Money Still Matters

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Abstract

The workhorse of modern macroeconomics is the New Keynesian model. This model assumes that monetary policy is transmitted through the path of the short-term nominal interest rate. Money, if it is included at all, is relegated to an inconsequential role in monetary policy analysis. The purpose of this paper is two-fold. First, we summarize the literature on the existence and role of money that is ignored in the New Keynesian models. Second, we discuss the importance of properly measuring monetary aggregates. These aggregates are then used to empirically examine the significance of money, both generally and in regards to the so-called Great Recession. Finally, we conclude by discussing promising alternatives to modeling money.

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1 Introduction

Does money matter? The widely used New Keynesian model says no. This workhorse of modern macroeconomics assumes that monetary policy is transmitted through the path of the short-term nominal interest rate alone.[3] Money, if it is included at all, is relegated to an inconsequential role. Modern monetary policy analysis, therefore, is divorced from money.

This non-money view of monetary policy is justified by three main criteria. First, most central banks around the world do not use monetary aggregates as intermediate targets for monetary policy. Often central banks use an interest rate as an intermediate target or control a short-term interest rate directly using a channel approach.[4] As a result, short-term interest rates rather than monetary aggregates are seen as the appropriate indicators of the path of monetary policy.

Second, the inclusion of a monetary policy rule that explicitly governs the behavior of the short-term interest rate implies that the money supply is endogenous and therefore mirrors the behavior of the short-term interest rate as a result of corresponding adjustments in money demand. The fact that money simply mirrors the interest rate suggests that it is redundant and can be excluded from the model.

Third, widely cited empirical research suggests that the demand for money is not stable over time and that traditional quantity-theoretic relationships have broken down in recent years.[5] As a result, monetary aggregates do not have predictable relationships with other economics variables and are therefore not useful for the conduct or analysis of monetary policy and business cycles.[6]

Despite these justifications and its widespread acceptance, the New Keynesian view of money relies on a circularity of logic that can be described as follows. The Arrow-Debreu-type general equilibrium framework underlying the New Keynesian model has no role for money as a facilitator of exchange since this approach represents a "theory of exchange in which it makes no difference who trades with whom and what is exchanged for what" (Niehans, 1978: 3n). As a result, money is modeled by simply appending it to the existing Walrasian structure by assuming that real money balances enter the utility function or that

[3] The New Keynesian model is a dynamic stochastic general equilibrium (DSGE) model. It consists of a set of equilibrium relations derived from the utility- and profit-maximization behavior of a representative household and representative firm, respectively, and an explicit monetary policy rule followed by the central bank. For an introductory overview, see Gali (2008). For a more complete treatment, see Woodford (2003).

[4] For more on the channel approach, see Woodford (2003).

[5] See, for example, Friedman and Kuttner (1992), Estrella and Mishkin (1997), and Rudebusch and Svensson (2002).

[6] There is reason to doubt the validity of these empirical results on the basis of how money is measured in these papers. More on this point below.

cash is required in advance of consumption.[7] These modeling simplifications for money are typically justified as necessary for making models tractable. Subsequently, when it is shown as in Woodford (2003) or McCallum (2001) that money can be removed from these models without fundamentally altering the model's implications, the lesson drawn is that money does not matter.

Put differently, money is incorporated into the New Keynesian model in a manner that strips away its important role of reducing information and search costs in decentralized trade. When money is then shown to be unimportant to the model's implications, the conclusion drawn is not that the abstraction has gone too far, but rather that money can be excluded altogether. The logical circle is thus completed.[8]

The purpose of this paper is to demonstrate that these modeling abstractions are consequential. By failing to take money seriously, the New Keynesian model is losing valuable information about the stance of monetary policy and its influence on economic activity. That means monetary policy that relies on New Keynesian modeling is impaired and not responding as efficiently as it could to the business cycle.

This paper addresses this important shortcoming of the New Keynesian model by first drawing upon a large but often overlooked literature – at least in the context of the contemporary debate – that shows money matters in theory and should be taken seriously by monetary authorities. Specifically, this literature argues that when money is presented in the context of decentralized exchange, one can understand the origins and existence of money, the desire to hold money balances, the decision to hold money in conjunction with other interest-bearing assets, and significance of money for macroeconomic fluctuations.[9] The paper then turns to empirical support to show that money matters in practice. Here, the paper notes that a failure to properly measure money in the past has lead to some of the New Keynesian confusion on the importance of money. Once this is corrected, money can easily shown to be important as demonstrated in this sectoin of the paper. Finally, the paper concludes by discussing ways to better motivate money in models. Specially, it is argued that that the search-theoretic monetary framework of Lagos and Wright (2005) represents a promising alternative to the New Keynesian approach to monetary policy.

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[7] In modern macroeconomic theory money was introduced in the utility function by Patinkin (1965), who attributes the initial insight to Walras. The cash-in-advance constraint was initially used by Clower (1967) to dichotomize the budget constraint, but is most often associated with Lucas (1980).

[8] David Laidler (1997: 1214) makes much the same point.

[9] Earlier references to money in this role include Leijonhufvud (1981), Brunner and Meltzer (1993), and Laidler (1997). See also chapter 1 of White (1999) and the papers collected in Starr (1989).

2 Money Matters in Theory

2.1 Why Money?

It was commonly argued among classical economists, such as Smith (1776) and Jevons (1875) that the existence of money coincides with the emergence of decentralized exchange. This insight is particularly important as it relates to the contemporary approach. As Niehans (1978: 99) explains,

> neoclassical theory left exchange arrangements indeterminate. All inputs are devoted to production and consumption; exchange requires no inputs. As a consequence, a given allocation of resources to production and consumption is consistent with an infinite variety of exchange arrangements, none of which is preferred to another. Exchange is simply not an economic activity. Lacking an economic theory of exchange, neoclassical theory was forced to treat money metaphorically as a potential consumer or producer good, which, in fact, it is not.

As this distinction suggests, a proper understanding of the role of money requires a comparative institutional framework, namely contrasting barter with monetary exchange.

At the center of the emergence of money is the role of information. Consider a barter economy in which each individual receives an endowment of tradable goods and seeks to transform this endowment to a basket of consumption that maximizes utility. In a standard Walras-Arrow-Debreu general equilibrium model, the Walrasian auctioneer solves this problem by calling out prices until the price vector resolves excess demand in all markets. In such a scenario there is no meaningful role for money, firms, or other institutions. Information thus ”occupies a slum dwelling in the town of economics” (Stigler, 1961: 213) .

In reality, barter exchange requires substantial search costs. Individuals lack knowledge about the existence of particular goods and fellow traders, the quality of the goods being offered, and relative prices. In addition, there is likely to be a dispersion of relative prices among sellers as a result of both imperfect information and the terms of sale regardless of the degree of homogeneity of the product (Stigler, 1961). Moreover, the cost of acquiring information is likely to differ across goods and across sellers. Once information is exchanged, there might still exist costs associated with negotiation, contracts, and the transfer of ownership.

As Stiger (1961) and Clower (1969) demonstrate, increased time devoted to search will lead to better terms of sale. However, search itself is also costly. As a result, the cost function associated with exchange activity will be U-shaped with respect to time.[10] In other words, individuals can reduce the cost associated with exchange by devoting time for search until the point at which search costs outweigh the additional benefits of better terms of sale; after which point the total cost of search begins to increase.

