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Working Paper 1985-002B
http://research.stlouisfed.org/wp/1985/1985-002.pdf

1985
Revised November 1987

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Revised November 1987

SELECTING AN INTERMEDIATE TARGET FOR MONETARY POLICY

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85-002

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INTRODUCTION

Because the ultimate goal variables of the Federal Reserve (unemployment, inflation or, more generally, economic activity) are not controllable directly, the Fed typically has followed a two step process in the conduct of monetary policy. First, the Fed determines the growth rate or level of some intermediate target variable(s) that is most likely to correspond to the desired growth rate or level of some ultimate goal variable(s). The Fed then designs a procedure for achieving the desired growth rate or level of the intermediate target that is consistent with the ultimate policy objective. Monetary policy is successful in this context if, by achieving the specified growth rate or level of the intermediate target variable, the desired growth rate or level of the goal variable is attained.

It is clear from the mechanics of monetary policy that two necessary characteristics of an intermediate target variable are that it is controllable and has a predictable relationship with the Fed's ultimate goal variable, economic activity.

The purpose of this article is to investigate empirically whether a wide range of possible intermediate target variables possess these qualities. We demonstrate that it is possible to use these criteria to make explicit choices among the alternative intermediate target variables.

The Relationship Between Monetary Targets and Economic Activity

A convenient framework within which to investigate the relationship between any particular monetary target and economic activity is the St. Louis equation. This equation was developed by Andersen and Jordan (1968) to compare the relative impacts of monetary and fiscal actions on nominal economic activity, as measured by the growth of nominal GNP. A commonly accepted general form of this equation is the following:

$$(1)\quad \dot{Y} = \alpha + \sum_{i=0}^{J} \beta_i \dot{M}_{t-i} + \sum_{i=0}^{K} \gamma_i \dot{G}_{t-i} + \delta S_t + \varepsilon_t,$$

where $\dot{Y}$, $\dot{M}$ and $\dot{G}$ are the compounded annual growth rates of nominal GNP, a measure of monetary actions and cyclically-adjusted government expenditures, respectively, and S is the change in the quarterly average of days lost due to strikes as a percentage of the civilian labor force.[1/]

The intermediate monetary targets investigated here are M1, M2, M3, the adjusted monetary base (AMB), the federal funds rate (FFR), the corporate AAA bond rate (RAAA), total nonfinancial debt (NFD), the London price of gold (PG), the International Monetary Fund's (IMF) effective exchange rate (EER) and the IMF's index of non-fuel primary commodity prices (PCOM).[2/] These variables were selected because they represent a wide range of the alternatives commonly suggested in the professional economics literature and by critics of current intermediate targets.[3/] The orders of the distributed lags (J, K) were determined using Akaike's final prediction error (FPE) criterion, as outlined in Batten and Thornton (1984). The estimation period is II/1962 to II/1986; the beginning of this period was constrained by the availability of M2 and M3 data and the use of a maximum lag of 12 quarters in the pre-test estimation for selecting the lag length.

The results of these estimations are presented in table 1. They provide some interesting contrasts. For example, the explanatory power is quite similar across the various monetary and debt aggregates. The FFR equation exhibited the highest explanatory power, but also counterintuitive results. In particular, the sum of the coefficients

of FFR is positive and statistically significant, indicating that the Fed can stimulate economic activity by "forcing up" the Fed funds rate. This is obviously a statistical quirk, most likely reflecting reverse causality; that is, stronger economic activity generates increased credit demand and hence, interest rates rise. The sum of the coefficients of both RAAA and PG are not significantly different from zero at the 5 percent level, which implies a change in the corporate bond rate or the price of gold has no lasting impact on economic activity. Finally, the summed coefficients of both the effective exchange rate and the commodity price index are statistically significant and have the expected sign even though the explanatory power of each equation is low, relative to the other equations.

