

Efficiency of the Federal Reserve under Globalization and Presence of Electronic Transactions

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ABSTRACT

The Federal Reserve – the central bank of the United States – often is cited as the regulator of our economy. This economy is the largest in the world, and, by virtue of the interdependence of other global economies through the foreign exchange market and other capital markets, the Federal Reserve exerts an enormous influence for our financial architecture. All of this influence stems from its power to ‘create’ and ‘destroy’ money, and, by that process, it affects inflation, interest rates, and rates of foreign exchange world-wide. This work explains in depth how these come into being and shows the inter-link *via* monetary base, money supply, and exchange rates as they relate to stock in money supply. The first section delineates the change in money supply in the traditional economic framework, and in the second section, the relationship between money and exchange rate is sketched out in both the traditional and in the new age of globalization. Finally we question the adequacy of the inter-connectedness in terms of efficacy and immediacy of effectiveness when the electronic component of the money in circulation is factored in.

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I. INTRODUCTION

The Federal Reserve (the Fed, in shorthand) is the monetary policy arm for the U.S. economy. By its almost exclusive power to “create” and “destroy” money stock, it can regulate the flow of money supply for the economy, and, by this regulative flow of the money supply, it can moderate and/or control major economic variables in the economy. These major variables are interest rates, inflation rates, and exchange rates. Money traditionally means coins and currencies well as checks and check-type instruments the consumers and business houses have been using. However, The Federal Reserve Bank of Chicago recently notes, “in recent years, however, consumers seem to be changing their minds. Cash and checks are still widely used. Currency is used for the vast majority of payments, mainly for smaller purchases, and checks are the payment choice for about 10 percent of transactions each year, but the percentage of transactions done electronically is growing dramatically. The important role of electronic payments can be seen by looking at the value of payment transactions. Electronic payments account for more than 90 percent of the dollar value of transactions. This growth is made possible by electronic payment networks, which move funds in and out of accounts using electronic messages. Electronic payment systems range from the now-familiar automated teller machines (ATM) to Internet bill payments. This essay discusses the different types of electronic payment systems and looks at the future of electronic money.” This phenomenon needs a close-up look at the money flow and its control on the economy or economies.

Various scholars (Boorman and Havrilesky (1973), de Leeuw (1965), Meigs (1962), Bernanke and Kuttner (2005), Bullard and Waller (2004), Demiralp and Jorda (2004), Fand (2004), and so on) have made early attempts to explain the controlling mechanism of the Fed and have given guidance as to how to construct a framework for analytical discussion on the Federal Reserve’s tools, techniques, and efficacy of policy decision. In the next section (Section II) we present the increase or decrease of money supply effected by this monetary authority in the traditional structure of analysis, and then we examine the efficacy of the controlling and regulating power of the Fed when we factor in velocity of circulation of money in the electronic transaction conduits. In Section III, we bring out the relationship amongst interest rates, inflation rates, and exchange rates without and with the reality of electronic funds transfer for the United States. In Section IV, we conclude with some observations.

II. MONETARY STRUCTURE

For any modern economy, and certainly for the United States in the traditional framework, the money supply is anchored in its monetary base (MB, also known as high power money). It is defined as follows:

$$MB = RT + CC, \quad (1)$$

where RT stands for total reserves held by commercial banks, partly as a mandate from the Federal Reserve and partly as a matter of prudence, and CC measures the coins and currency in circulation. Note that

$$RT = RR + RE \quad (2)$$

Here RR means required reserves held by banks as a mandate from the central bank, and RE stands for excess reserves banks hold as a matter of prudence and as revenue-generating amounts for inter-bank loans at *federal funds rate*. Since banks maintain two types of deposit liabilities – demand deposits (DD) such as checking accounts and time deposits (TD) such as savings accounts – the central authority (the Fed) requires that each bank must maintain a fraction of each type of deposit either in the bank's own vault or in the district Federal Bank or in a corresponding bank or any combination thereof. That means,