[10] See, for example, Figure 1 in Clower (1969).

A number of social institutions arise to minimize these costs. The appearance of middlemen, for example, helps to facilitate a central meeting place for exchange. This emergence of organized markets helps to economize on information costs associated with strict barter. In addition, competition among middlemen leads to the emergence of specialist traders, who possess a lower cost means of assessing the quality and other characteristics of particular goods. Trade between specialists and non-specialists will similarly result in a reduction in the costs of transacting (Alchian, 1977). Each of these innovations "shift the cost curve down" in common parlance.

Money, as the medium of exchange, is an example of a social institution that emerges to minimize information, search, and transacting costs. In a world of barter exchange, individuals must choose the "transactions chains" (Brunner and Meltzer, 1993: 67) that allow them to convert their initial endowment to the consumption bundle that maximizes their utility. These transaction chains are not random, but systematically chosen to lower both the cost of information and the transactions themselves (Brunner and Meltzer, 1971). Through market interaction, learning, and observation, traders are able to discern what commodities are more "saleable" (Menger, 1892) and ultimately this process "leads to a small subset of goods or assets which are dominantly used in settling transactions" (Brunner and Meltzer, 1993: 67), or media of exchange. Money, in serving as a medium of exchange, therefore emerges as a "substitute for investment in information and labor allocated to search" (Brunner and Meltzer, 1993: 67).

As Alchian (1977: 139) details, the emergence of specialist traders and money are inextricably linked:

> If costs for some good are low and generally low across some members of society, the good will become a medium through which information costs can be reduced and exchange made more economical. But it will rise only with the rise of chains of experts in various goods and commodities, who know the goods cheaply, whose reputation for evaluation is high, and who, because of that knowledge and the low cost of assuring buyers, become specialist middlemen in the good both as inventory carriers and buying and selling agents.

In other words, in the absence of specialist traders who reduce information and transaction costs, it remains possible that barter is less costly than trade using a common medium of exchange. Alchian's insight therefore echoes and formalizes the simultaneous emergence of the division of labor, organized market exchange, and money outlined by Adam Smith (1776).

This discussion of the role of money in reducing the costs of information and search is central to an understanding of money, but any analysis of money is not complete without considering the role of money in the context of alternative assets. Money, broadly defined, consists of a multitude of different assets including cash, bank deposits, and repurchase agreements. In the case of repurchase agreements, it is possible to consider the underlying collateral as money. An important characteristic of any monetary analysis should not only feature an explicit explanation of how money reduces the costs associated with

information and search, but must also be explicit about the characteristics that allow cash to circulate with other interest-bearing money, why rates of interest vary across monies of different type, and why certain interest-bearing assets do not have a transactions role.

In the presence of the higher yield, bonds would be preferable as a asset to money. Expenditures could simply be financed by simultaneous sales of bonds and purchases of goods and services. So why then are positive stocks of money held?[11]

Taking into account the costs associated with information, search, and transactions themselves can make clear why positive money balances are held. Consider the role of money discussed in the previous section. Money economizes on the costs of exchange, but does not eliminate such costs. For example, price dispersion exists even in the context of a monetary economy (Stigler, 1961) and therefore some search is still required. Money therefore reduces the costs of search, but not the need for search.[12] In this sense, money is a substitute for information. As the discussion of costs above suggests, increased time devoted to search and the acquisition of additional information initially reduces the costs. However, at some point the costs of additional search exceed the reduction in cost associated with better terms of trade. In addition, these costs more than likely differ across individuals and across goods and services. As outlined by Laidler (1988), the nature of search implies a stochastic nature to the timing of transactions and, correspondingly from the perspective of specialist traders, sales. Specialists traders will seek to set prices to clear the market. However, setting prices requires the acquisition of information about potential customers. The more time spent trying to predict fluctuations in demand, the more costly the endeavor. As a result, specialist traders will seek to hold buffer-stock inventories of goods (Alchian, 1969). Similarly, in a monetary economy, the stochastic nature of transactions implies a discrepancy between cash inflows and outflows. As a result, individuals (and firms) will seek to hold a buffer-stock inventory of money (Laidler, 1974; 1984; 1988).

Still, it remains possible that individuals could hold a buffer-stock of an alternative asset with a higher yield. This claim, however, relies on the assumption that financing the purchase of goods and services

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[11] Some, following Tobin (1958, 1965) have attributed money balances to the uncertainty associated with interest rates on other assets. However, in the presence of assets that are almost safe from capital losses, there would be no need to hold money. As Niehans (1978) demonstrates, the introduction of transaction costs is capable of explaining the use of money as a asset in this context. Others, such as Wallace (1983), have posited the claim that money is held because of legal restrictions. As White (1987) and Brunner and Meltzer (1993) note, however, the legal restrictions theory assumes that transaction and computation costs associated with using interest-bearing assets is zero.

[12] Consider an economy with n goods and assume that there is a fixed costs associated with visiting a particular trading post. In a barter economy, there would be [n(n-1)]/2 trading posts. In a monetary economy with a common medium of exchange, there would only be n-1 trading posts. With a fixed cost of visiting each trading post, the costs under monetary exchange are lower than under barter, but still positive.

with the simultaneous sale of bonds (or some other asset) does not entail any additional costs than drawing down one's money stock. In reality, the purchase and sale of alternative stores of value entail transaction costs in the form of an opportunity cost of foregone yield, payments to middlemen or specialist traders in the form of brokerage fees, and "shoe leather" costs, among others. These costs might vary with the quantity of the purchase or sale or might be fixed. For example, brokerage costs associated with financial assets are often independent of the quantity purchased. The existence of fixed costs ensures that individuals do not re-allocate their portfolios after every purchase. This is the basis of the conventional inventory approach to money demand as outlined by Baumol (1952) and Tobin (1956).

This view captures an important element of money demand. The contrast between interest-bearing assets and non-interest bearing money ignores the difference between the return on money and that on other assets. The "return on money takes the form of a service yield, a saving in the costs of acquiring information and transacting" whereas "the return to financial assets take the form of an explicit payment of interest" (Brunner and Meltzer, 1993: 69). Factors that increase the cost of information lead to increases in the return to money and therefore cause a substitution to money away from other stores of value.

2.2 Macroeconomic Implications

The notion of buffer-stock money demand has important implications for the macroeconomy. Even in a world of complete certainty as in the standard Baumol-Tobin framework, actual money balances fluctuate around an average level. Introducing the stochastic nature of transactions and, as a by-product, income similarly implies that actual money balances can deviate from desired balances, where the latter is often determined in relation to a scale variable of economic activity and opportunity cost variables. Exogenous shocks to actual money holdings or the determinants of long-run money demand cause deviations of actual and desired money balances and therefore "the agent will attempt to move towards his long-run target demand for money by altering his current rate of flow of expenditures on goods, services, and asset accumulation" (Laidler, 1984). If money is a substitute for information, as argued above, this adjustment process will be gradual rather than instantaneous.

