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A STATISTICAL FRAMEWORK FOR MONETARY POLICY[1]

EDGARDO P. ZIALCITA[2]

I. Introduction

There are two senses in which monetary policy can be defined: first as the set of measures which are adopted by the monetary authorities and second, as the objective(s) which the adopted measures are intended to achieve. This paper is not, however, directly concerned with policy as measures or policy as objectives. It is concerned with a yet another aspect of policy—the theoretical underpinning of policy—or with policy as theory. Behind every policy measure or policy goal that is adopted stands a theory, whether this theory consists of a set of many inter-related equations or of one simple relationship.

In this paper, we attempt to construct and estimate a simple model which can serve as a theoretical framework for monetary policy. In carrying out this attempt, no imputation is made that the existing policy framework is defective. As a matter of fact, some of the relationships appearing in the model are mere quantifications of ideas which are of common knowledge and which are used by many people including those who make or criticize monetary decisions. This should not be surprising

[1] In substance, this is essentially the same paper as that read at the PSA Conference held last August 9, 1968 at the Philippine Columbian Association. Despite the introduction of some revisions, this paper must be considered as prelimnary. The statistical portion of this paper was prepared by the following staff members of the Central Bank, Department of Economic Research: Raul Aristorenas, Clarita Sacote, under the supervision of Aida R. Saldua. All calculations done in this paper were carried out by means of desk calculators.

[2] Technical assistant, Department of Economic Research, Central Bank of the Philippines.

since statistical relationships and knowledge are both based on past experience: the difference—and this is one of the advantages of the former—is that statistical analysis usually embraces a longer period than what knowledgeable people use or can encompass in judging past experience. Another advantage of a formally constructed model is that anyone else can use it for forecasting purposes while the making of "judgment" forecasts or forecasts based on knowledge is often the exclusive prerogative of a single person. For simliar reasons, a model can more easily be studied and improved upon by others, if necessary.

It should be emphasized that the theoretical framework presented here is a preliminary version of the model which we want to use in analyzing past monetary experience and in making projections for the future. Many improvements can still be made on the raw data and on the functional forms of the equations used in the model. At the data level, for instance, the accuracy of the balance of payments figures is relatively low; morever additional adjustments should be made to eliminate those transactions which do not have monetary effects. There is also the question of what exchange rate to apply in deriving the peso value of foreign exchange receipts and disbursements for 1960-61, a period when multiple rates were in existence. Similarly, the data on government expenditures can be revised so as to exclude transactions (e.g. debt payments to the Central Bank) which do not actually increase money supply. Data showing the actual cash operations of the government are not also available for earlier than 1957 and have yet to be collected.

Increasing the number and altering the forms of some, of the relationships can be another way of improving the model. Almost all of the equations specified in the model are estimated by simple linear regression; this is to make the calculations easier. There is also need to investigate the possibility or introducing or substituting new or additional variables and equations.

Lastly, further disaggregation of the model may make some relationships more meaningful. This applies particularly to the

commercial banking sector which is dominated by a government-owned bank, the Philippine National Bank (PNB). Domestic credits granted by the PNB may behave differently from those granted by private commercial banks and should thus be segregated.

II. General Description of the Framework

The basic equation of our theoretical framework is the money supply factor equation. This equation, which appears in tabular form in the quarterly Economic Notes and Annual Report of the Central Bank, is expressed in the form of an identity. It traces the overall change in the stock of money to three sources: foreign exchange transactions, government operations, and banking operations with the private sector (including local and semi-government entities). In equation form, the identity looks like this:

(1)

Change in money supply = balance of payments surplus + government deficit + net private credit creation.

The majority of the remaining equations of the model are thus grouped around the three sectors which participate in the money creation process. The role of these three sectors is to establish the level of the money stock which in turn will determine the level of money income and, going one step further, the level of imports (including outward transfer payments).[3] Assuming that we can estimate through some other means the level of exports (including inward transfer payments) and that of net capital movements, the model can then be used to calculate what the balance of payments position will be for a given level of the money stock.