$$RR = RR_D + RR_T \quad (3)$$

Here RR_D and RR_T refer respectively to required reserves on demand deposits and time deposits. Let r_D (say, 8 percent) be the required reserve ratio on demand deposits (DD) and r_T (say, 3 percent) be the required reserve ratio on time deposits (TD). That is,

$$r_D = RR_D/DD \quad (4A)$$

$$r_T = RR_T/TD \quad (4B)$$

Putting (3) and (4A- 4B) into (2), we get then:

$$RT = r_D \cdot DD + r_T \cdot TD \quad (5)$$

We also introduce some behavioral assumptions on household behavior and bank practice as follows:

$$TD = \alpha \cdot DD \quad (6)$$

$$RE = \beta \cdot DD \quad (7)$$

It all means that, for every dollar deposited in demand deposit, the representative household puts $\alpha \cdot DD$ (say, $\alpha = 0.3$) into time deposit. In more common language, it is being stated that, when the household puts \$1,000 in a checking account (demand deposit), it puts \$300 in a savings account (time deposit) as a practice of behavioral normality or as a desired asset allocation decision. Similarly, it is postulated that, for every dollar in demand deposit, the bank on its own keeps $RE = \beta \cdot DD$ as excess reserves where β is a fraction (such as $\beta = 0.12$). We further assume that the typical household keeps a fraction of its checking account deposits into coins and currency holding. Let this coins and currency holding be as follows:

$$CC = \gamma \cdot DD, \quad (8)$$

where γ (say, 0.03) is that fraction.

Substitute (5), (6), (7), and (8) into (2), and obtain the following:

$$RT = (r_D + \alpha \cdot r_T + \beta) \cdot DD \quad (9)$$

Now plug in (8) and (9) into (1) to get the following:

$$MB = (r_D + \alpha r_T + \beta + \gamma) \cdot DD \quad (10)$$

In the U.S. economy we compute different monetary aggregates or money stocks such as M1, M2, M3, and L. For your convenience in analytical examination, we take M2, which is defined as follows:

$$M2 = DD + TD + CC \quad (11)$$

Now the insertion of (6) and (8) into (11) yields:

$$M2 = (1 + \alpha + \gamma) \cdot DD \quad (12)$$

Equations (10) and (12) together then result in the following expression:

$$M2 = \{(1 + \alpha + \gamma)\} / [(r_D + \alpha r_T + \beta + \gamma)] \cdot MB = \mu \cdot MB \quad (13)$$

This expression (13) is where we see the link between monetary base and money supply. $\{(1 + \alpha + \gamma)\} / [(r_D + \alpha r_T + \beta + \gamma)] \equiv \mu$ is the money multiplier, and this multiplier is one of the areas in which the Fed exerts its power of influence, and it is embedded in this multiplier. Note the Fed has the power to change r_D and r_T , and, by doing that, it can increase (“create”) and decrease (“destroy”) money supply, everything else remaining unchanged. An increase (decrease) in r_D and/or r_T can trigger a decrease (increase) in money supply.

How often does the Fed manipulate these required ratios? Empirical evidence suggests that very infrequently these tools are used, but, if they are used, they are very effective in changing the money supply. That revelation then takes us to the exploration of the more frequently-used tool in the control kit in the hands of the Federal Reserve, and this is the federal funds rate (i_F). What is the federal funds rate, and how does it affect the money supply and other financial variables?

Recall we noted excess reserves that banks choose to maintain – the reserves held beyond the required reserves. There are two reasons why banks hold excess reserves. First, since deposits fluctuate significantly and sometimes unpredictably, to cope with these scenarios, prudent bank management dictates that banks hold more reserves than required reserves just like households keep more money in the checking account than required to pay expected bills. Secondly, excess reserves, it should be noted, are not idle non-interest bearing assets in a real sense. In financial markets some banks virtually are in shortage to maintain required reserves, and these banks borrow from others banks with excess reserves. The rate charged on these actively-traded reserve funds is the federal funds rate. The Federal Reserve manages this rate, and, through this manipulation, it sends a signal in the market for other interest rates to follow the suit.

