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and Interest Rates Don't**

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Monetary Policy: Why Money Matters *and Interest Rates Don't*

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Abstract

Monetary policy is now conducted by targeting a very short-term interest rate. The Fed and other central banks attempt to control the price level by manipulating aggregate demand by adjusting their interest rate target. At best, money's role is tertiary. Indeed, a few prominent and influential macroeconomists have suggested that money is not essential, or perhaps is irrelevant, for the determination of the price level. Against this backdrop, this paper argues that the essential feature of money is that it guarantees "final payment" and is essential for price determination. It also suggests that the ability of the central banks to control interest rates may be greatly exaggerated.

JEL Codes: E41, E43, E52

Key Words: money, medium of exchange, monetary policy, federal funds target, structure of interest rates, price-level determination

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*We'd always thought that if you wanted to cripple the U.S. economy, you'd take out the payment system... Businesses would resort to barter and IOUs; the level of economic activity across the country could drop like a rock—Alan Greenspan, **The Age of Turbulence**, p. 2.*

In central banking today, “monetary policy” should be more aptly named “short-term interest rate policy.” Despite their name, monetary policymakers pay virtually no attention to money in the United States or elsewhere. Central banks around the world implement monetary policy by targeting a very short-term interest rate such as the federal funds rate or similar interbank rate. Prominent monetary economists such as Woodford (2000, 2007), Friedman (1999) and King (1999) have suggested the possibility of a moneyless economy: Friedman and King argue that this would severely limit the effectiveness of monetary policy, while Woodford argues that it would not. This paper discusses what money does, why money is critical for economic growth and prosperity, and why money is essential for price determination—in short, why money matters for monetary policy. I also discuss reasons why central bankers’ control over interest rates is more limited than is commonly thought. Indeed, recent evidence (Thornton, 2007) suggests that the Fed has had little effect on long-term rates despite its apparent increased control over the effective federal funds rate.

The remainder of the paper is as follows. Section 2 discusses money’s role in trade and exchange and, most importantly, why money is essential from the determination of the price level. Section 3 discusses some reasons for the failure of orthodox economic theory to provide an essential, economic-welfare-enhancing role for money. Section 4 discusses reasons why central banks’ ability to influence interest rates is more limited than commonly thought and presents some recent evidence that

the Fed has had little effect on long-term rates despite its increased control over the federal funds rate. Section 5 concludes.

2.0 Why Money Matters

Money matters for the simple reason that it has been and remains the most efficient means of exchange. Growth in economic welfare is enormously dependent (directly or indirectly) on trade (domestic and international). Money is essential for trade because, of the three possible means of exchange—barter, credit, and money—money is far and away the most efficient. To understand the fundamental importance of money, consider an autarkic economy where everyone is self-sufficient—there is no trade. Individuals get utility from consumption and leisure. Leisure is merely the amount of time not spent in the production of consumption goods. Individuals produce their own consumption good using their share δ_i , $0 < \delta_i < 1$, $i = 1, 2, \dots, N$, (where N is the size of the population) of an aggregate economy-wide resource, R . The economic welfare of such a society is presented in Figure 1, where U is an index of the maximum ordinal utilities of each individual at each possible level of the resource. U^* denotes society's economic welfare when the amount of society's resource is R^* .

The effect of trade using barter as the means of exchange is illustrated in Figure 2. Economic welfare increases from U^* to U'^* as society goes from autarky to an exchange economy. The upward shift in the utility contour is due to Ricardo's principle of comparative advantage. However, because exchange is costly, society's gain is less than the vertical shift from U to U' at R^* . This is due to the fact that part of society's resource is used in trade.

Because trade is costly, individually, and in the aggregate, society could be better off if there were a more efficient method of exchange. There are only three

possible methods of exchange—barter, credit, and money. Barter is well understood and requires no explanation. Credit is where one individual obtains a commodity from another by promising to pay the individual the same or a different commodity at a future date. In essence, credit is inter-temporal barter. Money is where one commodity is chosen as a general medium of exchange and all goods (including credit contracts) are exchanged for money.

Figure 3 shows the effect of moving from barter as the medium of exchange to money. The upward shift in the utility contour is due to the fact that because money reduces the cost of exchange, more trade takes place. While there may be other reasons why the use of a more efficient means of exchange increases the volume of trade, elsewhere (Thornton, 2000) I show that reducing transactions cost increases the range of relative prices over which transactions can occur. This increases the likelihood that an exchange will take place. Increased trade leads to increased specialization and more trade. By reducing exchange costs, money also frees up resources, previously used in trade, for production (or leisure). The net effect of the social invention of money is a marked increase in economic welfare.¹ Because the stock of money is costly to produce and maintain, there is some welfare loss relative to a make-believe economies with costless exchange.²

It is very important to note that being a medium of exchange is not the most important function of money. Being a medium of exchange is really a consequence of money's most important function—guaranteeing *final payment*. Barter has the desirable property that final payment occurs when the exchange takes place—the good that you don't want is exchanged for the one that you want. In a money transaction, a good that you don't want is traded for another good that you don't

¹ Thornton (2000) shows why money cannot be a private good.

intend to consume—money. The difference is that individuals are confident that they will be able to trade money for a good that they want. Money is held because exchange (converting a good that you don't want into one that you do want) is done most efficiently if you hold money. This is why individuals trade goods for money: this is why money is a medium of exchange.

Of the three mediums of exchange, credit is the least efficient. Credit—the exchange of a good for the promise to receive a larger quantity of the same or another good at a future date—is rarely used in exchange. Indeed, in a monetary economy, it would be rare to find any willingness exchange a good for a promise of a good (other than money). That is why credit per se is the least efficient medium of exchange. The existence money makes credit an effective means of exchange. Like many people, I carry out a large proportion of my transactions with a credit card rather than checks or cash. I am able to do this because I promise to settle my account with the credit card company with cash or by transferring money from my deposit in a financial institution. I doubt the credit card company would be so willing to “finance” my economic transactions if I promised final settlement in sacks of potatoes or economic consulting services. It is the existence of money that makes the widespread use of credit transactions feasible. Were it not for the existence of money, credit would seldom be used as a medium of exchange.³ It is hardly surprising that credit economies don't exist.

