Philippine Review of Economics and Business
Volume XXX, No. 1, June 1993

FIXING THE MONEY STOCK VS. FIXING THE INTEREST RATE: A VAR MODEL

By Benjamin A. Endriga*

The "instrument problem" in monetary policy has centered on the question of whether controlling the money stock or fixing the interest rate is more preferable in terms of higher and more stable output. The former policy implies a stable price level but less investments due to a fluctuating interest rate; the latter implies a more stable investment climate but a volatile price level.

This paper examines the conditions under which either of the two policies would be more suitable for the case of the Philippines. This study uses monthly data on money supply, output, prices, interest rates, and exchange rates for the period 1981-1991. A vector autoregressive model based on a work by Christopher Sims (1980) is used to estimate the parameters. The regression results show that a money-target regime seems to be more appropriate for the Philippine case as a result of the price effects of money-stock changes and the non-significance of the interest rate coefficients in the output equations.

1. Introduction

The "instrument problem" in monetary policy has centered on the problem of which policy variable is best to control: the money supply or the interest rate. It is a basic principle that one variable cannot be set independently of the other. If the Central Bank decides to fix the money supply or maintain its growth along a specific growth path, then it would have to allow the interest rate to adjust to changes in the demand for money to bring it back to equality with the (fixed) supply of money. If, on the other hand, the Central Bank decides to fix the interest rate, then it would have to supply the amount of money demanded at the interest rate. The choice thus boils down to which of the two instruments can be targetted or fixed, with the objective of attaining a stable and full-employment level of output.

---

*Teaching Fellow, University of the Philippines, School of Economics (UPSE).
This paper is based on the author's masteral thesis submitted to UPSE in April 1993. The Authur wishes to thank Dr. Socorro Gochoco-Bautista and Dr. Joseph Lim for their comments and support.

The main argument for targetting or fixing the money stock and allowing the interest rate to fluctuate is the effect of (changes in) the money stock on the price level. Proponents of this view contend that over the long run, growth in the physical volume of output is determined mainly by real or nonmonetary factors; monetary changes will therefore influence only the price level (Palgrave, 1987). There are also variations in which a fixed money supply policy can be achieved: through a constant rate of growth of the money stock or through adjusting its rate of growth in response to the current state of the economy, causing the money stock to grow more rapidly in recession and less rapidly in boom (Poole, 1970). Whatever variation it may take, it is still the money supply variable being targetted in order to be as close to potential output as possible and to avoid a more volatile price level. For the purposes of this paper, such variations will still be considered "fixing the money stock". Further, it should be kept in mind that the idea of fixing the money stock or fixing the interest rate is referred to as mere intermediate targets; the final objective is that of attaining the full employment level of output.

The argument for a fixed interest rate policy, on the other hand, is its effect on having a more stable investment climate. This centers attention on the relation of capital purchases to expectations of future profitability (Sims, 1980). With the interest rate or the cost of capital fairly stable, capital purchases by firms and consumers can be made more predictable and less costly than if the interest rate changed rapidly. In such a case future purchases of capital stock must therefore be adjusted in response to changes in the interest rate.

2. Theoretical Framework

Vector autoregressions (VAR) are very useful for time series data. Its applications are many and varied: forecasting, causality testing, tests of theories, hypothesis-seeking, data characterization, innovation accounting, impulse response analysis, and policy analysis. Of the many uses of VARs, however, only causality testing, innovation accounting and impulse response analysis will be the relevant applications for this paper.

In its simplest form, a scalar (as distinguished from a vector) autoregression is just a regression of a variable on its own past values:[1]

(1) $x_t = \sum_{i=1}^{n} \pi_i x_{t-i} + u_t$

where u_t is a mean-zero, serially uncorrelated unobservable scalar random variable, and the π_i are scalar parameters. A vector autoregression, as its name implies, differs from the above in that x_t and u_t are vectors and the coefficients are square matrices:

(2) $x_t = \sum_{i=1}^{n} \pi_i x_{t-i} + u_t, \; E(u_t u'_t) = \Sigma$

In estimating VAR models, the econometrician makes no attempt to use theory to distribute zeros in the coefficient matrices, so that prior information guides only the selection of the variable to enter x_t and the lag length n. The errors in (2) are thus not assumed to be contemporaneously uncorrelated. To facilitate interpretation it is customary to premultiply (2) by the unique triangular matrix with units on the main diagonal that diagonalizes the error covariance matrix:

(3) $Tx_t = T \sum_{i=1}^{n} \pi_i x_{t-i} + n_t, \; E(n_t n'_t) = D$

where $n_t = Tu_t$ and $D = T\Sigma T'$, a diagonal matrix. The n_t are termed the orthogonalized innovations.

