THE EFFECT OF MONETARY POLICY ON ECONOMIC OUTPUT

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An earlier version of this paper was presented at the 2002 Missouri Economics Conference. We would like to thank session participants for their comments, especially Susan Kozicki and Bob Rasche. The views expressed are the authors'.

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1. INTRODUCTION

There is widespread agreement that the Federal Reserve targets the federal funds rate. While it relatively easy to identify the Fed's operating target, a more difficult and substantive questions is: Does there exist a sufficient statistic—a single indicator—for monetary policy? A sufficient statistic, if it existed, would be useful to policymakers who want to control the macroeconomy, researchers who want to understand the macroeconomy and perhaps forecasters who want to predict the quantitative impact that monetary policy would have on the future path of the macroeconomy.

Two approaches recently have been offered to find such a measure. In one approach, researchers have argued that the real interest rate is the sufficient statistic for monetary policy. The idea is that movements in the real interest rate are key to the transmission mechanism from monetary policy actions to broad measures of economic activity. Economic theory is offered as support for this basic mechanism linking decisions made by central bankers to output fluctuations at business-cycle frequencies.[1]

The second approach maintains that the nominal money supply is a sufficient statistic. Admittedly, movements in the nominal money supply do not necessarily indicate course changes in a monetary policy, particularly in economies where the central bank is targeting a nominal interest rate. Still, Meltzer (1999) argues that there exists sufficient information from monetary sources, especially movements of the real monetary base, that helps predict movements in output. Nelson (2002) tests Meltzer's claim and presents evidence that movements in lagged values of the real monetary base help to

[1] See, for instance, Fuhrer and Moore (1995), Kerr and King (1996), Rotemberg and Woodford (1997), McCallum and Nelson (1999), and Rudebusch and Svensson (1999, 2002) for papers that present specifications interpreted as output demand being a function of the real interest rate.

predict movements in output. His findings are based on quarterly data from the United States and United Kingdom.

The purpose of this paper is to broaden the scope of the on-going investigation on the correlation between monetary policy, money supply and output. Three questions motivate our investigation. First, Rudesbusch and Svensson (2002) study the relationship between monetary policy and output by estimating an output gap equation where the real federal funds rate serves as the sole measure of monetary policy. Based on U.S. data covering the period 1961-1996 (they cite a velocity change after 1996 as rationale for truncating the sample) they find that movements in the *ex post* real federal funds rate are significant in explaining the real output gap. Thus, our first extension is to determine whether there is a significant difference in the parameter estimates that occurs when post-1996 additional data are included.

Second, specifications such as those used by Rudebusch and Svensson and others routinely include a variable that measures deviations in output from trend, referred to as the output gap. A commonly used measure is the one computed by the Congressional Budget Office (CBO). A second question, therefore, is to assess whether the estimated regression coefficients and subsequent policy conclusions are sensitive to the method of detrending output. In this vein we compare results based on specifications using the popular CBO gap measure to ones that decompose output into its trend and cycle components using the Hodrick-Prescott (1997, hereafter HP) filter.

Third, following Meltzer and Nelson, we consider whether different measures of the money supply help predict movements in the output gap, given the influence of the real rate of interest. Our sense is that economic theory leaves the appropriate measure of money as an open question. Meltzer's claim (and Nelson's evidence) that the real monetary base contains information that helps predict movements in the gap is based, in part, on the notion that this measure most closely reflects the operating choices made by the Federal Reserve. It may be that the broader monetary aggregates contain such useful information, and more. Consequently, we systematically assess this point by estimating separate equations corresponding to the monetary base, M1 and M2.

Our results are easily summarized. By extending the data through the year 2000, our evidence indicates that there is a statistical break in the relationship between output gap and the real federal funds rate. We present evidence that does not reject the break 1982:4 as the break point. Our test statistics thus reject the null hypothesis of constant coefficients across the 1961-2000 period.[2] The evidence suggests that conclusions based on this regression—and the usefulness of the real federal funds rate as the sufficient statistic for monetary policy—are not robust. We find that the real federal funds rate is significantly correlated with output in the 1961-82 sample, but is statistically insignificant in the 1982-2000 sample. We also find that this instability is not affected by the estimate we use for the output gap: whether we employ the HP filter-based estimate of the gap or one using the CBO's measure of trend output.

