their sample period (2011:Q3), the US money multiplier was still at one of its lowest levels. Also, over the post 2008 period, US government expenditures, deficit per GDP, as well as debt per GDP have been unprecedentedly high. Moreover, the recovery phase of the current business cycle has not reached the point that a contractionary countercyclical monetary policy action is necessarily contemplated. Overall, the US financial landscape has changed drastically since 2008.

Therefore, our conjecture is that under the aforementioned conditions, pursuing contractionary monetary policy would increase the debt servicing burden of the US government. Furthermore, large losses would be incurred in Federal Open Market Operations selling long-term, fixed-income financial instruments, accumulated on the Fed's balance sheet from recent efforts to restore the real estate market, at a much higher rate environment. Given the quantity of these instruments on its balance sheet, these losses would significantly reduce the financial contributions from the Fed to the Treasury, which increases US borrowing and creates a heavier burden on the US government and eventually the US taxpayers. On the other hand, given the current excess reserves in the banking sector, restraining from aggressive contractionary monetary policy measures would result in an unacceptable inflation level in the economy. As articulated in the international finance literature, high US inflation would lead to devaluation of the dollar which may help the US trade balance and lessen the servicing burden of existing national debts. However, the US national debts will not be retired any time soon; therefore, inflation would exacerbate the interest cost to refinance the US debt and its additional borrowings. Therefore, the recent US countercyclical monetary policy is a splendid, but still incomplete, story.