[3] The level of imports also has a feedback effect on the level of money stock: the above description of the monetary process therefore fails to take into account the complete simultaneous interaction between money stock, money income and money imports.

Since growth and price stability are two other important policy objectives of the Central Bank, it is necessary to expand the model to show how monetary changes affect real income and the price level. A fourth sector is thus added, which, besides incorporating the equation showing how the level of money income is determined by the money stock, attempts to explain the level of real income in terms of current and past values of gross domestic investment. The current level of investment in turn is assumed to be solely dependent on the credit operations of the commercial banking system.[4] Thus, with the level of bank credit known—investment, real income and, consequently, the growth in real income can be estimated. Finally, with the estimated level of real income, the price level can be derived by dividing real into money income.

III. Foreign Sector

The foreign sector of our monetary model consists simply of three equations. The first two equations deal with the current account of the balance of payments, while the third covers the capital account. Sources of our data for the foreign sector model are the balance of payments accounts of the Philippines for 1949-1967. For our theoretical purposes, the foreign exchange record would have been more appropriate, since only foreign exchange transactions involving actual cash receipts and disbursements are reported therein while the balance of payments table includes non-monetary transactions such as those covering barter, reparations imports and donations in kind. On the other hand, the balance of payments account is used here because it provides the type of breakdown which we need and which is not readily available from the foreign exchange record.[5]

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[4] A basic defect of this assumed dependence is that the investment of the public sector is not provided for, except in so far as public investment is financed by borrowings from the commercial banking system.

[5] A basic weakness, therefore, of the external sector data, in addition to the fact that many transactions fail to be reported, is that they include transactions which do not add to or subtract from the stock of money. The capital account, however, has been adjusted so as to exclude Central Bank loan transactions.

A. *Current Account Receipts*

The items falling under credit column of the current account section of the balance of payments table compose the first external sector variable that the model attempts to explain. Since a large portion of current account receipts arises from exports, it may be considered logical to use as explanatory variables prices and incomes, two variables which are ordinarily used to explain fluctuations in exports.[6] However, there are two other items which bulk large in the current account (receipts side) of the Philippine balance of payments, namely, services and transfer payments. These two items are not apparently closely related to prices or incomes abroad. Consequently, current account receipts, E_t, can be treated as an exogenous"[7] variable although for purposes of projection, we can express them as a linear function of time:

$$E_t = e_o + e_1 t \tag{2}$$

B. *Current Account Payments*

Current account payments, I_t, the debit items under the current account section of the balance of payments table, can also be explained by a price variable and an income variable. In this model, however, only an income variable is used to explain current account payments. While the services component is also large, this is closely tied up with import payments because one of the large items of services is "freight and insurance" payments or imports (and exports). These payments more closely with imports. Thus, we do not treat current account payments as exogenous but relate them to current GNP, Y_t:

$$I_t = i_o + i_1 Y_t \tag{3}$$

[6] In another paper published, movements in the volume index of exports were explained satisfactorily by a ratio of domestic prices to foreign prices and by the weighted average income of six countries.

[7] Exogenous in the sense that it is not dependent on any of the jointly dependent variables of the system.

C. *New Capital Inflow*

The third foreign sector variable is net capital inflow. Its over-all movement, as well as the movements of its three components (loans, other capital and errors and omissions), has been so erratic that it would be most difficult to find an explanatory variable which can adequately explain it. It is probable that given a more accurate set of figures on loan availments and payments, foreign investments as well as exports and imports, the series on net capital inflow will become more manageable and easily explainable. In this regard it may be useful to mention that studies have already been made on the amount of under- (and over-) estimation in Philippine trade data. These studies can probably be used to correct our trade data which in turn will result in better figures on the the errors and omissions component of net capital inflow. Moreover, it may also be possible to get more accurate figures for loans and investments from other sources. In the meanwhile, only the loan transactions of the Central Bank, which have no monetary impact are excluded from the original data on net capital inflow. The adjusted figures R_t, were related to changes in the money stocks, M_t:

$$(4) \qquad R_t = r_0 + r_1 (M_t - M_{t-1}$$

IV. Government Sector

The Central Bank Statistical Bulletin's series on the cash operations of the national government provides the raw data for measuring the contribution of the government sector to changes in the level of the money stock. In general, the government increases money supply by its cash expenditures and reduces it by its cash receipts.