Our evidence also suggests that Nelson's results are sensitive to the estimation period. When base money or M1 is included in the regression with lagged gap and the

[2] An alternative procedure would treat the join point as being a random variable. We specify a nonstochastic join point for two reasons. First, this break point is used because velocities of the narrow monetary aggregates began to shift dramatically about that time. Second, this period is generally recognized as the end of the so-called monetarist experiment when the Federal Reserve reverted to its policy of focusing on controlling the federal funds rate and not the monetary aggregates.

real federal funds rate, we find a statistically significant correlation between lagged real money and the output gap in the 1961-82 sample, but find both to be insignificant in the 1982-2000 sample. In contrast, when the broader M2 aggregate is used along with the real interest rate, there exists a significant correlation for both variables in both sample periods. However, this result is altered using the HP gap: In that instance we find no significance of the real rate or any money measure over the post-1982 period. The complex role of M2 in affecting output is considered in detail.

We interpret our results as indicating that federal funds rate fundamentalism is just as misguided as money supply fundamentalism. In the heyday of Monetarism, many economists believed that some measure of money served as a sufficient statistic for monetary policy. In recent years, in the wake of the success of the Taylor Rule, the same kind of optimism has come to surround the federal funds rate. Perhaps, many hoped, the federal funds rate would fulfill the long-sought-after role as a sufficient statistic for monetary policy. However, the results from this paper demonstrate that single-equation OLS models with just one or two monetary indicators, while serviceable for simulations, do not provide stable, statistically significant econometric results.

The remainder of the paper is organized as follows. Section 2 specifies the model that is estimated. In Section 3 we present results for the baseline model, on the stability of the relationship when the sample is extended to include the 1997-2000 observations, and we extend the analysis to examine the sub-samples and examine the role of money as a marginal predictor of future output movements. Section 4 offers a brief summary and recommendation for future analyses.

2. THE MODEL

Much empirical and theoretical analysis of monetary policy in recent years relies upon a dynamic general equilibrium model wherein nominal price rigidities establish lags in the effects of policy actions. The model, used by Goodfriend and King (1997) and McCallum and Nelson (1997), among others, for a theoretical treatment of policy, is very much in the spirit of the standard IS-LM Keynesian model. Clarida, et al. (1999) dubbed it the "New Keynesian" macro model.[3] The model is developed in greater detail in a variety of papers. Here we opt for a brief presentation, referring the reader to the other published works for details.[4]

The so-called consensus model is described by three equations: an aggregate demand equation, a Phillips-type curve equation and a policy rule. A representative version of this dynamic model may be written as[5]

(1) $y_{gt} = a\, y_{gt-1} + b\, E_t(y_{gt+1}) - c\,[R_t - E_t(p_{t+1})] + e_{1t}$

(2) $p_t = d\,(y_{gt}) + w_1\, p_{t-1} + w_2\, E_t(p_{t+1}) + e_{2t}$

(3) $R_t = r^* + E_t(p_{t+1}) + f\, y_{gt-1} + g\,(p_{t-1} - p^T)$

where y_{gt} is the output gap, measured as the deviation of real output from its potential, R is the nominal rate of interest, p is the rate of inflation, r* is the equilibrium real rate of interest and p^T is the central banker's target rate of inflation. The terms e_1 and e_2 are stochastic shocks, and the coefficients w_1 and w_2 sum to unity.[6]

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[3] Under particular specifications, the model delivers linear decision rules that roughly correspond to the educed-form equations presented in the standard IS-LM model.
[4] See for example, Clarida, et al (1999) for a discussion and references.
[5] This version is taken from Meyer (2001). It is representative of the models found in, among others, Fuher and Moore (1995), Clarida et al. (1999) or McCallum and Nelson (2000).
[6] To ensure that stability conditions for the system of first-order linear stochastic equations are satisfied.

Equation (1) is akin to the IS equation in Keynesian models save for the fact that the output gap is dependent on future output as well as the real rate of interest. A key element in this formulation is the forward-looking nature of the model. The Phillips curve given as equation (2) reveals the role of expected inflation and past inflation, the latter component providing price stickiness in the model. This price stickiness helps generate the lagged response time of the economy to policy changes, emanating from the policy rule given in equation (3). In the policy rule, the interest rate is the central bank's policy instrument and is adjusted as the economy deviates from the policymaker's perception of where actual inflation and output growth are relative to the target rate of inflation and full-employment or trend output growth.

One distinction of this model is that it eliminates the LM function. In a standard IS-LM model, the LM function describes equilibrium in the money market, where money supply and money demand equate to derive the market-clearing real interest rate. The model above jettisons this relationship, replacing it with a description of how policymakers establish the equilibrium interest rate. Policy actions are taken to adjust the money supply, given money demand conditions, to achieve an interest rate that satisfies the conditions laid out in equation (3). In an older terminology, the money supply is demand determined and, if the rate of interest is fixed according to equation (3), it is the money supply that must accommodate changes in demand. But, as many have noted, the Taylor Rule type of specification adequately captures the process by which modern central banks conduct policy.[7]

[7] Still, there is much debate over the empirical robustness of the Taylor Rule. Examples of studies investigating its stability and usefulness over time include Kozicki (1999), Hetzel (2000), and Onatski and Stock (2000).