Buffer-stock money demand thus serves as the core of what Warbuton (1950) and Yeager (1986) refer to as the theory of "monetary disequilibrium." In particular, the central proposition of monetary disequilibrium theory is that deviations of actual from desired money balances lead to an adjustment process in which individuals attempt to re-allocate their portfolio and restore money balances to their desired level. If prices do not instantaneously adjust or if there are segmented markets, monetary disequilibrium therefore results in a decline in both real and nominal spending before prices ultimately

adjust to restore equilibrium.[13] This concept, which dates back at least to Hume (1752), is consistent with the outline of the transmission of monetary shocks in Friedman (1956), Friedman and Schwartz (1963a, 1963b, 1982), and Brunner, Cukierman, and Meltzer (1980, 1983).[14] The notion of monetary disequilibrium, especially couched in the context of the institutional analysis described above, is also broadly consistent with the framework articulated by Clower (1965), Leijonhufvud (1968, 1981), and Howitt (1979) in which such fluctuations are the result of deviations between notional and effective demand.[15]

The theory of monetary disequilibrium can be described in the context of the institutional structure outlined above as follows.[16] Consider a fully monetized pure exchange economy in which trading posts are operated by specialist traders who exchange money for a particular commodity. Individuals buy and sell commodities through specialized traders. For simplicity, assume that there is one trading post for each commodity and each specialist sets the price of the commodity in an attempt to equate supply and demand.[17] The difference between sale orders and purchase orders is excess demand. When there exists a discrepancy between sales and purchases, the specialist trader uses a deterministic rule to determine what transactions actually take place. Subsequently, the trader adjusts the price of the corresponding commodity.

Despite the fact that the trading post has a deterministic rule for facilitating transactions in the presence of excess demand (supply), the decisions will have a stochastic nature to individuals because they do not have the same information as the trading posts. The possibility that sell orders will differ from purchase orders coupled with the stochastic nature of transactions provide the necessary condition for

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[13] Non-instantaneous price adjustment should follow from the desire to hold buffer-stock inventories. As detailed in Alchian (1969), the holding of inventories will increase the cost to buyers in the form of a reduction in sellers or higher prices. However, if these costs are lower than the cost associated with price variability, sellers will find it advantageous to maintain stable prices. Laidler (1974) suggests that sticky prices are a necessary condition for buffer-stock money demand.

[14] Brunner, Cukierman, and Meltzer (1983) represents an early attempt to tackle the issues raised in the present paper.

[15] This latter approach differs in regards to the self-correcting nature of the economic system. Leijonhufvud (1981), for example, posits that there is a "corridor" in which the system is self-correcting that corresponds to normal circumstances. However, in the presence of large shocks, wage and price mechanisms might not be sufficient to restore equilibrium. The degree to which the economic system is self-correcting is beyond the scope of this paper. Put succinctly, much of what follows assumes that the economy remains comfortably within the corridor.

[16] What follows can be viewed as a modified Walrasian framework in which specialist traders have replaced the auctioneer. This simple modification is used to demonstrate that in the absence of the auctioneer, individuals can trade even when prices are not at their equilibrium values. Elsewhere this has commonly been referred to as "false trading", although the nomenclature is perhaps inappropriate.

[17] The existence of specialist traders should be synonymous with bid-ask spreads between sales and purchases. However, this would unnecessarily complicate the present analysis.

individuals to hold a buffer-stock inventory of money. Otherwise, since purchases require money, sell orders that were not executed would necessarily require a corresponding reduction in purchase orders.

Within this context, suppose that the economy is in equilibrium; prices are such that excess demand is zero at each trading post and actual money balances are equal to desired money balances. Now suppose that there is an increase in the demand for money (desired money balances).[18] In the absence of a corresponding increase in the money supply, actual money balances are now less than desired balances. Since money is not a producible good, the individuals whose demand for money has increased will reduce purchase orders in an attempt to increase their money balances. Contrary to an exogenous increase in the demand for a particular good at a trading post, the use of money as a medium of exchange implies that an increase in the demand for money results in an excess supply of goods at every trading post. If prices instantaneously adjust, the real value of actual money balances would rise until real balances were equal to the desired level. However, for specialist traders, sale and purchase orders are stochastic, as they do not know the preferences of individual transactors. As such, the extent to which prices adjust is determined by the expectations about the persistence of the change in demand.

In addition, the excess supply that persists in goods markets implies that the sales income of sellers declines. The reduction in sales income coupled with the fact that transactions are stochastic from the perspective of the individuals implies that planned consumption will decline. The extent to which consumption declines is determined by how much of the reduction of sales income is expected to be permanent.[19] Ultimately, this process continues until relative prices adjust such that the excess supply in goods markets is resolved and the overall level of prices adjusts to equate actual and desired real money balances.

Some general comments on monetary disequilibrium can now be made. First, there exists an important distinction between the adjustment of the individual and the market to deviations between actual and desired money balances. When actual money balances are less than desired money balances, individuals can increase actual balances using a corresponding reduction in spending. However, from the perspective of the market, it is not possible for actual and desired balances to be equal at the prevailing price level. The adjustment process therefore results in a decline in both nominal and real spending. Second, the size and the duration of the change in spending are determined by the speed of adjustment, which itself is determined by preferences and the extent to which the exogenous shock is expected to be permanent.[20]

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[18] The same scenario would result from a reduction of the money supply in the presence of an unchanged demand for money.

[19] This insight is important as it ties together Friedman's view of money demand (Friedman, 1956) and his permanent income hypothesis (Friedman, 1957).

[20] This point is also important. The traditional Keynesian-cross-type analysis suggests a multiplier effect from such changes in spending with production rising or falling by more than the initial change

This proposition also has important implications for the particular role of money in economic fluctuations as well as for monetary policy. In particular, as Howitt (1974) demonstrates within a similar context to that just described, the quantity theory of money holds as a long run proposition. Thus, the institutional view has quantity-theoretic foundations and suggests that the quantity of money determines the price level. Money is therefore important to a central bank as either an intermediate target or as an information variable.

In addition, even if money is not a part of the conduct of monetary policy, monetary disequilibrium theory suggests that real balances might convey information not contained in short-term interest rates. For example, the central proposition of monetary disequilibrium theory is that deviations of actual from desired money balances results in an adjustment of spending flows on assets as well as goods and services thereby affecting relative prices. Within a richer model specification, this would include "the role of relative price adjustments over the whole range of assets, between old assets and newly produced assets, and between assets and real consumption or yields of assets" (Brunner, 1978: 62). If money demand is a function of a broad spectrum of asset yields, as in Friedman (1956), real money balances will thus "capture the many channels of monetary transmission" (Meltzer, 2001: 125). This was perhaps the primary theoretical distinction between the role of monetary shocks in the monetarist literature and the conventional IS-LM approach.[21] Given that the New Keynesian framework is a dynamic, forward-looking analog to the IS-LM approach, the institutional view represents a distinct contrast to the notion espoused in contemporary monetary theory that the short-term interest rate is sufficient for capturing the effects of monetary policy.

Thus, the importance of money in economic activity and monetary policy is not an antiquated idea without a theoretical foundation. Rather, the importance of money is predicated on an explicit recognition of the nature of monetary exchange. In other words, as Laidler (1988: 697) notes, "if we take the proposition that monetary exchange reduces, but does not eliminate, uncertainty from market transactions, we are …led to postulate the precautionary model of money holding." The institutional view of money is the microeconomic link to monetary disequilibrium theory.