Overall, the results in table 1 offer three preliminary conclusions. First, the nonsignificant sum coefficients for RAAA and PG suggest that they are not viable candidates for an intermediate target. Regardless of whether they are controllable, their failure to have a permanent effect on economic activity indicates that using either of these two variables as an intermediate target would leave monetary policy largely impotent in its efforts to achieve a nominal GNP policy objective. Second, the counterintuitive results for the Fed funds rate

apparently reveal that the FFR is influenced by changes in economic activity, rather than influences economic activity. Hence, it hardly appears to be a viable intermediate target of monetary policy. Third, the similarity of explanatory power across the various monetary indicators for equation (1) suggests that selecting a particular variable as the one most closely linked to economic activity requires more systematic testing than a superficial inspection of $\bar{R}^2$. In sum, the results in table 1 only permit us to drop three variables -- FFR, RAAA and PG -- from our list of ten potential intermediate targets.

Choosing an Intermediate Target: Some Further Tests

Because M1 is contained within both M2 and M3, whether or not one (or both) of these broader aggregates is preferred to (or is as good as) M1 can be tested easily. In particular, this test can be conducted simply by examining whether the non-M1 components of either M2 or M3 provide additional explanatory power over that of M1 in the estimation of equation (1). If not, the broader aggregates' relationship to economic activity actually reflects the M1-GNP relationship contained within these aggregates.

Following the approach of Batten and Thornton (1983b), we estimated equation (1) with M1 and the non-M1 components of M2 included separately and then performed the same experiment with M3. Table 2 presents the relevant results of these two experiments, along with the estimation results of (1) with M1 above as a frame of reference. The results for M3 are unambiguous: The non-M1 components of M3 (NM) add nothing to the explanatory power of equation (1) when M1 is also included as evidenced by the nonsignificant sum of the NM coefficients. Furthermore, the F-statistic for testing the hypothesis that all of the coefficients of the non-M1 components of M3 are jointly zero is 1.61, well below the 5 percent critical value of 2.49. In other words, the explanatory power of M3 comes entirely from the M1 component in it. Consequently, it is clear, given our criterion, that M1 is preferable to M3 as an intermediate target of monetary policy.

The M2 results are less clearly interpreted. In particular, the sum coefficient for the non-M1 components of M2 (in table 2) is statistically significant, indicating that the non-M1 components of M2 add explanatory power. Yet, the F-statistic for testing the hypothesis that all of the coefficients of the non-M1 components of M2 are jointly zero is 2.02, below the 5 percent critical value of 2.49.

That is, the F-test indicates that the non-M1 components do not add explanatory power. As a result, it is not clear that M1 is preferable to M2 or that M2 is preferable to M1 based on this analysis.

Given the ambiguity between M1 and M2, it is instructive to compare the relationship between these two aggregates and GNP with that between AMB and GNP. Since the AMB is the resource base for money creation, each of these aggregates is linked to the monetary base by its multiplier. In particular, the relationship between the growth rates of either M1 or M2 and AMB can be expressed as:

$$(2) \quad \dot{M} = \dot{m} + \dot{AMB}$$

where M is either M1 or M2 and m is the M1 or M2 multiplier. From this relationship, one can see clearly that the only information contained in either aggregate that is not contained in $\dot{AMB}$ involves changes in the growth of its multiplier ($\dot{m}$). If these changes have no impact on nominal GNP, then one must conclude that the AMB is a preferable intermediate target vis-a-vis either aggregate since the Fed has direct control over AMB and only indirect control over M1 or M2.

To investigate this issue empirically, equation (1) is re-estimated separating each aggregate into its components ($\dot{m}$ and $\dot{AMB}$) as in equation (2). The results are reported in table 3; the AMB only results are also reported for reference. These results suggest that, because the sum of the coefficients of $\dot{m}$ in the M1 (second) equation is not statistically

significant, there is no information in M1 that is related to economic activity, that is not contained in AMB. Furthermore, the F-statistic for testing the hypothesis that the coefficients of the M1 multiplier are jointly zero is 1.33, well below the 5 percent critical value of 2.49. Because one would prefer a broader aggregate to the base only for its additional information, these results and the direct controllability of the base suggest AMB as a better intermediate target relative to M1.

The comparison of AMB with M2 is not as transparent. As for the M1/M2 comparison, the sum and joint tests yield conflicting results. Specifically, the sum coefficients of the M2 multiplier are statistically significant, indicating that M2 does add to the explanatory power of AMB. Alternatively, the F-statistic for testing the hypothesis that the coefficients of the M2 multiplier are jointly zero is 2.02, which is <u>not</u> statistically significant at the 5 percent level. Thus, these results do not enable an unambigous selection of AMB over M2 or vice versa. The conclusion to be taken from tables 2 and 3 is that M1 and M3 can be deleted from the list of potential intermediate targets, leaving us with five to evaluate.

