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

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Monetary Policy: Why Money Matters
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Abstract

Since the late 1980s the Fed has implemented monetary policy by adjusting its target for the overnight federal funds rate. Money's role in monetary policy has been tertiary, at best. Indeed, several influential economists suggest that money is irrelevant for monetary policy: Central banks effect economic activity and inflation by a) controlling a very short-term nominal interest rate and b) by influencing financial market participants' expectation of the future policy rate. I offer an alternative perspective: namely, that money is essential for the central bank's control over the price level and that the monetary authority's ability to control interest rates is greatly exaggerated.

JEL Codes: E41, E43, E52
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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: Adventures in a New World***, p. 2.

1.0 Introduction

Today "monetary policy" should be more aptly named "interest rate policy" because policymakers pay virtually no attention to money.[1] Prominent monetary/macroeconomic economists such as Woodford (2000, 2003, and 2008), Friedman (1999) and King (1999) have suggested the possibility of a moneyless economy: Friedman and King argue that the absence of money would severely limit the effectiveness of monetary policy; Woodford argues that it would not. In a similar vein, Svensson (2008) suggests that over the past 50 years monetary theorists and policymakers have learned that "monetary aggregates matter little, or even not at all, for monetary policy."[2] Given the prominence of these economists and the lack of interest in money by central bankers around the world, one might think it foolish to assert that money is essential for economic activity and monetary policy. It will no doubt seem even more foolish to suggest that monetary policymakers' ability to influence interest rates, especially those that matter for the efficacy of monetary policy, is greatly exaggerated. This paper is an attempt to motivate discussion and debate about the essence of monetary policy. It is often fruitful to have such debates. It may be particularly useful now because the Federal Reserve and most other central banks ignore money and are pursuing unconventional monetary policies in an effort to enhance the effectiveness of countercyclical policy. Challenging orthodoxy is useful even if it only serves to solidify one's belief in it.

[1] This is true of virtually every central bank; however, the focus here is on the Federal Reserve.
[2] Svensson (2008), p. 4.

The remainder of the paper is as follows. Section 2 argues that money is essential for economic activity and is critical for determining the price level. Section 3 suggests several reasons why money's critical role for economic activity and monetary policy, as discussed in Section 2, is not reflected in modern macroeconomic models. Section 4 analyzes several reasons to be skeptical of the extent to which the Federal Reserve affects interest rates.[3] Section 5 concludes.

2.0 Why Money Matters

The fundamental importance of money for economic activity and welfare is most easily seen by first considering an autarkic economy. Everyone is self-sufficient so there is no trade and, hence, money would not exist. Individuals get utility from consumption and leisure, where leisure is the amount of time not spent in the production of consumption goods. Individuals produce consumption goods using their share, $\delta_i, \quad 0 < \delta_i < 1, \quad i = 1, 2, ..., N$, (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 quantity of society's resource is R^*.

The effect of trade using barter as the sole means of exchange is illustrated in Figure 2. Economic welfare increases from U^* to $U^{*\prime}$ 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—everyone who trades is better off, while those who don't are no worse off. Because exchange is costly, society's welfare gain is less

[3] See Bernanke and Gertler (1995) and Thornton (2012b) for a discussion of other reasons to be skeptical of the efficacy of the interest rate channel.

than the vertical shift from U to U' at R^*. The difference represents the fact that some of society's resource is used in trade.

The fact that barter is costly means that society could be better off if there were a more efficient method of exchange. The only alternatives are credit and money. Credit is where one individual obtains a quantity of a commodity from another by promising to pay that individual a quantity of the same or a different commodity at a future date: Credit is inter-temporal barter. Credit will tend to be less efficient than contemporaneous barter because of the addition waiting time. Moreover, unlike barter, credit is accompanied by the default risk.

Money, on the other hand, is a commodity that is chosen to be a general medium of exchange: All goods (including credit contracts) are exchanged for money: That is, money is a social contrivance that significantly reduces the transactions costs associated with barter (or credit).

Figure 3 shows the effect of moving from barter to money. The upward shift in the utility contour is due to the fact that more trade takes place because money reduces the cost of exchange. The volume of trade could also increase because the use of money increases the range of relative prices over which transactions can occur, which increases the likelihood that an exchange will occur (Thornton, 2000). Of course, increased trade leads to increased specialization and more trade. By reducing exchange costs, money frees up resources for production (or leisure). The net effect of the social invention of money is a marked rise in economic welfare.[4] However, because the stock of money is costly to produce and maintain, there is some welfare loss relative to a world where either trade or money is costless.[5]

[4] Thornton (2000) shows why money cannot be a private good.
[5] Thornton (2000) speculates that such costs contributed to the evolution to fiat money systems.

Economic welfare depends enormously on trade, and the use of money increases both the efficiency and volume of trade. Therefore, money is crucial for the functioning of markets for the simple reason that, of the three possible means of exchange—barter, credit, and money, money is far and away the most efficient.[6]

Barter has the property that it guarantees final payment—a good that one does not want is exchanged for the desired good, the trade is complete. Money also guarantees final payment. A good that one does not want is traded for money which can be easily traded for the desired good. While the use of money requires an additional transaction, the trade is effectively complete when the good is exchanged for money; the use of money essentially guarantees that no more than two transactions will be required to exchange something you don't what for something you want. It is money's property of guaranteeing final payment that enables it to serve as a generalized medium of exchange.

Because of the widespread use of credit to make transactions in modern economies it is important to understand that the predominance of credit is due to the existence of money. In a world without money the use of credit would be severely limited for two reasons. First, of the three means of exchange—barter, credit, and money—credit is far and away the least efficient: A credit transaction would require the exchange of a good for the promise to receive a larger quantity of the same good or a other quantity of another good at a future date, when the good received would be exchanged for the desired good.[7] Clearly credit is inferior to barter in facilitating exchange.

The second, the use of credit for inter-temporal trade would be limited for the same reason that barter is limited for intra-temporal trade. The use of money greatly

[6] For a detailed analysis of why money dominates barter and credit as a medium of exchange see Thornton (2000).

facilitates the development of credit markets because credit contracts are denominated in money (final payment). This fact, in combination with other financial innovations, has led to the widespread use of credit for trade. However, this could not have occurred without the existence of money. Like many people I carry out a large proportion of my transactions with credit, rather than with checks or cash. I am able to do so because I promise to settle my account with cash or by transferring balances from my deposit in a financial institution. I doubt the credit card company would be so willing to "finance" my 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 feasible. Hence, the fact that many, perhaps even most transactions are initiated with credit does not eliminate money's essential role for economic activity. Were it not for the existence of money, credit markets would be significantly smaller and credit would be infrequently used for trade for the simple reason that barter is more efficient.[8]

The dominance of money over barter and credit as means of exchange is reflected in the fact that money continues to function as the primary means of exchange even when the cost of holding it is extremely high, as it is during hyperinflations.[9] This observation is important because it implies that an individual's demand for money will be relatively insensitive to changes in the cost of holding money. The insensitivity of the use of money to the cost of holding it is a natural consequence of money's dominance over barter and credit as a means of exchange.

The idea that the demand for money is insensitive to changes in the price of money conflicts with the portfolio-balance theory of money which argues that

[7] See Thornton (2000) for more reasons.
[8] See Thornton (2000) for other limitations of the usefulness of credit as a method of exchange.
[9] See Thornton (2000) for a more complete discussion of reasons for the dominance of money as a means of exchange.

individuals efficiently allocate their assets between interest-bearing bonds and non-interest-bearing money and reallocate wealth between money and debt when interest rates change. There are reasons to be skeptical of the importance of the portfolio-balance effect. For one thing, money is a very poor store of wealth because it is dominated by a wide variety of interest-bearing assets.[10] Moreover, economic agents are unlikely to significantly reallocate their portfolio between money and bonds in response to a change in interest rates because a) there are no good substitutes for money as a medium of exchange, and b) the benefits from making frequent reallocations, a la′ Baumol (1952) and Tobin (1956), are likely to be smaller than the explicit or implicit transactions costs. 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 and costless instantaneous transfers are not possible. While economic models are populated by continuously optimizing economic agents, the real world is not. Hence, while the portfolio-balance effect is conceptually valid, it may have little practical importance.