All this is easier to interpret in a simple two-variable example. The assumption is made that the maximum lag length is one period and, following Sims (1972), that the two variables are the money stock m and income y. Then the reduced form corresponding to (2) would be estimated as

(4) $m_t = \pi_{11} m_{t-1} + \pi_{12} y_{t-1} + u_{mt}$,

(5) $y_t = \pi_{21} m_{t-1} + \pi_{22} y_{t-1} + u_{yt}$,

where $E(u^2_{mt}) = \sigma_{mm}$, $E(u^2_{yt}) = \sigma_{yy}$, and $E(U_{mt} U_{yt}) = \sigma_{my}$. If (4) is multiplied

[1] Most of what follows for this section was taken from LeRoy and Cooley (1985).

by σ_{my}/σ_{mm} and the result subtracted from (5), the transformed system is

(6) $m_t = \rho_{11} m_{t-1} + \rho_{12} y_{t-1} + n_{mt}$,

(7) $y_t = \delta_{mt} + \rho_{21} m_{t-1} + \rho_{22} y_{t-1} + n_{yt}$,

where n_{mt} and n_{yt} are uncorrelated contemporaneously and serially, and δ and the ρ_{ij} are parameters. Equations (6) and (7) correspond to (3) above.

As already noted, one of the applications of VARs is on causality or exogeneity tests. Following the example above, suppose there are two time series $\{m_t\}$ and $\{y_t\}$. The series $\{y_t\}$ fails to Granger-cause $\{m_t\}$ according to the Granger (1969) test if, in a regression of m on lagged m and lagged y, the latter takes on a *zero coefficient*. In terms of the VAR model presented above from equation (4), the term that must equal zero is the coefficient π_{12}. Similarly, $\{y_t\}$ fails to Granger-cause $\{m_t\}$ according to the Sims (1972) test if, in a regression of y on lagged y and future m, the latter takes on a zero coefficient. This is analogous to saying that lagged y does not contribute to a statistically significant reduction in the variance of m. The above, however, were the methods used by Sims (1972), Lamberte (1983), and Canlas (1985), and will thus be considered the more precise causality test. If y fails to Granger-cause m, it is said that m is exogenous with respect to y. If in addition m does Granger-cause y, m is said to be causally prior to y.

The justification for using a vector autoregression for this study arises as a result of its application to causality or exogeneity tests. To say that policy instruments, such as the money stock, are good predictors of output or of future economic activity is to assume that the money stock is exogenous to output. Further, if extended to a multivariate system, the relationships among the variables can be more efficiently determined when all variables are treated endogenously and tested for exogeneity.

Given the 5-variable system for this study, the influence of each variable may be more efficiently determined when one variable is successively added to another, beginning with a 2-variable system. The bivariate system follows Sims (1972):

$$M_t = \pi_{11}(L)M_t + \pi_{12}(L)Y_t + u_t$$

$$Y_t = \pi_{21}(L)M_t + \pi_{22}(L)Y_t + u_t$$

where L is the lag operator running from 1 to 12 lag periods (in months). As already noted, M is exogenous to Y if $\pi_{11} = 0$ and $\pi_{22} \neq 0$ (i.e. $\pi_{22} > 0$).

To determine the price effects of the money stock, a price variable (P) is added:

$$M_t = \pi_{11}(L)M_t + \pi_{12}(L)Y_t + \pi_{13}(L)P_t + u_t$$
$$Y_t = \pi_{21}(L)M_t + \pi_{22}(L)Y_t + \pi_{23}(L)P_t + v_t$$
$$P_t = \pi_{31}(L)M_t + \pi_{32}(L)Y_t + \pi_{33}(L)P_t + w_t.$$

Following Sims (1980), an interest rate variable (r) is then included to determine its influence on the system of equations, particularly on output. Changes in the money stock parameters may also be observed:

$$M_t = \pi_{11}(L)M_t + \pi_{12}(L)Y_t + \pi_{13}(L)P_t + \pi_{14}(L)r_t + u_t$$
$$Y_t = \pi_{21}(L)M_t + \pi_{22}(L)Y_t + \pi_{23}(L)P_t + \pi_{24}(L)r_t + v_t$$
$$P_t = \pi_{31}(L)M_t + \pi_{32}(L)Y_t + \pi_{33}(L)P_t + \pi_{34}(L)r_t + w_t$$
$$r_t = \pi_{41}(L)M_t + \pi_{42}(L)Y_t + \pi_{43}(L)P_t + \pi_{44}(L)r_t + x_t.$$

Finally, to have an open-economy setting, an exchange rate variable (e) is also included. The exchange rate may also have an influence on the monetary variables M and r:

$$M_t = \pi_{11}(l)M_t + \pi_{12}(l)Y_t + \pi_{13}(l)P_t + \pi_{14}(l)r_t + \pi_{15}(l)e_t + u_t$$
$$Y_t = \pi_{21}(l)M_t + \pi_{22}(l)Y_t + \pi_{23}(l)P_t + \pi_{24}(l)r_t + \pi_{25}(l)e_t + v_t$$
$$P_t = \pi_{31}(l)M_t + \pi_{32}(l)Y_t + \pi_{33}(l)P_t + \pi_{34}(l)r_t + \pi_{35}(l)e_t + w_t$$
$$r_t = \pi_{41}(l)M_t + \pi_{42}(l)Y_t + \pi_{43}(l)P_t + \pi_{44}(l)r_t + \pi_{45}(l)e_t + x_t$$
$$e_t = \pi_{51}(l)M_t + \pi_{52}(l)Y_t + \pi_{53}(l)P_t + \pi_{54}(l)r_t + \pi_{55}(l)e_t + z_t$$

where l is the lag operator from lag periods 1 to 9. (Subsequent estimation made only 9 lags feasible due to the lack of degrees of freedom relative to the number of observations.) The u_t, v_t, w_t, x_t, and z_t are the error terms.