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in spending. This is particularly important because this effect could be de-stabilizing. Leijonhufvud (1981) suggests that de-stabilizing movements outside the corridor are the result of an increase in the responsiveness of consumption to current income. This claim is consistent with FriedmanÕs claim that the responsiveness of consumption to current income is dependent upon the relative variance of the permanent component of income. Similarly, Meltzer (1978) suggests that a primary difference between traditional Keynesian and Monetarist analysis is that the latter assumes that secondary effects from rising unemployment are dependent on whether the change in income is expected to be permanent.

[21] See, for example, Brunner and Meltzer (1976, 1993) and Friedman (1976).

3 Money Matters in Practice

3.1 Expanding the Definition and Understanding of Money

While the discussion above provides an important theoretical basis for the importance of money, it is also important to consider whether the empirical evidence is consistent with theory. Empirical evaluation of the relative importance of money requires that it is properly measured. Much of the existing empirical evidence on money does not meet this criteria.

The broadest monetary aggregate traditionally used in empirical analysis is M2. Over the last 25 years, however, the number of assets that are both consistent with the view of money above and excluded from M2 have grown significantly. The measure M2 is no longer broad enough to encompass all assets that should be included in a monetary aggregate. It only is a measure of retail money assets. Over the last 25 years, there has been significant growth in institutional money assets. This is largely the result of a change in the size of institutional cash pools. These cash pools refer to the cash balances of large, global corporation and institutional investors, such as pension funds and securities lenders. From 1990 to 2010, Pozsar (2011) estimates that aggregate size of these institutional cash pools have risen from $100 billion to $1.9 trillion.

Large corporations and asset managers would prefer to invest these cash pools in safe, short-term, liquid assets. However, traditional banking options are not sufficient for these purposes for two reasons. First, the size of the cash pools make it prohibitive for corporations and institutional investors to make deposits in the traditional banking system because of the upper bound on deposit insurance. The desire for safety and liquidity initially resulted in an increased demand for U.S. Treasury bills. However, as Pozsar (2011) notes, the size of institutional cash pools relative to the supply of short-term government debt implies that there was (and there remains) a shortage of T-bills. The desire for safe, liquid alternatives to standard deposit contracts in the absence of a sufficient supply of short-term government debt helped contribute to the growth of the so-called “shadow” banking system. The excess demand for safe, liquid, short-term assets was largely filled with asset-backed commercial paper and through repurchase agreements.

While the assets held in institutional cash pools might not traditionally be considered money, they do fit with the characteristics described above. While retail investors, such as households, are traditionally thought to hold money assets primarily to finance transactions, institutional investors use T-bills, asset-backed commercial paper, and repurchase agreements to not only finance transactions, but also to manage collateral and liquidity and as a form of investment. However, a deeper understanding of money suggests that the differences between retail and institutional demand for money assets might not be all that different. For example, Laidler’s buffer-stock view of money demand described above would seem to

suggests that retail and institutional investors have the same motivation for holding money assets, even though each group is holding distinct asset groups.

The sheer growth in the institutional cash pools and the use of T-bills and other short term assets in repurchase agreements imply that such assets should be included in the construction of monetary aggregates.[22] M2 is no longer a sufficient measure of the broad money stock.

The type of assets to include in a particular monetary aggregate is only one of the problems that careful monetary analysis must address. Much of the existing empirical research on money uses simple sum monetary aggregates. The use of simple sum aggregates has long been considered inadequate for measuring the stock of money.[23] This type of aggregation implies that each asset is a perfect substitute for all other assets in the aggregate, a result contradicted by empirical research (Barnett, et. al, 1992; Serletis, 2000).

An alternative to simple sum aggregates are the Divisia monetary aggregates derived by Barnett (1980). Divisia monetary aggregates weight the individual money assets by their expenditure share. This distinction from simple sum aggregates is important because money assets that are more liquid relative to other assets tend to have lower pecuniary rates of returns. As such they are given higher weights in aggregate. Assets with less liquidity are given lower weights.

The Divisia monetary aggregates are theoretically superior to simple sum aggregates because they have explicit microeconomic foundations and are consistent with index number theory. There is also evidence of their empirical superiority. Belongia (1996), for example, demonstrates that five seemingly puzzling results in the monetary literature can be resolved by using Divisia, rather than simple sum, aggregates. In addition, Hendrickson (2014) shows that the Divisia monetary aggregates outperform the simple sum counterparts when considering the stability of money demand and the predictive ability of money. In addition, he finds that changes in real money balances, as measured by the Divisia aggregates, have a statistically and economically significant effect on the output gap in estimated IS equations. This result is significant because the failure to identify an effect of money on the output gap has been a source of justifying the exclusion of money from monetary policy analysis.[24]

Consistent with the issues above, the empirical analysis in the next section uses Divisia M4 as the proper monetary aggregate for analysis. Divisia M4 consists of all of the assets in M2 as well as commercial paper, repurchase agreements, and Treasury bills. In addition, the aggregate is constructed to be consistent with index number, aggregation, and microeconomic theory.

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[22] The idea that T-bills should be included among monetary aggregates has been made elsewhere as well. See Krishnamurthy and Vissing-Jorgensen (2010), for example.

[23] See, for example, Fisher (1922) and Friedman and Schwartz (1970).

[24] Hanke (2015) also views the Divisia aggregates as superior to simple sum aggregates and useful for evaluationg the stance of monetary policy.

3.2 Empirical Analysis

This paper has made the case that money still matters. This claim is empirically assessed in this section of the paper using three different approaches. First, a vector autoregression (VAR) is estimated over a long period to see if shocks to the money supply generate dynamic responses in the economy that are consistent with the monetary theory laid out above. Second, the path of the money supply over the past decade is examined and run through a counterfactual simulation to see if it could generate the collapse in economic activity experienced during the Great Recession. Third, following the work of Belongia and Ireland (2013), the full employment level of money supply is estimated to see if it shows a monetary shortfall during the Great Recession.

As noted above, a properly constructed monetary aggregate should include retail and institutional money assets and be constructed as a Divisia. The empirical analysis done below uses two such measures. The first one is Divisia M4. It consists of all the assets in M2 as well as commercial paper, repurchase agreements, and Treasury bills. The second measure is Divisia M4 Minus and is equal to Divisia M4 less Treasury bills. This latter measure can be seen as a broad monetary aggregate of privately-produced inside money assets and is useful to consider alone since its component money assets are largely endogenous to the economy.[25] For comparison, the more commonly used monetary aggregates, M1 and M2, are also included in Divisia in the analysis below. Figure 1 shows the full sample for all four Divisia measures of money comes from the Center for Financial Stability.