An important feature of money is that it is so much more efficient than barter or credit as a means of exchange that it continues to function as the primary means of

² Elsewhere, I (Thornton, 2000) speculate that such costs motivated the evolution to fiat money systems.

³ See Thornton (2000) for limitations on the usefulness of credit as a medium of exchange.

exchange even when the cost of holding it is very high, as during hyperinflations.⁴ This observation has important implications for the portfolio-balance theory of money. The portfolio-balance theory of money assumes that individuals efficiently allocate their assets between bonds and money. In this model, changes in the rates of return on bonds cause individuals to reallocate their portfolios from money to bonds, suggesting that the demand for money is relatively interest sensitive. Economic agents are price takers. Given the prices of goods, individuals hold the quantity of nominal (and hence real) money balances that are necessary to execute their planned transactions over their planning period. They may or may not hold some additional money balances as a safeguard for unexpected transactions (i.e., precautionary money demand). Given prices and their expenditure plans, the ability of individuals to reallocate their portfolio between money and bonds in response to a change in interest rates is limited. The problem is that there are no good substitutes for money as a medium of exchange. Of course, individuals can economize on their holdings of money by making more frequent allocations between non-interest-bearing money and interest-bearing bond, a la Baumol (1952) and Tobin (1956). For most people the incentive to behave in such a way is very small, however. For example, assume that an individual has an average monthly money balance of \$10,000 and the interest rate is 5 percent. A procedure that instantaneously moves funds from interest-bearing assets to non-interest-bearing money at precisely the instant when each transaction occurs would generate an additional \$500 annually—\$1.37 per day. The typical individual holds considerably less than \$10,000 in money balances. Moreover, while economic theorists populate economies with continuously optimizing economic agents, real world economies are not. It seems more likely that individuals alter their

⁴ See Thornton (2000) for a more complete discussion of reasons for the dominance of money as a means of exchange.

money holdings only when it becomes clear that the current allocation no longer meets their needs due to changes in income or expenditure patterns or when the rates of return on bonds increase very substantially. Hence, even relatively large changes in the rate of return on bonds should generate relatively modest changes, and for many individuals, no change in their holding of money.

Finally, it is extremely important to note that the price level is the price of commodities in terms of money. This simple fact means that money is essential for the determination of the price level as we know it. In a fiat money world, the dollar is nothing more than a name given to a unit that the government guarantees can be used for final settlement—for the payment of all debts public and private. The long-term existence of fiat money depends on the government's guarantee of final payment. Absent this guarantee, transactions may take place an abstract unit of account called the "dollar," with private institutions providing the guarantee of final payment. There is no way to keep these institutions from buying goods by simply entering "dollar" claims against themselves, nor is there anyway to keep them from reneging on their "guarantee." The essential function of money is to guarantee final payment, and only the government can credibly make such a guarantee in a fiat money world.⁵

Typically, governments guarantee final payment by issuing currency which is legal tender. Deposits of all types can be redeemed at a fixed one-to-one exchange rate with currency, making currency and deposits perfect substitutes. The central bank controls the price level by controlling the supply of base money—currency and central bank deposits. Historically, base money has consisted of currency plus deposits with the central bank. The central-bank-deposit component of the U.S. monetary base is shrinking because most banks sweep transactions deposits (e.g.,

⁵ See Rolnick and Weber (1983, 1984) and Rockoff (1974) for a discussion of the failure of free banking because of the inability to guarantee final payment.

Anderson and Rasche, 2001) in order to avoid the “reserve tax.” Given the advancements in technology, I am not sure whether currency will always exist; however, I agree with Charles Goodhart (2000) that it is unlikely that currency will go out of existence anytime soon. But if it were to go out of existence, the government would simply guarantee final payment in some other way. As long as the government guarantees final payment of whatever is the unit of account, money will exist. As long as the monetary authority controls the aggregate nominal quantity of the base money that supports this guarantee, it can control the price level. While the exchange technology will continue to evolve, there will never be a world without money.⁶

3.0 The Role of Money in Economic Theory

I believe that many if not most economists support the broad theory of the role of money outlined above. The problem is the failure of economic theory to devise a model that incorporates the salient features of money’s fundamental role as a guarantor of final payment. This failure is due in part from starting in the wrong place. Rather than introducing money into a model of exchange where the sole means of exchange is barter and where money evolves to reduce the transactions costs, money is often appended to models where it has no essential function. Particularly troubling are models based on a Walrasian auctioneer. The auctioneer calls out prices in terms of numeraire until markets clear.⁷ Goods are then exchanged. There is no need to guarantee final payment. Such economies don’t need money. Incorporating

⁶ It is worth noting that money is never the sole medium of exchange in a monetary economy. Barter is also used; however, its use is limited. Barter is primarily used in the case of second-hand sales of non-homogenous goods, to avoid taxes, and for illegal transactions.

⁷ See Thornton (2000, pp. 47-48) for an argument for why the coexistence of the medium of exchange and unit of account functions and why it is inefficient to guarantee payment in anything other than the unit of account.

money into such a model is fruitless. The Walrasian auctioneer completely eliminates the transactions costs that motivate the social contrivance called money.⁸

There is also no role for money to play in other macroeconomic models that profess to have microeconomic foundations. A number of researchers (e.g., Hoover, 2006, and Forni and Lippi, 1997) have observed that the representative framework—which is the *sine qua non* of these models—is actually devoid of agent-by-agent modeling and aggregation essential for true microeconomic analyses. This flaw is fatal in the case of money. Money’s sole purpose is to facilitate exchange between economic agents. Without agent-by-agent modeling, it is difficult to motivate the existence of money.

Mainstream economic theory has attempted to provide a role for money by requiring a “cash-in-advance constraint,” or by arbitrarily included money in either household’s utility functions or in producer’s production functions. Because money plays no real role in these models, economic wellbeing is increased (or at least not reduced) by removing money.