The estimated coefficients of a vector autoregression, however, are difficult to interpret. It is convenient to look at the impulse response functions and variance decompositions (or innovation accounting) of the system to draw implications about a VAR. A variance decomposition determines the proportion of each variable's forecast error that is attributable to each of the orthogonalized innovations in the VAR model.

The VAR model (3) can be inverted and written in moving average form:

(8) $$X_t = \sum_{i=0}^{\infty} A_i n_{t-i},$$

where the n_t are contemporaneously and serially uncorrelated. From this moving average representation (8), each variable can be written as a function of the innovations, so that the response of the ith element of X_{t+k} to the innovation in the jth variable at date t is just the i, j element of the matrix A. A tabulation of those responses for $k = 0, 1, ...$ is called an impulse response function. (For this study, k was made to run from 0 to 36, or 3 years, to determine the longer-term effects of each innovation on each variable.) In other words, an impulse response function separates the determinants of the endogenous variables into shocks or innovations identified with specific variables. It then traces the effect on current and future values of the endogenous variables of one standard deviation shock to the innovations. If the errors, u_t and v_t in the 2-variable case, for instance, are uncorrelated, then u_t is the M innovation and v_t is the Y innovation. The same principle follows for the other equation systems.

Because the covariances among the innovations are zero by definition, the variance of each variable will be a weighted sum of the variances of each variable, with the weights being determined by the elements of the matrix A_k. Innovation accounting, or variance decomposition, is the exercise of determining which innovations contribute to the forecast error of each variable.

A variance decomposition is similar to an impulse response function in that it shows the response of a single series to all types of shocks; the difference is that the response is measured as the percentage explained in the variation of the series by each shock or variable.

This in effect provides another justification for the use of a VAR: variance decompositions measure the percentage variation in a variable as a result of a shock from another variable. (Tables 5 and 6 in the next section show the relevant variance decompositions.)

If a vector autoregression is useful for this paper, it is also the source of its limitations. First, it is not possible to test for contemporaneous causation with a VAR. Whether present money affects present output, for instance, cannot therefore be determined. At best, only a lag of one period is feasible. Second, VARs are widely criticized as being "atheoretical", i.e. they are not supported by economic theory. Any set of variables can thus be tested using a VAR even if only a perceived relationship exists among the variables — even without theoretical basis. For this study, the work of Poole (1970) is the closest framework to which it is related. Further, the acceptability of Sims's (1980) article — although also criticized — may lend some validity to this paper.

Finally, it must be pointed out that the ordering of variables in a vector autoregression may influence the results. Different coefficients may be obtained for different variable orderings, and may thus influence the conclusions. Such changes in orderings were also attempted, but fortunately yielded the same conclusion, although changing a few parameters (discussed in the next section). The ordering of variables discussed above, however, will be the one followed as it is the more conventionally used and more logical sequence.

3. Results and Analysis

All of the data used in this study were obtained from the Central Bank. Monthly data from the period 1981-1991 were used. The five main variables are the following:

M1 = money stock variable (*M*1 component of money supply)
PROD = index of industrial production, base year 1985
CPI = the consumer price index
TB91 = 91-day treasury bill rates (nominal)
ER = peso to dollar nominal exchange rate

A crisis variable was also used to reflect the economic crisis years 1984 and 1985. These observations carried a value equal to one; the other observations, the non-crisis years, carried a value equal to zero. In all the systems of equations, the crisis variable (DUMMY) was used as an exogenous variable. The main variables above were treated endogenously to determine correlations or feedback effects among the variables.

Prior to estimation, the raw data were first prefiltered to achieve stationarity. This was necessary to remove the trends and seasonalities inherent in stochastic time series data which may eventually bias the estimated parameters. A variable is said to be stationary, as Pindyck and Rubinfeld define it, when it is invariant with respect to time. The implication of this is tht the estimated parameters would also be stationary, i.e. the estimated coefficients would be valid for the whole period covered — and beyond.

The above variables thus underwent the identification stage prior to estimation. At this stage, the autocorrelation function must drop off rapidly for the variable tested to become stationary. If the autocorrelation function does not behave this way, the inherent trends or seasonalities in the variable must therefore be removed. This may be done by taking the log of the variable for each observation or by differencing the series. For the variables in this study, the following detrending and deseasonalizing methods were used to achieve stationarity or near-stationarity:

M1 – deseasonalized first difference of logs
PROD – deseasonalized first difference of logs
CPI – deseasonalized second difference of logs
TB91 – first difference of logs
ER – deseasonalized first difference of logs

The term "deseasonalized" refers to the additive deseasonalizing method. This method consists of first computing a centered moving average of a series. It then computes the difference of each observation from the moving average. These differences are then averaged over all the years in the sample, for each month separately. These averaged differences are the seasonal factors, i.e. the difference of the adjusted series to the unadjusted series. Finally, the seasonally adjusted series is then computed by subtracting it from the seasonal factors.