A. *Government Expenditures*

Government cash expenditures are of two kinds: current or operating and financial. It is safe to assume that all current expenditures serve to increase the stock of money. A similar

assumption, however, cannot be made with respect to government's financial disbursement which include sinking fund payments, interest payments and debt repayments. Such disbursements as are made, for example, to the Central Bank or to foreign residents have no positive monetary impact as payments to other sectors would. They should therefore be excluded from the series on government cash expenditures. However, corrections, like this can not be made because a breakdown of the financial disbursements is not provided by the Central Bank series. As an alternative, the assumption is made that all financial expenditures do not increase the stock of money. This may be partly justified by the fact that debt holdings of the Central Bank and foreign residents are much larger than the combined holdings of commercial banks and other security holders.[7] Government expenditures which have a positive effect on money supply are thus identified with government operating disbursements alone.

For our first government sector relationship, the operating expenditures of the government, G_t, are assumed to increase over time according to a linear trend equation fitted to the period 1957-1967[8], or:

$$(5) \qquad G_t = g_o + g_1 t$$

B. Government Receipts

Aside from operating receipts from borrowings from (or sales of securities to) non-inflationary sources, i.e., from the private sector and the government non-banking sector, should be included in government cash receipts. Borrowings from the banking sector however are not included because ordinarily they do not serve to reduce the money stock. However, since

[7] This statement would apply more particularly to securities which are about to be redeemed. Redemption payments are normally larger than interest payments.

[8] No data on cash expenditures are available for years prior to 1957 although data on accounting or book expenditures are available for earlier years.

the purchases of government securities by the private sector have been relatively small and since the purchases by government non-bank financing institutions, though relatively large, are partly financed by borrowings from the commercial banking system or are ultimately unloaded with the Central Bank, it can be assumed that the government borrows only from, or sells securities only to, the Central Bank and commercial banks. In short we assume that operating receipts are the only form of government receipts which act to reduce the monetary stock. In line with basic theory, government cash (or operating) receipts, T_t, are linearly related to current GNP in the second government sector equation:

$$T_t = t_o + t_1 Y_t \qquad (6)$$

V. Banking Sector

The banking operations which are covered by the model include the following:

1. The granting of credits by the Central Bank to local and semi-government entities, with the total of such credits outstanding being measured by D_t^{CL};

2. The granting of credits by the commercial banking system to the private sector and to local and semi-government entities, or private commercial bank credits,[9] for short; the outstanding level of such credits is indicated by D_t^{PCL};

3. The movement in non-monetary liabilities of the banking system, the level of which is indicated by N_t.

Since it is the changes in these variables that affect the stock of money, it is necessary to subtract from each of these three variables the corresponding previous year's values.

[9] This is to be distinguished from private bank credit which combines private commercial bank credits with the credits extended by the Central Bank to the local and semi-government sector (and the private sector, if any).

A. Central Bank Credit to Semi-Government Entities

Three semi-government entities account for the bulk of Central Bank credit to the local and semi-government sector. These are the Development Bank of the Philippines, the Philippine Virginia Tobacco Administration and the Agricultural Credit Administration. Two other local agencies which have received fairly substantial amounts of credit assistance from the Central Bank are the National Power Corporation and the Nawasa.

The level of credit assistance to semi-government entities is obviously a matter which can be decided upon by the national government and/or the Central Bank. It can therefore be considered as a strictly exogenous. It may, however, be instructive to see how it has behaved over time; thus we have made it a linear function of time:

$$(7) \qquad D_t^{CL} = d_0 + d_1 \, t$$

B. Commercial Banking System Credit to the Private Sector

Private commercial bank credits are defined here so as to include the credits granted by the commercial banking system to the local and semi-government sector in addition to those granted to the private sector. This is despite the fact that the main source of commercial bank credit to the local and semi-government sector has been the government-owned PNB, which makes it, therefore, more or less identical to the credit assistance which the Central Bank extends to the same sector.

