MONEY, THE MONETARY BASE, AND NOMINAL GNP

William E. Cullison

The relationship between money and nominal GNP has been generally stable, financial innovations notwithstanding, although the relationship between the monetary base and nominal GNP has been slightly more predictable.

Recently, a number of influential policymakers have argued that innovations in the means of making payment have changed past relationships between the money supply and aggregate income (see, for example, Morris [18], Solomon [20], and Wallich [21]). These policymakers have asserted that financial innovations such as NOW accounts, money market mutual funds, customer repurchase agreements, and deposit-sweeping arrangements obscure the relationship between a narrowly defined monetary aggregate such as M1[1] and money balances held for transactions purposes. The apparent plausibility of this view has spawned the corollary notion that M1 should be replaced as a primary intermediate target[2] for monetary policy. Frank Morris, President of the Federal Reserve Bank of Boston, for example, advocates total liquid assets (L) as an "intermediate goal" [18, p. 9]. Others have simply advocated that the FOMC be flexible in choosing which aggregate to target.

The first purpose of this paper is to investigate whether financial innovations have indeed obscured the relationship between narrow monetary aggregates and nominal income. On the basis of the empirical evidence, the article shows that contrary to popular opinion, financial innovations did not have a substantive effect on the relationship between M1 and GNP over the period examined, 1959 to 1981 (except possibly for the three-year period from 1975 to 1978).

This is, of course, not to say that financial innovations might not change the historical relationship of M1 to GNP at some future date. But even if that relationship changed, there is another money/income relationship, namely that between the monetary base[3] and GNP, that is thought to be relatively immune to financial innovations (see Meltzer [17] for a succinct explanation of this assertion). Therefore, a second purpose of this paper is to examine the monetary base to see whether it has potential as an intermediate target for monetary policy. Several recent studies have tended to dismiss the monetary base as an intermediate target on the grounds that M1 has borne a closer empirical relationship to GNP over the years than has the monetary base. This article reexamines the evidence and concludes that the base actually bore a slightly more predictable relationship to GNP than did M1.

Narrowly Defined Monetary Aggregates As Targets for Monetary Policy

Milton Friedman has argued that ". . . the monetary authority should guide itself by magnitudes that it can control, not by ones that it cannot control" [7, p. 486]. Broad aggregates like total liquid assets are not (in practice) controllable through the reserve base, whereas narrowly defined aggregates can be controlled through the monetary authority's control over bank reserves, the basis for monetary expansions and contractions.[4]

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[1] M1 is currently defined to include currency and coin, demand deposits, traveler's checks, and NOW accounts. This sum was named M1B in 1981. For simplification, whenever M1 is referred to in this article, the current definition will be relevant.

[2] Under current operating procedures, nonborrowed reserves are used as the operating target. M1, therefore, is called an intermediate target—i.e., intermediate between nonborrowed reserves and nominal GNP.

[3] The monetary base is defined as the sum of reserves held at the Federal Reserve and currency and coin outside the Federal Reserve System and the Treasury. It is adjusted for changes in reserve requirements. In all subsequent discussion of the monetary base in this article, the figure referred to will be the monetary base as constructed by the Federal Reserve Bank of St. Louis.

[4] See Goodfriend [10] for an analysis of this issue. Contemporaneous reserve accounting, of course, is a necessary precondition for direct control of money through the reserve base.

Broad monetary aggregates are (in practice) controllable, if at all, only through measures designed to affect interest rates. As a result, they are subject to considerably larger targeting errors than are narrowly defined monetary aggregates. Also, in attempting to stabilize a broad aggregate by reacting to changes in the demand for credit, the monetary authority may actually destabilize the economy. This perverse outcome may come about because the monetary authority may misperceive the lag between a policy action and the subsequent impact of that action on the economy. Friedman [7] has noted that, for this reason, past Federal Reserve actions designed to stabilize the economy have nearly always proved to be destabilizing.

The argument that financial innovations can cause loss of control of monetary aggregates is not new. On the contrary, it represents a resurrection of the well-known Gurley-Shaw thesis [12] that was discussed widely in the economics literature in the late 1950s. This thesis held that near-monies such as deposit liabilities of savings and loan associations, savings banks, and other financial intermediaries—which were outside the jurisdiction of the Federal Reserve System—rendered monetary policy per se useless as an anti-inflationary weapon. In particular, Gurley and Shaw argued that the Federal Reserve could not stop inflation because it could not control nonbank financial intermediaries and thus could not limit the creation of near-monies that were regarded as effective substitutes for M1. Accordingly, the issue in the fifties was, as it is today, whether monetary control is feasible in a financial system that can produce an endless array of money substitutes, i.e., whether an easily controllable monetary aggregate such as M1 (or the monetary base) could be used to control the entire credit superstructure and therefore total spending.

Both the Gurley and Shaw thesis and the current financial innovations argument can be tested empirically. Both propositions imply that the relationship between money and nominal GNP is extremely variable and unpredictable. Equivalently, the financial innovation theses imply that the income velocity of money, far from being stable, is a will-of-the-wisp. (By definition, MV = GNP, where M is a monetary aggregate and V is the income velocity of that monetary aggregate.)

The simplest and most straightforward way of examining the relationship between money and GNP is to regress the percentage change in GNP on the percentage change in the monetary aggregate (see Friedman and Meiselman [8]). This method is

employed below. Before presenting the model, however, a word of caution is in order. Results from single-equation regression models are always subject to potential statistical difficulties. Even so, the evidence reported below is sufficient to demonstrate that (1) the relationship between M1 and GNP has been generally stable except for one three-year period, and (2) the monetary base has also borne a stable relationship to GNP. The analysis will proceed by first examining the relationship of M1 to GNP and, subsequently the relationship of the monetary base to GNP.