Expression (13) can be re-written as follows:

$$M2 = \{(1 + \alpha + \gamma)\} / [(r_D + \alpha r_T + \beta + \gamma)] \cdot f(i_M - i_F), \quad (14)$$

where $MB = f(i_M - i_F)$, Here i_M the market rate of interest rate, and $f'(\cdot) > 0$. A rise in the federal funds rate makes the cost of money higher, and the availability of credit gets squeezed. The spectrum of interest rates tend to move along with the change in federal funds rate, and money becomes tight. The opposite scenario on federal funds rate going down eases up the credit market and other interest rates follow the direction of federal funds move. The Federal Reserve has another tool to affect and regulate money supply, and it is the discount rate (i_D), the rate at which a bank can borrow from the Federal Reserve after satisfying a few conditions. A drop in i_D causes the money supply to increase, and a rise in i_D causes the money supply to dwindle.

We now bring out further the following identities:

$$RT = RR + RE \quad (2)$$

$$RT = RU + RB \quad (15)$$

Here RU and RB stand for unborrowed and borrowed reserves. From (2) and (15), we can easily note that:

$$RU = RR + RE - RB = RR + RF, \quad (16)$$

where $RF \equiv RE - RB$ stands for free reserves. In the existing literature (see, among others, Boorman and Havrilesky (1973) and Meigs (1972)), we have also the concept of unborrowed monetary base as:

$$MBU = MB - RB \quad (17)$$

and

$$RB = g(i_M - i_D) \quad (18)$$

where $g'(\cdot) > 0$. Now it is obvious that M2 can be re-expressed as follows:

$$\begin{aligned} M2 &= \{(1 + \alpha + \gamma)\} / [(r_D + \alpha.r_T + \beta + \gamma)] \cdot f(i_M - i_F) \\ &= \{(1 + \alpha + \gamma)\} / [(r_D + \alpha.r_T + \beta + \gamma)] \cdot (MBU + g(i_M - i_D)) \end{aligned} \quad (19)$$

Open market operations – that is, buying and selling of Government securities in the open markets – by the Fed affects the price of the securities and thereby leads the rates of interest in the opposite direction. Open market sales make the securities prices go downward and interest rates upward. Open market purchases do exactly the opposite. Open market operations are more commonly and frequently used tool employed by the Fed, and they affect i_M in (14) and thus the economy's stock of money.

Given a downward-sloping demand for money, enunciated by Keynes (1936) and further explained by Tobin (1958) in his classic explanation of liquidity preference as a behavior toward risk, and a normal upward-sloping supply curve of money, the equilibrium interest rate is a simple reality. In a given situation of equilibrium, if it is perturbed by an increase (decrease) in money supply by any of the Federal Reserve's policy tools, interest rate moves to a lower (higher) level. That signifies an inverse relation between interest rate and money supply. The next question then is: how are interest rate and inflation rate related (Perez (2003))? Irving Fisher in his classic work

has already shown the following relationship – the so-called Fisherian relationship-- as follows:

$$1 + n = (1 + \rho)(1 + \pi), \quad (20)$$

where n = nominal rate of interest, ρ = real rate of interest, and π = inflation rate. From (15), one easily derives:

$$n = \rho + \pi + \rho \cdot \pi \quad (21)$$

Assuming $\rho \cdot \pi$ as negligible, the Fisherian relation is often expressed as:

$$n = \rho + \pi \quad (22A)$$

or

$$n - \pi = \rho \quad (22B)$$

To maintain the real rate unchanged or moved within an accepted range, the Federal Reserve often, as recently as a few weeks ago, raises nominal interest rate to contain or match any inflation increase. The Federal Reserve appears to have been often successful, at least in the short-run.