2.1 Money and Prices

The central role of money in the exchange of goods and services and financial contracts means that prices are stated in units of money. The price level, in theory and

[10] The lack of an appropriate role for money in macroeconomic models is witnessed by Tobin's (1958, p. 65) attempt to justify Keynes' idea of liquidity preference: "Nearly two decades of drawing downward sloping liquidity preference curves in textbooks and on classroom blackboards should not blind us to the basic implausibility of the behavior they describe. Why should anyone hold the non-interest bearing obligations of the government instead of its interest bearing obligations?...What needs to be explained is not only the existence of a demand for cash when its yield is less than the yield on alternative assets but an inverse relationship between the aggregate demand for cash and the size of this differential in yields." Tobin's analysis only justifies money's existence as a store of wealth not its role

in practice, is an aggregation (index) of the money prices of commodities. This simple fact necessitates that money is essential for the determination of the price level as we know it. Woodford (2001, 2003) has challenged this idea suggesting that in a fiat monetary system, money is nothing more than a "unit of account," which is "defined in terms of the liabilities of the central bank." He suggests that

> The special feature of central banks, then, is simply that they are entities the liabilities of which happen to be used to define the unit of account in a wide range of contracts that other people exchange with one another. There is perhaps no deep, universal reason why this need be so; it is certainly not essential that there be one such entity per national political unit. Nonetheless, the provision of a well-managed unit of account—one in terms of which the equilibrium prices of many goods and services will be relatively stable—clearly facilitates economic life. And given the evident convenience of having a single unit of account be used by most of the parties with whom one wishes to trade, one may well suppose that this function should properly continue to be taken on by the government.[11]

Woodford's analysis is misleading in at least two dimensions. First, Woodford sees the fact that the medium of exchange and unit of account functions of money are combined as a mere coincidence, rather than as an outcome of optimizing behavior. While it is conceptually possible to separate these functions, the same commodity serves both functions because economic efficiency requires it (Thornton, 2000).

Second, in a fiat monetary system the government is the guarantor of final payment. The government empowers the central bank to control the nominal units of final payment. Of course, this need not be the case. For example, in a commodity-money world, the commodity that guarantees final payment.

Historically, governments have guaranteed final payment by issuing currency, the use of which is facilitated by declaring it legal tender. While it is not essential, bank deposits and currency typically exchange at a fixed at one-to-one ratio, which

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in effecting final payment. Money exists because it effectively guarantees final payment, not because is an effective store of wealth, which it isn't.

[11] Woodford (2001), p. 346-47.

significantly enhances the use of deposits in exchange. The central bank controls the price level by controlling the supply of base money—currency plus deposits at the central bank. Until very recently, the central-bank-deposit component of the monetary base was small and shrinking (e.g., Anderson and Rasche, 2001). Given advances in technology, I am not sure whether currency will always exist; however, I agree with Charles Goodhart (2000) that it is unlikely that it will go out of existence anytime soon. In the mean time, as long as the monetary authority controls the aggregate nominal quantity of base money, it can control the price level. While the exchange technology will continue to evolve, I do not believe that there will ever be a world without money—without a generally used method of guaranteeing final payment.[12] Economic efficiency will dictate that money will exist.

The existence of fiat money and financial innovation during the last four decades have obscured the relationship between money and economic activity described above and have destroyed relationships between various money aggregates and prices or money growth and inflation, except using very low frequency data. This has undoubted contributed to the conclusion by some economists and policy makers that money is nothing more than an accounting device with no real economic consequences.

3.0 The Role of Money in Modern Monetary Theory and Policy

How can money play the essential role outlined above and yet have virtually no significant role in modern macroeconomics and monetary policy?[13] One possibility is that the role of money described above is simply wrong. I reject this possibility because the role of money outlined in Section 2 is basically what monetary theorists

[12] 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.
[13] See Hoover (1996) for an analysis that is broadly similar to that presented here.

have believed for some time and still believe. I am inclined to believe that the absence of money in monetary policy is due in part to the fact that economic theorists have yet to develop models that incorporate money's fundamental role in economic activity and price level determination described above. There are several reasons for this; however, I believe an important reason is existing models start at the wrong place. Rather than introducing money into a model of exchange where the sole means of exchange is barter (or credit, with non-centralized exchange), and where money arises endogenously to reduce the transactions costs, money is appended to models but given no essential function, i.e., no reason to exist. For example, some "monetary" models start with a framework that incorporates a Walrasian auctioneer. The auctioneer calls out prices in terms of numeraire until all relative prices are determined so that all markets clear.[14] Goods are then exchanged. There is no role for money in this framework of "centralized barter." People who have goods that they do not want come to a centralized market to trade these goods for ones that they want once the equilibrium prices (exchange rates) have been determined. There is no need for a generally-used-method-of-guaranteeing-final-payment; final payment is achieved by exchanging goods for goods (i.e., barter). The existence of a centralized market and a very clever auctioneer eliminate the sort of transactions costs that give rise to the social contrivance of money. This synthetic marketplace greatly simplifies economic modeling, but it does not help one understand the importance of money in real-world economies: If real-world economies had economy-wide centralized markets with a clever Walrasian auctioneer, money would not exist.

Aware that the Walrasian framework provides no essential role for money, monetary theorists have attempted to capture money's essential role in a variety of

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

ways. One is the “cash-in-advance economy,” where money is required for all transactions. However, because money does not exist because it reduces transactions costs, economic welfare can be enhanced simply by removing the constraint, i.e., removing money. The problem, of course, is money has no essential function, i.e., it does not arise endogenously to mitigate some of the costs of trade. Hence, rather than enhancing individual and social welfare,e money is a welfare-reducing constraint: everyone would be better off if they were not required to use money to make their otherwise costless transactions.

Theorists have attempted to capture money’s essential role in other ways such as including money in a household’s utility function or a producer’s production function. The money-in-the-utility-function approach simply asserts that individuals get utility from holding money, even though money plays no essential role in the economy. All other things the same, the more money individuals have the better they feel. In essence, money is as a store of wealth. The problem is that non-interest bearing money is dominated by interest-assets as a store of wealth. Non-interest-bearing money would not exist if its sole purpose was to transfer wealth inter-temporally. There are far too many assets that can perform this function at a lower cost.

The money-in-the-production-function models simply require that money be used in the production of goods. All other things equal, the more money the producer has, the greater the level of output. Like the money-in-the-utility-function approach, such models fail to explain both the reason money is required for production, and the exact mechanism by which money increases production; they merely assert that it does.

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unit of account.

There has been considerable effort during the past few decades to improve macroeconomics and monetary theory by providing it with stronger microeconomic foundations. This effort has generated some useful insights; however, it has yet to produce a model that adequately reflects money's essential role in economic activity. I believe the reason for this shortcoming is that the representative agent framework—which is the *sine qua non* of these models—is devoid of agent-by-agent modeling and equilibrium heterogeneity that is essential for realistic microeconomic analyses (e.g., Hoover, 1996, 2006, and Forni and Lippi, 1997, and Solow, 2008). Money's role in facilitating exchange depends on agent-by-agent modeling. If there is no agent-by-agent modeling, there is no role for money. Money exists because of heterogeneity among economic agents and, therefore, cannot be adequately reflected in models where heterogeneity either does not exist or vanishes in equilibrium. In short, the representative agent methodology which permeates these models is simply inadequate for developing a meaningful model for money and for understanding the massive increase in economic welfare that is a consequence of its existence.[15] The effort to provide macroeconomics with adequate microeconomic foundations is laudable. However, these models remain a long way from providing a useful basis for understanding money's role in economic activity and, consequently, its critical role in monetary policy.

Nowhere is the failure to incorporate money in models more injurious to monetary policy than in the New Keyesian (NK) macroeconomic model—the workhouse model of modern monetary policy. The NK model is a particular problem

[15] The exchange between Solow (2008) and Chari and Kehoe (2008) does not reflect this important point. The issue is not the whether these models have a number of different types of agents but that there is no heterogeneity among economic agents of a given type. This problem is not easily solved by having an aggregate that captures the average response of a given type of agents. While this approach is useful for some analyses, it is not useful for understanding the existence of money and the essential role money plays in economic activity.

because it appears to satisfies the needs of those who believe that money is essential for monetary policy and inflation and those who believe that money is irrelevant.

The NK model consists of an IS curve, an expectations-augmented Phillips curve, and a monetary policy rule, typically a Taylor-style rule. Money is not explicitly included in the model. McCallum (2001) argues that money's role is implicit 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."[16] Despite McCallum's claim that money is implicit in the NK model, it is not essential for the determination of prices. Inflation is determined by inflation expectations, the gap between actual and potential output, and a stochastic shock. Money has no special—let alone unique—role in the determination of the price level and, hence, inflation (e.g., Woodford, 2008). Indeed, monetary policy per se is not essential for controlling inflation. Inflation could be controlled by the fiscal authority setting an inflation objective and using fiscal policy to control aggregate demand relative to potential output.[17] At best one could argue that monetary policy is essential for setting inflation expectations, but if inflation were effectively controlled through fiscal policy, so too would be inflation expectations.