Another feature of this model is that money plays no direct role in determining the path of output or inflation. Instead of policy actions impacting money growth rates and then the economy via some real-balance effect, the policy transmission mechanism embedded in this model runs from policy changes that move the short-term real rate of interest which in turn affect the output gap which then alter inflation over time. The assumed short-term rigidities in the model ensure that a change in the reserve position of the banking system impacts short-term real interest rates, since prices are slow to adjust. As Meyer (2001) suggests, this model "may bypass money, but it has retained the key conclusion that central banks ultimately determine the inflation rate."

For this model to be a useful description of the dynamics of the economy and as a guide to monetary policy, it is important to establish the empirical validity of the link between policy actions and economic outcomes. In that sense we focus on equation (1) and its empirical counterparts found in the literature. We are interested in establishing whether the transmission mechanism from policy actions to the real rate to the real economy is robust. If the gap is not affected in a predictable manner by changes in the real rate of interest, or if one can establish a direct effect of monetary aggregates on the gap independent of movements in real interest rates, then policy decisions based on this model are questionable.

Recent estimates of equation (1) have been made for several countries, though most attention focuses on results for the U.S. [Rudebusch and Svensson (2002), Nelson (2002)] and the United Kingdom [Nelson (2002)].[8] We present the main regression result from Rudebusch and Svensson (2002) as a point of reference, especially given the

[8] Amato and Gerlach (2002) provide estimates for South Africa.

attention their work has garnered. Estimating a version of equation (1) for the U.S. over the period 1961 to 1996, Rudebusch and Svensson report the following outcome (t-statistics in parentheses):

$$(4) \qquad y_{gt+1} = \underset{(14.70)}{1.161\, y_{gt}} - \underset{(3.36)}{.259\, y_{gt-1}} - \underset{(2.75)}{.088\, (i - p_t)}$$

$$\bar{R}^2 = .90; \;\; SE = .823; \;\; DW = 2.08$$

where y_{gt} is the output gap, measured as the percentage difference between actual real GDP and potential GDP based on the Congressional Budget Office (CBO) construct, i is the four-quarter average of the quarterly average of the federal funds rate, and p_t is the inflation rate, measured as the four-quarter average rate of inflation in the GDP chain weighted index.[9] The variables are constructed as deviations from the mean values before estimation, hence the omission of a constant term.

Rudebusch-Svensson (2002) report that this estimated relation is stable across their 1961-96, and that "lags of money (in levels or growth rates) were invariably insignificant when added" to equation (4).[10] Rudebusch and Svensson use this finding to argue for dropping monetary aggregates as one of the "three pillars" approach to policy established by the European Central Bank. Indeed, Rudebusch and Svensson use this empirical result to support the theoretical conclusions reached in the model above, namely, that monetary policy should focus on the real rate of interest and eschew monetary aggregates in determining a policy course.

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[9] See Rudebusch and Svensson (2002) for more discussion of this.

[10] This outcome corroborates the findings of Gerlach and Smets (1995) who find that adding M2 or M3 fitting a three-variable VAR model consisting of output, inflation and a nominal interest rate, does not improve the model's explanatory power when estimated for each of the G-7 countries. The inability of simple VAR models to reject the importance of money has been explored in Hafer and Kutan (1998, 2002). Their results indicate that, for many countries including the U.S., the assumed stationarity assumptions imposed on the data significantly impact the outcomes.

This conclusion has been questioned by Nelson (2002). Nelson argues that central banks choose to smooth out changes in real money balances; this turns a current change in real money into a signal of expected future changes in real money. Therefore, since persistent increases in real money balances will push down long-term interest rates, today's observable rise in real money is associated with a fall in the imperfectly-observable (but extremely important) long-term real interest rate. Meltzer (1999), using somewhat different reasoning, argues that monetary policy actions that adjust short-term real interest rates (assuming sticky prices) must impact the banks' balance sheet. If policy actions are not fully summarized by interest rate changes, and since interest rates are affected by more than monetary policy actions alone, then there exists an empirical role for the monetary aggregates to have an affect on aggregate demand that is independent of the real interest rate. Indeed, Nelson's estimates for the US and the UK using the real monetary base as an additional variable to equation (4) show that its lagged values are statistically significant.