The Relationship of M1 to GNP: The Empirical Evidence Countless analyses of GNP and M1 have been undertaken for different reasons since Friedman and Meiselman. One recent analysis performed by Richard Davis [5] is shown below. Davis used a single-equation model of the form,

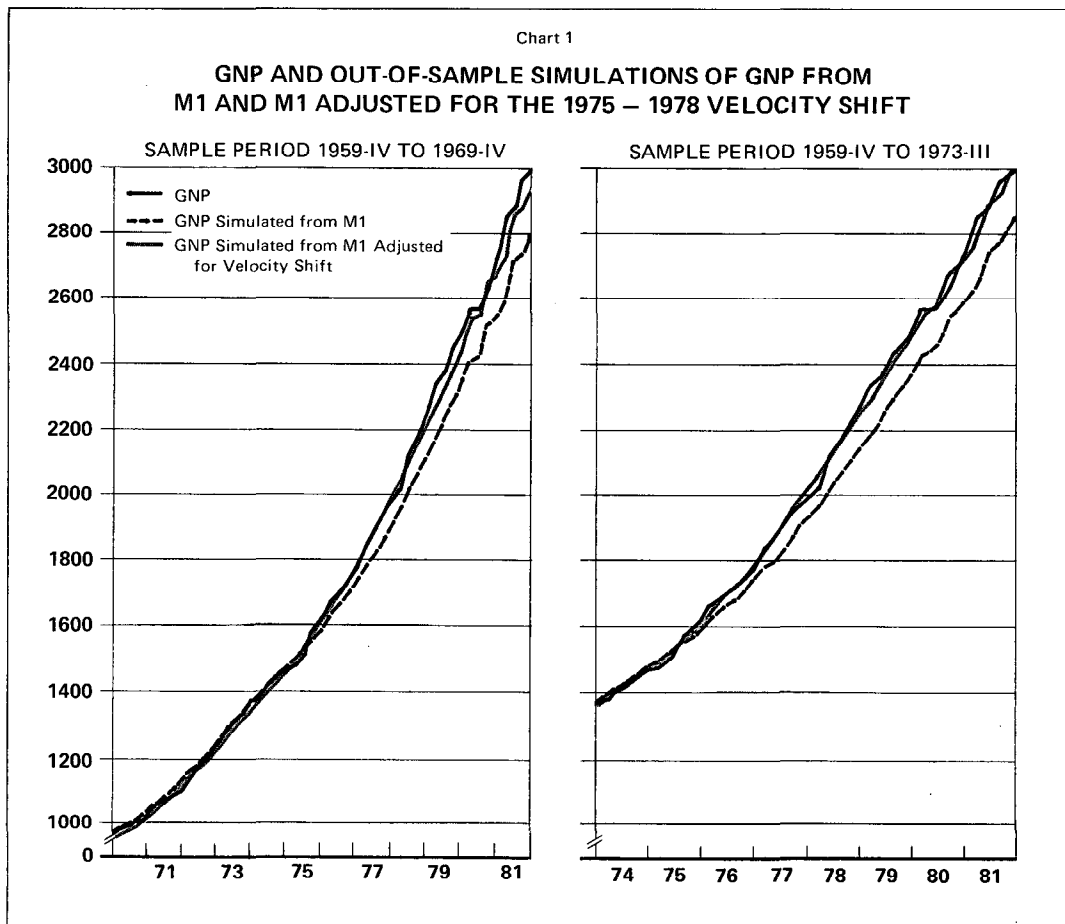$$g_t = \alpha + \sum_{i=0}^{4} \beta_{t-i} \cdot m_{t-i},$$

where g is the percentage change in nominal GNP and m is the percentage change in M1. This model is employed in the present article.[5]

Parameter estimates in a model such as this will be influenced by the state of the economy at the end of the estimation period. As Friedman concluded on the basis of an extensive historical study, ". . . income velocity tends to rise during cyclical expansions when real income is rising and to fall during cyclical contractions when real income is falling" [6, p. 329]. Consequently, in order to minimize possible bias from that source, the regression coefficients for this study were always estimated o;er a period from one quarter before the peak of one business cycle (as defined by the NBER) to one quarter before the peak of another.[6]

The results of the regressions estimated (with quarterly data) from 1959-IV to 1969-IV, 1959-IV to 1973-III, and 1959-IV to 1979-IV are shown in Table I. In-sample results by themselves, while of some interest, cannot give much information about the long-run stability of M1 velocity. Thus, the equations were simulated dynamically from the fourth

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[5] The Davis equation was used as a model for the analysis because he concluded that M1 was more closely related to GNP than was the monetary base. This article subsequently examines that question, as noted before, and his form of the equation will be used to evaluate his conclusion. The equation was estimated with unconstrained lags.

[6] See Cullison [4] for an example of the pitfalls that can be associated with disregarding Friedman's advice.

Chart 1

GNP AND OUT-OF-SAMPLE SIMULATIONS OF GNP FROM
M1 AND M1 ADJUSTED FOR THE 1975 – 1978 VELOCITY SHIFT

quarter of 1959 through fourth quarter of 1981.[7] Chart 1 shows the resulting out-of-sample forecasts (from 1959-69 and 1959-73 data) plotted against actual GNP. As is apparent, the equations predicted nominal GNP fairly accurately until the second quarter of 1975, when velocity growth rose as the economy moved out of the recession. The simulation began to track the changes in the actual GNP again in 1978,[8] although simulated GNP was at a lower level.

After an ad hoc adjustment was made to simulated GNP to account for the 1975-78 velocity shift, the forecasts came back on track. The adjustment involved adding 0.5 percent per quarter to the percentage change in nominal GNP over the period from 1975-II to 1978-II. Chart 1 also shows the out-of-sample simulation of GNP forecasted from M1 with

that adjustment, and Table II reports the forecast errors in the out-of-sample period. As the table shows, the simulations adjusted for the velocity shift missed actual fourth quarter 1981 GNP by only $34.1 billion (1.1 percent) in the simulation from the parameters estimated from 1959-69 data and only $2.3 billion (0.08 percent) in the simulation based upon 1959-73 data. Considering that these were dynamic simulations with the only actual GNP data entering the forecasts coming in 1959-IV (the beginning of the simulation), the closeness of the forecasts to actual GNP in the post-sample period is striking.