Given the irrelevance of money and monetary policy in the NK model, it is ironic that this model is widely used both by economists who believe that money is essential for long-run inflation control and by those who believe that money is irrelevant. The reason is that while the NK model does not specifically include money, it does not preclude it either. Woodford (2008) notes "the model [NK model]

[16] McCallum (2001, p. 146).
[17] Of course, fiscal policy could have no affect on aggregate demand if the economy were Ricardian, see, for example, Bullard (2012).

is thus not one that requires the existence of a money-demand relation…but not one that is incompatible with the existence of such a relation either."[18]

Does the NK model require the existence of money? Woodford (2001) says no, arguing that the NK model is "*compatible* with a world in which there is no special role for money in facilitating transactions and hence no reason for money not to be perfectly substitutable with any other similarly riskless nominal asset."[19] McCallum (2008) says yes, arguing, "it is not clear that the central bank can control the interest rate(s) of macroeconomic importance—R_t in equation (1) [the IS equation]—in a world in which there is no monetary aggregate that facilitates transactions and hence serves as the dominant medium of exchange and, as a consequence, also becomes the MOA [medium of account]."[20] I agree. In a monetary economy the monetary unit serves both as the method of final payment and the unit of account. Consequently, the price of bonds and the price level are stated in that unit. The real interest rate is the nominal rate stated in monetary units, less the expected rate of inflation stated in the same monetary unit—the rate of increase in prices of commodities in monetary units. It would make no sense to calculate the real interest rate by subtracting the inflation rate, determined by prices of commodities stated in one unit of account from a nominal interest rate determined by the price of bonds in a different unit of account. McCallum (2008) suggests that the existence and meaning of the price level in an economy without money is "questionable." I go further: I believe it would be meaningless.

It is difficult to envision an economy with decentralized markets without a method of final settlement for making transactions: It is difficult, if not impossible, to

[18] Woodford (2008), p. 1574.
[19] Woodford (2008), p. 1573.
[20] McCallum (2008), p. 1789, parentheses added.

envision an economy without money. Consequently, it is unfortunate that macroeconomists and policy makers have coalesced around a model where money's role is so abstract that the model is used by leading macro/monetary theorists and central bankers who believe that money is neither important for economic activity nor critical for determining the price level. Because the NK model has no essential function for money, it cannot provide a useful description of a monetary economy. It is simply wrong to assume that an economy where all of the variables (bond prices, inflation, output and the output gap, the price level, etc.) are dominated in money is observationally equivalent to an economy where money performs no essential function.

The belief that money is irrelevant for monetary policy or the determination of the price level has been exacerbated by the fact that a close empirical link between money growth and short run output and inflation is only observable in economies where money (or currency) is the principal means of exchange. The development of financial markets is due to the existence of money. Unfortunately, the more advanced financial markets become the less obvious it is that money matters for economic activity and the determination of the price level. The irony is that while the existence of money is essential for economic growth, the development of goods and financial markets, the division and specialization of labor, etc., the more advanced economies become the more it looks like money is irrelevant. In economies where money in the form of cash is essential for the bulk of everyday transactions, say modern day China, it is less easy to argue that money is irrelevant.

Despite the opaqueness of money's role in the NK model and the lack of interest in monetary aggregates by monetary theorists and policymakers generally, recent quantitative easing moves by the FOMC have sparked concern among some

economist and policymakers about the potential for inflation. This concern arises from the fact that economic theory and historical experience have demonstrated that the relationship between money growth and inflation is at least analogous to the relationship between oxygen and fire: Oxygen is not responsible for fire, but the fire cannot exist without it. Ironically, this was the view of Federal Reserve Chairman, Arthur Burns, who many (if not most) economists believe bears responsibility for the Great Inflation. At the March 18-19, 1974, FOMC meeting, Burns noted that while he was not a monetarist, he found "a *basic and inescapable truth* in the monetarist position that inflation could not have persisted over a long period of time without a highly accommodative monetary policy."[21] Burns (1979) reiterated this point in his Per Jacobsson Lecture (which ironically was delivered just six days prior to Volcker's FOMC's dramatic change in monetary policy) saying, "the Federal Reserve System had the power to abort the inflation at its incipient stage fifteen years ago or at any later point, and it has the power to end it today...at any time within that period, it could have restricted the money supply and created sufficient strains in the financial and industrial markets to terminate inflation with little delay." Burn's belief that central banks could control inflation was dramatically demonstrated by Volcker's actions, which brought an end to the Great Inflation.[22]

The oxygen/fire analogy is compelling but not causal. The analytical framework outlined in Section 2, however, suggests a causal link from money to inflation—"too" much money will "cause" inflation. The necessity of a causal link is nicely illustrated by a statement Al Broaddus, former President of the Federal Reserve Bank of Richmond, made at the June 2003 FOMC meeting. Broaddus noted that "common sense tells us…that a determined expansion of the monetary base has to be

[21] Memorandum of Discussion, 1974, pp. 110-12, italics added.
[22] For a more detailed discussion of this point see Thornton (2012b).

effective against deflation at the zero bound. If that were not the case, we could eliminate all taxes, and the government could permanently finance its operations with money creation alone."[23] If excess monetary base growth were not inflationary, societies could solve a lot of problems very quickly and at essentially no cost by simply increasing the supply of money.

I believe that the failure of modern macroeconomic models to provide an essential role for money is a consequence of the fact that developing a monetary model is extremely difficult because of monetary neutrality. If wages and prices are flexible and the economy is in equilibrium, a change in the nominal money stock has no effect on the equilibrium values of real variables. Neutrality gave rise to the "classical dichotomy," the idea the real and monetary aspects of economic activity could be modeled separately. The equilibrium real quantity of money is endogenous and depends on the equilibrium quantities of real variables that are independent of the nominal supply of money in equilibrium. This means that a model that attempts to reflect how the economy re-equilibrates following a change in the nominal money supply will be highly model specific. The modeling problem is exacerbated by the *invariance principle* (e.g. Archibald and Lipsey, 1958, and Clower and Burstein, 1960)—the fact that the equilibrium outcome is invariant to how the supply is increased.

4.0 Monetary Policy: *Why Interest Rates Don't Matter*

The previous sections have argued that: a) money exists for the simple reason that it is the most efficient method of achieving final payment in exchange, b) the existence of money is essential for the development of goods and financial markets, c) any marked deterioration in the money-payment system would "cripple" economic

[23] FOMC Transcript, June 24-25, 2003, p. 35.

activity as Greenspan's opening quote indicates, and d) the profession has yet to develop a model (beyond the simple framework sketched in Section 2) that reflects the essential role that money plays in the economy. Consequently, most economist and policymakers have coalesced around a model where money is not essential; indeed, it need not exist. Monetary policy is thought to work primarily, if not exclusively, through the "interest rate" channel, i.e., monetary policy actions affect the overnight policy rate, which affects the entire structure of risk-free and risky rates, which affect aggregate demand, which affects economic activity and inflation, and so on and so forth. This section argues that the Fed's (or any central bank's) ability to affect interest rates has been exaggerated.

Since the late 1980s the Fed has implemented monetary policy by targeting a very short-term interest rate—the overnight federal funds rate. It is widely acknowledged; however, that the efficacy of policy depends critically on a wide-range of rates, especially longer-term yields.[24] Consequently, the efficacy of the interest rate channel is significantly impaired if policy actions with respect to the funds rate are not transmitted throughout the interest rate structure. The efficacy of the interest rate channel of monetary policy is based on two fundamental propositions: a) that the Fed can and has controlled the overnight federal funds rate; and b) that policy-induced changes in the overnight rate are transmitted throughout the structure of rates. This section discusses several reasons to be skeptical of either proposition. However, any significant doubt about a) is sufficient reason to doubt the efficacy of the interest rate channel.