Money plays no essential role in the canonical new Keynesian macroeconomic model. The model consists of an IS curve, some form of an expectations-augmented Phillips curve, and a monetary policy rule, typically a Taylor-type rule. Some prominent macroeconomists, e.g., McCallum (2001), argue that money’s role in this model is important but implicit. Like the great and powerful Wizard of Oz, money is hidden. Specifically, McCallum (2001) argues that money is critical because “the central bank’s control over the one-period nominal interest rate ultimately stems from its ability to control the quantity of base money in existence.”⁹ I have more to say about central banks’ ability to control interest rates in Section 3. For now I simply

⁸ I believe Walras did monetary theorists no favor by constructing this synthetic marketplace.

⁹ McCallum (2001, p. 146).

note that inflation is determined by the expectations-augmented Phillips curve. That is, current inflation is completely determined by inflation expectations and the gap between actual and potential output. Money has no special—let alone unique—role in the inflation process. Monetary policy is simply one of many factors that affect aggregate demand and, thereby, inflation. Inflation can be controlled as easily with fiscal policy as it can with money. Money is not essential.¹⁰ Because the New Keynesian model does not preclude controlling inflation by controlling the money stock, it is widely endorsed both by economists who believe that money is essential for long-run inflation control and those who believe money to be irrelevant.

The output gap is the difference between the actual level of output and the natural level of output—which Woodford (2003) defines as “the level of output that *would* occur in equilibrium with flexible wages and prices, given current real factors (tastes, technology, government purchases).”¹¹ The only difference between inflation theory circa 1960-70 and today is that in the former period inflation was thought to be the “cost-push” variety.¹² Aggregate demand was thought to be relatively inconsequential.¹³ Today, aggregate demand has taken center stage. Nevertheless, policymakers remained concerned about the “inflationary impact” of cost-push factors—higher wages, oil price shocks, etc.

It is useful to consider the Keynesian view of the effectiveness of monetary policy circa 1970 with the New Keynesian model of today. Just as today, changes in the money supply were thought to generate changes in interest rates. Nevertheless, monetary policy was thought to have a minor effect on aggregate demand. Changes in interest rates would simply induce individuals to change their holding of money

¹⁰ See Nelson’s (2008) comment on Woodford (2007) for a discussion of why money is essential to this model in the long-run.

¹¹ Woodford (2003, p. 8).

¹² See Laidler (2004) and Bronferbrenner and Holtzman (1963).

balances. The endogenous response of velocity would largely or completely offset the effect of the change in interest rates on aggregate demand.

Moreover, the direct effect of the change in interest rates on aggregate demand was thought to be relatively inconsequential: Evidence indicated that consumption and investment were relatively insensitive to changes in interest rates, e.g., Bernanke (1993). I am unaware of evidence that the interest elasticity of spending is much higher than previously thought. In spite of this, monetary policy is now thought to be highly effective in controlling aggregate demand to stabilize output and control inflation by changing very short-term interest rates.¹⁴ Nowadays, monetary policy controls inflation by adjusting the real interest rate relative to the *natural rate of interest*, “the real rate of interest required to keep aggregate demand at all times equal to the natural rate of output.”¹⁵

How did the economics profession shift from believing that central banks had limited ability to affect inflation to believing that central banks can control inflation, while at the same time believing that money plays, at best, a tertiary role in inflation control? I believe there are two reasons. First, because of some institutional changes, most notably the Monetary Control Act of 1980, the empirical relationship between M1 (and other monetary aggregates) and nominal GDP broke down. Without a clear statistical relationship between the growth rate of some measure of money and inflation, even monetarists reduced their dependence on monetary aggregates for the conduct of monetary policy.

The second reason is the lack of a monetary policy transmission mechanism that directly links money to inflation. At an abstract level, I believe virtually every

¹³ See Nelson (2005), Romer and Romer (2002), Laidler (2004), and Thornton (2007).

¹⁴ For more recent evidence on the interest sensitivity of consumption and short-term rates, see Croub and Fernandez-Corugedo (2004).

¹⁵ Woodford (2003, p. 248).

economist acknowledges the crucial role of money in facilitating exchange and enhancing economic welfare described in Section 2. The problem is the lack of a credible model of the transmission of money to inflation. This problem is exacerbated by monetary neutrality. Given the equilibrium stock of real money, changes in the nominal money stock result in a higher price level without affecting the equilibrium level of economic activity or economic welfare. The classical dichotomy—relative prices and output being determined by real factors and the price level determined by the demand for real money relative to the supply of nominal money—has not been modeled fully. Indeed, developing a transactions model where changes in the nominal stock of money have short-run effects on real variables (due to frictions), but ultimately affect only the price level is no simple task. In the absence of a rigorous theory of the monetary transmission mechanism, economists have resorted to an “output gap” theory of inflation. I believe that the fact that the New Keynesian model does not require money for inflation control has led prominent macro-theorists such as Woodford (2000, 2007) to conclude that money is both unimportant and unnecessary. In the short-run, inflation is determined by inflation expectations and the output gap. Since the long-run is nothing more than the integral of the short runs, money is also unnecessary in the long-run.

It is now recognized that inflation expectations play a critical role in the inflation process. This gives central banks considerable control over inflation because central banks play a crucial role in anchoring inflation expectations. However, it also reinforces the belief by some that money is not crucial for inflation control.

Policymakers merely anchor inflation expectations. But, as I have already noted, controlling inflation and, hence, anchoring inflation expectations does not require controlling the nominal supply of base money in either the short or the long runs.

4.0 Monetary Policy and the Interest Rate

In this section I discuss reasons to believe that the Fed's ability to control interest rates may be more limited than is commonly thought. Historically there has been a very close relationship between the Fed's target for the funds rates and the funds rate. Indeed, until very recently, the relationship has been extremely tight—just a few basis points different on average over the month or quarter. This fact notwithstanding, I believe that there are some important reasons to be skeptical of the Fed's, or any other central bank's, ability to control interest rates more generally.