During 1981, nationwide NOW account ownership was authorized and NOW accounts, a component of M1, grew rapidly. At the same time, the economy experienced an immense increase in outstanding shares of money market mutual funds. Money market mutual fund shares, while checkable (under certain restrictions), are not included in M1. Could the relationship of predicted to actual GNP have remained so close in 1981 if financial innovations had obscured the relationship of M1 to GNP?

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[7] In the dynamic simulations, the regression equation predicts the percentage change in nominal GNP. Actual GNP in the beginning period is used as the base and never again enters the simulation.

[8] Thanks are due Stephen Hale for pointing this out to me.

During 1981, the Federal Reserve paid close attention to a monetary aggregate denoted shift-adjusted M1B—i.e., M1 adjusted to remove any shifts from time and savings deposits into NOW accounts. That aggregate was also tested in the simulations of GNP in 1981. The NOW-shift adjusted simulation gave considerably poorer results than did the simulation based upon actual M1.[9] This result was somewhat puzzling, for it implied that the NOW-shift adjust-

ment was faulty and that M1 (then M1B) continued to be the appropriate measure of transactions accounts. One explanation may be that money market mutual funds were absorbing funds designed for savings whereas NOW accounts were absorbing transactions balances. The 1981 experience does illustrate that financial innovations have made monetary targeting more difficult.

These simulation results, in any event, are not consistent with an unstable and unpredictable relationship between M1 and GNP. Therefore, econometric money demand equations that are unstable and unpredictable may well be misspecified. (See also Hafer and Hein [13] and Hetzel [14] who reach similar conclusions using different methodology.) Marvin Goodfriend [11] has shown that there are

[9] The root mean squared error for 1981 of GNP simulated from M1 was $44 billion compared to $76.5 billion for GNP simulated from M1 adjusted for the shift into NOW accounts. Additionally, the geometric averages of the quarterly percentage changes in actual GNP and the GNP simulations for 1981 were 9.69 percent for actual GNP, and 10.2 percent for GNP simulated from M1, but only 7.5 percent for GNP simulated from "shift-adjusted M1B."

Table I

RESULTS OF REGRESSIONS OF GNP ON THE ST. LOUIS MONETARY BASE AND M1*

(All variables are represented as quarter-by-quarter percentage changes. All lags are unconstrained.)

Regression Equation, $g = \alpha + \sum_{i=0}^{4} (\beta_{t-i}) \cdot (M_{t-i})$

(M is equal to M1)

Sample Period, 1959-IV to	α	β_t	β_{t-1}	β_{t-2}	β_{t-3}	β_{t-4}	R^2†	dw	SEE
1. 1969-IV	.86 (3.78)	0.554 (2.77)	−0.350 (−1.42)	0.664 (2.70)	0.213 (0.86)	−0.19 (−0.91)	0.36	1.30	0.00656
2. 1973-III	.8 (3.39)	0.571 (3.09)	−0.208 (−0.90)	0.44 (1.88)	0.289 (1.23)	−0.108 (−0.56)	0.364	1.93	0.0072
3. 1979-IV	.74 (3.34)	0.525 (3.14)	0.002 (0.01)	0.403 (1.96)	0.313 (1.50)	−0.192 (−1.11)	0.371	1.96	0.0078

(M is equal to the monetary base)

Sample Period, 1959-IV to	α	β_t	β_{t-1}	β_{t-2}	β_{t-3}	β_{t-4}	R^2†	dw	SEE
4. 1969-IV	.7 (2.56)	0.253 (0.83)	0.103 (0.29)	0.663 (1.79)	0.110 (0.30)	−0.269 (−0.89)	0.23	1.60	0.0072
5. 1973-III	.7 (2.43)	0.445 (1.64)	−0.047 (−0.15)	0.470 (1.47)	0.380 (1.19)	−0.325 (−1.21)	0.28	1.88	0.0076
6. 1979-IV	.6 (2.41)	0.400 (1.58)	0.126 (0.44)	0.276 (0.96)	0.547 (1.91)	−0.400 (−1.61)	0.29	1.80	0.0083

Regression Equation, $g = \alpha + \sum_{i=1}^{2} (\beta_{t-i}) \cdot (BASE_{t-i})$

(Form preferred for analyzing relationship between monetary base and GNP)

Sample Period, 1959-IV to	α	β_{t-1}	β_{t-2}	R^2†	dw	SEE
7. 1969-IV	.76 (3.02)	0.226 (0.80)	0.630 (2.23)	0.27	1.54	0.0070
8. 1973-III	.78 (3.113)	0.226 (0.85)	0.621 (2.34)	0.27	1.90	0.0077
9. 1979-IV	.76 (3.02)	0.368 (1.49)	0.506 (2.06)	0.26	1.89	0.0085

* Numbers in parentheses represent "t" statistics.

† Corrected for degrees of freedom.

OUT-OF-PERIOD FORECASTING ERRORS FOR QUARTERLY GNP FROM DYNAMIC SIMULATIONS ENDING IN 1981-IV**

Date Forecast Began	Actual 1981-IV GNP Less Estimated GNP	Number of Out-of-Sample Quarters	Root Mean Squared Error
	$ billions		$ billions
1970-I			
M1 (Eq. I)*	176.7	48	119.9
M1 Adjusted†	34.1	48	29.3
Monetary Base (Eq. 4)*	57.3	48	31.2
Monetary Base (Eq. 7)*	43.8	48	35.0
Trend Alone	−446.3	48	156.0
1973-IV			
M1 (Eq. 2)*	142.0	33	98.5
M1 Adjusted†	−2.3	33	23.0
Monetary Base (Eq. 5)*	47.1	33	36.9
Monetary Base (Eq. 8)*	45.6	33	41.2
Trend Alone	−374.8	33	147.4
1980-I			
M1 (Eq. 3)*	−37.8	8	34.7
Monetary Base (Eq. 9)*	−21.5	8	32.9
Trend Alone	−158.5	8	41.6

* Equation numbers refer to regression equations in Table I from which simulations were made.