4.1 Reason for Skepticism, a): Monetary Policy and the Supply of Credit

[24] For example, Woodford (2001, pp. 307-08, emphasis added) suggests that, "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-

A well-known economist and policymaker once asked me why I was skeptical of the Fed's ability to affect interest rates, indicating that the demand for money being a function of the interest rate was sufficient. I responded incorrectly, saying that the interest elasticity of the demand for money was a necessary but not sufficient condition for monetary policy to have a significant effect on interest rates. In reality the interest elasticity of money demand is neither necessary nor sufficient. It is not necessary because the interest rate is the price of credit, not the price of money (i.e., the price level.)[25] I will argue that the ability of monetary policy to affect interest rates is a consequence of the effect of policy actions on the supply of credit, not on the supply of money.

The Fed's lending and investing activities not only change the supply of money, they also change the supply of credit. When the Fed makes loans or purchases assets (any asset) it alters the total supply of credit by the amount of the loan or asset purchase. It is this effect of monetary policy actions that causes interest rates to change. Interest rates would change even if the demand for money were independent of the interest rate. Hence, the interest elasticity of the demand for money is not necessary for monetary policy actions to affect interest rates. The effect of monetary policy actions on the supply of credit is sufficient for interest rates to change.

The Fed's contribution to the total supply of credit is given by the size of its balance sheet or, more generally, by the size of the (adjusted) monetary base. The Fed's contribution to the supply of credit is considerably smaller than its contribution to the supply of money because of the fractional reserve banking system.

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market prices, such as longer-term interest rates, equity prices, and exchange rates." Also, see Woodford (2005) for a discussion of the relationship between the funds rate target and long-term rates.

[25] The fact that the demand for money is a function of the interest rate only implies that whatever the equilibrium rate is, the demand for money must be consistent with it. As an aside, for reasons discussed in Section 2, the demand for money is likely to be relatively interest insensitive. I would also note that

When the Fed increases the supply of credit by increasing loans to banks or purchasing securities, the initial effect will be on short-term rates, with the largest effect on the federal funds rate. This effect is propagated to the rest of the financial market over time. It is the propagation of the effect of policy actions through the financial market that generates a reason to doubt the magnitude of the effect of monetary policy actions on the equilibrium structure of interest rates. Prior to Lehman Bros.' announcement that it was filing for bankruptcy protection on September 15, 2008, the contribution of monetary policy actions to the total supply of credit was small relative to the size of the credit market. The monetary base was $844 billion in August 2008. The size of the domestic credit market at the time was about $50 trillion. Consequently, the Fed was supplying about 1.5 percent of the total domestic credit supply. Credit markets are international, so the Fed's contribution to the supply of credit in the economically relevant credit market was significantly smaller.

Also the contribution of monetary policy actions to changes in the total supply of credit have been small. For example, from January 2000 through August 2007 the average yearly change in the monetary base was about $30 billion, compared with a $3 trillion average yearly increase in the size of the domestic credit market. Hence, the Fed actions account for only about 1 percent of the yearly change in the total supply of domestic credit and, of course, a much smaller share of the change in the economically relevant international credit market.[26] Given the relatively small size of the Fed's contribution to the total credit supply, a priori, it is hard to see how the Fed could significantly affect the equilibrium level of interest rates. Cochrane (2011) and Bauer and Rudebusch (2011) recently have used the identical argument to question

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traditional arguments for why money demand depends on the interest rate are not compelling (e.g., Laidler, 1993).

[26] For additional discussions along this line, see Thornton (1995), Friedman (1999), McCloskey (2000), and Fama (2012).

the effectiveness of the FOMC's quantitative easing (QE) actions on interest rates, and these actions are immense relative to historical policy actions.

Friedman (1999) argues that the Fed's contribution to the total supply of credit is implausibly small to have a significant effect on interest rates.[27] He suggests that the central bank's ability to control interest rates does not depend on its contribution to the total supply of credit, but is a consequence of the fact that the Fed "is a monopoly supplier (and withdrawer) of reserves." Specifically, he argues that "when the monopolist central bank reduces the supply of reserves, banks therefore must reduce the amount of money that they supply to households and firms. As households and firms compete with one another to hold the now shrunken supply of money, their individual efforts to sell securities for money cannot produce any more money but do, collectively, drive the price of securities down—that is, they drive interest rates up."[28]

Friedman's (1999) analysis is a partial equilibrium analysis, however. To understand why being the monopoly supplier of reserves does change the fact the effect of Fed actions on the equilibrium structure of interest rates depends on its contribution to the total supply of credit it is important to realize that the federal funds market is not segmented from the rest of the credit market as it once was. Figure 4 shows the federal funds rate, the 3-month T-bill rate, and the discount rate from January 1955 through October 1978. Until the late 1960s the discount rate was an effective ceiling for the funds rate, but not for the T-bill rate. When the T-bill rate (and other short-term rates) rose above the discount rate, the funds rate would not. The reason is that prior to the mid-to-late 1960s, the federal funds market was segmented from the rest of the credit market because banks used the market for the sole purpose of meeting their statutory reserve requirements. Banks with reserve

[27] Friedman (1999), p. 325.
[28] Friedman (1999), p. 325.

deficiencies could either go to the discount window or borrow reserves from another bank in the federal funds market. Banks would borrow in the funds market when the fund rate was below the discount, but go to the discount window if the funds rate was higher than the discount rate—the discount rate was an effective ceiling for the funds rate.

This characteristic feature of the relationship between the funds rate and the discount rate began to change in the mid-to-late 1960s. At first the funds rate went above the discount rate on only a few occasions; however, by the late 1960s, the funds rate was frequently and then consistently above the discount rate. This relationship changed because large banks began using the federal funds market as a continuous source of funds for lending (Meulendyke, 1998). The marked change in the relationship between the discount and federal funds rates was an endogenous response of large Banks when Regulation Q interest rate ceilings began to bind in the mid-1960s. Finding it increasingly difficult to meet all of their funding needs in the market for certificate of deposits (CDs), large banks increasingly they turned to the overnight federal funds market as a permanent source of funds.

As federal funds and CDs became closer substitutes, the Fed's ability to affect the federal funds rate by making modest adjustments to the supply of credit necessarily changed. The following simple thought experiment explains why. Assume that the Fed increases the supply of reserves by purchasing government securities. The initial effect of an open market purchase is on banks' deposit balances with the Fed and, consequently, on the funds rate. The lower federal funds rate creates an arbitrage opportunity. Banks find it more advantageous to meet their funding needs in the federal funds market relative to the CD market. This causes the funds rate to rise and the CD rate to fall. In order to keep the funds rate at the lower target level, the

Fed would find it necessary to increase the supply of reserves further. But this creates another arbitrage opportunity causing the Fed to further increase the supply of credit. This process would continue until the equilibrium funds rate was at the lower target level and the structural relation between the funds and CD rates was reestablished.

The difficulty in controlling the funds rate is exacerbated by the degree of substitution between CDs and other short-term debt instruments. Consequently, the Fed would have to increase the supply of credit by whatever amount is necessary to bring the funds rate down to the new target level, while leaving the equilibrium structure of rates unchanged. In general, the ability of a change in the supply of a specific asset to affect the equilibrium interest rate of that asset depends on the size of the market for the asset, the interest elasticity of demand for the asset, and the cross elasticity of demand with the rest of the credit market. All other things the same, the effect on the federal funds rate will be larger the more the funds market is segmented from the rest of the credit market. Prior to the mid-to-late 1960s, the federal funds market was completely segmented from the rest of the credit market: Banks only used the federal funds market to meet their reserve requirements. Consequently, the Fed could produce a relatively large change in the funds rate with a relative small open market operation. This has not been the case since the late 1960s, however.

Of course, the more segmented the market, the larger the effect of a policy action on the funds rate, but the smaller the effect on interest rates that matter most for economic activity: Having a larger effect on the funds rate means having a smaller effect on economically important interest rates and, hence, economic activity. In any event, if the effect of policy actions on interest rates is small because their effect on the total supply of credit is small, being a monopoly supplier of reserves does not alter this fact.

Some might argue that this paradigm cannot account for the historically close relationship between the federal funds rate and the FOMC's funds rate "target" observed in the data—a relationship that occurred without massive changes in the supply of reserves. It is important to note, however, that prior to the late 1980s/early 1990s the Fed did not use the funds rate as a policy instrument (e.g., in the sense of a policy rule, like a Taylor rule). Rather the funds rate was an operating instrument. It was used to gauge money market conditions and for conducting daily open market operations. Consequent with this hypothesis, the FOMC's funds rate "target" was adjusted relatively frequently and quickly with change in short-term rates.