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Table 1

Period	ex-re	ms-m1	ch-pb	ck-dp	bk-re	sy-mb	cd-rt	rd-rt	m1-mt	pr-m1	si-08	si-00	ac-cp	po-cp	3m-bl	10-bd	30-mg
2000 Q1	1.21	1107.60	516.90	582.20	40.73	570.43	0.89	0.07	1.97	1124.33	.	1124.33	5.21	6.70	5.69	6.26	8.24
2000 Q2	1.12	1102.90	521.20	573.20	40.17	574.81	0.91	0.07	1.95	1120.60	.	1132.97	2.81	4.01	5.69	6.10	8.29
2000 Q3	1.15	1099.50	524.10	566.80	39.56	576.83	0.92	0.07	1.94	1116.39	.	1136.94	3.25	3.92	6.00	5.80	7.91
2000 Q4	1.33	1087.90	531.30	548.20	38.69	589.96	0.97	0.07	1.89	1117.32	.	1162.82	2.30	5.71	5.77	5.24	7.38
2001 Q1	1.25	1109.10	539.20	561.70	38.41	591.21	0.96	0.07	1.91	1126.83	.	1165.29	3.44	1.71	4.42	4.89	6.95
2001 Q2	1.25	1126.10	548.70	569.40	38.83	601.55	0.96	0.07	1.90	1144.78	.	1185.68	3.63	3.94	3.49	5.28	7.16
2001 Q3	19.02	1204.80	567.70	629.00	57.92	637.97	0.90	0.09	1.91	1220.33	.	1257.45	0.90	0.29	2.64	4.73	6.82
2001 Q4	1.64	1182.90	581.30	593.50	41.38	639.90	0.98	0.07	1.89	1207.28	.	1261.26	-1.57	0.56	1.69	5.09	7.07
2002 Q1	1.40	1192.40	595.40	589.10	41.05	649.19	1.01	0.07	1.86	1208.20	.	1279.57	2.48	3.22	1.79	5.28	7.01
2002 Q2	1.24	1192.40	610.10	574.50	39.12	662.82	1.06	0.07	1.82	1209.42	.	1306.44	2.46	4.72	1.70	4.93	6.65
2002 Q3	1.48	1195.70	618.30	569.60	38.88	669.65	1.09	0.07	1.81	1210.44	.	1319.89	2.67	3.52	1.63	3.87	6.09
2002 Q4	2.01	1220.40	626.30	586.30	40.28	686.23	1.07	0.07	1.82	1248.35	.	1352.57	2.21	2.88	1.19	4.03	6.05
2003 Q1	1.63	1238.60	639.40	591.50	41.17	693.84	1.08	0.07	1.81	1254.90	.	1367.58	4.62	4.36	1.13	3.81	5.75
2003 Q2	2.04	1280.00	647.20	625.20	42.26	703.35	1.04	0.07	1.85	1298.04	.	1386.32	-1.74	-3.57	0.92	3.33	5.23
2003 Q3	1.51	1297.60	652.80	637.20	44.14	708.98	1.02	0.07	1.85	1312.28	.	1397.42	4.37	3.86	0.94	4.27	6.15
2003 Q4	1.05	1306.60	662.50	636.30	42.54	725.21	1.04	0.07	1.84	1335.95	.	1429.41	0.86	2.64	0.90	4.27	5.88
2004 Q1	1.81	1329.30	667.10	654.40	44.87	725.66	1.02	0.07	1.86	1346.91	.	1430.29	3.45	1.78	0.94	3.83	5.45
2004 Q2	1.93	1342.20	677.50	657.00	45.87	738.97	1.03	0.07	1.84	1363.29	.	1456.54	3.85	4.85	1.27	4.73	6.29
2004 Q3	1.65	1362.10	690.40	664.00	46.48	750.55	1.04	0.07	1.84	1379.52	.	1479.35	1.91	2.12	1.65	4.13	5.75
2004 Q4	1.91	1375.90	697.60	670.80	46.43	764.66	1.04	0.07	1.84	1406.34	.	1507.16	4.00	5.03	2.19	4.23	5.75
2005 Q1	1.78	1371.90	702.30	662.10	46.82	764.67	1.06	0.07	1.82	1392.73	.	1507.19	2.92	3.21	2.74	4.50	5.93
2005 Q2	1.74	1379.20	708.30	663.50	46.10	770.80	1.07	0.07	1.82	1401.62	.	1519.28	1.24	1.59	2.97	4.00	5.58
2005 Q3	2.00	1377.50	716.90	653.30	46.40	777.51	1.10	0.07	1.80	1395.70	.	1532.49	10.53	11.61	3.42	4.20	5.77
2005 Q4	1.90	1374.70	724.00	643.50	44.96	793.38	1.13	0.07	1.78	1410.91	.	1563.77	-1.41	1.07	3.89	4.47	6.27
2006 Q1	1.51	1383.50	735.60	641.00	43.88	798.24	1.15	0.07	1.77	1409.73	.	1573.35	3.23	3.29	4.51	4.72	6.32
2006 Q2	1.78	1373.60	740.70	626.00	45.54	805.02	1.18	0.07	1.74	1399.35	.	1586.72	4.21	5.89	4.79	5.11	6.68
2006 Q3	1.76	1362.60	742.40	613.30	43.32	803.22	1.21	0.07	1.73	1385.89	.	1583.17	1.98	2.52	4.81	4.72	6.40
2006 Q4	1.86	1366.30	749.60	609.90	43.12	818.40	1.23	0.07	1.71	1403.53	.	1613.09	0.59	2.52	4.85	4.56	6.14
2007 Q1	1.62	1366.80	750.70	609.50	41.94	813.85	1.23	0.07	1.72	1396.59	.	1604.12	4.31	3.62	4.94	4.56	6.16
2007 Q2	1.75	1365.20	755.60	603.10	44.20	820.00	1.25	0.07	1.70	1393.03	.	1616.25	3.79	4.80	4.61	5.10	6.66
2007 Q3	1.73	1373.20	760.40	606.40	43.33	819.94	1.25	0.07	1.70	1394.36	.	1616.13	2.53	1.94	3.89	4.52	6.38