** All dynamic simulations began on 1959-IV. Forecast errors, however, include only those errors that began after the estimation period.

† Adjustment on the M1 simulations adds 0.5 percent (2 percent annual rate) per quarter to the simulated change in GNP over the 1975-II to 1978-II time period.

sound theoretical reasons to believe that conventional money demand equations are indeed misspecified.

There remains, however, the troublesome fact that the rate of growth of income velocity of M1 apparently did increase in the 1975-78 period. One can adjust for such shifts on an ex post basis, but if an aggregate is to be an appropriate target for monetary policy, such shifts should be predictable ex ante. Fortunately, there is another narrowly defined monetary aggregate whose relationship to nominal GNP did not shift through the fourth quarter of 1981—one that is amenable to control by the monetary authority. That variable is the monetary base.

The Relationship of the Monetary Base to GNP

Three Federal Reserve articles have recently considered the monetary base as a policy target (John Carlson [2], Richard Davis [5], and Carl Gambs [9]). Their conclusions were generally unfavorable toward the base, although all agreed that the base could be better controlled than other monetary aggregates, even under current institutional arrangements. All three articles concluded that the empirical evidence weighed against using the monetary base as a policy target because it was not as closely related to nominal GNP as was M1. In addition, the studies enumerated several theoretical reservations against targeting the monetary base. This article will focus primarily on the empirical arguments against the base, although the theoretical reservations voiced in the articles will be discussed.

The Davis and Gambs studies (which contained the empirical work) reach the conclusion that the base is less closely related to aggregate demand by comparing the correlation coefficients of regressions of nominal GNP on money with those of GNP on the monetary base. There are slight variations in techniques, but each used current and lagged values of the monetary variables to estimate his single-equation model. As is shown in Table I, this article's regressions of GNP on the base and on M1 were consistent with the result found by Davis and Gambs, namely that the multiple correlation coefficients of the M1/GNP regressions were higher than the multiple correlation coefficients of the base/GNP regressions. Both papers, however, gave insufficient attention to a very important criterion, forecast performance in out-of-sample simulations. That omission is illustrated in Chart 2.

Chart 2 shows actual GNP and two dynamic simulations of GNP in out-of-sample periods. One is based upon a regression of GNP on M1 (without adjustment for the 1975-78 velocity shift). The other is based upon a regression of GNP on the monetary base. The chart shows out-of-period forecasts from parameters estimated from 1959-IV to 1969-IV, and from 1959-IV to 1973-III. GNP simulated from M1 began to go off track in the second quarter of 1975, but GNP simulated from the monetary base continued to track nominal GNP through the fourth quarter of 1981. This result contradicts Davis and Gambs's conclusion that the monetary base is less closely related to GNP than is M1. Note that this contradiction occurs even though the multiple correlation coefficients were consistently higher for the regressions of GNP on M1 than for the regressions of GNP on the base.

Chart 2

GNP AND OUT-OF-SAMPLE SIMULATIONS
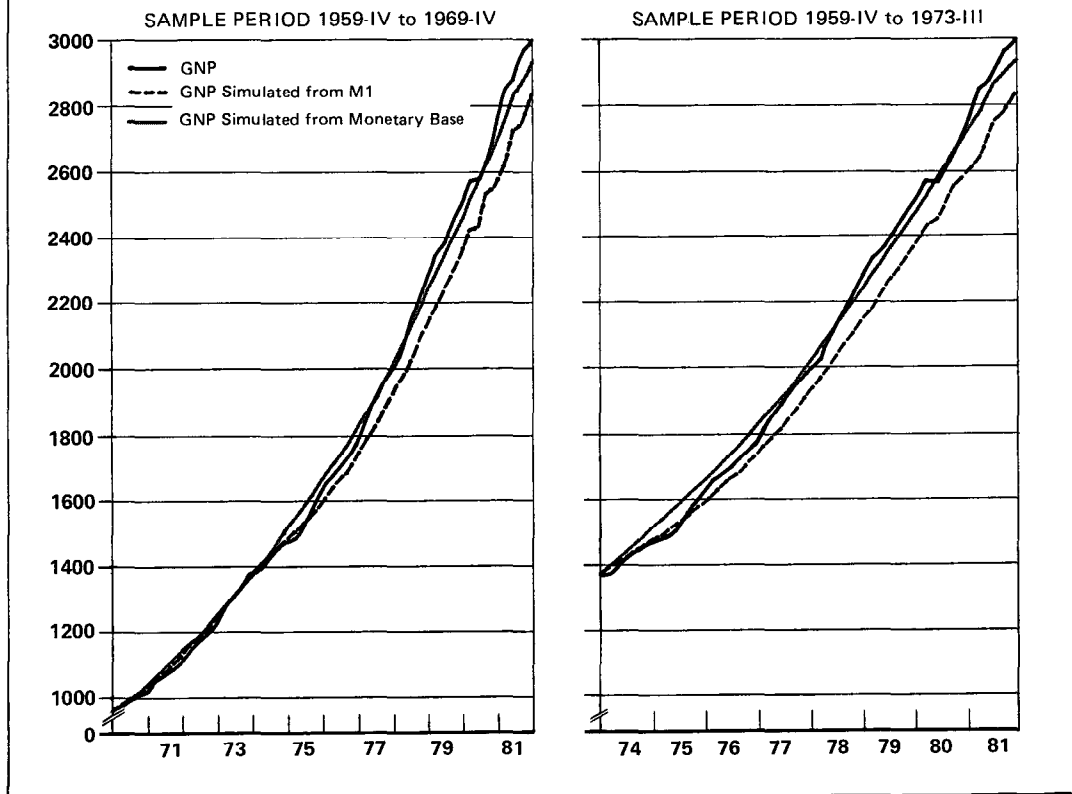OF GNP FROM M1 AND THE MONETARY BASE

Table II provides measures of the dynamic tracking ability of the out-of-sample simulations. As the table shows, GNP simulated from the monetary base always ended up closer to actual fourth quarter 1981 GNP than GNP simulated from M1 (not adjusted for the velocity shift). The root mean squared error (RMSE),[10] a measure of overall forecasting error reported in Table II, also shows smaller errors for the simulations derived from the monetary base.