In the next section, we extend the analysis by examining the role of the real rate of interest and money in determining movements in the US output gap. In addition to investigating the sensitivity of the results different measures of money—e.g., Nelson focuses on the monetary base, Rudebusch and Svensson on M2—we consider whether the way in which the gap is measured affects the policy conclusions drawn from the estimation results. Perhaps equally important we address the question of whether the estimated relations are stable over time.

3. ANOTHER LOOK AT THE RESULTS

Nelson's (2002) evidence suggests that the results of Rudebusch-Svensson (2002) are sensitive to the choice of monetary aggregate included in the estimation. Because their results have been cited as strong evidence in favor of a policy that focuses on the behavior of the real federal funds rate, it is imperative that other issues be addressed. For example, Rudebush and Svensson use the CBO measure of potential GDP to construct their output gap even though there are alternatives that have been suggested in the literature, such as one based on applying an HP filter.[11] Rudebusch and Svensson also argue that because the reliability of M2 may be hampered by a velocity shift that occurred in the early 1990s, they limit their analysis to a data sample that ends in 1996. Are the results robust to extending the sample? In this section, we re-consider the affects of the real rate and money on the output gap by considering a) the sample period, b) alternative measures of potential output and c) the inclusion of different monetary aggregates.

3.1 Estimates of the Basic Model

Table 1 provides our estimate of equation (4). The variables are constructed as in Rudebusch and Svensson (2002) and Nelson (2002).[12] Column (2) presents the results that we will henceforth refer to as our "baseline" estimate since it is most closely associated with equation (1) in the model described earlier, and it uses the same sample period as Rudebusch and Svensson.[13] For purposes of comparison, column (1) of Table 1 recaps the Rudebusch and Svensson results based on their 1961-1996 sample data. Our

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[11] In an earlier paper, Rudebusch-Svensson (1999) suggest that using a simple quadratic trend approach to deriving the output gap does not substantially alter the results.

[12] Data for the federal funds rate and the GDP chain-weighted price index are taken from the Federal Reserve Bank of St. Louis's FRED data base; the gap measure is measured using the CBO potential output series.

attempt to replicate their results is quite successful: The magnitude and significance of the estimated coefficients are comparable, as is the overall fit of the equation. The results in the first two columns of Table 1 indicate that, even after accounting for prior movements in the gap, the real federal funds rate possesses statistically significant information that improves the prediction of the gap.

Are these results sensitive to the sample period? The estimates reported in column (3) of Table 1 address that issue by extending the sample through 2000.[14] With regard to the updated sample, the CBO-based estimates using the 1961-2000 data are almost identical to those for the 1961-1996 sample. The estimated coefficients are quite similar in size and significance, as is the comparability of the summary statistics. Thus, the evidence suggests that increasing the sample to the end of the business cycle does not materially affect the parameter estimates.

Are the results sensitive to how one measures the output gap?[15] We use two gap series, the CBO measure of potential output, and the other derived from an application of the HP filter. While the two series behave in a similar fashion across the sample, they are not identical: the simple correlation is 0.74. Moreover, the two series exhibit different characteristics at any one point in time. For example, the relative size in the gap measure changes in the late-1960s, the early 1980s. In the early 1990s the CBO gap measure is larger than that from our HP filter. In 1996 that pattern shifts, with the CBO gap becoming increasingly positive and the HP gap measure indicating little difference

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[13] Note also in this version we demean the data before estimation; hence the omission of a constant term.
[14] In this and all future regressions we do not demean the data prior to estimation.
[15] A number of papers compare and contrast alternative measures of potential output and how these different measures can impact policy decision. A representative collection of such work is de Brouwer (1998), Clarida, et al (2000), Claus, et al (2000), Haltmaier (2001) and the CBO (2001). Neiss and Nelson

between actual and potential output.[16] Since this shift-point occurs exactly at the time when our sample-update begins, it is possible that the earlier results could be affected.

The differences shown in the behavior of the gap measures suggest that comparing estimates using each measure is a useful robustness check on the baseline model. Column (4) reports the results for the full sample when the HP gap measure is used in place of the CBO gap. While there are some quantitative changes, using the HP filter to generate the gap measure delivers the same qualitative story: the lagged real interest rate continues to significantly impact the gap.

We also considered the overall stability of the estimated equations. To this end we calculated standard F-statistics, using 1982.4 as the hypothesized break point. The F-test based on the 1961-1996 sample indicates that we cannot reject stability, at least at the 10 percent level. When the 1961-2000 sample is used, however, the null of stability is rejected easily. As shown in columns (3) and (4), there is strong evidence of parameter instability in the estimated equation regardless of whether one uses the CBO or HP measure of the gap.