Results from Non-Nested Tests

Finally, we turn to a comparison of AMB and M2 with the remaining three potential intermediate targets -- NFD, EER and PCOM. In doing so, however, a conventional F-test cannot be employed to compare the relationships of these variables with GNP because the specification of equation (1) using any one is not nested in the specification using another. Consequently, this comparison must be conducted using a method for testing non-nested hypotheses, such as the J-test developed by Davidson and MacKinnon (1981). This procedure establishes one specification as the null hypothesis and then tests whether an alternative specification adds to the explanatory power of the specification under the null hypothesis. In particular, assume that we want to test the specification,

$$H_o: \quad y = f(x, z) + \varepsilon_1,$$

against the alternative,

$$H_1: \quad y = g(w, z) + \varepsilon_2.$$

The J-test is conducted simply by estimating

$$(3) \quad y = (1-\phi)f(x, z) + \phi\, \hat{g} + \varepsilon,$$

where $\hat{g}$ is the vector of predicted y under the alternative hypothesis, and testing whether ϕ is significantly different from zero using a conventional t-test. If the data are better fit to

f(x, z), then ϕ should not be different from zero. Alternatively, if ϕ is different from zero, then g(w, z) adds to the explanatory power of f(x, z). The process is repeated by reversing the null and alternative hypotheses and repeating the same testing procedure.

The t-statistics for the comparisons of AMB and M2 with NFD, EER and PCOM in the framework of equation (3) are presented in tables 4 and 5. As can be seen, the hypothesis, $\phi=0$, can be rejected for each comparison. In other words, these results do not provide a basis for distinguishing the specification of equation (1) with either AMB or M2 as the monetary target from the specifications with NFD, EER or PCOM. The J-tests still leave a list of five potential intermediate targets.

CONTROLLABILITY OF THE POTENTIAL TARGET VARIABLES

The foregoing tests have reduced the initial list of potential intermediate targets to a set that includes the adjusted monetary base, M2, nonfinancial debt, the effective exchange rate and the non-fuel commodity price index. Because these tests could not discriminate among these on the basis of their relationship with nominal income, the choice of an intermediate target necessarily depends on a second requirement for an intermediate target variable: its

controllability. That is, of the variables that statistical tests have shown to have the closest and most predictable relationships with GNP, does the Federal Reserve have better direct control over one of them?

Because the Federal Reserve can control base growth directly [see, e.g., Balbach (1981)], the answer to the question would seem clear. The remaining candidates could be considered acceptable targets for monetary policy, however, if they shared close and predictable relationships with the Fed's control variable, AMB. In particular, the desired properties of the estimation of these relationships would include a close, contemporaneous response of each potential target to a change in AMB, a nonsignificant constant term, and the absence of autocorrelation. A nonsignificant constant term is desirable because it indicates that the potential target's base multiplier is relatively constant over time. Hence, not having to predict multiplier movements would greatly facilitate achieving desired growth paths for the intermediate target. The presence of autocorrelation also is complicating as it suggests that the target is being consistently and persistently influenced by forces outside the control of the Federal Reserve. A contemporaneous relationship is important because Fed actions

designed to achieve a specified goal will not be effective if a change in AMB affects the intermediate target only after some lag.

Pre-test estimation for determining the lag structure indicated that M2, EER and PCOM were each best fit to only contemporaneous base growth while NFD was best fit to contemporaneous and six lagged values of base growth. In other words, the tests for lag length suggested that movements in base were likely to have a significant effect on growth of M2, EER and PCOM immediately, without persistence, while the impact of a change in base growth on NFD would linger almost two years.