The monetary base/GNP equation was specified to conform to Davis's analysis. Having no further need of this specification, the monetary base/GNP relationship was reestimated using a different lag structure. This preferred equation regresses the percentage change in GNP on percentage changes in the monetary base over the two previous quarters. The results are reported in Table I, and simulations from them are evaluated in Table II.

[10] The RMSE is defined as the square root of the sum of the squared forecasting errors divided by the number of forecasted periods. The squaring procedure not only prevents negative errors from offsetting positive errors in the summing up, but it also penalizes large errors more than proportionately.
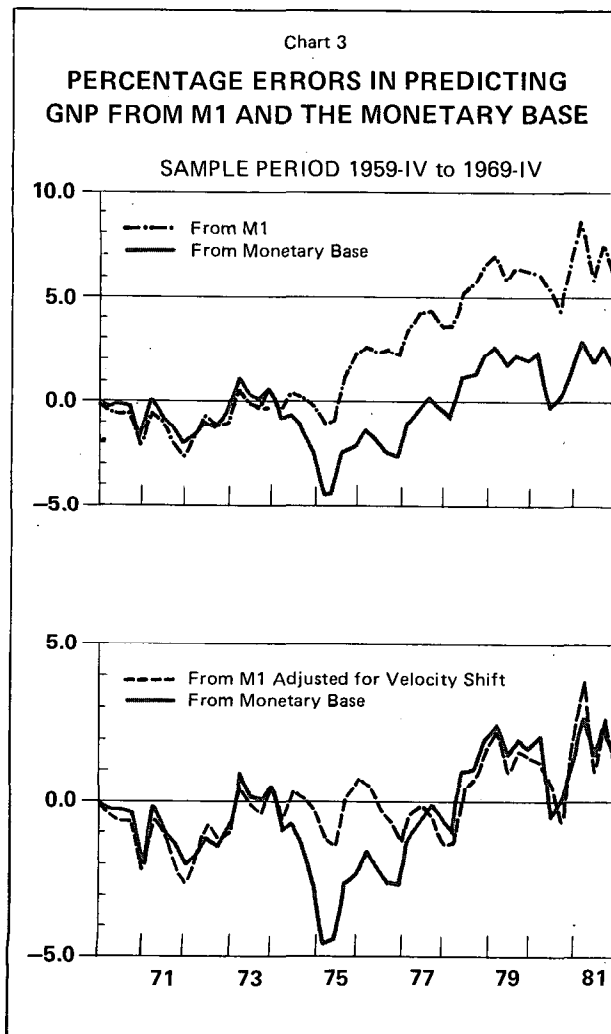
This particular lag structure was chosen because it avoids current period relations between the base and GNP, and it is relatively uncomplicated. Avoidance of contemporary relationships between GNP and the base is predicated upon the assumption that changes in the monetary base affect GNP only after a lapse of time. As can be seen from Table I, in the preferred lag form the bulk of the effects of changes in the base on GNP take place with a two-quarter lag.

The out-of-sample forecasting errors (in percentages)of the simulations of GNP from the preferred monetary base equation, from M1, and from M1 adjusted for the velocity shift are shown in Chart 3. (The relative accuracy of the forecasts is more apparent from percentage errors than from levels.) GNP simulated from M1 adjusted for the velocity shift outperformed GNP simulated from the monetary base during the 1973-76 period, although they were virtually identical before and after. The simulation from the monetary base, however, substantially outperformed the simulation from unadjusted M1. Thus, the simulation from the base did not predict the 1973-75 recession, while the simulation from M1 did not

pick up the changing trend in income velocity in the 1975-78 period.

The failure of the base to predict the 1973-75 recession represents a shortcoming in its feasibility as a target for monetary policy. Note, however, that the base came back on track after the recession with no ad hoc adjustment, and it did not mispredict the other out-of-sample recessions. The explanation may lie in the character of the 1973-75 recession, which began with the oil embargo and was influenced throughout by energy supply effects. If, as many economists believe, the base is less influenced by feedback from GNP than is M1,[11] M1 might be expected to show the effects of the 1973-75 recession

[11] This paper's regression results reported in Table I indicate that the contemporaneous relationship between M1 and GNP was more pronounced than the relationship between the base and GNP. The result is consistent with, but no proof of, the explanation advanced above.