In essence, the FOMC's funds rate target was largely endogenous (Fama, 2012). This hypothesis is supported by Figure 5 which shows the daily effective funds rate and the funds rate target for the period September 12, 1974, through October 5, 1979, a period when it is widely accepted that the FOMC was "targeting" the federal funds rate.[29] With the exception of some large spikes, most of which occurred on Settlement Wednesdays (the day when the maintenance period reserve requirement is binding), ends of quarters, or year's end, the relationship between the funds rate and the funds rate target is remarkably close. Indeed, if one excludes Settlement Wednesdays and the first and last days of the year, the average absolute daily difference between the funds rate and the target is 8.5 basis points. This close relationship has prompted some analysts to conclude that the Fed successfully controlled the funds rate.

The funds-rate-control interpretation is significantly weakened by the fact that the "target" was adjusted very frequently—99 times during this period; an average of a change every 2.5 weeks. Such frequent adjustments are difficult to reconcile with

[29] The target comes from Rudebusch (1995a,b).

the idea that the FOMC used the funds rate as a policy instrument in the sense of a Taylor-style rule. However, they are consistent with the fact that interest rates were relatively volatile during the period, and the idea that the target was adjusted to keep it in line with other short-term rates.

The endogeneity hypothesis is also supported by the fact that the FOMC did not set a specific target for the funds rate. Rather, the "target" shown in Figure 5 is the mid-point of a "target range," of 50 to 75 basis points. The hypothesis is further supported by the fact that most of the target changes during this period were made by the trading desk of the Federal Reserve Bank of New York in consultation with the Chairman, and not by the FOMC. These facts together with Thornton's (2004) finding, that Treasury rates responded only on days when the market was informed of the target change in the *Wall Street Journal* and not on days when there was no announcement, provides relatively strong support for the endogeneity hypothesis.[30]

Thornton (2006) shows that by late 1982 the FOMC began focusing more attention on the funds rate in their policy discussions. Initially the FOMC was using the funds rate much as it had during the 1974-79 period. However, as the usefulness of monetary and credit aggregates deteriorated, the FOMC increasingly focused on the funds rate in its policy deliberations. Thornton (2006, 2012a) shows that by the late 1980s the FOMC was starting to use the funds rate as a policy instrument in the

[30] The belief that the Fed caused changes in the funds rate is spported by Cook and Hahn's (1989) finding that Treasury rates along the yield curve responded statistically significantly to *Wall Street Journal* (*WSJ*) announcements of target changes. However, Thornton (2004) shows that only about 40 percent of the target changes identified by the *WSJ* coincide with target changes reported by Rudebusch (1995a,b). Importantly, he found no statistically significant relationship between changes in the 3-month T-bill rate and Rudebusch-identified target changes that were not announced in the WSJ. Hence, Cook and Hahn's results appear to be due to an announcement effect rather than to open-market-operations induced change in interest rates.

sense of a Taylor-style rule.[31] The evolution to funds rate targeting was acknowledged by Greenspan at the July 1997 FOMC:[32]

> 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 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...

The change in the FOMC's use of the funds rate is reflected in the relationship between the funds rate and the FOMC's funds rate target shown in Figure 6, which plots the average monthly difference between the federal funds rate and the FOMC's funds rate target from January 1983 through March 2007. Consistent with Greenspan's statement, deviations from the funds rate target were relatively large until the late 1980s. The large deviations occurred in spite of the fact that target adjustments were relatively frequent; from January 1983 through December 1989, a change occurred about every 2.5 months.[33]

As was the case during the 1973-79 period, prior to the early 1990s, the target was the mid-point of a range, many of the target changes were in reaction to changing market conditions (Thornton, 2005b). Moreover, most target changes were made during the intermeeting period. Hence, prior to at least the late 1980s it is arguably the case that the funds rate target was essentially endogenous.

[31] However, Meade and Thornton (2012) find no evidence that the FOMC implemented policy using a specific policy rule.
[32] A more detailed accounting of the evolution to using the funds rate as a policy instrument can be found in Thornton (2006, 2010b).
[33] That target changes were less frequent than during the 1973-79 period may simply reflect the fact that interest rates were less variable.

After the late 1980s target changes were less frequent and target changes were made in response to economic conditions (Thornton, 2010b). Importantly, the market was becoming increasingly aware of the FOMC's use of the funds rate to implement policy.[34] Hence, the tightening of relationship between the funds rate and the funds rate target was due to *open mouth operations* rather than open market operations: The FOMC only had to announce a target change and the funds rate adjusted without changing the supply of credit using open market operations. As the FOMC became increasingly specific about the level of the funds rate target the relationship tightened and the funds rate changed immediately when target changes were effectively announced (Taylor, 2001; Friedman, 1999, 2000; Woodford, 1999).

Empirical investigations of the effect of open market operations on the federal funds rate using daily data (e.g., Hamilton, 1997; Thornton, 2001ab, 2004, 2007; and Carpenter and Demiralp, 2006) show that open market operations had at best a modest effect on the federal funds rate. This evidence is also consistent with the funds rate target being endogenous until the late 1980s and the funds rate increasingly being determined by open mouth operations thereafter. More generally, the liquidity effect—the response of interest rates to an exogenous, policy-induced change in the supply of credit—has been extremely difficult to isolate at any frequency (Hamilton, 1997).[35] This fact alone should cause economists and policymakers to question the degree to which such policy actions directly affect interest rates.

[34] Based on an analysis of the *Wall Street Journal* a few days prior to and after FOMC meeting, Poole, et al., (2002), concluded that "despite the increased awareness that the Fed was paying attention to the funds rate in conducting monetary policy, there is little indication that the market was aware that the Fed was setting an explicit objective for the federal funds rate before 1989."

[35] An exception is nonborrowed reserves. Pagan and Robertson (1995) a negative and statistically significant relationship between nonborrowed reserves and the federal funds rate. However, Thornton (2001b) shows that this negative relationship arose because the Trading Desk of the Federal Reserve Bank of New York conducted open market operations to offset changes in borrowing induced by changes in the funds rate. The Desk's behavior is optimal under either money supply or funds rate targeting. Consequently, the "liquidity effect" obtained with nonborrowed reserves is not a true liquidity effect.

4.2 Reason for Skepticism, b): Monetary Policy and the Structure of Rates

Increased control over the funds rate through open mouth operations does not necessarily translate into control over other interest rates. The theoretical basis for controlling the interest rate structure by controlling the overnight federal funds rate is the expectations hypothesis of the term structure of interest rates (EH). Unfortunately, the EH has been rejected using a variety of interest rates, time periods, monetary policy regimes, etc. (e.g., Campbell and Shiller, 1991; Cochrane and Piazzesi, 2005; Bekaert, Hodrick, and Marshall, 1997; Sarno, Valente, and Thornton, 2007; and Thornton, 2005a and the literature therein).

The empirical relevance of the EH depends critically on the ability of market participants to predict the future short-term rate. However, short-term rates are very difficult to predict beyond their current level (e.g., Guidolin and Thornton, 2010). If market participants are unable to predict the future short-term interest rate with any reasonable degree of accuracy, there is no particular reason to believe that longer-term rates should be tightly linked to the short-term policy rate.

Woodford (1999, 2012) argues that the effectiveness of a central bank's interest rate policy could be enhanced if the policy rate was more inertial. That is, policymakers could affect interest rates further out on the term structure by credibly committing to a path for the short-term rate. Woodford's suggestion has prompted several central banks, the Reserve Bank of New Zealand, the Norges Bank, the Riksbank, the Czech National Bank, and the Federal Reserve to adopt what is called *forward guidance*, i.e., announcing a path for the policy rate. The evidence suggests that forward guidance has been relatively ineffective, however. Anderson and Hoffman (2010), Goodhart and Lim (2008), and Kool and Thornton (2012) find little or no improvement in the predictability of short-term rates or longer-term yields.

It is important to note that nearly all of the work on the EH has looked solely at the term structure of sovereign debt, a relatively thin slice of an enormously complex interest rate structure. The yields that matter most for economic activity are private debt yields. Hence, the important question for the efficacy of monetary policy is whether and to what extent forward guidance has enhanced policymakers' ability to affect yields on private securities. Empirical analyses using a wide range of private rates have been limited and they have focused on high-frequency announcement effects, which may overstate the permanent effect (Wright, 2011).