In looking for variables to explain the movement of private commercial bank credits, the problem is not one of finding a good explanatory variable but that of choosing among many good ones. Our final choice is a composite variable, the sum of currency in circulation and deposit balances of commercial banks with the Central Bank, or credit base, for short. The danger of making this choice is that this particular variable,

is that it indicated here by F_t, may turn out to be the explained instead of the explanatory variable. Thus, the line of causation may move from the expansion of bank credit to an equivalent expansion in circulating currency and in bank reserves held in the form of deposits with the Central Bank. This danger, however, also exists even if we use other "credit base" variables like bank borrowings from the Central Bank, savings and time deposits and banks' net worth. The equation explaining private commercial bank credit is thus,

$$(8) \qquad D_t^{BPL} = b_o + b_1 F_t$$

Equation (8) introduces a new variable, F_t, which must also be explained. This variable is assumed to depend on the levels of current account receipts and government operating expenditures:

$$(9) \qquad F_t = f_o + f_1 E_t + f_2 G_t$$

C. *Non-monetary Liabilities of the Banking System*

The non-monetary liabilities of the banking system (commercial banks and Central Bank) consist of the non-money supply deposits and the net miscellaneous accounts of the banking system.

Non-money supply deposits are largely composed of national government cash balances (demand deposits with the Central Bank and commercial banks, trust funds with the Central Bank, and Treasury cash holdings), savings and time deposits, and marginal deposits. The net miscellaneous accounts are the differences between the other liabilities and other assets of the banking system.

Despite the heterogeneous composition of the non-monetary liabilities of the banking system, this variable can be conceived as forming part of the savings of the economy. Thus, a correlation with current gross national income can be tried to explain its movement:

$$(10) \qquad N_t = n_o + n_1 Y_t$$

It shall be noted that the foregoing banking sector equations do not cover the credit operations of the Central Bank and of commercial banks that arise in connection with the financing of the government deficit. These are already provided for in the system of equations relating to government operations. A case can also be made for the exclusion of the cash balances of the national government from the non-monetary liabilities created by the banking system and to shift them to the government sector. This can be done in a later version of the model.

VI. Aggregate Sector

Thus far, in attempting to explain the money creation process, we have built up a system of 10 equations containing 16 variables. Four of these variables are lagged and can therefore be classified as exogenous together with the time variable, t. Three others, E_t, G_t, D_t^{CL}, are functions only of time: hence, they too can be classified as exogenous. If they are so classified, then this will in effect reduce the number of equations to 7. Since the number of remaining variables, all of which are considered as endogenous or jointly dependent, is 8, we have more unknowns than equations.[10] Obviously, one additional relationship is needed which will not increase the number of unknowns. This condition is provided by the following relationship between current GNP and money stock:

$$(11) \qquad Y_t = y_o + y_1 M_t$$

With the addition of equation (11), the system (1) — (11) becomes complete and can be solved for the value of any single endogenous variable or combination endogenous variables well as those of the three unlagged exogenous variables. In particular, it can be used to calculate the balance of payments,

[10] If the three variables which are functions of time were treated as endogenous, then the number of unknowns (11) would still exceed the number of equations (10) by one.

which is simply equal to: $E_t + R_t - I_t$. However, since real income and the price level do not appear in the model, it is obvious that their values can not be determined by it. To make the model more useful for Central Bank purposes, we will therefore introduce a new sector which we shall call the aggregate or macro sector. Equation (11) can be part of this sector since it attempts to explain how aggregate current income is determined. We shall henceforth treat it as one of the macro sector equations.