Chart 3

PERCENTAGE ERRORS IN PREDICTING GNP FROM M1 AND THE MONETARY BASE

SAMPLE PERIOD 1959-IV to 1969-IV

more closely than would the monetary base.[12] The failure of the base to predict the 1973-75 recession, however, should provide a caution to anyone relying solely upon it as a forecasting tool.[13]
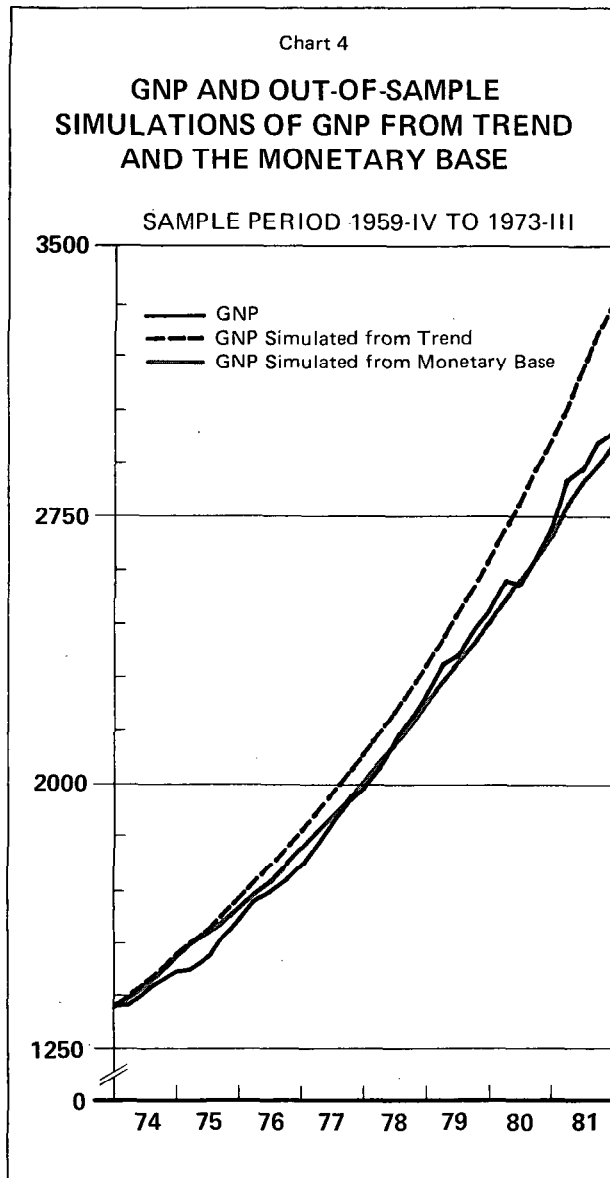
Chart 4 shows actual GNP plotted against simulations of GNP from the preferred monetary base equation and from GNP's own trend. The chart clearly shows that GNP simulated from the trend extrapolation is subject to substantially higher forecast error than GNP simulated from the monetary aggregates. Table II, which reports the out-of-period forecasting statistics, confirms this visual observation.

Are Monetary Aggregates Endogenous or Exogenous? The empirical relationship between the monetary base and GNP has been dismissed by some analysts on the ground that the base is endogenous to GNP (i.e., that the base responds to changes in GNP rather than vice versa). This contention is difficult to resolve. Like the money supply, the monetary base has passed statistical causality tests that indicate that the monetary aggregates add some-

[12] If adjustment of currency holdings is more costly than adjustment of demand deposits, the result can also be consistent with a transaction cost analysis of the demand for money that distinguishes between transitory and permanent input variable changes (see, for example, Goodfriend [11]). Such analysis would seem to be able to rationalize why M1 should track transitory changes in income better than the monetary base.

Finally, the explanation might be advanced that inherent technical problems related to the composition of the base caused the base to mispredict the 1973-75 recession. It is indeed true that a trend toward a larger proportion of currency in the base seemed to begin somewhere around 1973. As a result, currency increased from 65.8 percent of the base in the fourth quarter of 1973 to 68.8 percent by the third quarter of 1976, a rate of increase of approximately 0.4 percent per quarter. This trend in the currency composition of the base has continued since that time, however, although at a slower 0.2 percent per quarter rate. Given, however, that the predictions from the base came back on track of their own accord even though the composition of the base was continuing to change; and given that the parameters of the equations from which the simulations were made were estimated during a period in which there was very little change in the composition of the base (0.06 percent per quarter), compositional changes seem an unlikely explanation of the miss in the 1973-76 period.

[13] In comparison to the forecasters reported by Stephen McNees [15] in his article evaluating forecast performance over the 1976-II to 1980-III period, however, the simple base equation estimated over the 1959-IV to 1973-III period (Equation 8 in Table I) performed respectably. In terms of one-quarter forecast horizons, the average absolute error from the base equation turned out to be 3.27 percent, measured at a compound annual rate, which was lower than nine of the sixteen average forecast errors reported by McNees. Using the base equation to forecast two quarters out (this could be done by assuming that the rate of growth of the base in time period t−1 was the same as in t−2, which would be known), the average absolute error turned out to be 2.4 percent, which was as low as that of any forecaster reported in McNees's article.

Chart 4

GNP AND OUT-OF-SAMPLE SIMULATIONS OF GNP FROM TREND AND THE MONETARY BASE

SAMPLE PERIOD 1959-IV TO 1973-III

——— GNP
— — — GNP Simulated from Trend
———— GNP Simulated from Monetary Base

(vertical axis: 0, 1250, 2000, 2750, 3500)
(horizontal axis: 74 75 76 77 78 79 80 81)

thing to predicting GNP whereas GNP adds little or nothing to predicting the monetary aggregates. The power of these tests is somewhat limited, however, for there is a contemporaneous relationship between both aggregates and GNP (although Table I shows the contemporaneous M1/GNP relationship to be more pronounced).

To illustrate this problem, suppose the Federal Reserve System were using an interest rate target while nominal GNP and hence demands for liquidity were rising rapidly. In this case, interest rates would be under upward pressure, so the System would provide reserves to keep short-term rates down. Increases in nominal GNP would thus be correlated with concurrent increases in the monetary base and M1. A monetarist would argue that these contemporaneous changes in the monetary aggregates would have feedback effects on GNP that would show up a few months later.

The endogeneity argument provides an additional reason to prefer a base/GNP regression that avoids the contemporaneous relationship. It must be acknowledged, however, that avoidance of the contemporaneous relationship does not answer the endogeneity charge, for the one- and two-quarter lags could be providing a proxy for concurrent changes.