III. INTEREST RATE, INFLATION, AND EXCHANGE RATE

We have already established a relationship between interest rate and inflation rate by using the Fisherian expression. Here we take a step forward by opening the economic frontiers and thus going beyond the closed economy that we have implicitly drawn in Section II. In this section, the open economic structure is used, and more of Fisher analysis is discussed. First, using a two-country framework (home and foreign), we extend the previous result of (22A) for both countries as follows:

$$\text{Home country: } n^H = \rho^H + \pi^H \quad (23A)$$

$$\text{Foreign country: } n^F = \rho^F + \pi^F \quad (23B)$$

The superscripts H and F denote variables in the home country and foreign country, respectively. Note that by the celebrated factor price equalization theorem, $\rho^H = \rho^F$ and hence (23A) and (23B), yield:

$$n^H - n^F = \pi^H - \pi^F \quad (24)$$

Equation (24) shows that interest rate differential between home country and the foreign country equals the inflation differential between these two countries. In more concrete terms, if the U.S interest rate is 5 percent and U.K's interest rate and inflation rate are 2 percent 7 percent, respectively, the U.S inflation rate is 10 percent. Evidence bears this relationship pretty well. Now, bring out Fisher's Quantity Theory of Money, which is as follows:

$$P \cdot Q = M \cdot V, \quad (25)$$

where P stands for price level, Q for total output (GNP in physical units), M for money supply, and V for the velocity of circulation of money. Now attaching H and F for home country and foreign country, as before, we get (see Ghosh *et al* (2000) and Calvo (2001)):

$$P^H \cdot Q^H = M^H \cdot V^H \quad (26A)$$

and

$$P^F \cdot Q^F = M^F \cdot V^F \quad (26B)$$

From (26A) and (26B), one easily gets:

$$\frac{P^H}{P^F} = \frac{M^H V^H}{M^F V^F} \cdot \frac{Q^F}{Q^H} \quad (27)$$

From the purchasing power parity theorem, we further have the following result:

$$E = \frac{P^H}{P^F} \quad (28)$$

Here E stands for the exchange rate of foreign currency in terms of domestic currency. Equations (27) and (28) now establish:

$$E = \frac{P^H}{P^F} = \frac{M^H V^H}{M^F V^F} \cdot \frac{Q^F}{Q^H}, \quad (29)$$

whence:

$$\frac{dE}{E} = \left(\frac{dM^H}{M^H} - \frac{dM^F}{M^F} \right) + \left(\frac{dV^H}{V^H} - \frac{dV^F}{V^F} \right) + \left(\frac{dQ^F}{Q^F} - \frac{dQ^H}{Q^H} \right) \quad (30)$$

It is clear now that the percentage change in exchange rate $\left(\frac{dE}{E} \right)$ is equal to (i) home country's percentage change in money supply *minus* the foreign country's percentage change in money supply *plus* (ii) percentage change in velocity of circulation of money supply in the home country *minus* percentage change in velocity of circulation of money supply in the foreign country *plus* (iii) percentage change in the foreign GNP *minus* that of the home country. In a stable economy and/or in the short-run, velocity remains virtually unchanged, and so the second term in the parenthesis in the right-hand side is considered negligible. Then it is evident that, other things remaining constant, the money supply and GNP change affect the exchange rate perceptibly. In other words, the Federal Reserve plays a crucial role in affecting exchange rate. From the purchasing power parity, it is evident again from (28) that the exchange rate change is equal to the inflation differential:

$$\frac{dE}{E} = \frac{dP^H}{P^H} - \frac{dP^F}{P^F}, \quad (31)$$

where $\frac{dP^H}{P^H}$ is nothing but domestic inflation rate (π^H), and $\frac{dP^F}{P^F}$ is the foreign inflation rate (π^F). Now, combining (31) with (24), we get the following fundamental result:

$$n^H - n^F = \pi^H - \pi^F = \frac{dE}{E} \quad (32)$$

Any deviation is an arena for the Federal Reserve to step in and take corrective action. In the foreign exchange market, the Fed sometimes engages in intervention – sterilized or non-sterilized, and regulation of money supply by the Fed is the basic power in the hand of this institution.