The results of estimating these relationships over II/1962-II/1986 are shown in Table 6. Several implications can be drawn from these estimations. First, growth of AMB explains a very small percentage of the variation of any of these four potential targets. That is, none of these four variables exhibits a very close relationship with AMB. In fact, there is no statistically meaningful relationship between the rate of AMB growth and the rate of growth of the effective exchange rate (EER). AMB growth does explain more than 50 percent of the variation in NFD growth, but only after six quarters; this lagged response, however, would no doubt complicate monetary control. Second, three of the

four estimations yield nonsignificant intercept terms, with only the M2 multiplier varying significantly over time. Third, and most important, each of these estimated equations exhibits first-order autocorrelation. In other words, each of these potential targets is influenced consistently by factors other than changes in rate of growth of the monetary base. Hence, the ability of the Federal Reserve to control any of these potential targets would be severely limited. Overall, this analysis indicates that, of the five variables examined, only the AMB, which is controlled directly by Federal Reserve actions, exhibits a sufficient degree of controllability to qualify as an appropriate intermediate monetary target.

Summary and Conclusion

In the conduct of monetary policy, the Fed typically has employed an intermediate target strategy. The critical and necessary attributes of an intermediate target for monetary policy are that it have a predictable relationship with the ultimate goal of policy--influencing economic activity--and that it can be controlled by the Federal Reserve. In this paper we have compared a wide variety of possible intermediate monetary targets. The results are generally unambiguous. The corporate AAA bond

rate and the price of gold did not exhibit any lasting relationship with nominal GNP and, consequently, cannot be considered as viable intermediate targets. The federal funds rate, a popular candidate for intermediate target, exhibited a significant, but counter-intuitive, positive relationship with GNP. The broader monetary aggregate, M3, was inferior relative to AMB and M1 on the basis of its information content, while the results concerning M2 were less clearly interpretable. A result quite different from what has been reported previously was that the M1 multiplier offered no additional information relative to movements in the monetary base such that AMB would be preferred to M1 as an intermediate target. Finally, while the data could not discriminate among AMB and M2 and NFD, EER and PCOM on the basis of their relationships with GNP, the mechanics of monetary control and test results clearly demonstrated that AMB can be controlled more easily and more directly than any of the other four potential targets.

The financial deregulation and innovation that has recurred during the 1980s has complicated the implementation of monetary policy. Specifically, the usefulness of the traditional monetary aggregates, especially M1, as intermediate monetary targets has

been questioned widely. This paper has examined a wide range of possible intermediate targets and evaluated their usefullness based on two criteria -- their relationship with GNP and their controllability. The findings are relatively clear. No potential target exhibited a closer relationship to GNP (in a statistically meaningful sense) than did the adjusted monetary base. Furthermore, since the base is controlled directly by the Federal Reserve, no potential target was more controllable. Hence, our study indicates that the monetary base appears to be the most worthy intermediate monetary target within the current economic environment. As Lothian (1976) found: In situations where there exists substantial variation in the cost of holding deposits relative to other assets and substantial variation in the "moneyness" of deposits, the monetary base appears to be a more useful definition of money than monetary aggregates that include deposits.

FOOTNOTES

1/ These variables are defined in Tatom (1981). Use of the St. Louis equation to test the relative effectiveness of monetary and fiscal actions have been criticized on several grounds including the problem of simultaneous equation bias (if money is endogenous), and differences in the model's predictions and policy implications as the choice of a measure of monetary actions varies. Our concern here, of course, is in establishing statistical criteria that will provide a basis for answering the second criticism. For further discussion of these issues and references, see Batten and Thornton (1983a).

2/ The interest rate variables are entered as first differences.

3/ In the professional literature, see, for example, Silvia (1984), Hafer (1984), Batten and Thornton (1983b), Davidson and Hafer (1983), Friedman (1982) and Higgins and Roley (1979). In the popular press, sources of comment on various potential intermediate target variables include ... o.g. Wanniski, Reynolds, etc.