I begin my discussion by noting that what matters for economic activity is the level of the structure of interest rates not the level of the overnight policy rate. As Woodford (2001) puts it, “changes in central-bank targets for overnight rates in affecting spending decisions (and, hence, ultimately pricing and employment decisions) is *wholly* dependent upon the impact of such actions upon other financial-market prices, such as longer-term interest rates, equity prices, and exchange rates.”¹⁶

As Former Chairman Greenspan put it,

The problem that we have here is that monetary policy works through its effects on overall financial markets. The presumption that a 25 basis point, a 50 basis point, or even a 75 basis point change in an overnight rate can come to grips with the supply-demand imbalance is in my view silliness in the extreme. The overnight rate is just not tied into this process in any direct way. What we actually do is to foster a term structure of interest rates by our policy actions and thereby influence real long-term rates.¹⁷

From a broad perspective, the structure of interest rates is complicated.

Interest rates differ by the maturity of the contract, the issuer of the note, special features of the contract such as the existence and quality of collateral, whether the note is callable, etc. The term structure of interest rates collapses a complicated multi-

¹⁶ Woodford (2001, pp. 307-308) emphasis added. Also, see Woodford (2005) for a discussion of the relationship between the funds rate target and long-term rates.

¹⁷ Transcript of the FOMC meeting, February 1-2, 2000, p. 124.

dimensional structure to two dimensions—the interest rate and maturity—by holding all other things constant. Empirically this is achieved by considering only default-risk-free, zero-coupon government securities. In practice, however, economists and policymakers sometimes have term structure discussions about assets that do not meet the stringent requirement of the theory.

Economists can debate the extent to which spending decisions are affected by the behavior of short-term or long-term rates. But whether explicitly stated or not, to be totally effective, monetary policy must affect interest rates across the entire structure of rates. That is, it must affect *the* interest rate, where *the* interest rate can be thought of as an index of interest rates analogous to *the* price level.

There are two ways that policy can affect *the* interest rate—directly and indirectly. The direct effect stems from the realization that the demand for money depends on the interest rate.¹⁸ The interest sensitivity of money demand gives rise to the possibility that an exogenous change in the supply of nominal money balances (and, hence, real at existing prices) can affect the interest rate. There are several reasons to be skeptical of the direct effect of a change in the money supply on interest rates.

First, the price level, not the interest rate, is the price of money. The interest rate is the price of credit. In equilibrium, the interest rate, the price level, the quantity of real money balances, and the quantity of real credit are determined simultaneously. Ultimately, the effect of a change in the supply of money on the interest rate is limited to the effect of a change in the supply of money on the supply of credit. It is well known that an exogenous change in the supply of money has a relatively small effect on the net supply of credit—being essentially equal to the change in the supply of

base money.¹⁹ The small size of changes in the monetary base—roughly, the Fed’s contribution to changes in the total supply of credit—makes it difficult to understand exactly how the Fed can have such a large effect on the interest rate. Friedman (1999) notes this problem by asking how the Fed’s actions of buying or selling \$1 or \$5 billion of securities over an entire year can have a major impact on a \$14 trillion market. He notes that the disparity between the size of central bank actions and the markets they operate is characteristic of other economies too. The puzzle is exacerbated by the fact that perhaps more than any other market, financial markets are global. To have a significant effect on the interest rate, Fed actions must significantly alter the supply of credit worldwide. Friedman (1999) argues that historically, the Fed’s ability to affect the interest rate is due to its monopoly control over reserves, which he believes is eroding for a variety of reasons.

It is important to note, however, that monopoly power is not enough. Reserve requirements mean only that Fed open market operations impact the amount of credit supplied by institutions that have reserve requirements relative to those that do not. The impact of open market operations on the total supply of credit is limited to the change in base money regardless of whether or not the Fed imposes reserve requirements.

Second, the conclusion that changes in the money supply affect interest rates is predicated on the belief that prices and output do not respond initially to a change in the money supply. Sticky prices—the hallmark of modern macroeconomic theory—is the principal reason economists believe that changes in the money supply affect interest rates (e.g., Abel and Bernanke, 1992). If changes in the money supply don’t

¹⁸ There was once a debate about whether the demand for money depended on a long-term or short-term interest rate. For this analysis, it is assumed that the demand for money depends on *the* interest rate, without concern for whether long-term or short-term rates might matter more.

affect output or prices, they affect the interest rate. There is evidence that individual prices are not that sticky. Moreover, it could be that, initially, individuals passively adjusting their money holdings and only, subsequently, their spending, so that, initially, a change in the supply of money has no effect on output, prices, or the interest rate.

Third, for reasons noted earlier, the demand for money should be relatively interest inelastic. Consequently, relatively small exogenous changes in the supply of money should be accompanied by relatively large changes in interest rates. Indeed, if the impact of an exogenous change in the nominal money supply on interest rates is as strong as policymakers and economists seem to believe, it should be relatively easy to observe in the data. Just the opposite is true. Empirical work using monthly and quarterly data provided no evidence of a liquidity effect.²⁰

Furthermore, the evidence (Hamilton, 1997; Thornton, 2001ab, 2004, 2007ab; and Carpenter and Demiralp, 2006) suggests that Fed actions have a modest impact on interest rates at the daily frequency. Hence, the liquidity effect has been extremely difficult to isolate at any frequency. The inability to find convincing evidence of the effect of a change in money or reserves on the interest rate should cause economists and policymakers to question the degree to which policy actions affect interest rates.

Those skeptical of the central bank's ability to control the interest rate directly rely on indirect control, which stems from the central bank's ability to control a very short-term interest rate—in the case of the Fed, the overnight federal funds rate.

Federal funds are deposits of depository institutions in Federal Reserve Banks that are

¹⁹ For additional discussions along this line, see Thornton (1995), Friedman (1999), and McCloskey (2000).

²⁰ The sole exception is nonborrowed reserves, see Pagan and Robertson (1995). However, Thornton (2001b) showed that the "liquidity effect" obtained using nonborrowed reserves is solely a consequence of the trading desk of the Federal Reserve Bank of New York offsetting the nonborrowed

bought or sold among depository institutions. Changes or expected changes in the funds rate are thought to be translated throughout the structure of rates.