Table 1 - 2-Variable system: *M1, PROD*

a. *M1* as dependent variable*

Variable	Coefficient	Std. Error	T-Stat.
SFDLM1(-5)	- 0.1981027	0.1050282	- 1.8867849
SFDLPROD (-2)	0.3059091	0.0841091	3.6370496
SFDLPROD (-3)	0.2469021	0.8298708	2.7472999
R-squared	0.243914		
Adjusted R-squared	0.040665		
F-statistic	1.200074		

b. *PROD* as dependent variable

Variable	Coefficient	Std. Error	T-Stat.
SFDLM1 (-3)	0.4419206	0.1351467	3.2699319
SFDLM1 (-6)	0.3813696	0.1425820	2.6747394
SFDLM1 (-9)	0.3058073	0.1427936	2.1416040
SFDLPROD (-1)	- 0.4252396	0.1038425	- 4.0950449
R-squared	0.393482		
Adjusted R-squared	0.230440		
F-statistic	2.413371		

Table 1 shows the partial regression results for a 2-variable VAR, with *M1* and *PROD* as the variables. Table 1a shows that there is some feedback from *PROD* to *M1* at lags 2 and 3; Table 1b shows that *M1* explains *PROD* at lags 3, 6, and 9. A comparison of their corresponding R^2 and adjusted R^2, however, reveals that the *PROD* model is more reliable. The *M1* equation has an adjusted R^2 of only 0.04, while for the *PROD* model, adjusted $R^2 = 0.23$. It can therefore be concluded that under a 2-variable VAR in this case, *M1* is a good predictor of output *PROD* with feedback effects being ruled out.

Table 2 - 3-Variable System: *M1, PROD, CPI*

a. M1 as dependent variable

Variable	Coefficient	Std. Error	T-Stat.
SFDLM1 (-6)	- 0.2051862	0.1163861	-1.7629788
SFDLPROD (-2)	0.2716583	0.0923015	2.9431632
SFDLPROD (-3)	0.2215781	0.0962746	2.3015216
SSDLCPI (-4)	0.7592813	0.4922295	1.5425353
SSDLCPI (-7)	0.9593533	0.5785299	1.6582606
SSDLCPI (-12)	-0.7866026	0.4305494	-1.8269741
C	0.0165889	0.0068514	2.4212202
R-squared	0.367885		
Adjusted R-squared	0.075532		
F-statistic	1.258358		

* The prefixes attached to the variable names refer to the prefiltering these series underwent prior to estimation.

b. PROD as dependent variable

Variable	Coefficient	Std. Error	T-Stat.
SFDLM1 (-1)	- 0.2217996	0.1399279	- 1.5850989
SFDLM1 (-3)	0.2310294	0.1454579	1.5882907
SFDLM1 (-5)	- 0.2370890	0.1485977	- 1.5955095
SFDLM1 (-6)	0.2517195	0.1461459	1.7223849
SFDLPROD (-1)	- 0.4669318	0.1074679	- 4.3448485
SFDLPROD (-2)	- 0.1786589	0.1159029	- 1.5414536
SFDLPROD (-3)	- 0.2084944	0.1208919	- 1.7246347
SSDLCPI (-1)	1.5437958	0.4812207	3.2080825
SSDLCPI (-2)	0.8227257	0.5229045	1.5733764
SSDLCPI (-3)	1.0006554	0.5627829	1.7780487
SSDLCPI (-4)	1.3585668	0.6180924	2.1980008
SSDLCPI (-5)	1.3460141	0.6347662	2.1204880
SSDLCPI (-6)	2.3804381	0.6769440	3.5164475
SSDLCPI (-7)	1.4434459	0.7264594	1.9869602
SSDLCPI (-9)	1.3510767	0.6926944	1.9504657
C	0.0189087	0.0086033	2.1978357
R-squared	0.555813		
Adjusted R-squared	0.350376		
F-statistic	2.705521		

c. *CPI* as dependent variable

Variable	Coefficient	Std. Error	T-Stat.
SFDLM1 (-1)	0.0549651	0.0320069	1.7172873
SFDLM1 (-2)	0.0586112	0.0329559	1.7784752
SFDLPROD (-2)	0.0489189	0.0265115	1.8451993
SSDLCPI (-1)	- 0.4142562	0.1100738	- 3.7634415
SDDLCPI (-2)	- 0.4440222	0.1196085	- 3.7122965
SSDLCPI (-3)	- 0.5251721	0.1287302	- 4.0796337
SSDLCPI (-5)	- 0.2718431	0.1451956	- 1.8722545
SSDLCPI (-11)	0.2012545	0.1318358	1.5265540
DUMMY	- 0.0037573	0.0021941	- 1.7124592
R-squared	0.483550		
Adjusted R-squared	0.244692		
F-statistic	2.024427		

This same result can also be seen when comparing Tables 2a and 2b, although the lower t-scores of *M1* in the *PROD* equation show *M1* to be a weaker predictor of *PROD* when *CPI* was added to the system. But the PROD model (adjusted $R^2 = 0.35$) is still superior to the *M1* equation (adjusted $R^2 = 0.07$). The important point to note here, however, is the positive price effects of money stock policy (Table 2c): *CPI* shows a weak positive response (at lags 1 and 2) from changes in *M1*. In addition, *PROD* shows a positive response from *CPI* (Table 2b); *CPI* also responds positively from *PROD* changes (Table 2c). These two latter results are reminiscent of the idea of growth being accompanied by an increase in the price level, and of producers responding to price increases by increasing output, respectively.