For the first empirical exercise a VAR is estimated that has the following vector of endogenous variables:

$$x_t = \left(m_t, y_{t,} u_t, w_t, i_t, r_t, c_t, p_t, \right)'$$

where m_t is the money supply, $y_{t,}$ is real GDP, u_t is the unemployment rate, w_t is real household wealth, i_t is the 3-month Treasury bill yield, r_t is a risk premium measure, c_t is commodity prices, and p_t is the price level all at time *t*. The vector of endogenous variables is estimated as part of an autoregressive structural model of the form,

$$x_t = \beta_0 + \beta_1 x_{t-1} + \cdots + \beta_p x_{t-p} + e_t \qquad (1)$$

where x_t is the vector of endogenous variables, $\beta_0,\ldots, \beta_p$ are n x n parameter matrices, e_t is an n x 1 vector of shocks that are assumed to be multivariate normal with mean zero and unit variance, and *p* is the number of lags. This vector autoregression can be transformed into a vector moving average model to show the impulse response functions (IRFs) from a money supply shock. This is a useful exercise since IRFs reveal how the variables in the VAR respond over time to such shocks.

[25] It does, though, include currency in circulation which is not privately produced, but this is relatively small portion of the overall aggregate.

Typically, the use of IRFs requires imposing some identifying restrictions on the data. There are, however, numerous ways to force such structure on the data and each approach can lead to very different conclusions on the effect of shocks. Consequently, there is still much debate on how to properly identify structural shocks in a VAR.[26] To avoid this controversy and let the data to speak for itself, the generalized impulse response functions proposed by Peasaran and Shin (1998) are used here to create the IRFs. This approach minimizes the structure forced on the data by using the average impulse response function (IRFs) from multiple Choleski decompositions with every variable in turn ordered first.

One testable implication that comes out of the monetary theory discussed above is that non-forecasted changes or shocks to the money supply should, in the presence of sluggish price level adjustment, lead to monetary disequilibrium. As noted earlier, monetary disequilibriium should cause temporary real effects on the economy. In terms of the variables in the VAR, this means a positive shock to the money supply should temporarily raise real GDP, reduce the unemployment rate, raise household wealth, and lower risk premiums. It also means that interest rates will bear the brunt of the price adjustment in the short-run—a liquidity effect—since output prices are sluggish. Finally, over the long run the quantity theory of money should hold. That is, the money supply innovation should only permanently affect the price level. The IRFs can be used to determine whether these implications are borne out in the data and if so, whether they are borne out in the broader measures of the money supply as claimed above.

The sample period for the estimated VAR is limited to January, 1967 to December, 2013 by the availability of the Divisia measures. Real household wealth is constructed by summing up household real estate and stock market wealth in the U.S. Financial Accounts data and dividing it by the PCE deflator.[27] The risk premium is constructed by taking the spread between Moody's BAA and AAA corporate yield. The CRB spot index is used for commodity prices and the PCE deflator is used for the price level. Other than the yields and spreads, the data are in seasonally adjusted form.[28]

Figure 2 shows the IRFs generated from a 1 standard deviation shock to the four different Divisia measures. The solid line in the figure shows the IRF point estimate while the dotted lines show simulated

[26] See Liu and Theodoridis (2012) for a recent discussion of this debate.

[27] The Finaqncial Accounts code for household real estate wealth is FL155035005.Q. and for stocks it is FL153064105.Q.

[28] All variables not already in rate form are transformed into log levels. Though standard unit root tests indicate nonstationarity in these variables, here the common practice of estimating the VAR in log levels is followed since it has been shown that doing so does not asymptotically bias the coefficient estimates of the VAR parameters (Sims et al. (1990)). Moreover, estimating in levels allows for cointegration while not imposing it. The data are all at a quarterly frequency and 5 lags are chosen for the VAR since this amount is enough to eliminate serial correlation and because the likelihood ratio test suggests this many lags are adequate to capture the dynamics of the data.

standard error bands.[29] The first column in Figure 2 shows specifically what happens following a Divisia M1 shock. This money supply shock leads to an increase of Divisia M1 of about 1.10 percent upon impact. It is followed initially by modest and sometimes insignificant movements in real GDP, the unemployment rate, household wealth, and the risk premium that all run contrary to theory laid above. Real GDP declines, the unemployment rate increases, household wealth changes little, and the risk premium increases. Moreover, commodity prices and the price level permanently fall.

The shock to Divisia M2 leads to IRFs that are more consistent with the theoretical predictions, but not completely. The shock upon impact raises Divisia M2 about 0.80 percent and is followed by a gradual but temporary rise in real GDP that peaks at about 5 quarters out at 0.3 percent. Unemployment similarly experiences a temporary falls that bottoms out roughly 7 quarters out at 0.12 percent. Both responses are statistically significant too. Real household wealth increases, though not significantly, and a strong liquidity effect is present with the 3-month Treasury bill yield falling 0.27 percent upon impact. Though these results are consistent with the monetary theory laid out above, the other IRFs are not. The spread rises, commodity prices fall, and the price level falls.

The final IRFs that come from the shocks to the broader Divisia measure are completely consistent with monetary theory. Both shocks cause about 0.82 percent increase in the money supply and lead to statistically significant and relatively large changes in real GDP, the unemployment rate, and real household wealth. The M4 Minus Divisia shock temporarily raises real GDP by about 0.54 percent and lowers unemployment about 0.22 percent at peak. Real household wealth also briefly rises, topping out at about 1.26 percent growth. There is also a strong liquidity effect on the Treasury bill interest rate. The spread finally falls, though the effect is modest in size and commodity prices rise. The price level rises, but only after about 9 quarters. Similar, though, less precise IRFs occur for the regular Divisia M4. These results from the shocks to the Divisia M4 Minus and M4 IRFs empirically support the three theoretical claims laid out above: (1) money supply shocks create temporary real effects, (2) money supply shocks generate short-run liquidity effects, and (3) the quantity theory holds in the long run. That these results only hold with the broader monetary aggregates also lends support to the claim that a proper measure of money should now include both retail and institutional money assets.[30]

Given these findings, it is instructive to look at how these four Divisia measures actually evolved over the crisis. Figure 3 shows the four measures up close in both level and growth rate form. The grey bar in

[29] The standard error bands are technically fractiles that come from using Monte Carlo integration techniques to estimate the posterior density of the response coefficients. Sims and Zha (1999) recommend with this approach, which characterizes the likelihood shape, the use of a 68% posterior probability or a one-standard error band.

[30] The VAR was also estimated for the pre-crisis period of 1967:Q1 - 2007:Q4 for Divisia M4 Minus and M4. The IRFs from this period are very similar and do not fundamentally change.

the figures shows the period where aggregate nominal spending collapsed and remained below its peak of 2008:Q3. If anyone of the Divisia measures is a good measure of money, then the collapse in spending during this time should be reflected in it. Interestingly, Figure 3 shows that Divisia M1 and M2 actually accelerate during the initially decline in nominal spending.[31] This may reflect the fact that some of money assets in these aggregates are FDIC-protected and the demand for safe assets like them grew during the crisis. The broader monetary aggregates show a decline during the collapse, but only Divisia M4 Minus begins declining before nominal spending. Given the components of Divisia M4, this figure suggests a collapse in privately produced inside-money assets - a monetary disequilibrium - precipitated the collapse in nominal spending. This is not a novel claim. Gary Gorton (2010) makes the case that just like the Great Depression, there was a bank run during the Great Recession and in both cases the bank runs lead to a collapse in the money supply. The only difference is that in the Great Depression the bank run was on the retail banking system and affected retail money assets while during Great Recession the run was on the shadow banking system and affected institutional money assets. Money mattered in both cases, but one would not know it by looking at the traditional narrow measures of money during the Great Recession.