Historically, the Fed was thought to control the funds rate through the standard liquidity effect. But, as I have just noted, evidence of the liquidity effect is weak. Moreover, to control interest rates in this way, the Fed's actions must have a large effect on the total supply of credit. To see why, note that the initial effect of an open market sale or purchase is on banks' deposit balances with the Fed. By implication, open market operations should impact the funds rate. There are some technical issues worth considering, however. First, banks must maintain reserves on a daily average basis over a two-week maintenance period. This means that deposits held with Federal Reserve Banks during any day during the maintenance period are equally useful for satisfying the bank's reserve requirement. In principle, reserves held on any two days of the maintenance period are perfect substitutes for meeting the bank's reserve requirement. While Hamilton (1996) strongly rejects the martingale hypothesis implied by perfect substitutability, substitution of reserves between days of the maintenance period limits the Fed's ability to control the funds rate on a daily basis.

Reserve requirements are binding on the last day of the maintenance period, called settlement Wednesday. Hence, there is no limitation on the Fed's ability to control the funds rate at lower frequencies, such as a maintenance period. If the Fed fails to supply the aggregate amount of reserves that banks demand because of their lending and investment activities, the funds rate will rise on settlement Wednesday. Likewise, if the Fed happens to supply too many reserves in aggregate, the funds rate will fall. Hence, the Fed could raise the funds rate on a maintenance-period-average

reserves. effect on total reserves of interest-induced changes in borrowing—i.e., the estimated “liquidity effect” is not a genuine liquidity effect.

basis by providing fewer reserves than banks demand. Banks would restore the equilibrium in the reserve market by curtailing loans and investments and, hence, the supply of bank credit.

To understand potential problems with this mechanism consider first the case where the Fed is targeting the funds rate but the market is unaware that the Fed is doing so that market participants have no policy-related expectations for the policy rate. In this case, how much other rates moved depends on the Fed's ability to affect the supply of credit generally. To illustrate the point, assume that effect on the total supply of credit is essentially nil so that other rates were essentially unaffected by the Fed's action. Over the next maintenance period the funds rate would return to whatever level was consistent with other rates. If the Fed wants to keep the funds rate up, it must once again supply fewer reserves than banks require. This process must continue until the Fed reduces the supply of credit sufficiently to affect other rates. That is, the Fed's ability to affect the key interest rate is once again limited by its ability to affect the total supply of credit. In effect, the Fed would have to make the supply of reserves perfectly elastic at the target rate. The Fed nor any central bank has done this. The ECB has a 100-basis-point band on either side of the target rate, which gives them ample time to respond to changes in the equilibrium rate.

It is now widely accepted that the Fed moves the funds rate through "open mouth operations" rather than open market operations (e.g., Friedman, 1999, 2000; and Taylor, 2001). The funds rate apparently remains close to the funds rate target because market participants believe that the Fed could keep it there if they wanted to. As Friedman (1999) notes, "a widely shared opinion today is that central banks need

not actually *do* anything. With a clear enough statement of intentions, ‘the markets will do all of the work for them’.”²¹

In this case, other interest rates could be affected by changes (or expected changes) in the target rate via the expectations hypothesis (EH) of the term structure of interest rates. The EH is the proposition that a longer-term rate is equal to the average of the current and expected future short-term rate. If the EH holds, it holds for all possible maturities of long- and short-term rates.²² Hence, all rates would be linked to the overnight funds rate. Evidence against the EH is overwhelming (e.g., Campbell and Shiller, 1991; Cochrane and Piazzesi, 2005; Bekaert, Hodrick, and Marshall, 1997; Sarno, Valente, and Thornton, 2007; and Thornton, 2005). Hence, the ability of the Fed to control the interest rate through the EH mechanism is questionable.

4.1 Interest Rate Control across the Term Structure

It is arguably the case that the Fed has been conducting monetary policy using a short-term interest rate instrument throughout most of its history. It is commonly known that the Fed targeted the federal funds rate explicitly during the middle 1970s, but abandoned the procedure in October 1979 in favor of monetary aggregate targeting. Elsewhere (Thornton, 2006), I show that the Fed resumed funds rate targeting in 1982 but, preferring to be seen as targeting borrowed reserves, was unwilling to acknowledge this fact. Indeed, the Fed acknowledged targeting the funds rate long after market became well aware it.²³ Today, the Fed announces changes in

²¹ Friedman (1999, p. 322). See Woodford (2000) for a similar analysis.

²² Strictly speaking, the EH applies only to assets that are identical except for their term to maturity. Differences in default risk and other factors negates the strong predictive power of the EH.

²³ It is interesting to note that policymakers did not return to interest rate targeting because they wanted to, but rather because they thought they had no other choice. Chairman Greenspan made the point explicitly at the July 1997 FOMC meeting, stating, “I think we were well aware of what would happen when we shifted to an explicit federal funds rate target. As you may recall, we fought off that apparently inevitable day as long as we could. We ran into the situation, as you may remember, when the money supply, nonborrowed reserves, and various other non-interest-rate measures on which the Committee had focused had in turn fallen by the wayside. We were left with interest rates because we had no alternative. I think it is still in a sense our official policy that if we can find a way back to where

the funds rate target when they are made and the market attempts to determine the next likely target change.

Funds rate targeting today is much different than in the 1970s and the early 1980s. During the 1970s and early 1980s the funds rate was used as an operational guide for implementing daily open market operations. If the funds rate was trading high relative to the target, the desk would tend to add reserves; if it was low or high, reserves would be drained or add, respectively (Muelendyke, 1998). Moreover, the target was adjusted frequently with changing market conditions. For example, Rudebusch (1995) reports that the funds rate target was adjusted 99 times during the period from September 1974 to early October 1979, an average of once every two and a half weeks. The funds rate target was also adjusted frequently from September 1982 through December 1989—64 times, an average of once every five weeks. The less-frequent changes over this period can be attributed to the well-known greater tranquility of the economy and interest rates beginning in the early 1980s.

Target changes have been less frequent since 1989, averaging about a change every three months. There have been two periods of a year or longer when there was no target change. More important, once the market became aware that the Fed was targeting the funds rate and the level of the target, the Fed began adjusting the target to achieve its policy objectives rather than simply adjusting the target with changing market conditions as it had done previously. That is, the FOMC went from using the funds rate as an operational instrument to setting the target to achieve its policy objective.

we are able to target the money supply or net borrowed reserves or some other non-interest measure instead of the federal funds rate, we would like to do that. I am not sure we will be able to return to such a regime..., but the reason is not that we enthusiastically embrace targeting the federal funds rate. We did it as an unfortunate fallback when we had no other options...”, Transcript, July 1997 FOMC meeting, pp. 80–81.