The EH assumes perfect substitutability across assets in the term structure. This is a reasonable assumption for default-risk-free Treasury debt, but less reasonable across the entire structure of debt instruments. A priori, the degree of substitutability among any set of debt instruments is a declining function of the degree of heterogeneity among instruments in the set. The more heterogeneous two debt instruments are, the lower the degree of substitutability between them, i.e., the rate changes in one market will be reflected in another. Market segmentation provides the theoretical basis for the FOMC's large-scale asset purchase policy, QE, and its revival of Operation Twist—buying long-term government securities and selling an equal quantity of short-term government securities. The degree to which the credit market is segmented is open to debate. The point to be made here is that while market segmentation increases the impact of the Fed's relatively small operations in particular segments of the market, it limits the Fed's ability to affect bond yields throughout the market more generally.[36] If there is significant segmentation between the short- and long-ends of the market for Treasuries, segmentation would likely be even stronger between Treasuries and important segments of the retail securities

[36] Cochrane (2011) also makes this point.

market. Consequently, while market segmentation may enable the Fed to have a larger effect on longer-term Treasury yields, this does not necessarily translate into an increase the efficacy of policy.

Regardless of the empirical validity of the EH or the degree of market segmentation, Thornton (2010b) has shown that the marked improvement in the relationship between the funds rate and the FOMC's funds rate target since the late 1980s has been accompanied by a marked deterioration in the relationship between the federal funds rate and longer-term Treasury rates. This is illustrated in Table 1, which presents estimates of

$$\Delta i_t = \alpha + \beta \Delta ff_t + \varepsilon_t,$$

for periods before and after May 1988—the date on which Thornton's analysis suggests the change is most likely to have occurred. The 1-, 2-, 5-, and 10-year Treasury yields are denoted by i and the funds rate by ff. The sample periods are January 1983 through May 1988 and April 1988, through March 2007. For the first sample period the estimates of β are relatively large, statistically significant at the 5 percent significance level. The estimates of $\bar{R}^2$ also are relatively large. The estimates of β decline during the second period relative to the first, as do the estimates of $\bar{R}^2$. Indeed, the estimate of $\bar{R}^2$ for the second period indicates that the relatively strong relationship between the 10-year yield and the funds rate during the first period essentially vanished during the second.

Moreover, when the common trends in the rates are accounted for, the marked break in the relationship between changes in Treasury yields and changes in the funds rate is reflected in the levels of these rates as well. This is illustrated in Figure 8, which shows the de-trended federal funds rate and 10-year Treasury yield over the period January 1983, through March 2007. The vertical line denotes May 1988. The

strong positive relationship between the de-trended rates prior to May 1988 breaks down after that date. Thornton (2010b) hypothesizes that the marked change in the relationship between the funds rate and the 10-year Treasury yield is a consequence of the FOMC's use of the funds rate as a policy instrument. He presents evidence from a variety of sources that supports this hypothesis. Whether one finds Thornton's hypothesis and evidence convincing, the marked change in the relationships among the federal funds rate and various Treasury rates that he documents cannot be ignored. Nor can its implication: greater control over the funds rate does not necessarily translate into more control over other interest rates.

5.0 Conclusions

I argue that money matters for monetary policy because money is essential for economic activity and for the determination of the price level. Unfortunately, money's essential role is not adequately reflected in modern theory. I attribute this to: a) the difficulties associated with constructing models that capture the indispensability of money for economic activity and yet accompany money's neutrality, b) the fact that the more sophisticated financial markets become the less obvious it is that money is essential, c) the lack of a strong statistically significant relationship between money and economic activity or inflation, and d) the exaggerated belief in the ability of the Fed to control interest rates. As a consequence, prominent macro/monetary economists have unified around a model where, at best, money is implicit and, at worst, nonexistent. As a consequence, nearly all central banks implement monetary policy using a short-term interest rate; few pay attention to monetary aggregates in formulating or implementing policy.

My analysis the Fed's actions and the role of the federal funds markets suggest that the Fed's ability to control interest rates is exaggerated for the simple reason that

historically the effect of policy actions on the total supply of credit has been too small to have a significant effect on the level of the entire structure of interest rates. The relative inability to influence yields more generally is illustrated by the fact that the marked improvement in the relationship between the federal funds rate and the FOMC's funds rate target since the late 1980s was accompanied by marked deterioration in the relationship between the funds rate and longer-term Treasury yields.

The analysis suggests that the efficacy of monetary policy for countercyclical stabilization policy is much less effective than is commonly believed. Nevertheless, money is essential for controlling the price level. Hence, by aggressively pursuing countercyclical stabilization policymakers run a significant risk of missing on their inflation objective. An important implication of the analysis is policymakers would do well to have a single objective, price stability.

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Table 1: Estimates of $\Delta i_t = \alpha + \beta \Delta ff_t + \varepsilon_t$								
	1-year		2-year		5-year		10-year	
	Coef.	*p-value*	*Coef.*	*p-value*	*Coef.*	*p-value*	*Coef.*	*p-value*
	January 1983 – May, 1988							
α	-0.002	0.951	-0.005	0.891	-0.008	0.858	-0.008	0.861
β	0.742	0.000	0.708	0.000	0.596	0.000	0.488	0.004
$\bar{R}^2$	0.473		0.407		0.293		0.211	
s.e.	0.283		0.308		0.332		0.335	
	April 1988 – March 2007							
α	-0.005	0.696	-0.011	0.551	-0.016	0.415	-0.019	0.269
β	0.691	0.000	0.554	0.000	0.324	0.000	0.181	0.020
$\bar{R}^2$	0.339		0.174		0.059		0.021	
s.e.	0.188		0.233		0.245		0.221	