In the traditional financial framework, the concepts discussed work well, and the controlling mechanism depicted shows the inter-connection of the tubes and tunnels of transmission. In the new age of electronic payments structure in the midst of on-going globalization process a further scrutiny of the analytical structure is warranted. In this context, we re-visit the paradigm posited and revise it somewhat in view of the Posner paper (2006) and Rubin's work (2005). So, first and foremost, we must modify (26A and (26B)) as:

$$P^H \cdot Q^H = M_t^H V_t^H + M_e^H V_e^H \quad (33A)$$

$$P^F \cdot Q^F = M_t^H V_t^H + M_e^F V_e^F, \quad (33B)$$

where M_t^H = stock of money flowing through the traditional route in the home economy, and the corresponding velocity of circulation is M_t^H . M_t^F and V_t^F are similarly the counterparts of the foreign economy. M_e^H and M_e^F are the money stocks circulating through electronic transfer conduits; and V_e^H and V_e^F are the velocity counterparts. Now performing similar exercises as before, we can modify (30) and derive the following expression:

$$\begin{aligned} \frac{dE}{E} = & (\lambda_t^H \frac{dM_t^H}{M_t^H} - \lambda_t^F \frac{dM_t^F}{M_t^F}) + (\lambda_e^H \frac{dM_e^H}{M_e^H} - \lambda_e^F \frac{dM_e^F}{M_e^F}) \\ & + (\lambda_t^H \frac{dV_t^H}{V_t^H} - \lambda_t^F \frac{dV_t^F}{V_t^F}) + (\lambda_e^H \frac{dV_e^H}{V_e^H} - \lambda_e^F \frac{dV_e^F}{V_e^F}) + (\frac{dQ^F}{Q^F} - \frac{dQ^H}{Q^H}), \end{aligned} \quad (34)$$

where $\lambda_t^H \equiv \frac{M_t^H V_t^H}{M^H}$, $\lambda_t^F \equiv \frac{M_t^F V_t^F}{M^F}$, $\lambda_e^H \equiv \frac{M_e^H V_e^H}{M^H}$, and $\lambda_e^F \equiv \frac{M_e^F V_e^F}{M^F}$. We must note that here $M^H = M_t^H V_t^H + M_e^H V_e^H$ and $M^F = M_t^F V_t^F + M_e^F V_e^F$.

In the traditional framework, in the mature capitalistic economies, velocity of circulation of money remains virtually constant and definitely so on the short-run. However, in the era of globalization and electronic transfer situations, velocity of circulation of money (here, V_e^H and V_e^F) are quite volatile, as rigorously pointed out by Schienkman (2006). Cross-listed cross-currency securities and arbitrage opportunities make the volatility vibrant, and impacts of these un-measurable changes make the central banks less powerful and tentative in policy positions. A recent paper by Mishra *et al* (2005) has brought liquidity in the three-moment capital asset pricing paradigm, and its ramification may not be captured by the Fed because of the speed of interactions in the assets markets.

IV. CONCLUDING REMARKS

Theoretically, as it is evident, the Federal Reserve has a huge power to influence interest, inflation, and exchange rates. In this analytical framework we assume the foreign variables as parameters, and their counteractive influences are fully ignored. Once those factors are brought into being, and, in this process of globalization and cross-listing of assets, almost non-stop trading world-wide, and gargantuan currency trading, it is not clear what the extent of the efficacy the Federal Reserve actually may have. Prakash and Ghosh (2005), Ghosh, Prakash, and Mishra (2006), and Ghosh, Ghosh, Mishra, and Bhatnager (2007) examine these issues against the backdrop of arbitrage and speculation in a microeconomic framework. When the aggregation is attempted, the macro-structure of our analysis may come into play. A good deal of empirical examination may be of further value in our effort to examine such efficacy, and therefore a follow-up study is warranted.

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