Another way to see how important money was to the Great Recession is take the VAR estimated above and use it forecast where the economy would have gone given the actual path of the money supply. If money matters then the actual collapse of the money supply should lead to a forecast that mimics to some degree the Great Recession. This is done by feeding the actual path of Divisia M4 Minus and Divisia M4 over the 2008:Q1 through 2013:Q4 period into the VAR and then dynamically forecasting the rest of the other variables over this period.[32] The resulting counterfactual forecasts can be seen in Figure 4. In general, it shows a decline in economic activity that is similar to the actual economic slowdown but slower to adjust. Under the Divisia M4 Minus counterfactual, the forecasted real GDP declines to about the same level of actual real GDP. Unemployment reaches 9.3 percent under the forecast compared to actual high of just over 10 percent. Real household wealth declines roughly 33 percent under the counterfactual compared to real decline of 39 percent. The 3-month Treasury bill interest rate eventually hits 0 percent, but again at a slower pace than the true path. The forecasted risk premium and commodity price index follows a similar path to their actual values, but do not experience the sharp swings of the actual values. Finally, the growth of price level slowly decelerates until it falls to its actual level. The Divisia M4 counterfactual forecast creates similar results.

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[31] The Divisia M4 actually increases at the start of the nominal spending collapse. This reflects the increase in Treasury bills during this time.

[32] That is, the VAR starts forecasting in 2008:Q1 and uses its forecast of the endogenous variables as inputs into subsequent forecast over this period. Only the money supply measures are exogenously fed into the forecasts.

The importance of the counterfactual forecast is that it implies that much of the fluctuations in the variables in our model could have been predicted fairly well by knowing only the path of the money supply over this period. This suggests that the path of money over the course of the Great Recession was very important. This counterfactual sugggests that money does matter.

As a final check on whether money matters, a full employment level of the Divisia M4 and Divisia M4 Minus are estimated based on the work of Belongia and Ireland (2013). If money mattered in the Great Recession one would expect to find that the actual level of these money measures was well below the full employment level. The authors estimate the full employment level of money by plugging in a full-employment level etimate of nominal GDP and trend velocity into the equation of exchange and then solving for the money supply:

$$M_t^{Full\ Employment} = \frac{Nominal\ GDP_t^{Full\ Employment}}{Velocity_t^{Trend}} \tag{2}$$

The full-employment level of nominal GDP follows Beckworth (2015) who takes the average of four output gap estmates—CBO, IMF, OECD, and HP—and regreses it on a time-varying model of nominal GDP to get the full employment level of NGDP. Trend velocity is estimated via the HP filter. The results of this exercise are seen in Figure 5. It reveals that there was, in fact, a sharp drop in the money supply below its full employment level. The decline bottoms out in 2010 and at values ranging from 7 to 9 percent below the full employment level. Only gradually has this gap closed. These and the other empirical results above strongly suggest that money mattered a lot during the Great Recession.

4 Discussion and Conclusion

Over the last 30 years, macroeconomics has moved toward dynamic, stochastic representations of the traditional Walras-Arrow-Debreu general equilibrium framework. The transition has important implications for the analysis of money and monetary policy. For example, it has long been recognized that there is no place for money within traditional general equilibrium theory. The Walrasian auctioneer calls out prices until the price vector resolves excess demand. Such a simplification is certainly useful for a number of microeconomic questions. However, this type of framework is not conducive to studying the monetary economy. For example, Ostroy (1973) and Ostroy and Starr (1974) begin their analysis where the typical Walras-Arrow-Debreu model ends. They demonstrate that even when the Walrasian auctioneer has determined prices and traders know what trades to make, money allows the traders to surmount the complexity of barter.

Despite the criticism, the Walras-Arrow-Debreu equilibrium framework can be useful in examining monetary exchange provided that the framework is modified. For example, Niehans (1971, 1978) fully

integrates money with value theory by developing a model in which money and barter are special cases. Within this framework, it is shown that the commodity with the lowest transaction costs emerges as the medium of exchange. More recently, Starr (2003) demonstrates that by extending the Walras-Arrow-Debreu framework to include specialist traders ("trading posts") and transactions costs, consistent with the institutional approach, commodity money can be shown to arise endogenously as the commodity with the lowest transaction costs. Howitt (2005), using a similar trading post framework, explains the existence of fiat money.

The problem with the Walrasian framework is thus not the framework itself, but rather the way that money is treated within that framework. Money is introduced by simply appending it to the existing framework by putting real money balances in the utility function or by assuming that cash is needed in advance of purchase. Doing so means that money will be positively valued in equilibrium and allows the researcher to derive a money demand function from a standard optimization-based framework, but with little value. A cash-in-advance constraint, for example, is an additional constraint on the decision-making process and therefore necessarily welfare reducing. This is contrary to the role of money in increasing the efficiency of exchange.

It is important to note in this regard that much progress has been made recently using models that are able to take money seriously while also being tractable for monetary policy analysis. The "New Monetarist" literature described by Williamson and Wright (2010) is a prime example. Much of this literature uses monetary search models in which individuals seek to meet pair-wise with fellow traders for exchange thereby emphasizing the role of the double coincidence of wants. In addition, the terms of trade are determined in the context of an explicit account of the information available to each agent. In particular, the existence of money in this framework is due to the lack of commitment and absence of record-keeping; "money is memory" (Kocherlakota, 1998). Put differently, money is a substitute for information in the context of a search environment. This feature is important because the characteristics that give rise to various transaction assets can similarly have important implications for macroeconomic analysis. While a number of scholars have taken such a serious approach to the role of money in the past, the framework of Lagos and Wright (2005) has allowed for serious monetary analysis, analytical tractability, and proper microeconomic foundations.

For example, recent work using the "New Monetarist" approach represents a modern link to the history of thought on the subject of money. For example, Beckworth and Hendrickson (2014) outline a model in which non-interest-bearing money co-exists with private assets that earn a dividend. In the context of the model, non-interest-bearing money exists alongside other interest-bearing assets because the other assets are not perfectly liquid. In particular, the liquidity of the privately-produced assets are assumed to be stochastic. The stochastic nature of the liquidity of private assets is consistent with the

nature of privately-produced assets in the course of economic history in that this property captures the shift of assets from those that are information-insensitive to those that are information-sensitive (and therefore less liquid).[33] The explicit properties that explain the existence and co-existence of different types of transaction assets in the framework described by Beckworth and Hendrickson (2014) are similarly important for aggregative analysis. If the privately-produced assets experience an adverse liquidity shock, economic agents are liquidity constrained since the value of their assets is lower. The adverse liquidity shock results in a decline in nominal spending, real economic activity, and the supply of transaction assets. That framework represents a possible explanation for the "Great Recession" that began in December 2007.