The macro sector may also be called the real sector since it contains the equations explaining aggregate real income and real income and real investment. Real income, $\left(\frac{Y}{P}\right)_t$, is here assumed to be a function of past real investment decisions, or:

$$(12) \qquad \left(\frac{Y}{P}\right)_t \equiv y_t = h_o + h_1 K_t$$

where K_t is defined as the cumulative sum of gross investments from 1955 to the given year, t:

$$(13) \qquad K_t \equiv \sum_{o}^{t} V_t$$

In equation (13), V_t stands for real gross investment for a particular year. A more logical procedure would have been to use net investment data but the absence of good independent estimates of depreciation recommends against using these data. The variable, V_t, is assumed to depend on private commercial bank credits. The latter is deflated by the GNP implicit price deflator, since V_t is in real terms. Thus

$$(14) \qquad V_t = v_o + v_1 \left(\frac{D^{BPL}}{P}\right)_t$$

As the last of our macro-sector equations, the following identity:

$$(15) \qquad P_t \equiv \frac{Y_t}{y_t}$$

is used to show how the price level can be calculated from the model once the levels of real and money income are known.

To sum up, the addition of an aggregate sector has introduced four additional endogenous variables: Y_t, K_t, V_t and P_t. All in all, therefore, the number of endogenous variables becomes 12 but with the five additional marco equations, the number of equations has also been raised to a level sufficient to determine the values of these variables.

VII. The Complete Model

To make it convenient for the reader, the fifteen equations of the model are grouped together in this section.

Basic monetary equation (an identity):

1. Change in money stock = [Balance of payments surplus] + [Government deficit] + [Net private credit expansion]

$$\text{or, } M_t - M_{t-1} = [E_t - I_t + R_t] + [G_t - T_t] + [(D_t^{CL} - D_{t-1}^{CL}) + (D_t^{BPL} - D_{t-1}^{BPL}) - (N_t - N_{t-1})]$$

Equations for the external sector:

2. $E_t = e_0 + e_1 t$
3. $I_t = i_0 + i_1 Y_t$
4. $R_t = r_0 + r_1 M_t$

Equations for the government sector:

5. $G_t = g_0 + g_1 t$
6. $T_t = t_0 + t_1 Y_t$

Equations for the banking sector:

7. $D_t^{CL} = d_0 + d_1 t$

8. $D_t^{BPL} = b_o + b_1 F_t$

9. $F_t = f_o + f_1 G_t + f_2 E_t$

10. $N_t = n_o + n_1 Y_t$

Equations for the aggregate sector

11. $Y_t = y_o + y_1 M_t$

12. $\left(\frac{Y}{P}\right)_t = h_o + h_1 K_t$

13. $K_t \equiv \sum_{t_o=1955}^{t} V_t$

14. $V_t = v_o + v_1 \left(\frac{D^{BPL}}{P}\right)_t$

15. $P_t \equiv Y_t \div \left(\frac{Y}{P}\right)_t$

The variables, in the order of appearance, are:

M_t — Money supply (end of year);
E_t — Foreign exchange receipts under current account;
I_t — Foreign exchange payments under current account;
R_t — Net capital inflow;
G_t — Government operating disbursements;
T_t — Government operating receipts;
D_t^{CL} — Domestic credits of the Central Bank to the local and semi-government sector;
D_t^{BPL} — Domestic credits of the commercial banking system to the local and semi-government entities to the private sector;
N_t — Non-monetary liabilities of the banking system;
Y_t — Gross national product, at current prices;
F_t — Credit base, equal to the sum of currency in circulation and demand deposits of commercial banks with the Central Bank;

P_t — GNP implicit price deflator, 1955 = 100;
$(Y/P)_t$ — Gross national product, at 1955 prices;
V_t — Gross domestic investments, at 1955 prices;
K_t — Cumulative sum of real gross domestic investments starting from 1955.

VIII. Statistical Results

Equations (2) — (12) and (14) were estimated by the method of ordinary least squares. In view of the fact that most of the explanatory variables also appear in other equations as explained variables, the resulting estimates of the coefficients can be expected to be biased and not consistent. These estimates as well as the various measures of significance are shown in Tables I—IV. Accompanying charts comparing the movements of the actual series with the calculated series are also given.