When an interest rate variable, *TB91*, was added to make 4-variable system (Table 3), the *M1* equation (Table 3a) acquired more reliability (increase in R^2 and adjusted R^2). This is attributed to the immediate inverse relationship between the money stock and the interest rate, aside from the usual observation that adding more explanatory variables increases R^2. The *PROD* coefficients of *M1* also became significant. In contrast, the *PROD* equation (Table 3b) shows that the *M1* coefficients still show some weak significance at lags 3 and 6. This indicates some feedback from *PROD* to *M1* with the 4-variable system including interest rates. The more important point to note about the *PROD* equation in Table 3b, however,

Table 3 - 4-Variable System: *M1, PROD, CPI, TB91*

a. *M1* as dependent variable

Variable	Coefficient	Std. Error	T-Stat.
SFDLM1 (-7)	- 0.1886884	0.1261757	- 1.4954416
SFDLPROD (-2)	0.2237710	0.0916979	2.4403081
SFDLPROD (-3)	0.2023953	0.0975706	2.0743464
SFDLPROD (-5)	- 0.1540130	0.1010723	- 1.5237898
SFDLPROD (-10)	0.1386043	0.0920891	1.5051106
SSDLCPI (-4)	0.8425177	0.4834528	1.7427093
SSDLCPI (-6)	1.0161480	0.5343730	1.9015706
SSDLCPI (-7)	1.3467268	0.5798229	2.3226519
SSDLCPI (-8)	1.0629963	0.5752192	1.8479847
SSDLCPI (-12)	- 0.6626814	0.4317981	- 1.5347021
FDLTB91 (-5)	- 0.0483805	0.0316854	- 1.5269048
FDLTB91 (-6)	- 0.0781833	0.0318981	- 2.4510321
FDLTB91 (-8)	- 0.0669991	0.0344796	- 1.9431518
FDLTB91 (-10)	0.0547356	0.0343576	1.5931127
C	0.0116014	0.0071643	1.6193387
R-squared	0.517148		
Adjusted R-squared	0.169210		
F-statistic	1.486322		

b. *PROD* as dependent variable

Variable	Coefficient	Std. Error	T-Stat.
SFDLM1 (-3)	0.2776348	0.1822524	1.5233530
SFDLM1 (-5)	- 0.2641792	0.1752882	- 1.5071137
SFDLM1 (-6)	0.2794833	0.1717697	1.6270815
SFDLPROD (-1)	- 0.4794892	0.1164010	- 4.1192859
SSDLCPI (-1)	1.6857873	0.5224051	3.2269734
SSDLCPI (-2)	1.0457961	0.5631192	1.8571486
SSDLCPI (-3)	1.0124988	0.6120775	1.6542002
SSDLCPI (-4)	1.4300755	0.6673408	2.1429462
SSDLCPI (-5)	1.3294380	0.6973080	1.9065292
SSDLCPI (-6)	2.4667047	0.7376292	3.3440983
SSDLCPI (-7)	1.5018504	0.8003667	1.8764530
SSDLCPI (-9)	1.4814765	0.7750724	1.9114040
SSDLCPI (-11)	1.0278526	0.6419150	1.6012285
R-squared	0.589984		
Adjusted R-squared	0.294532		
F-statistic	1.996884		

Table 3 (Continued)

c. *CPI* as dependent variable

Variable	Coefficient	Std. Error	T-Stat.
SFDLM1 (-2)	0.0964461	0.0407199	2.3685219
SFDLPROD (-2)	0.0505450	0.0286395	1.7648738
SFDLPROD (-11)	- 0.0452378	0.0282615	- 1.6006885
SFDLPROD (-12)	- 0.0506419	0.0261235	- 1.9385598
SSDLCPI (-1)	- 0.4044689	0.1182005	- 3.4218883
SSDLCPI (-2)	- 0.4633056	0.1274126	- 3.6362634
SSDLCPI (-3)	- 0.5108817	0.1384900	- 3.6889434
SSDLCPI (-5)	- 0.2995928	0.1577744	- 1.8988682
DUMMY	- 0.0043551	0.0023487	- 1.8542258
R-squared	0.533548		
Adjusted R-squared	0.197428		
F-statistic	1.587374		

is that none of the *TB91* coefficients were found to be significant. (*TB91* is supposed to negatively influence *PROD* via investment demand.) In addition, *PROD* was also found to respond positively to changes in *CPI*.

From Table 3c it can be seen that *CPI* responds directly to *M1* after two months (and from *PROD* also at two periods). This also points to the price effects of expanding the money stock — and a potential cost for fixing the interest rate. The interest rate equation for this 4-variable system yielded insignificant results ($R^2 = 0.02$), and is thus not presented.

With exchange rates included to make a 5-variable *VAR* (Table 4), only a maximum of 9 lags was possible due to a lack of degrees of freedom relative to the number of observations. Table 4a shows that output *PROD* partly explains *M1* at lags 2 and 3.

Table 4b, on the other hand, shows that *M1* also explains *PROD*, but to a lesser extent than when interest rates and exchange rates were excluded from the estimation process. This suggests the existence (again) of feedback from output to money.