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Table 1
St. Louis Equation Estimated with Various Intermediate Monetary Targets:
II/1962 - II/1986

Monetary Indicator (M1)	Constant	ΣM1	ΣG	S	R^{-2} /SE	DW
AMB	1.591	1.021*	--	-0.933*	0.27	1.64
	(1.02)	(4.73)		(3.71)	3.86	
		0-1				
M1	4.655*	0.492*	0.093	-0.938*	0.22	1.55
	(3.76)	(2.90)	(1.88)	(3.59)	4.00	
		0-3	0			
M2	2.479	0.596*	0.094	-0.953*	0.25	1.65
	(1.63)	(3.95)	(1.96)	(3.72)	3.91	
		0-2	0			
M3	3.232*	0.478*	0.078	-0.909*	0.20	1.59
	(2.14)	(3.46)	(1.58)	(3.44)	4.05	
		0-1	0			
NFD	3.687*	0.432*	0.081	-0.917*	0.23	1.61
	(2.12)	(2.58)	(1.69)	(3.55)	3.96	
		0-1	0			
FFR	7.595*	1.182*	0.106*	-1.251*	0.37	1.74
	(13.27)	(2.45)	(2.42)	(5.20)	3.59	
		0-2	0			
RAAA	7.756*	0.041	0.102*	-1.227*	0.27	1.60
	(12.64)	(0.03)	(2.11)	(4.64)	3.86	
		0-3	0			
PG[1/]	9.061*	0.013	--	-1.198*	0.16	1.42
	(12.24)	(0.81)		(3.14)	4.50	
		0-7				
EER[2/]	9.922*	-0.250*	--	-0.951*	0.14	1.56
	(14.75)	(2.63)		(2.10)	4.59	
		0-5				
PCOM	7.329*	0.072*	0.095	-1.060*	0.20	1.49
	(10.87)	(3.46)	(1.90)	(3.96)	4.06	
		0-1	0			

Note: The items listed below the estimated coefficient are the absolute value of the t-statistic in parenthesis and the lags estimated where appropriate.

* Statistically significant at the 5 percent level.

1/ Sample period: I/1971 - II/1986

2/ Sample period: II/1973 - II/1986

Table 2
Comparison of M1 with M2 and M3

Monetary Variables	ΣM1	ΣNM	$\bar{R}^2$ /SE	DW
M1	0.492 (2.90)	---	0.22 (4.00)	1.55
M1 M2-M1	0.395 (2.29)	0.278 (2.17)	0.25 (3.91)	1.59
M1 M3-M1	0.473 (2.78)	0.177 (1.45)	0.24 (3.95)	1.55

Absolute value of t-statistics in parentheses.

NOTE: NM is the annual growth rate of M2-M1 in the second equation and M3-M1 in the third equation.

Table 3
Comparison of AMB with M1 and M2

Monetary Variables	ΣM1	Σm	R^{-2}/SE	DW
AMB	1.021	--	0.27	1.64
	(4.73)		3.86	
AMB	1.081	-0.179	0.28	1.66
mM1	(4.30)	(0.62)	3.85	
AMB	1.106	0.467	0.30	1.72
mM2	(4.68)	(2.18)	3.79	

Absolute value of t-statistics in parentheses.

Note: The multiplier (m) is for M1 in the second equation and for M2 in the third equation.

Table 4
J-tests: Comparison of AMB with NFD, EER and PCOM

	Alternative			
Null	AMB	NFD	EER	PCOM
AMB	—	2.415*	3.46*	2.82*
NFD	3.56*	--	--	--
EER	3.64*	--	--	--
PCOM	4.17*	--	--	--

* Statistically significant at the 5 percent level.

Table 5
J-tests: Comparison of M2 with NFD, EER and PCOM

	Alternative			
Null	M2	NFD	EER	PCOM
AMB	—	2.48*	5.11*	2.90*
NFD	3.13*	—	—	—
EER	4.53*	—	—	—
PCOM	4.09*	—	—	—

* Statistically significant at the 5 percent level.

Table 6
Controllability of Potential Targets

Target	Constant	AMB[1/]	$\bar{R}^2$/SE	DW
M2	3.235*	0.805*	0.22	1.01
	(2.95)	(5.36)	2.99	
NFD	1.160	1.238*	0.58	0.60
	(1.53)	(11.54)	1.63	
EER	15.139	-1.694	0.02	1.35
	(1.67)	(1.52)	13.68	
PCOM	-13.441	2.746*	0.05	1.01
	(1.60)	(2.39)	22.88	

* Statistically significant at the 5 percent level.

Absolute value of t-statistics in parentheses.

1/ Estimated coefficient for NFD equation is the sum of the coefficients on contemporaneous and six lags of AMB.