In much the same way that providing a strong theoretical basis is necessary for monetary analysis, the way in which money is measured is crucial to the empirical research on money. Over the last 25 years, the financial system in the United States has undergone a significant shift. The expansion of institutional cash pools have largely changed the size and composition of the money supply. The significant differences between the assets developed by the shadow banking system and those of the conventional commercial banking system also signify the importance of properly measuring money. The traditional simple sum aggregation procedure for money is adequate for this purpose since it implies that all assets in a particular aggregate are perfect substitutes. This implication is not only inconsistent with empirical evidence, but it is also contrary to the very emergence of the shadow banking system. Thus, the problem for empirical analysis is ensuring that monetary aggregates are also built on microeconomic foundations and consistent with imperfect asset substitution. It is our view that Divisia monetary aggregates accomplish this task and should be used for all empirical analysis of money. The use of simple sum aggregates should be strongly discouraged.

This paper has provided an overview of the importance of money in the history of economic thought and in practice. It is our view that the empirical results associated with using proper monetary aggregates demonstrates the importance of developing a better understanding of the mechanisms through which changes in the money supply, and monetary policy more generally, affect economic activity. As shown, the history of thought is replete with potential mechanisms through which money can be important. Recent advances in monetary theory give us confidence that we should see great progress in this regard. Money still matters.

[33] For more on this distinction, see Andolfatto and Martin (2013).

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Figure 1: Divisia Measures of the Money Supply