Table 4 - 5-Variable System: *M1, PROD, CPI, TB91, ER*

a. *M1* as dependent variable

Variable	Coefficient	Std. Error	T-Stat.
SFDLM1 (-8)	0.2174664	0.1185395	1.8345474
SFDLPROD (-2)	0.2412243	0.0887814	2.7170593
SFDLPROD (-3)	0.2248747	0.0903188	3.4874240
SSDLCPI (-7)	1.7099494	0.4903188	3.4874240
FDLTB91 (-1)	- 0.0497835	0.0303846	- 1.6384427
FDLTB91 (-5)	- 0.0505269	0.0317654	- 1.5906275
FDLTB91 (-6)	- 0.0802326	0.0315194	- 2.5454952
FDLTB91 (-8)	- 0.0450754	0.0299086	- 1.5071082
SFDLER (-8)	- 0.2788844	0.1365918	- 2.0417355
C	0.0112877	0.0061498	1.8354435

R-squared	0.512081
Adjusted R-squared	0.208779
F-statistic	1.688357

b. *PROD* as dependent variable

Variable	Coefficient	Std. Error	T-Stat.
SFDLM1 (-1)	- 0.3205059	0.1930950	- 1.6598351
SFDLM1 (-3)	0.5215831	0.1767813	2.9504431
SFDLM1 (-6)	0.3368122	0.1845414	1.8251309
SFDLM1 (-9)	0.2612795	0.1599427	1.6335823
SFDLPROD (-1)	- 0.3680022	0.1183219	- 3.1101792
SSDLCPI (-1)	1.8932576	0.6261251	3.0237688
SSDLCPI (-3)	1.7567879	0.7503761	2.3412097
SSDLCPI (-5)	1.2145040	0.7719726	1.5732475
SSDLCPI (-6)	1.3891907	0.7734849	1.7960152
SFDLER (-7)	0.4024484	0.1815785	2.2163881

R-squared	0.569162
Adjusted R-squared	0.301344
F-statistic	2.125180

Table 4 (Continued)

c. *CPI* as dependent variable

Variable	Coefficient	Std. Error	T-Stat.
SSDLCPI (-1)	- 0.3881383	0.1141086	- 3.4014822
SSDLCPI (-2)	- 0.4272537	0.1278608	- 3.3415522
SSDLCPI (-3)	- 0.3636175	0.1367528	- 2.6589400
SSDLCPI (-5)	- 0.2241225	0.1406887	- 1.5930391
FDLTB91 (-2)	- 0.0126598	0.0078977	- 1.6029696
SFDLER (-1)	0.1459619	0.0271595	5.3742455
SFDLER (-3)	0.0515161	0.0315974	1.6303897
DUMMY	- 0.0063104	0.0021815	- 2.8926905
R-squared	0.677239		
Adjusted R-squared	0.476605		
F-statistic	3.375482		

Table 4c indicates that *CPI* is partly explained by *TB91* at lag 2. This may be attributed to lower output associated with higher interest rates, i.e. due to the higher cost of credit. *TB91*, however, was not found to be significant in the output *PROD* equation in Table 4b. The interest rate and exchange rate equations for the 5-variable VAR yielded absurdly low adjusted R^2; this makes these equations unreliable in deriving any conclusion from them, and are thus not presented.

All of the above results so far seem to favor a fixed money stock policy for the variables given and for the period covered. The only finding that favored a fixed interest-rate policy was the negative effect on prices of the interest rate variable found in Table 4c. This is more than offset, however, by the following results that provide weak evidence for a money-target regime:

i) the confirmed price effects on *CPI* of *M1* in Tables 2c and 3c; and

ii) the non-significance of the interest rate *TB91* coefficients in the output *PROD* equations in Tables 3b and 4b.

The first finding refers to the cost of having a volatile price level if the interest rate were held fixed and the money stock were allowed to adjust accordingly. The second points to the supposedly negative effects of fixing the money stock and allowing the interest rate to vary, thus causing fluctuations in output by making investment unstable. But these interest rate coefficients in the output equations were not found to be significant.

In a different ordering of the variables in the estimation process, one of the interest rate coefficients was found to be significant. The corresponding variance decompositions also showed a higher variance explained by the interest rate *TB91* on output *PROD* — higher than its influence for the variable ordering shown in the tables. *TB91* explained 9 percent of the variation in output, an increase from 3 percent for the original variable ordering, compared to 11 percent for *M1*. The conclusion, however, remained the same: a money-target regime was still superior.

Chow tests were also attempted to test for the structural stability of the parameters, but proved not to be feasible. The number of parameters for most regressions could not be kept constant, for splitting the sample into two subperiods exhausted the degrees of freedom.

The above results for the original variable ordering are reinforced by the variance decompositions shown by Tables 5 and 6. Table 5 shows that even when interest rates and exchange rates are added to the system, the money stock *M1* still explains a significant proportion of the variation in output *PROD*. *M1* on the average explains about 18 percent of the variation in output after 12 months, compared to only 3 percent for interest rates *TB91*. Table 6 also shows that *M1* explains about 11 percent of the variation in *CPI*, compared to only 4 percent for *TB91*. What is interesting to note about the variance decomposition for *CPI* is that the exchange rate *ER* explains a great extent of the variation — about 30 percent after 11 periods. This may be attributed to the inflationary effects of a devaluation, a series of which occurred frequently and drastically throughout the eighties.

Although having a fixed interest rate policy seems to have its virtues by supposedly making investment stable and by making output and employment higher, the evidence, although weak, seems to favor a fixed money stock policy. That is, the costs of having an interest-rate target policy outweigh its potential benefits.