This instability is examined further by estimating the baseline model for each sub-period. These results are reported in Table 2. Irrespective of the gap measured used, the sub-period estimates show that the real rate of interest has absolutely no predictive power for the gap in the post-1982 sample. In both cases the estimated coefficient on the real rate, though correctly signed, is not statistically significant at any reasonable level. It would appear, then, that the empirical importance of the real federal funds rate stems

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(2002) provide a useful discussion of measuring the output gap as it relates to predicting inflation within the framework of a New Keynesian Phillips curve.

[16] The sensitivity of HP filters around the beginning and end of samples is discussed in Haltmaier (2001).

from its correlation with the gap during the 1961-1982 period, but not since. This finding thus calls into question the reliability of the model's ability to empirically pin down this part of the policy transmission mechanism.

3.2 A Role for Money and Money Multipliers

Is there a direct statistical role for money within the model? To investigate this question we add alternative measures of money to the baseline model. Following previous related work we first created real money balances by deflating nominal money by the GDP chain-weighted price index. To be consistent with the way in which the real rate of interest is measured, the money variable is then calculated as the percentage annual change in real money balances lagged one quarter. Unlike Nelson (2002), who introduces money into the equation using simple lagged values of quarterly money growth, our approach is in the spirit of how the real rate is measured and estimated in the Rudebusch and Svensson study.

Table 3 presents estimates of the baseline model with money added. Three measures of money are used: the monetary base, M1 and M2.[17] The initial column under each money measure uses data for the full 1961-2000 sample. The full-period results using the CBO gap are located in the upper panel of Table 3. These results are uniform in two ways: First, the estimated coefficient on the real rate of interest is negative, statistically significant and of nearly equal size across regressions. Thus, as in previous work, there appears to be a significant affect of changes in the real rate on the output gap. Second, the estimated coefficient on lagged money also is statistically significant across regressions. Whether money is measured as the monetary base, M1 or M2, money exerts a significant, independent impact on the output gap. Whether this reflects a real balance effect or Nelson's (2002) direct money channel, these results reject the popular notion that money plays no role in determining the path of economic activity.

The bottom of each column reports the probability of an F-statistic calculated assuming a 1982.4 break. For each CBO-based equation, the hypothesis of parameter stability is rejected, although only at the ten percent level for the equation that includes the monetary base. As before, this raises the question of whether the statistical importance of the real federal funds rate and money found for the full period are limited to the pre-1982 observations. The second column under each monetary aggregate answers this question. There we find that, based on 1982-2000 data, only when the monetary aggregate is M2 is the significance of *both* the real interest rate and money maintained. For the equations using the monetary base and M1, money and the real rate of interest are insignificant. This suggests that relying on the simple baseline model may not adequately capture the dynamic and complicated relation between the real interest rate, real money balances and the economy. The results using the CBO gap suggest that ignoring money in determining the transmission of monetary policy to the economy is unwise.

To determine if these results are robust to a change in the measure of the gap, the lower tier of Table 3 reports estimates using the HP-based gap measure. Those estimates provide a different picture of the possible linkages between the real rate of interest, money and the output gap. Looking first at the full-period estimates, the real federal funds rate continues to be statistically significant. Changing the gap measure impacts the

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[17] The nominal money measures are taken from the FRED data base. The monetary base measure used here

estimated coefficients on money: While M1 and M2 are significant, the coefficient on the monetary base is not significant at even the 10 percent level.[18] The stability test results, reported below each column, indicate that instability is problematic only for the regression using M1. For the regressions using monetary base and M2, however, we cannot reject stability at a reasonable level of significance. Still, given our earlier results using the CBO gap, are the post-1982 results vastly different than the full-period estimates? Those estimates corroborate the results found in the upper tier of Table 3: the significance of the real interest rate appears to occur from the pre-1982 portion of the sample. In contrast to the results using the CBO gap, when the HP gap is used the significance of M2 also is reduced.

Is there an explanation for the apparent instability in the affects of the monetary aggregates? One way to address this question is to decompose the aggregates into their component parts; namely, the monetary base and their respective multipliers. Leaving a theoretical discussion aside for a moment, the results in Table 4 are from regressions in which the monetary aggregates—M1 and M2—are decomposed into the base and their money multipliers.[19] One result is common across this set of regressions: as the sample period shrinks from 1961-2000 to 1983-2000 one sees a reduction in the coefficients on both the monetary base and money multipliers.

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is the St. Louis Adjusted monetary base.

[18] These results do not corroborate the findings of Nelson (2002). Nelson uses Anderson and Rasche's (2000) adjusted monetary base series which removes estimated holdings of U.S. currency from the St. Louis adjusted monetary base series. For sake of consistency, one should adjust the currency component of all the aggregates. Hence our decision to use the published data.