The transition from using the federal funds rate as an operational objective to a policy target was accompanied by a marked change in the relationship between the federal funds rates and Treasury yields. Figure 4 shows the federal funds rate and 3- and 6-month Treasury rates (*ff*, *tb3*, and *tb6*) and the 1-, 5-, and 10-year Treasury bond yields (*T1*, *T5*, *T10*) from January 1983 through March 2007. All rates tend to move together, with shorter-term rate demonstrating very high co-movement. The rates trend down over the period. This likely reflects lower inflation, lower and more firmly anchored inflation expectations, and perhaps a more stable real economy associated with the great moderation.

To remove the common trend from these rates, I estimate

$$(1) \quad i_t = \delta_0 + \delta_1^i trend + \delta_2^i trend^2 + \varepsilon_t^i,$$

where $i = ff, tb3, tb6, T1, T5$, or $T10$. The six equations are estimated over the entire sample period with the cross-equation restrictions $\delta_1^i = \delta_1^j$ and $\delta_2^i = \delta_2^j$, for all i and j , imposed.²⁴ Figure 5 presents the detrended federal funds and 10-year Treasury yields. The figure shows that the rates moved closely together until May 1988 (the date of the vertical line). This date was determined by a break-point test of a simple regression of the change in the 10-year yield on the federal funds rate using the procedure suggested by Andrews (1993). This date corresponds closely to when the market became aware that the Fed was targeting the funds rate (e.g., Poole, Rasche, and Thornton, 2002) and with evidence that the Greenspan regime began adjusting the target to achieve broader policy objectives (Thornton, 2007).²⁵

²⁴ The chi-square statistics for the tests of the hypotheses $\delta_1^i = \delta_1^j$ and $\delta_2^i = \delta_2^j$ are 1.78 and 0.25, respectively; neither is significant at conventional significance levels.

²⁵ See Thornton (2007) for additional evidence that the change was due to the FOMC switching from using the funds rate as an operational instrument to a policy target.

The switch from using the funds rate as an operating instrument to a policy target altered the relationship between the funds rate and other rates along the yield curve. This is illustrated in Figure 6, which shows the 24-month rolling correlation of the detrended federal funds and other detrended Treasury rates. The correlation between the detrended funds rate and other rates is high and stable until around May 1988, after which the correlation becomes much less stable. Longer-term rates are most affected. The correlation of the 10-year Treasury yield declines sharply for a level of about 80 percent in the early 1980s and becomes highly variable. There are several periods of more than two years (including the period that gave rise to Chairman Greenspan's famous "conundrum" remark) when the correlation is negative. The relationships between the funds rate and all other Treasury rates are affected to varying degrees. The relationship between the funds rate and other rates has weakened since the late 1980s despite a significant tightening of the relationship between the funds rate and the funds rate target. These data suggest that the effect of monetary policy actions on Treasury rates has been uneven. For short-term rates, the relationship is most often strong and positive, but varies over the sample period. The relationship is particularly weak during the mid- to late-1990s. The effect of policy actions on longer-term rates is very unstable, with extended periods where there is essentially no relationship or even a negative relationship. These data provide yet another reason to be skeptical about the Fed's ability to control interest rates across the term structure and, thereby, influence aggregate demand by adjusting the target for the federal funds rate.

5.0 Conclusions

I have argued that the essential function of money is to guarantee final payment. Monetary exchange makes it virtually certain that an individual will be able

to exchange a good that they don't want for one that they do want. Because of money's efficiency over barter (or credit) in providing this function, money's existence significantly enhances economic welfare by greatly increasing trade and specialization relative to what would be the case in the absence of money. Because the alternative mediums of exchange—barter and credit—cannot provide this function, economies will always have money. The price level is the money price of goods. Hence, controlling the nominal stock of final payment is essential to price control. Suggestions that the Fed can control prices without controlling the nominal stock of money (or final payment) are simply wrong. Such assertions appear to be motivated by the belief that the expectations-augmented Phillips curve adequately represents the economy's inflation (or price-setting) process. While inflation expectations are extremely important for the inflation process, the importance of the output gap or NAIRU is questionable (e.g., Staiger, Stock, and Watson, 1997; Piger and Rasche, 2007). In any event, the price level as we know it is inexorably tied to the nominal stock of money.

The negligible role of money in modern monetary policy is due in part to its unessential role in monetary theory. Models of monetary policy that purport to have micro-foundations are typically built upon a framework where money has no essential function to perform and, consequently, no reason to exist. In the canonical New Keynesian model, money's role is implicit. In the short-run, inflation is completely determined by inflation expectations and the output gap. Money plays no essential role in determining either inflation expectations or the size of the output gap. Both are determined by the monetary authority's setting of the overnight interest rate target. Because the long run is nothing more than the integral of all of the short runs, it is hardly surprising that some modern theorists have suggested that money plays no role

in price determination in either the short or long runs. It appears unlikely that money will be fully integrated into economic theory and, hence, monetary policy until the economics profession develops a model that incorporates money's essential function.

Modern monetary theory and policy rests on the ability of the central bank to control interest rates across the structure of debt instruments. There is little doubt that the Fed has controlled the overnight federal funds rate since the market has become aware that the Fed is targeting the funds rate. There is virtually no evidence that the Fed has controlled the funds rate via the traditional liquidity effect, however. Indeed, it is now commonly accepted that the Fed controls the funds rate through open mouth rather than open market operations. Regardless of how the Fed controls the federal funds rate, the relationship between the funds rate and other rates has changed dramatically since the late 1980s. While rates of all maturity assets are affected, the effect is larger at the longer end of the term structure, where the relationship can be negative for long periods of time.