Some simple tests were run to show that the fit of the regression of GNP on GNP lagged one, two, and three periods was substantially improved by adding the base lagged one and two periods, and that the fit of a regression of the monetary base on the monetary base lagged one period was not significantly improved by adding GNP lagged one and two periods. The results of these regressions are reported in the appendix, along with measures of their out-of-sample forecasting accuracy. These results are all consistent with a causal relationship running from the monetary aggregates to GNP. Other studies have come to similar conclusions (see Cagan [3], Hetzel [14], Mehra [16], and Sims [19]). Because of the contemporaneous relationship between GNP and the monetary aggregates, however, the direction of causation cannot be conclusively demonstrated by analyses such as these.

Conceptual Reservations to Using the Base As a Target for Monetary Policy The conceptual reservations to targeting the monetary base, mentioned earlier, are related to the definition of the monetary base. The base is defined as the sum of (1) currency outside the Federal Reserve System and the Treasury and (2) bank deposits at the Federal Reserve. Since currency accounts for over 70 percent of the base, many economists argue that currency changes would be given disproportionate weight if the monetary base were the target for monetary policy. This is particularly true since a dollar of bank reserves can support multiple dollars of money and credit.

The argument continues that if the Federal Reserve System were to react to changes in the demand for currency by making offsetting changes in bank reserves, the resulting effects on the economy would be destabilizing. As a result, targeting total (or nonborrowed reserves) and excluding currency has often been suggested as an alternative to targeting the monetary base.

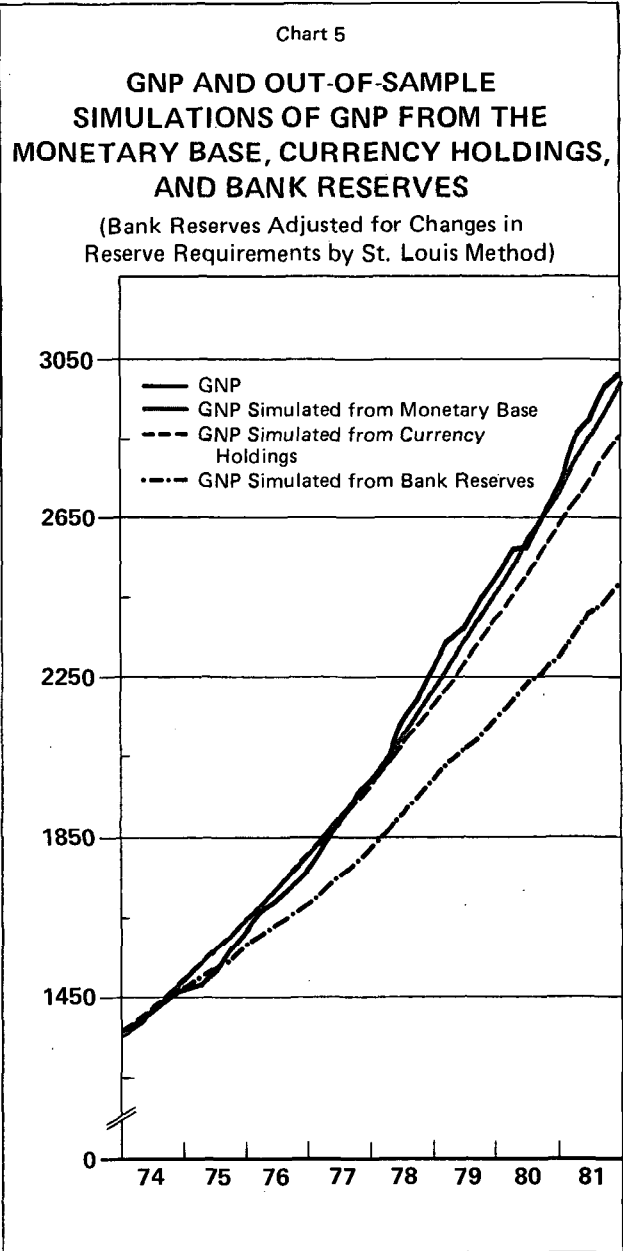Advocates of targeting the base answer that cur-

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rency is included in the monetary base because it, along with bank reserves, is a balance sheet item (liability) for the Federal Reserve System. Thus, changes in the total base measure changes in the asset side of the Federal Reserve balance sheet and, hence, measure Federal Reserve open market actions. Therefore, the argument goes, no distinction should be made between the components of the base.

To test this proposition, regressions were run of GNP on currency and on total reserves (adjusted for reserve requirement changes) from 1959-IV to 1973-III, and the results were simulated dynamically through the fourth quarter of 1981. Both simulations, shown in Chart 5, went off track. Moreover, both of the component simulations underpredict nominal GNP; the differences were not offsetting. This result implies that the monetary base as a whole is more closely related to GNP than is its components. And that result, if correct, would seem to contradict the conceptual argument advanced against the base at the beginning of this section (i.e., that currency changes are given disproportionate weight by the base).