[19] Note that the money multiplier is measured in percentage change terms. More specifically, the difference of the log ratio of the monetary aggregate divided by the monetary base. An early attempt to address this aspect of money's importance is Gordon (1985).

We are particularly interested in determining whether the coefficient on lagged base is significantly different from the coefficient on the lagged value of the money multiplier. As the results in Table 4 show, the estimated coefficients generally are significantly different from one another.[20] Interestingly, under the HP measure of the gap, the size of the coefficients switch as the sample period gets shorter; that is, the coefficient on lagged base money is algebraically larger than the coefficient on lagged money multiplier in the 1961-2000. When we move to the 1983-2000 sample period, the coefficient on the lagged money multiplier is larger than the coefficient on the lagged monetary base. However, the differences between the coefficients again are not significantly different from one another.[21] The implication is that the predictive content of lagged values of money is not materially affected by focusing on whether the money is inside or outside money.

Another surprising result is the statistical significance of changes in the monetary base in the M2-multiplier regression, regardless of the time period. In the regression that only includes the monetary base, the role for money is small in the overall sample, and neglible and incorrectly signed in the post-1982 sample. The story changes, however, for specifications in which the multiplier is included as an explanatory variable. Focusing on the M2 results, we see that when the monetary base rises by 1%, output rises by between 0.08 and 0.13 percent that quarter, regardless of the sample period. The M2 multiplier also is statistically significant.

[20] The Wald test probabilities from testing the hypothesis that the estimated coefficient on base money and the multiplier are, for the full period using the CBO gap, 0.24 and 0.11 for M1 and M2, respectively. When the HP gap measure is used, the probabilities are 0.34 and 0.87.
[21] The estimated probability for the M2 measure using the 1983-2000 data is 0.06, however.

These two facts—the larger role for the base and the positive impact of the multiplier—can be reconciled with the smaller role for the base found in most regressions if central bank innovations are responses to shifts in the multiplier. If the multiplier rises this quarter, a central bank trying to stabilize output will often restrict base money. This would lead to a lower correlation between money and output compared to a world with a stable multiplier. Further, the M2 multiplier's significant impact on output is itself interesting. It raises questions about the proper way to think about money and the business cycle. We now turn to these theoretical issues.

3.3 Theoretical foundations of a role for money

These results in Tables 3 and 4 indicate that while lagged M2 contains useful information about the current output gap, narrower measures of money apparently have lost some of their predictive usefulness over time. Outside money has been a less useful predictor than inside money—money that represents liabilities of the banking system—in recent decades. Why should this be so?

There is a substantial theoretical literature on the affects of outside money and inside money, much of which addresses these business-cycle questions. The insight offered by this literature and our results is that changes in outside money and inside money may have different macroeconomic affects. To illustrate this point, in Freeman and Huffman's (1993) economy a permanent increase in outside money can result in lowering the real return to outside money. Inside money endogenously increases and output increases. Here outside money and inside money are both positively related to future movements in output, as appears to have been the case in the 60's, 70's and early 80's. Alternatively, a reduction in the cost of banking can result in higher real returns paid on deposits and increases in future output. In this second setting, inside money is positively related to output, but outside money is uncorrelated with output. These changes in the cost of banking could range from technologically-induced innovations to shocks to bank balance sheets, such as the shocks to California subsidiaries of Japanese banks, documented by Peek and Rosengren (2000).

Our point is simply that there is a theoretical justification for examining outside and inside money as separate quantities in terms of each one's statistical relationship with output. Movements in outside money can reflect very different economic forces than movements in inside money. As the Freeman and Huffman (1993) model illustrates, these economic forces can result in qualitatively different correlations between outside money, inside money, and output.

Perhaps the clearest way to interpret the declining predictive power of inside money and the short-term real rate in our analysis is the commonplace observation that our financial system is far richer than in earlier decades. The Federal Reserve controls the real short-term rate, to be sure. In earlier decades, the U.S. economy's behavior was consistent with Nelson's (2002) model, where changes in money were proxies for changes in future real rates. But in recently that has changed. Real M2 forecasts future changes in the output gap, but narrower money measures that are more closely under the Fed's control appear to have no substantial relationship with the output gap. This may be because changes in M2 were caused mostly by changes in narrow money in the early period—where Nelson's model accurately described U.S. experience—but in later decades changes in M2 tended to be caused by shocks emanating from both the public and private sectors. Even though these shocks may explain the break down the relationship between narrow money and output, the relationship between a broad money measure like M2 and output remains.