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Figure 1

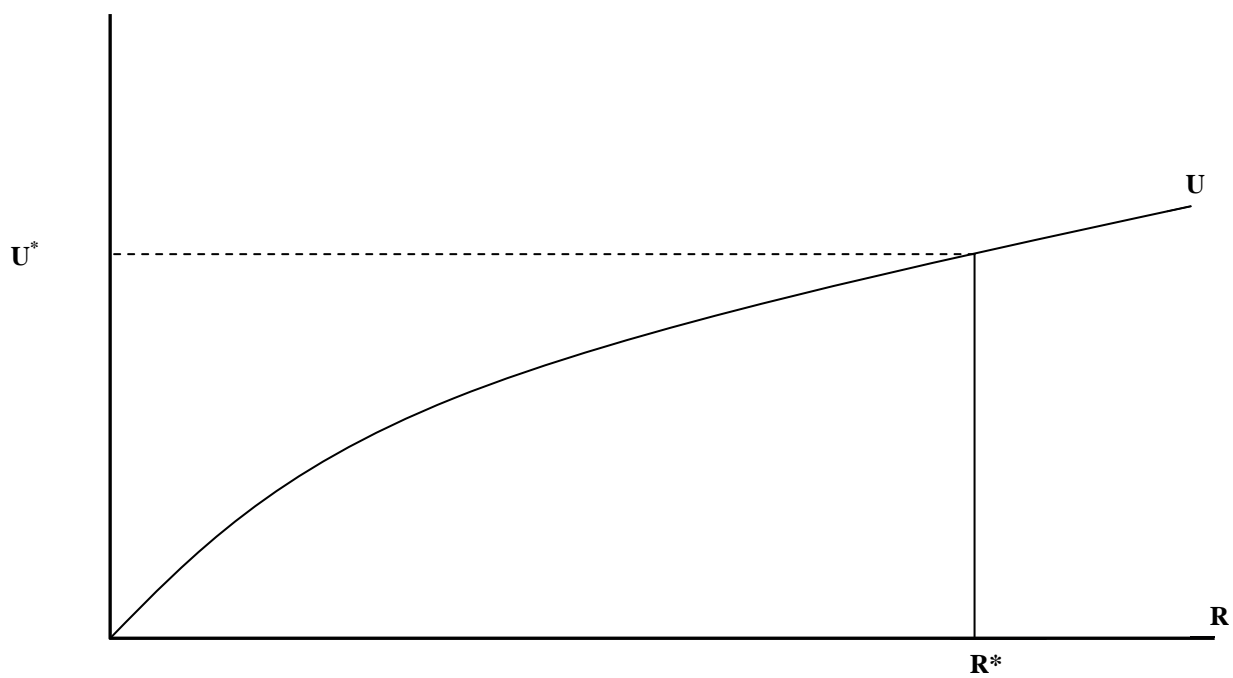


Figure 2

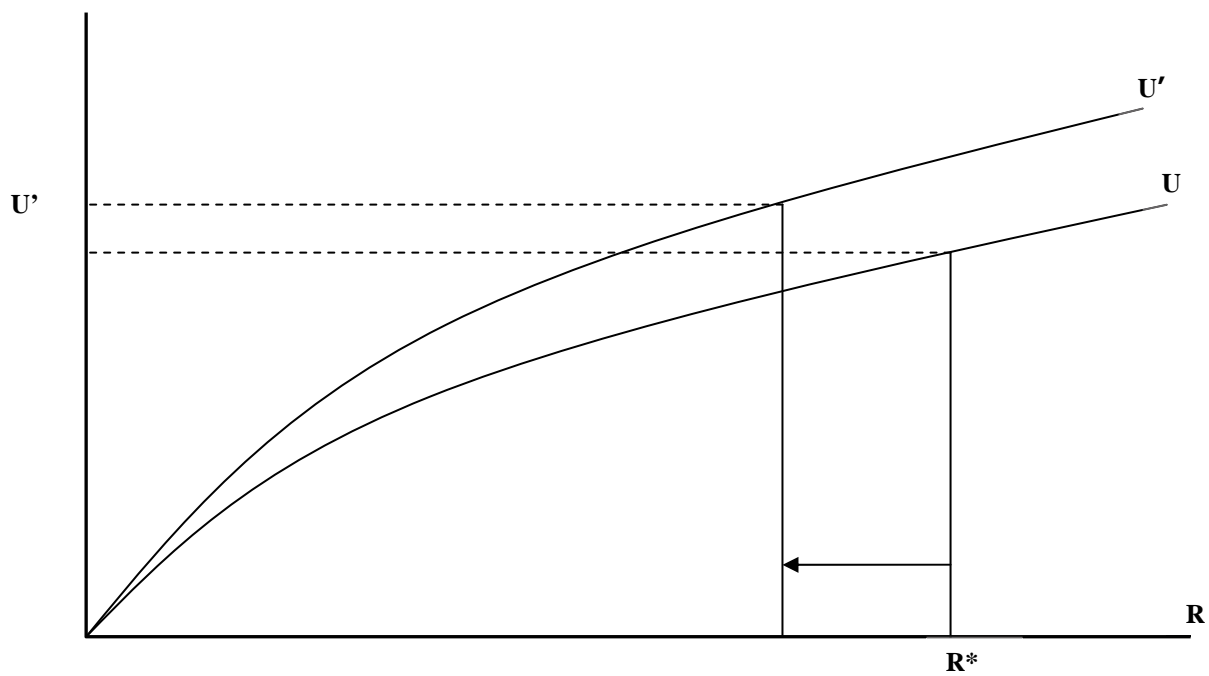
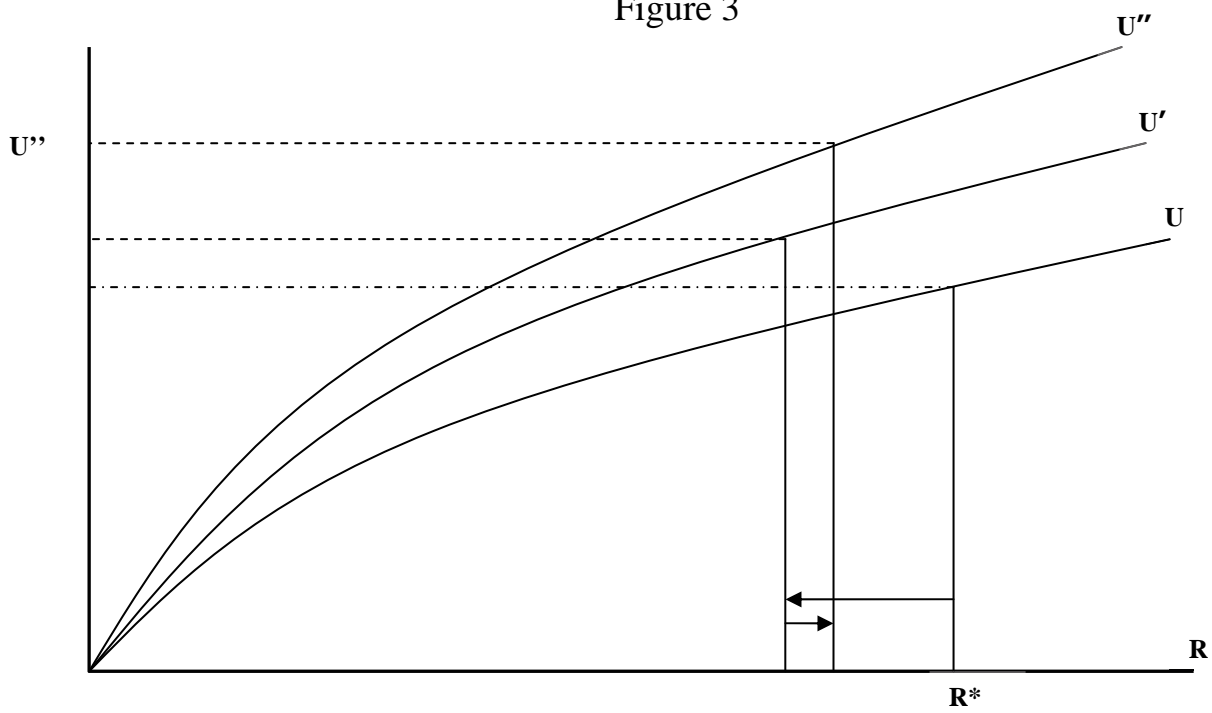