Figure 1

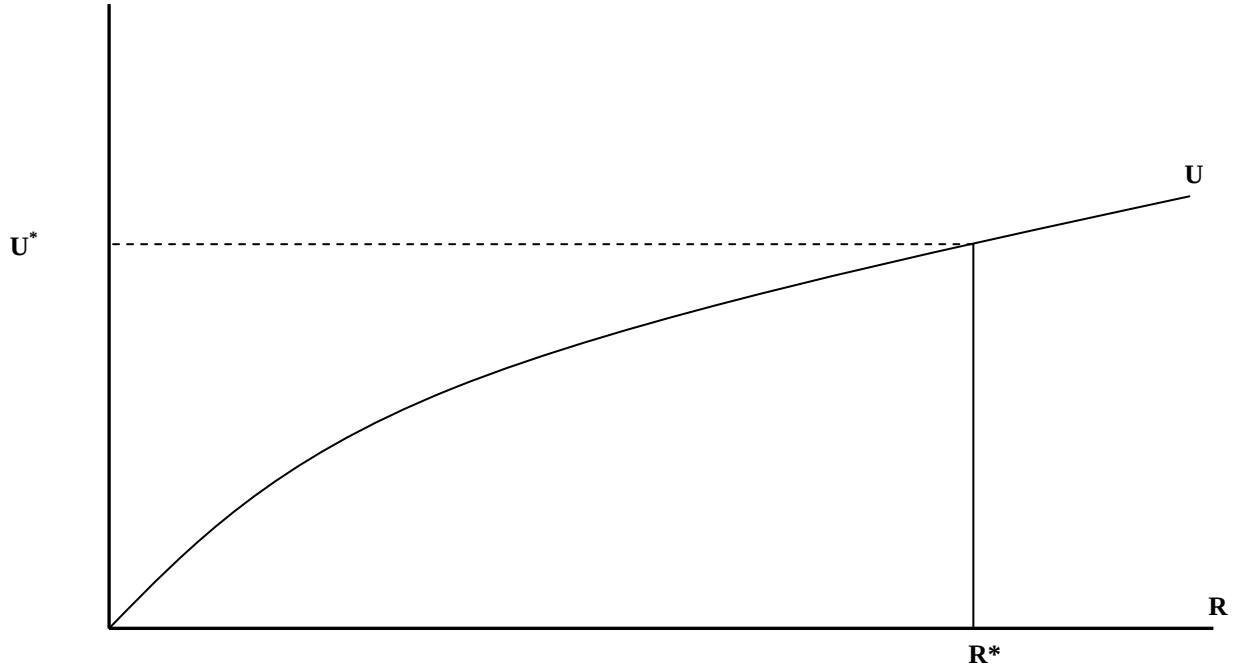


Figure 2

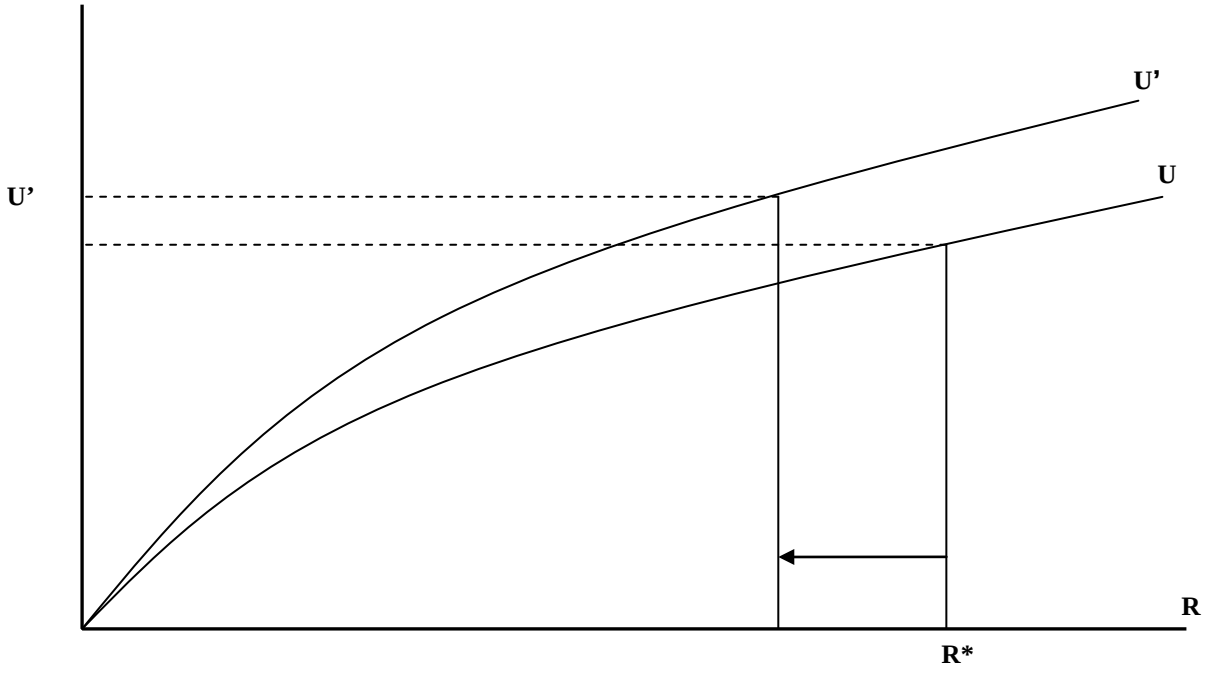
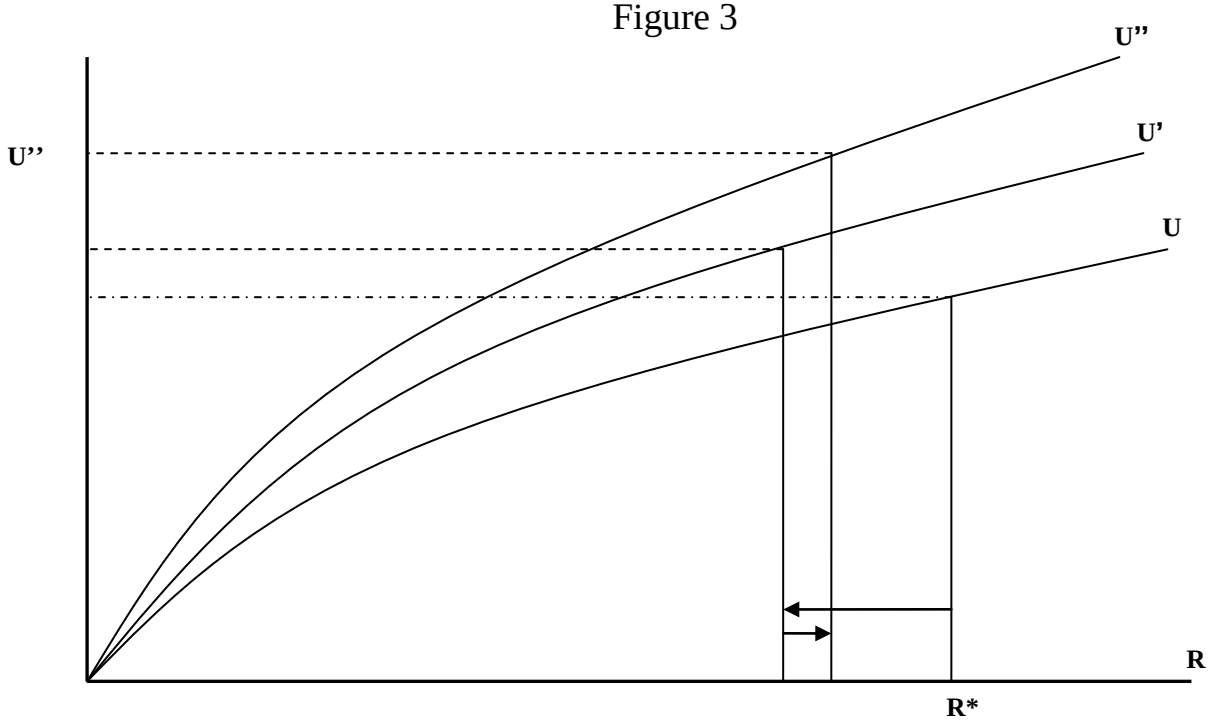


Figure 3



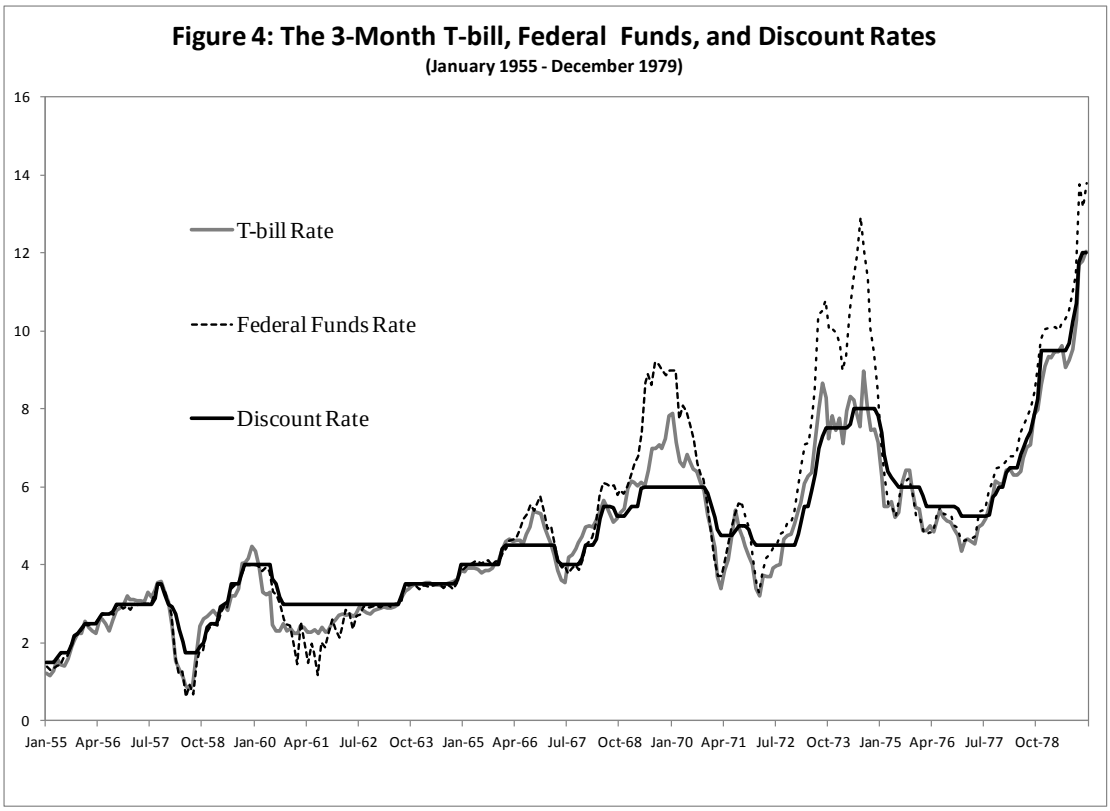


Figure 4: The 3-Month T-bill, Federal Funds, and Discount Rates
(January 1955 - December 1979)
16
14
12
10
8
6
4
2
0
T-bill Rate
Federal Funds Rate
Discount Rate
Jan-55
Apr-56
Jul-57
Oct-58
Jan-60
Apr-61
Jul-62
Oct-63
Jan-65
Apr-66
Jul-67
Oct-68
Jan-70
Apr-71
Jul-72
Oct-73
Jan-75
Apr-76
Jul-77
Oct-78