Phillip Cagan [3] recently provided another analysis of the currency issue. He also thought that currency was a questionable indicator of economic activity. He argued that reserves and checkable deposits are highly correlated and both provide the same information about the economy, implying that the reserve portion of the monetary base was the more important indicator of the effects of money on GNP. Using a modified Granger-Sims test, he found that ". . . when concurrent values are omitted, neither set of growth rates [of checkable deposits or the monetary base] can be shown by this test to add significant information not contained in the other" [3, p. 29]. His test pertained to in-sample data over the period from 1953-III to 1974-IV.
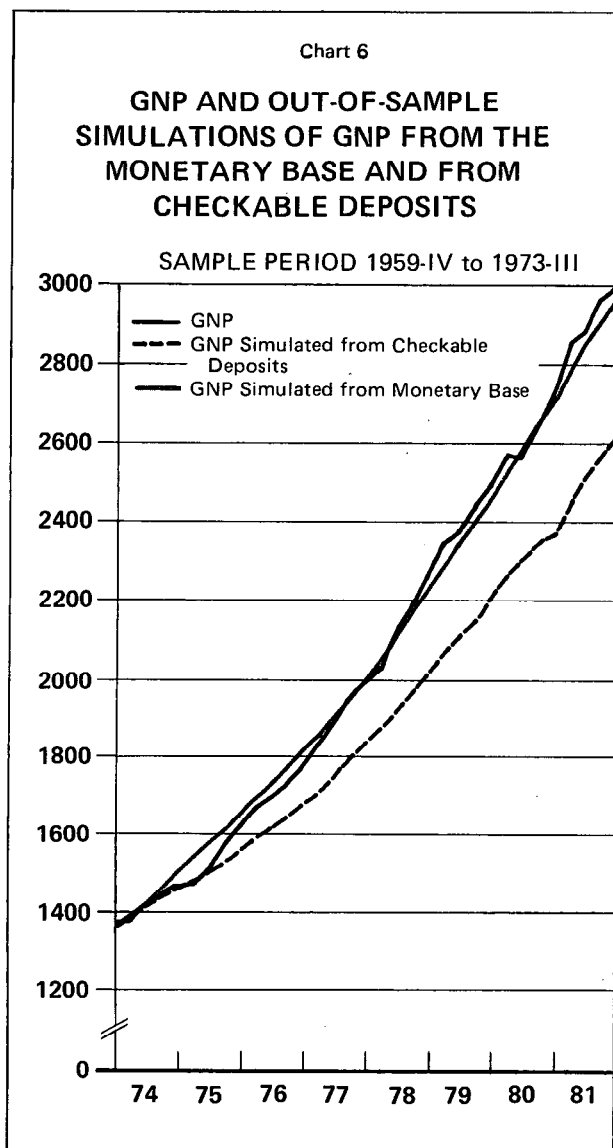
Using the methods outlined previously in this article, the percentage change in GNP was regressed on lagged values of the percentage change in checkable deposits over the 1959-IV to 1973-III period. The simulations therefrom are shown in Chart 6 compared to actual GNP and GNP simulated from the monetary base. The out-of-sample simulation from checkable deposits did not track nominal GNP at all well.[14]

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[14] The equation form specified for Chart 6 was similar to that for the "preferred base" simulation (Equations 6, 7, and 8 in Table I), having checkable deposits lagged one and two quarters. An alternative specification was also tried, using checkable deposits with five lagged quarters, but the simulation results were not appreciably different from those illustrated in the chart.

Chart 5

GNP AND OUT-OF-SAMPLE SIMULATIONS OF GNP FROM THE MONETARY BASE, CURRENCY HOLDINGS, AND BANK RESERVES

(Bank Reserves Adjusted for Changes in Reserve Requirements by St. Louis Method)

——— GNP
——— GNP Simulated from Monetary Base
– – – GNP Simulated from Currency Holdings
–·–· GNP Simulated from Bank Reserves

These last results combine with simulations from currency and reserves to favor those who recognize no distinction between the components of the monetary base. This conclusion deserves further testing, however.

Conclusion This article presents statistical results demonstrating that the trend in income velocity of the monetary base remained remarkably constant from 1959 to 1981 and that the trend in income velocity of M1 also remained remarkably constant except for the three-year period from 1975 to 1978.

Chart 6

GNP AND OUT-OF-SAMPLE SIMULATIONS OF GNP FROM THE MONETARY BASE AND FROM CHECKABLE DEPOSITS

SAMPLE PERIOD 1959-IV to 1973-III

indeed rendered money/income relationships meaningless, so the argument goes, then narrow monetary aggregates should be scrapped as targets for monetary policy. The analysis in this article suggests, however, that (except possibly for M1 during 1975-78) the much heralded financial innovations had no substantial impact upon the relationships between the narrow monetary aggregates and nominal GNP through the fourth quarter of 1981.

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These results imply (1) that the demand for money (M1) has been generally stable since 1959 but that (2) the monetary base has borne a slightly closer and more predictable relationship to the long-run trend in GNP than has M1.[15]

As noted at the outset, the argument has often been made that financial innovations such as retail repurchase arrangements, money market mutual funds, Eurodollars, and NOW accounts have obscured past relationships of monetary aggregates to nominal income. And if financial innovations have

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[15] See also Andersen and Karnosky [1], who reached a similar conclusion using somewhat similar methodology in 1977.

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APPENDIX

ILLUSTRATION OF NECESSARY (BUT NOT SUFFICIENT) CONDITIONS FOR THE MONETARY BASE TO BE EXOGENOUS TO NOMINAL GNP

(sample period from 1959-IV to 1973-III)

Form of Equation	Multiple Correlation Coefficients (uncorrected for degrees of freedom)	Root Mean Squared Errors (forecast period from 1973-IV to 1981-IV, 33 observations)
1. $g = f[\beta(-1), \beta(-2), g(-1), g(-2), g(-3)]$	0.310	\$ 39.87
2. $g = f[g(-1), g(-2), g(-3)]$	0.142	146.45
3. $\beta = f[g(-1), g(-2), \beta(-1)]$	0.59	3.71
4. $\beta = f[g, g(-1), g(-2), \beta(-1)]$	0.61	3.25
5. $\beta = f[\beta(-1)]$	0.58	4.21

Definitions: g = percentage change in nominal GNP, β = percentage change in St. Louis monetary base. Equations are linear regressions with unconstrained lags, estimated by ordinary least squares.

F test for significance of differences in multiple correlation coefficients from Kmenta, Elements of Econometrics (New York: Macmillan and Company, 1971), p. 371.

For Eq. 1 versus Eq. 2, $F(2,50) = 6.09$*

For Eq. 3 versus Eq. 5, $F(2,52) = 0.63$**

For Eq. 4 versus Eq. 5, $F(3,51) = 1.31$**

* Significantly different at 0.01.

** Not significantly different at 0.10.