It may also be appropriate to cite the article of Stiglitz and Weiss (1981). Under conditions of imperfect information, the loan market can be in equilibrium with a credit-rationing level of interest rate prevailing. Banks can maximise profits by maintaining this credit-rationing situation

Table 5 - Variance Decomposition of *SFDLPROD*

Period	S.E.	*SFDLM1*	*SFDLPROD*	*SSDLCPI*	*FDLTB91*	*SFDLER*
1	0.030880	2.603936	97.39606	0.000000	0.000000	0.000000
2	0.035329	7.804586	83.82292	7.809989	0.035867	0.526637
3	0.036355	9.130114	79.16909	8.791557	0.344652	2.564586
4	0.038437	13.08249	71.59330	9.525527	2.083862	3.714822
5	0.038791	12.93022	71.51627	9.587244	2.097611	3.868661
6	0.039803	14.95982	67.95244	10.81622	2.564299	3.707215
7	0.040936	18.95055	64.33389	10.23364	2.924936	3.556986
8	0.042459	18.05835	60.98630	9.577748	3.257786	8.119822
9	0.043855	18.59098	60.34667	9.416573	3.059710	8.586063
10	0.044408	19.16020	59.87108	9.326025	2.998183	8.644515
11	0.044824	18.86365	59.03239	10.52107	3.097975	8.484908
12	0.044954	18.75490	58.88652	10.57250	3.221600	8.564477
13	0.045341	18.46114	57.90375	11.01998	3.176111	9.439022
14	0.045687	18.51057	57.03005	11.26751	3.282352	9.909523
15	0.045820	18.71045	56.70101	11.22614	3.273184	10.08922
16	0.046041	18.53589	56.75217	11.45789	3.242532	10.01151
17	0.046131	18.47005	56.54873	11.69921	3.236496	10.04551
18	0.046183	18.44001	56.42604	11.68854	3.290267	10.15515
19	0.046384	18.32107	55.94003	11.66126	3.386382	10.69126
20	0.046487	18.38751	55.69202	11.90314	3.371442	10.64589
21	0.046584	18.32014	55.47923	11.97566	3.365080	10.85988
22	0.046666	18.25640	55.29557	12.12698	3.404089	10.91697
23	0.046695	18.30699	55.23262	12.11212	3.432125	10.91614
24	0.046725	18.30207	55.17150	12.09851	3.427813	11.00011
25	0.046742	18.29143	55.14254	12.10111	3.460038	11.00489
26	0.046773	18.28357	55.09832	12.16209	3.465338	10.99069
27	0.046799	18.26517	55.06730	12.20912	3.467978	10.99043
28	0.046874	18.21119	54.98545	12.22585	3.460331	11.11718
29	0.046888	18.19985	54.98633	12.21885	3.482436	11.11252
30	0.046902	18.19803	54.95562	12.23169	3.488709	11.12595
31	0.046914	18.19557	54.92757	12.25558	3.487058	11.13421
32	0.046922	18.18924	54.91556	12.25195	3.487488	11.15570
33	0.046929	18.18801	54.90046	12.26458	3.486648	11.16031
34	0.046939	18.20055	54.87668	12.25935	3.507319	11.15611
35	0.046970	18.17726	54.80775	12.26741	3.503060	11.24452
36	0.046981	18.19345	54.78839	12.26130	3.502454	11.25441

because of adverse selection, by screening out potential high-risk borrowers who would normally be willing to pay a higher interest cost, and moral hazard, for raising the interest rate may induce borrowers to undertake high-return but high-risk projects. Thus, this implies that

Table 6 - Variance Decomposition of SSDLCPI

Period	S.E.	*SFDLM1*	*SFDLPROD*	*SSDLCPI*	*FDLTB91*	*SFDLER*
1	0.005628	3.731363	0.903658	95.36497	0.000000	0.000000
2	0.006944	8.517898	1.338284	66.92656	0.032802	23.18446
3	0.007562	7.254452	1.450132	65.20888	3.040971	23.04557
4	0.007594	4.204488	1.442235	65.16401	3.326767	22.86250
5	0.007953	12.03715	2.484404	59.73779	3.795273	21.94539
6	0.008091	11.64672	2.544860	57.93236	4.397850	23.47821
7	0.008181	11.43194	2.490779	57.34059	4.318682	24.41800
8	0.008333	11.03583	2.482167	58.38939	4.225958	23.86665
9	0.008699	12.51314	2.476063	56.50872	3.879871	24.62220
10	0.008806	12.21440	2.566441	55.62524	3.828888	25.76503
11	0.009159	11.53453	2.509943	51.74578	3.594853	30.61489
12	0.009214	11.89634	2.628876	51.19267	3.784242	30.49786
13	0.009233	11.87973	2.825163	51.01656	3.769555	30.50899
14	0.009285	11.81461	3.112501	50.90476	3.744733	30.42340
15	0.009324	11.83264	3.098379	50.48214	3.846942	30.73989
16	0.009366	11.72892	3.245485	50.03082	6.856907	31.13787
17	0.009445	11.73282	3.387957	49.94540	4.300265	30.63355
18	0.009455	11.79261	3.415025	49.87082	4.305951	30.61560
19	0.009497	11.72761	3.407297	49.45292	4.482639	30.92953
20	0.009515	11.70039	3.534968	49.27951	4.571039	30.91409
21	0.009521	11.71391	3.562028	49.22631	4.621593	30.87615
22	0.009535	11.80457	3.591379	49.16753	4.647716	30.78880
23	0.009544	11.81980	3.586627	49.22334	4.639068	30.73116
24	0.009552	11.88085	3.581539	49.17245	4.649334	30.71583
25	0.009574	11.87787	3.608187	48.98962	4.662877	30.86145
26	0.009580	11.91057	3.641616	48.94979	4.671538	30.82648
27	0.009583	11.90843	3.639425	48.94912	4.670382	30.83264
28	0.009584	11.91054	3.642738	48.93923	4.670843	30.83665
29	0.009588	11.92156	3.640482	48.93002	4.667651	30.84028
30	0.009589	11.91892	3.640548	48.91816	4.666530	30.85584
31	0.009594	11.92112	3.637843	48.91862	4.693483	30.82871
32	0.009596	11.91910	3.637072	48.91739	4.693483	30.83296
33	0.009597	11.91757	3.639220	48.91795	4.695328	30.82994
34	0.009599	11.91832	3.641222	48.90784	4.693557	30.83906
35	0.009599	11.91734	3.643083	48.90466	4.698568	30.83635
36	0.009601	11.91294	3.641487	48.91476	4.696558	30.83426