4. CONCLUSIONS

Our results indicate that the importance of the short-term real rate of interest as a sufficient statistic for monetary policy in the U.S. may be overstated. Investigating the role of the real federal funds rate within the spirit of studies such as Rudebusch and Svensson (2002) and Nelson (2002), we find that the statistical importance of the real rate in explaining movements in the output gap is not robust. Using a data set that spans the 1961-2000 period, we find that the real rate-gap link is not stable. Using a 1982 break point, our evidence suggests that the statistical importance of the real rate found in earlier work likely emanates from the 1961-1982 period. When estimated using post-1982 data, the real rate has no statistically significant impact on the output gap at any reasonable level of significance. This finding also is robust to changes in the gap measured used, whether it is the common CBO measure or one derived from an HP filter.

We also have examined the potential role for money. Our results suggest that calls for omitting money from the set of variables used to determine monetary policy actions are premature. Though these results also are sensitive to the sample, with the strongest result coming from estimating a gap equation that includes M2 and the real federal funds rate. We cannot reject the statistical importance of M2's influence on the gap, independent of the influence from movements in real rate of interest.

Are professional forecasters ahead of academic researchers in this area? Indeed, why does the Conference Board continue to use real M2 as a leading economic indicator, long after the academic mainstream moved away from money measures in business cycle research? As Lucas (1976) argued so forcefully, forecasting and policymaking require two different tools. But as Lucas (1977) reminds us, modern business cycle researchers may well return to the pre-Keynesian days where our predecessors hoped to catalogue and understand the many institutional factors creating economic instability. The evidence presented here on the possible role of financial-sector “shocks” as a driver of business cycles naturally encourages us to find out whether the disruptive impact of those shocks can or should be minimized. By including the oft-neglected money multiplier in this analysis, we uncovered evidence of the continued impact of both base money and M2 in recent decades, evidence that was not apparent in regressions that only include base money.

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Table 1
Estimates of Baseline Model
Sample periods: 1961-96 and 1961-2000

	Replication results[1]		**Gap Measure**[2]	
	RS	OURS	CBO	HP
Variable[3]	1961-1996	1961-1996	1961-2000	1961-2000
GAP (-1)	1.162	1.177	1.177	1.078
	(14.70)	(15.09)	(15.74)	(14.34)
GAP (-2)	-.259	-.269	-.261	-.250
	(3.36)	(3.49)	(3.53)	(3.32)
Real Rate(-1)	-.088	-.085	-.077	-.062
	(2.75)	(2.74)	(2.57)	(2.23)
Constant	NA	NA	.002	.002
			(2.12)	(1.87)
$\bar{R}^2$	.90	.91	.91	.78
SE	.823	.008	.008	.009
DW	2.08	2.10	2.09	2.11
F (pr)*	NA	.101	.039	.038

1. RS refers to Rudebusch-Svensson (2002). These estimates use the CBO gap measure. Absolute value of t-statistics appear in parentheses.
2. HP refers to the gap measure, based on the Hodrick-Prescott (1997) filter.
3. Variables are defined in text.
4. Probabilities for F-statistic based on 1982/IV break.

Table 2
Subperiod Results[1]

	Gap Measure/Sample Period			
	CBO		HP	
Variable	1961-1982	1983-2000	1961-1982	1983-2000
GAP (-1)	1.083	1.195	.991	1.106
	(10.50)	(10.84)	(9.72)	(10.26)
GAP (-2)	-.153	-.295	-.139	-.314
	(1.46)	(2.80)	(1.32)	(3.13)
Real Rate(-1)	-.174	.012	-.160	.026
	(3.45)	(.32)	(3.38)	(.76)
Constant	.003	-.0003	.002	-.0005
	(2.10)	(.20)	(2.01)	(.36)
$\bar{R}2$	.910	.94	.781	.83
SEE	.009	.005	.009	.004
DW	2.03	2.20	2.07	2.30

1. See notes to Table 1.

Table 3
Estimations Results with Money[1]

Results using CBO gap
Monetary Aggregate/Sample Period

Variable	MB 1961-2000	MB 1982-2000	M1 1961-2000	M1 1982-2000	M2 1961-2000	M2 1982-2000
GAP (-1)	1.127	1.254	1.139	1.260	1.013	1.112
	(14.44)	(11.33)	(14.90)	(11.76)	(13.28)	(10.36)
GAP (-2)	-.226	-.339	-.218	-.347	-.106	-.214
	(2.99)	(3.16)	(2.85)	(3.28)	(1.42)	(2.07)
Real Rate(-1)	-.086	-.001	-.079	-.001	-.081	-.118
	(2.88)	(.04)	(2.66)	(.15)	(2.91)	(2.46)
M(-1)	.040	.004	.033	-.004	.106	.099
	(2.06)	(.18)	(2.01)	(.28)	(5.18)	(3.47)
Constant	.002	-.000	.002	.0003	-.001	.002
	(1.39)	(.00)	(1.79)	(.23)	(.80)	(1.32)
$\bar{R}^2$	.91	.94	.91	.94	.92	.95
SE	.007	.005	.008	.005	.007	.005
DW	2.10	2.27	2.06	2.29	2.05	2.21
F (pr)*	.09		.00		.06	