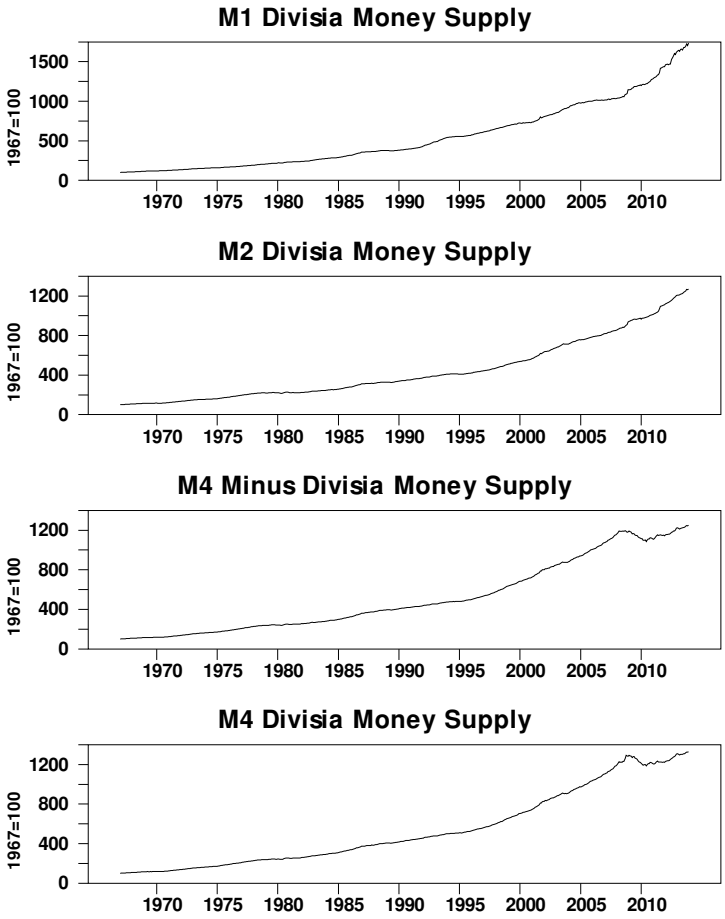

Figure 2: IRFs from Standard Deviation Shock to the Money Supply

1967:Q1-2013:Q44

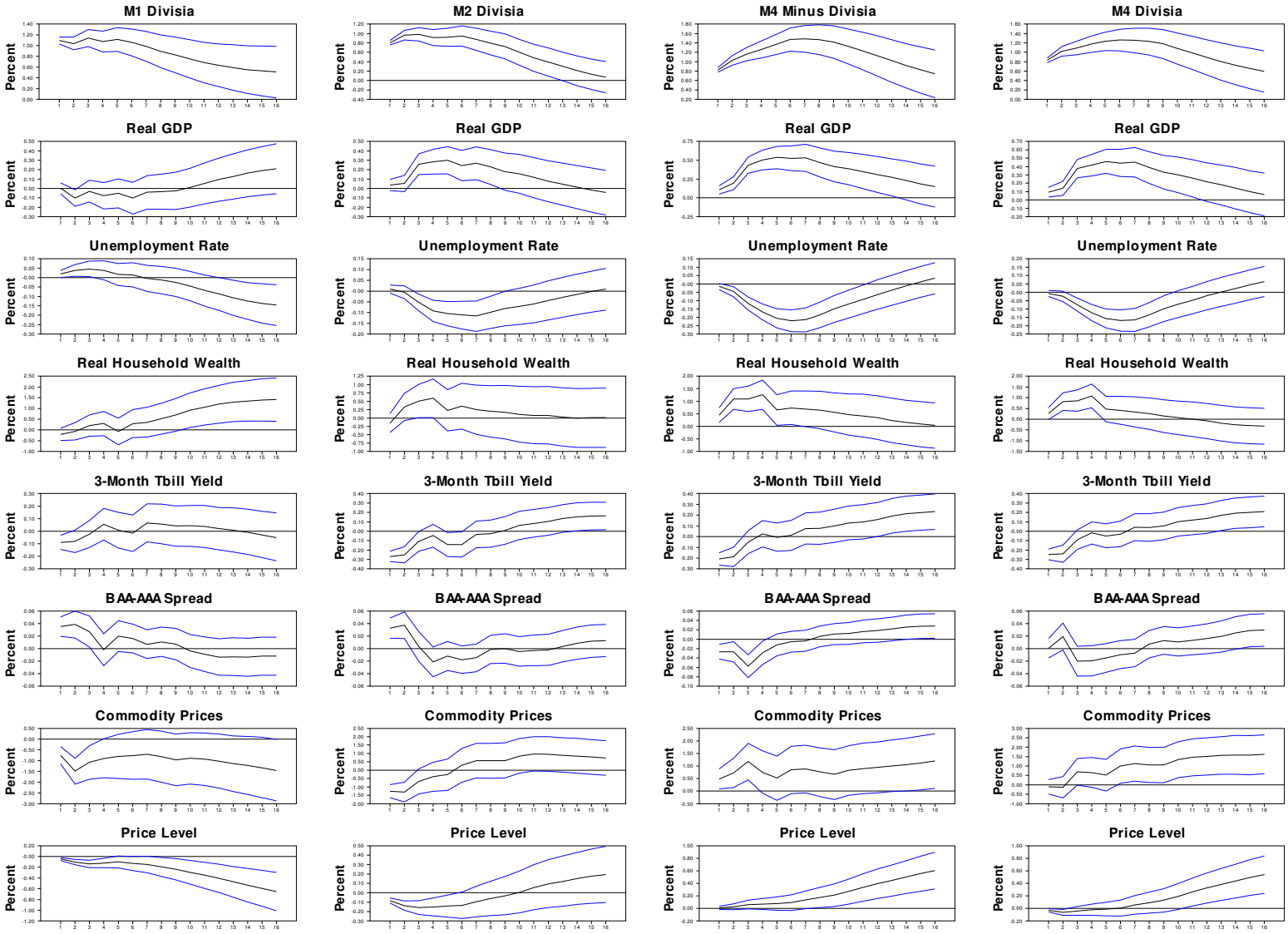

Figure 3: Money During The Great Spending Crash of 2008-2010

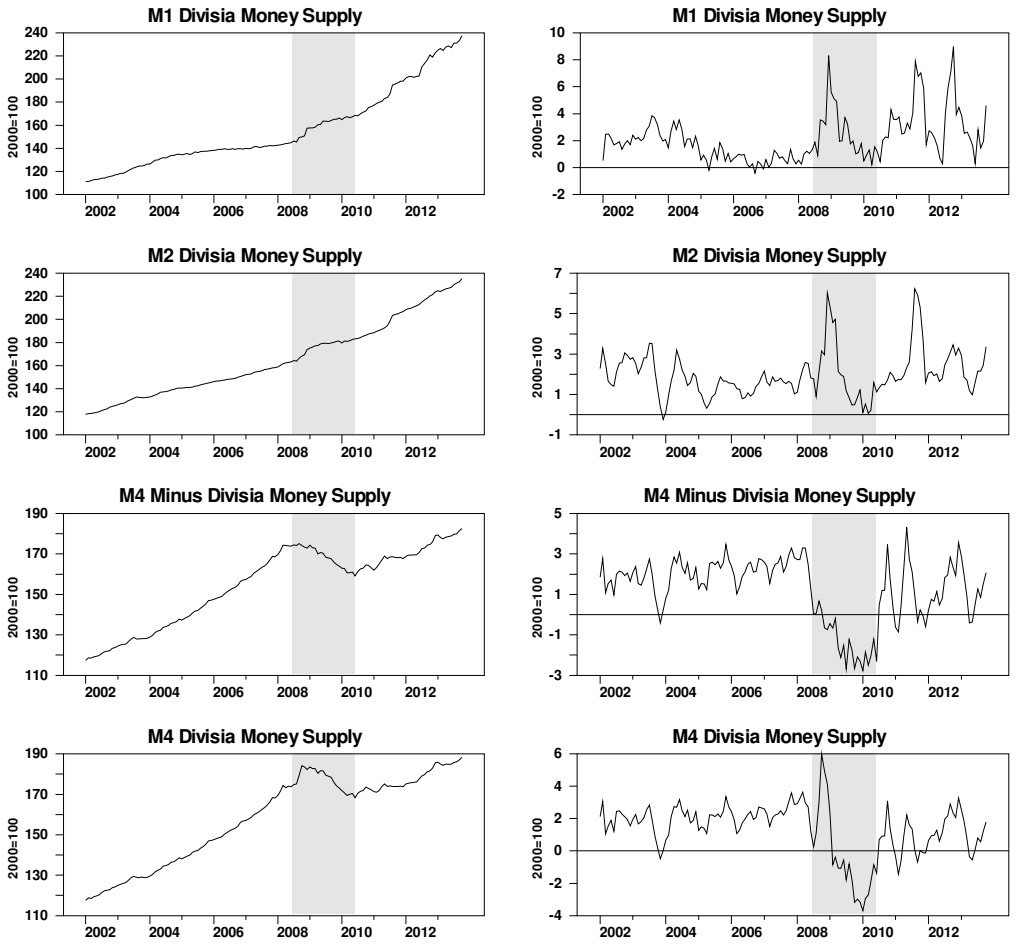

Figure 4: Dynamic Forecast Conditional on Actual Money Supply

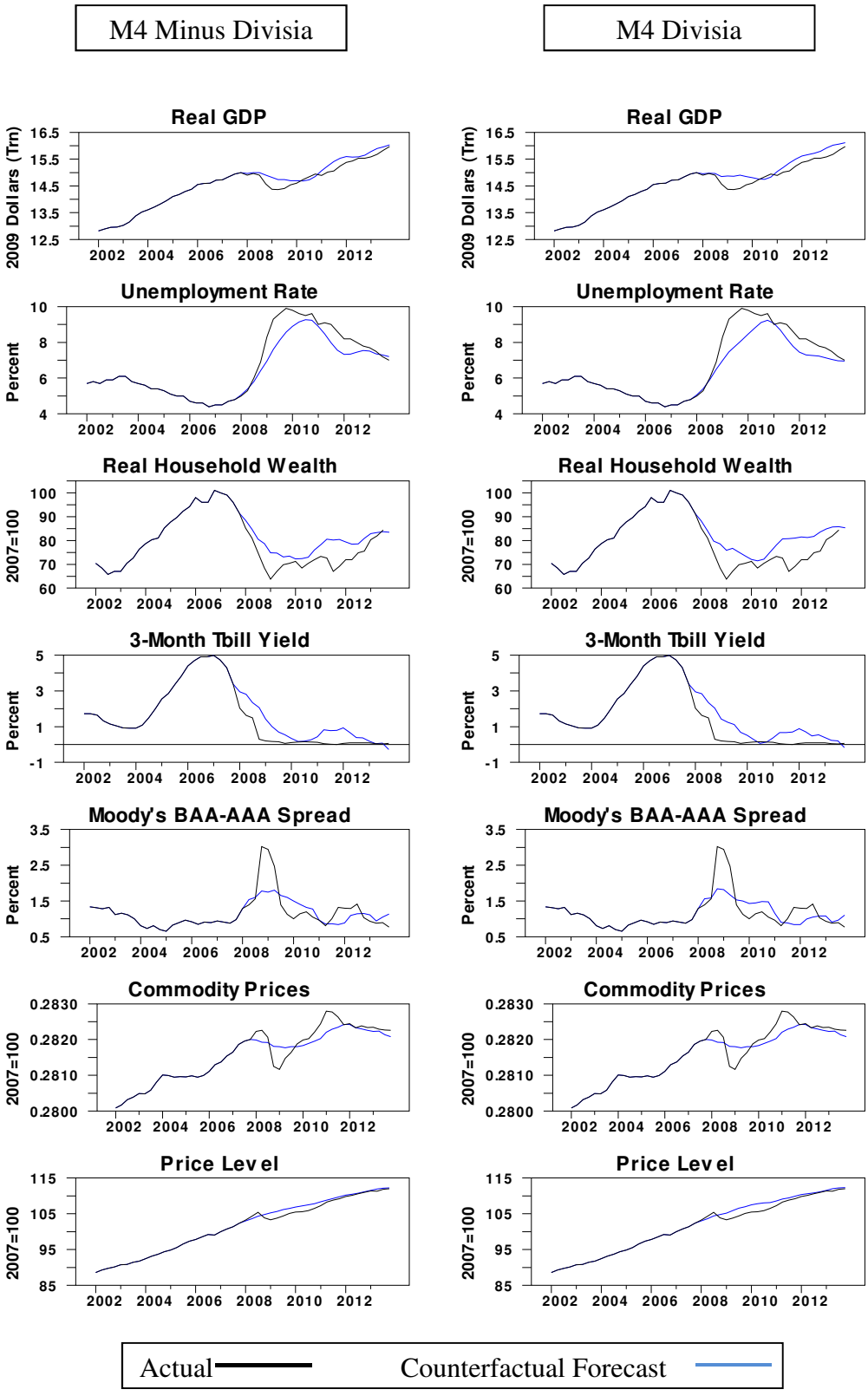

Figure 5: Actual versus Full Employment Money Supply