Figure 5: The FOMC's Federal Funds Rate Objective and the Federal Funds Rate
(September 13, 1974 - September 19, 1979)

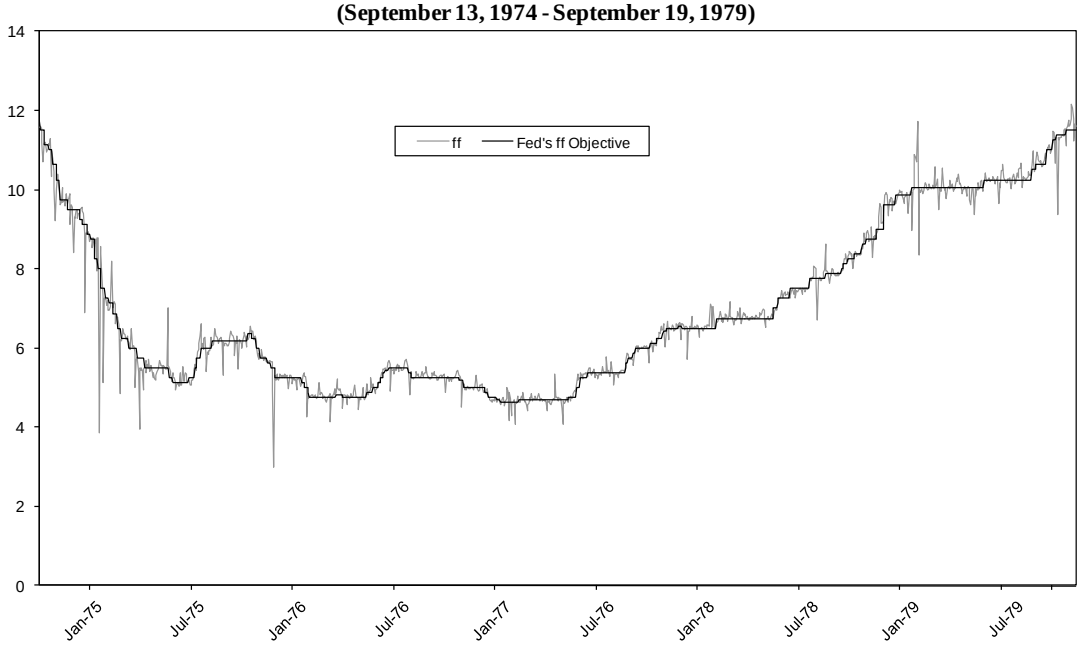
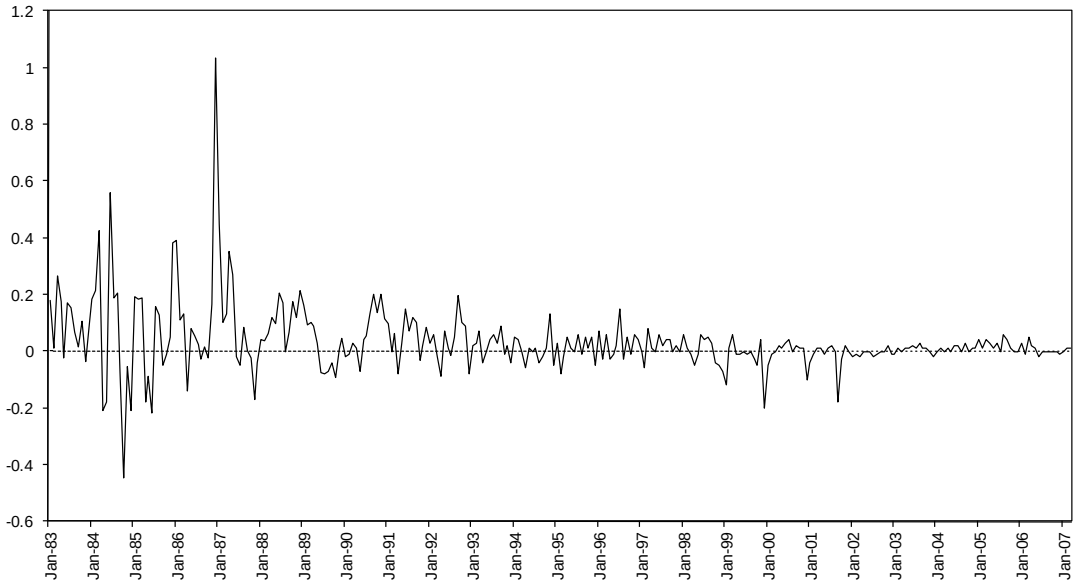


Figure 6: Average Difference Between the Federal funds Rate and the FOMC's Funds Rate Target
(January 1983 - March 2007)



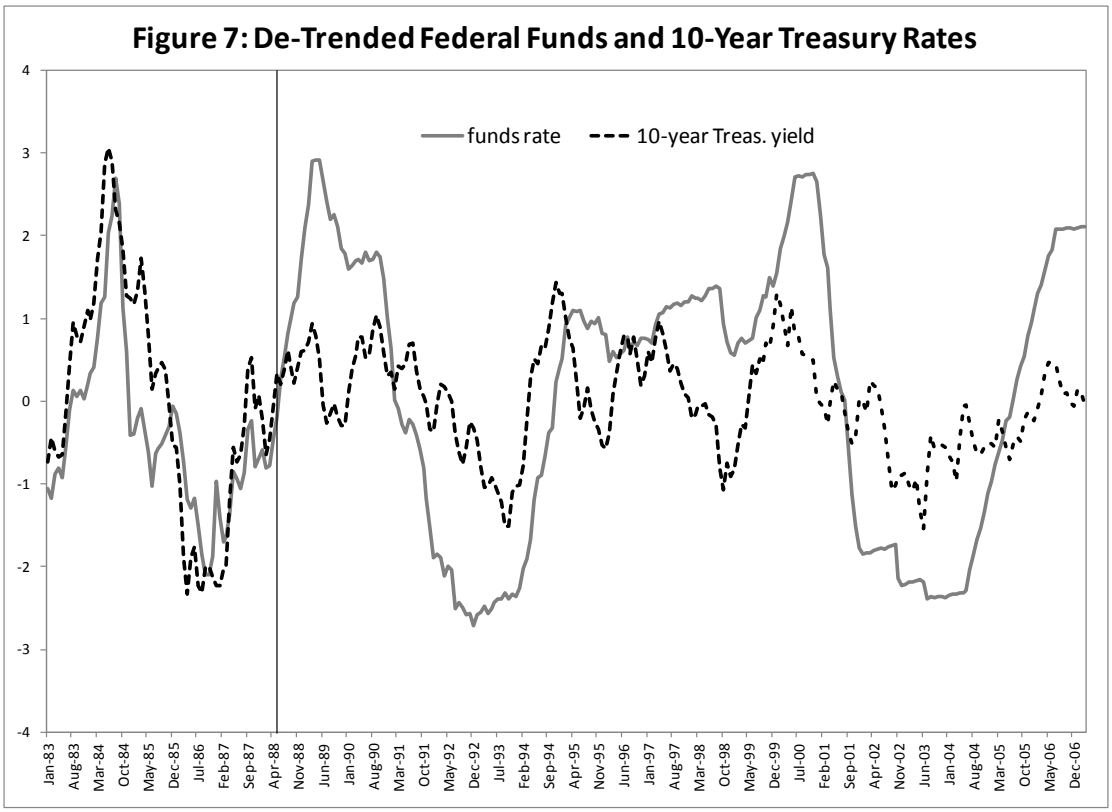


Figure 7: De-Trended Federal Funds and 10-Year Treasury Rates
funds rate
10-year Treas. yield
4
3
2
1
0
-1
-2
-3
-4
Jan-83
Aug-83
Mar-84
Oct-84
May-85
Dec-85
Jul-86
Feb-87
Sep-87
Apr-88
Nov-88
Jun-89
Jan-90
Aug-90
Mar-91
Oct-91
May-92
Dec-92
Jul-93
Feb-94
Sep-94
Apr-95
Nov-95
Jun-96
Jan-97
Aug-97
Mar-98
Oct-98
May-99
Dec-99
Jul-00
Feb-01
Sep-01
Apr-02
Nov-02
Jun-03
Jan-04
Aug-04
Mar-05
Oct-05
May-06
Dec-06