the amount of credit (serving as a money-stock proxy), rather than the interest rate, becomes the relevant variable. That is, money-stock targetting becomes the superior policy. The propositions of Stiglitz and Weiss (1981) may be valid for this paper when one considers the non-significance of the interest rate coefficients in the output equations.

This interpretation, however, is very different from the Friedman monetarist theory or Poole's perspective, both of which concentrate on the effect of money supply on aggregate demand.

It must be pointed out that if indeed a money-stock target policy is more favorable in terms of higher and more stable output, caution must be exercised in increasing the money supply during economic downturns due to the money stock's feedback effects on output and its significant and positive influence on the price level.

4. Conclusion

This paper has made a modest attempt in determining whether a money-stock target policy or an interest-rate target policy is preferable in terms of higher and more stable output, using a vector autoregressive model developed by Christopher Sims (1980). An article by William Poole (1970) was also useful for this study. The regression results for the period covered, 1981-1991, provided some evidence to support a money-stock target policy for the case of the Philippines. It was found that the interest rate coefficients in the output equations were insignificant, and that money significantly influenced both output and prices. From Poole, this suggests that it is the investment demand function (as depicted by the IS schedule) that has been subject to greater instability than the money demand function (LM schedule). Another interpretation may be attributed to the reasons proposed by Stiglitz and Weiss (1981), implying that it is the money stock or quantity of credit variable that becomes more important for output. This may perhaps also be attributed to various political crises that have plagued the country over the years or to the government's unclear policies on investment, creating uncertainties in the investment climate, and perhaps outweighing the influence of the interest rate on investments.

References

Boyer, Russell S. (1978), "Optimal Foreign Exchange Market Intervention," *Journal of Political Economy*, 86:6:1045-1055.

Canlas, Dante B. (1985), *Monetary Policy and Economic Activity in a Low Income Country: An Empirical Investigation.* UP. 1985.

Cooley, Thomas F. and LeRoy, Stephen F. (1985), "Atheoretical Macroeconomics: A Critique," *Journal of Monetary Economics* 16:283-308.

Cueva-Mercader, Myrna N. (1985), *The Effects of Monetary Policy on Real Output and Price Level in the Philippines: 1946-1983*, M.A. Thesis, University of the Philippines, School of Economics.

Dornbusch, Rudiger and Fischer, Stanley (1990), *Macroeconomics*, 5th ed, McGraw-Hill Publishing Co., pp. 407-416.

Encarnación, José Jr. (1990),"Reflections on Economic Development: Wages and Interest Rate," Unpublished.

Gochoco, Ma. Socorro H. (1991), "Financial Liberalization and Interest Rate Determination: The Case of the Philippines, 1981-1985," *Journal of Macroeconomics,* 13:2:335-350.

Hsiao, Cheng (1981), "Autoregressive Modelling and Money-Income Causality Detection," *Journal of Monetary Economics,* 7:85-106.

Lamberte, Mario B. (1983), "Monetary Aggregates and Economic Activity," Philippine Institute for Development Studies, Staff Paper Series No. 83-03.

Pindyck, Robert S. and Rubinfeld, Daniel L. (1981), "Properties of Stochastic Time Series," in *Econometric Models and Economic Forecasts*, 2nd ed., McGraw-Hill, Inc., pp. 493-513.

Poole, William (1970), "Optimal Choice of Monetary Policy Investments in a Simple Stochastic Macro Model," *Quarterly Journal of Economics*, pp. 197-216.

Sims, Christopher A. (1972), "Money, Income and Causality," *American Economic Review*, 62:4:540-552.

Sims, Christopher A. (1980), "Comparison of Interwar and Postwar Business Cycle: Monetarism Reconsidered," *American Economic Association*, 70:2:250-257.

Stiglitz, J.E. and Weiss, A. (1981), "Credit Rationing in Markets with Imperfect Information," *American Economic Review*, 71:3:393-410.

Tan, Edita A. (1974), "Considerations for Changing the Interest Rate Policy," UP-IEDR Discussion Paper no. 74-7.

The New Palgrave: A Dictionary of Economics, MacMillan Press Ltd., vol. 3, pp. 492-496.