Figure 3



**Figure 4: The Funds Rate and Treasury Rates
(January 1983 - March 2007)**

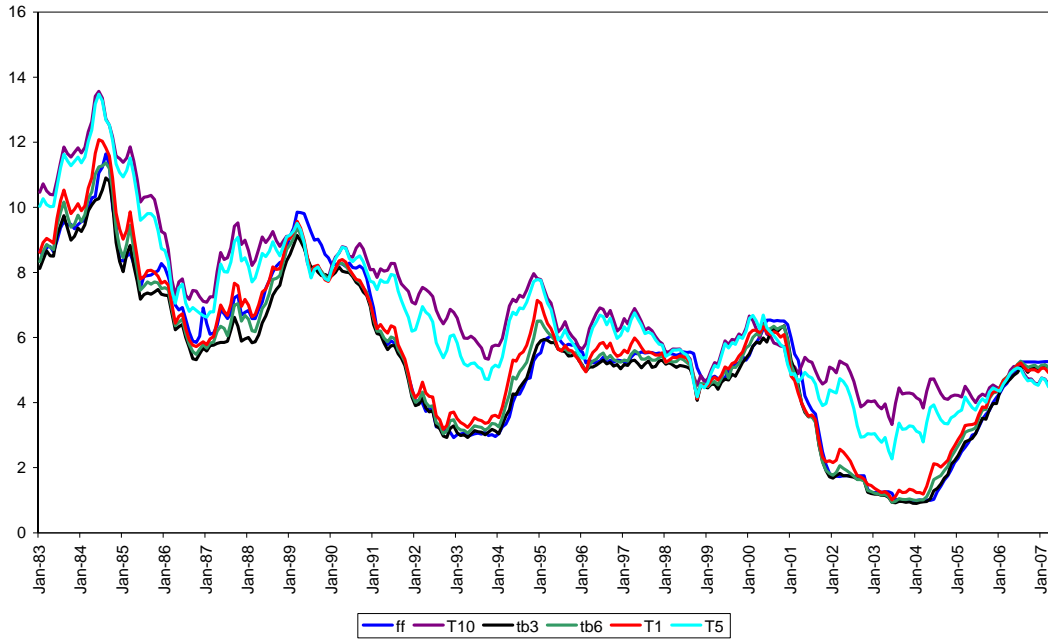


Figure 5: Detrended Federal Funds Rate and 10-Year Treasury Yield

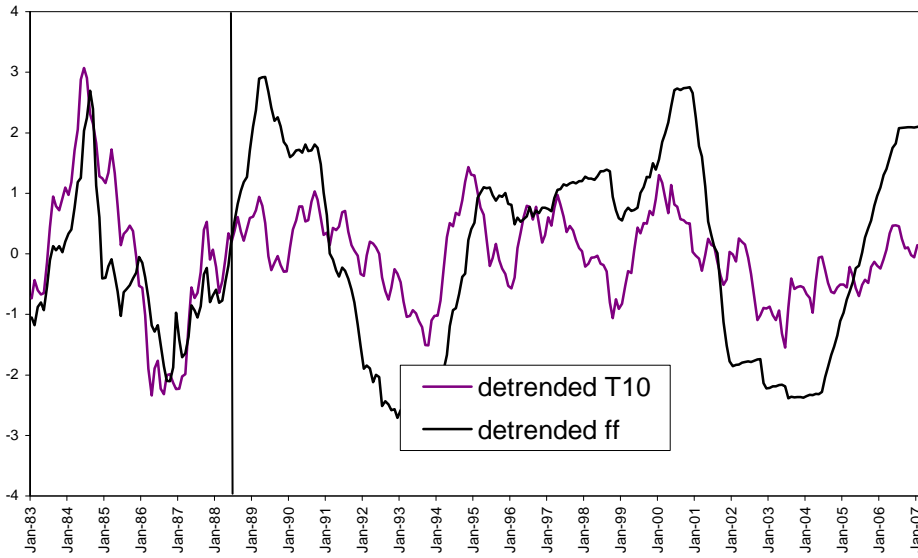


Figure 6: 24-Month Rolling Correlation of the De-Trended Funds Rate with Other De-Trended Rates
(Data are plotted on the last month of the corresponding sample)