2007 Q4	1.79	1374.10	760.10	607.80	43.13	829.76	1.25	0.07	1.70	1413.08	1413.08	1635.49	5.56	6.90	3.00	4.10	6.10
2008 Q1	2.65	1388.10	758.80	623.20	44.94	826.03	1.22	0.07	1.72	1420.32	1420.32	1628.12	3.79	2.23	1.26	3.51	5.97
2008 Q2	2.23	1401.00	768.20	626.70	46.03	832.83	1.23	0.07	1.71	1426.76	1432.02	1641.53	7.52	7.56	1.86	4.10	6.32
2008 Q3	59.48	1461.60	781.10	674.70	103.33	900.92	1.16	0.15	1.65	1482.95	1549.10	1775.74	2.60	7.85	1.13	3.69	6.04
2008 Q4	767.32	1604.70	816.10	783.00	820.19	1659.22	1.04	1.05	0.98	1621.51	2852.96	3270.37	-13.67	78.80	0.03	2.42	5.33
2009 Q1	723.10	1578.80	842.30	731.20	779.41	1642.37	1.15	1.07	0.97	1593.55	2824.00	3237.17	2.13	1.67	0.21	2.82	5.00
2009 Q2	749.40	1656.20	851.80	799.10	809.81	1679.35	1.07	1.01	0.99	1668.52	2887.58	3310.05	4.27	3.98	0.18	3.72	5.42
2009 Q3	859.89	1662.90	861.00	796.70	922.17	1795.70	1.08	1.16	0.93	1669.35	3087.64	3539.39	2.03	15.47	0.12	3.40	5.06
2009 Q4	1075.20	1695.40	863.70	826.60	1138.68	2022.13	1.04	1.38	0.84	1706.97	3476.97	3985.68	2.75	27.64	0.05	3.59	4.93
2010 Q1	1120.37	1711.90	870.80	836.10	1185.95	2076.99	1.04	1.42	0.83	1723.70	3571.30	4093.81	0.03	5.43	0.15	3.73	4.97
2010 Q2	1034.93	1728.00	882.40	840.70	1099.85	1998.89	1.05	1.31	0.87	1737.56	3437.01	3939.87	-0.09	-10.03	0.12	3.20	4.74
2010 Q3	980.83	1763.70	899.10	859.80	1047.76	1957.77	1.05	1.22	0.90	1768.76	3366.31	3858.83	1.82	-4.93	0.15	2.65	4.35
2010 Q4	1006.64	1836.30	918.70	912.90	1077.36	2013.66	1.01	1.18	0.92	1847.75	3462.40	3968.98	3.94	6.07	0.14	3.29	4.71
2011 Q1	1362.15	1890.00	937.30	948.00	1436.16	2392.15	0.99	1.51	0.79	1900.15	4113.20	4715.00	4.79	42.49	0.10	3.41	4.84
2011 Q2	1588.73	1951.90	963.10	984.30	1666.62	2644.91	0.98	1.69	0.74	1958.65	4547.81	5213.19	3.52	26.61	0.04	3.00	4.51
2011 Q3	1550.98	2123.20	982.10	1136.70	1642.24	2633.70	0.86	1.44	0.81	2126.36	4528.54	5191.10	2.99	-6.92	0.01	1.98	4.11
2011 Q4	1502.21	2160.40	1001.50	1154.60	1597.10	2614.50	0.87	1.38	0.83	2169.29	4495.52	5153.25	0.68	-2.86	0.01	1.98	3.96
2012 Q1	1509.59	2221.90	1026.90	1190.90	1607.82	2652.41	0.86	1.35	0.84	2232.69	4560.71	5227.98	3.19	3.81	0.08	2.17	3.95
2012 Q2	1457.48	2265.40	1045.40	1216.00	1557.18	2615.85	0.86	1.28	0.87	2272.93	4497.85	5155.92	-0.05	-5.25	0.09	1.62	3.68
2012 Q3	1409.44	2373.80	1068.60	1301.30	1515.89	2593.19	0.82	1.16	0.92	2377.88	4458.89	5111.26	4.02	-2.73	0.11	1.72	3.50
2012 Q4	1458.75	2440.10	1090.90	1345.40	1569.02	2674.31	0.81	1.17	0.92	2449.48	4598.37	5271.15	-0.16	3.79	0.07	1.72	3.35

Sources: Board of Governors of the Federal Reserve System and simulations by the authors.

Notes: Column headings in Table 1

1. Period: Time period
2. ex-re: Excess reserves
3. ms-m1: Money supply M_1
4. ch-pb : Cash held by public

5. ck-dp: Checkable deposits
6. bk-re: Bank reserves
7. sy-mb: Monetary base
8. cd-rt: Cash held by the public to checkable deposit ratio
9. rd-rt: Banks' reserve to checkable deposit ratio
10. m1-ml: Money M_1 multiplier
11. pr-m1: Predicted M_1 money supply using the calculated periodic money multiplier
12. si-08: Simulated M_1 money supply using the calculated value of multiplier at 2008:Q1
13. si-00: Simulated M_1 money supply using the calculated value of multiplier at 2000:Q1
14. ac-cp: Actual inflation
15. po-cp: Potential inflation (based on the simulated M_1 money supply using the calculated value of money multiplier at 2000:Q1 which is 1.97)
16. 3m-bl: 3 month T-bill rate
17. 10-bd: 10 year T-Bond rate
18. 30-mg: 30 year fixed mortgage rate.