Results using HP gap
Monetary Aggregate/Sample Period

Variable	1961-2000	1982-2000	1961-2000	1982-2000	1961-2000	1982-2000
GAP (-1)	1.050	1.198	1.042	1.200	1.005	1.148
	(13.66)	(11.24)	(13.65)	(11.34)	(13.20)	(10.76)
GAP (-2)	-.233	-.368	-.209	-.366	-.152	-.304
	(3.07)	(3.60)	(2.71)	(3.52)	(1.92)	(2.88)
Real Rate(-1)	-.065	.0001	-.066	.001	-.063	-.053
	(2.36)	(.17)	(2.41)	(.12)	(2.35)	(1.18)
M(-1)	.028	.004	.032	.002	.066	.050
	(1.58)	(.20)	(2.10)	(.22)	(3.29)	(1.87)
Constant	.001	-.0001	.001	.0001	-.0001	.001
	(1.22)	(.05)	(1.55)	(.07)	(.12)	(.75)
$\bar{R}^2$	.78	.85	.78	.85	.79	.86
SE	.007	.005	.007	.004	.008	.004
DW	2.12	2.36	2.09	2.35	2.07	2.28
F (pr)*	.13		.001		.12	

1. See notes to Table 1

Table 4
Estimations Results with Base and Money Multiplier[1]

Results using CBO gap
Monetary Aggregate/Sample Period

Variable	MB 1961-2000	MB 1983-2000	M1 1961-2000	M1 1983-2000	M2 1961-2000	M2 1983-2000
GAP (-1)	1.127	1.196	1.120	1.187	0.982	1.050
	(14.44)	(10.54)	(14.29)	(10.31)	(12.53)	(9.62)
GAP (-2)	-.226	-.296	-.211	-.301	-.086	-.155
	(2.99)	(2.73)	(2.74)	(2.76)	(1.13)	(1.49)
Real Rate(-1)	-.086	.011	-.085	.012	-.087	-.158
	(2.88)	(.26)	(2.81)	(0.29)	(3.12)	(2.82)
MB(-1)	.040	-.002	.048	-.003	.131	.081
	(2.06)	(.12)	(2.32)	(0.12)	(5.11)	(2.80)
Multiplier(-1)			0.021	-.010	.102	.013
			(1.08)	(.060)	(4.96)	(3.96)
Constant	.002	-.0002	.002	-.001	-.001	.005
	(1.39)	(.07)	(1.40)	(.24)	(1.12)	(2.12)
$\bar{R}^2$	.91	.93	.91	.93	.92	.94
SE	.007	.005	.008	.005	.007	.004
DW	2.10	2.19	2.07	2.22	2.06	2.12
F (pr)*	.09		.00		.17	

Results using HP gap
Monetary Aggregate/Sample Period

Variable	MB 1961-2000	MB 1983-2000	M1 1961-2000	M1 1983-2000	M2 1961-2000	M2 1983-2000
GAP (-1)	1.050	1.108	1.036	1.107	0.993	1.073
	(13.66)	(10.17)	(13.41)	(10.10)	(12.85)	(9.89)
GAP (-2)	-.233	-.314	-.209	-.310	-.148	-.247
	(3.07)	(3.11)	(2.70)	(3.00)	(1.87)	(2.34)
Real Rate(-1)	-.065	.023	-.067	.022	-.065	-.063
	(2.36)	(.64)	(2.43)	(.62)	(2.41)	(1.09)
MB(-1)	.028	-.005	.039	-.004	.078	.032
	(1.58)	(.24)	(2.04)	(.22)	(3.26)	(1.18)
Multiplier(-1)			.027	.003	.062	.061
			(1.49)	(.21)	(3.02)	(1.87)
Constant	.001	-.0002	.001	-.0001	-.0003	.003
	(1.22)	(.11)	(1.29)	(.07)	(.30)	(1.09)
$\bar{R}^2$	.78	.83	.78	.83	.79	.83
SE	.007	.004	.007	.004	.007	.004
DW	2.12	2.30	2.09	2.29	2.07	2.22
F (pr)*	.13		.000		.21	