A. *External Sector*

The external sector group includes the one regression equation which obtains a consistently low score on all the tests of significance. This is the equation relating net capital movements to changes in money stock. The standard error of estimate, which is not shown because the average of net capital movements is negative, is high while the correlation is very low. Furthermore, though the sign of the coefficient estimate is correct, its standard error is high.

The estimated trend equation for current account receipts has a high standard error of estimate and a moderately high correlation coefficient. On both measures, the results are likely to improve if the fitting period is broken up into sub-periods, 1949-1960 and 1961-1967.

For the regression equation relating current account payments to gross national product, the correlation is high, and the coefficient estimate is statistically significant and with the correct sign. However, the standard error of estimate is not too low. It is possible that improvements on trade data will bring about a lower standard error of estimate.

TABLE I

EXTERNAL SECTOR EQUATIONS

(All absolute values in million pesos)

Equation Number	*Explained Variable*	*Explanatory Variable*	*Coefficient of explanatory variable*	*Constant term*	*Correlation Coefficient*	*Standard error of estimate as % of mean*	*Durbin-Watson test*	*Fitting period*
2	Current account receipts	Time	235.8 (33.57)	179.0 (183.85)	0.862	34.8	0.17	1949-67
3	Current account payments	Current GNP[a]	0.23 (0.044)	-672.0 (191.18)	0.970	15.2	0.75	1949-67
4	Net Capital inflow	Change in money stock	-0.42 (0.49)	-196.3 (104.08)	-0.237	[b]	0.52	1949-67

[a] Based on the old NEC series.

[b] No entry is made because the mean is negative.

B. Government Sector

The coefficient estimates for the two government sector equations have the correct signs and are statistically significant. The correlation coefficients are also high and the standard errors of estimate relatively low. Presumably, similarly good results will be obtained once earlier data and a breakdown of government expenditures and receipts become available.

C. Banking Sector

Although all four regression equations for the banking sector show a high degree of correlation and coefficient estimates which possess the correct sign and are statistically significant, two of them also have relatively high standard errors.

The high standard error of the equation relating Central Bank credits to semi-government entities to time may be traced to two factors. One is the essentially irregular nature of the legislative process which from time to time turns out measures compelling the Central Bank to support the activities of semi-government agencies like the Philippine Virginia Tobacco Administration (PVTA) and the Agricultural Credit Administration (formerly ACCFA), The other is the stand-by agreement with the International Monetary Fund. Initially, this agreement, which first came into force into 1962, served to restrict Central Bank credit to government entities up to 1965. Afterwards, this was relaxed, thus enabling the government to freely utilize Central Bank credit once more. It should be noted that the movement of this variable more or less paralleled that of government disbursements: Central Bank credits to semi-government entities may thus be combined with the latter in a future version of the model.

The second equation with a high standard error is that expressing private commercial bank credits as a function of credit base. A glance at the chart plotting both the computed and actual values of private commercial bank credits shows that the actual series is smoother than the computed series. A

TABLE II

GOVERNMENT SECTOR EQUATIONS

(All absolute values in million pesos)

Equation Number	*Explained Variable*	*Explanatory Variable*	*Coefficient of explanatory variable*	*Constant term*	*Correlation Coefficient*	*Standard error of estimate as % of mean*	*Durbin-Watson test*	*Fitting period*
5	Government operating expenditures	Time	220.6 (23.92)	1,189.1 (75.65)	0.951	10.9	1.52[a]	1957-67
6	Government operating receipts	Current GNP[b]	0.13 (0.01)	48.2 (182.3)	0.972	8.0	1.17[a]	1957-67

[a] This may be significant but the distribution of the Durbin-Watson statistics starts with a sample size of 15.

[b] Based on the old NEC series.

trend equation may thus fit the data better than a regression against credit base, especially if the series is broken up into two sub-periods.

Credit base is explained by two variables. Comparison of the magnitudes of the two coefficient estimates and their corresponding standard errors indicates that credit base can be adequately explained by government cash expenditures alone. Current account receipts are nevertheless retained as a second explanatory variable because subsequent inclusion of earlier years in the fitting period and use of differences rather than absolute values may increase its importance as an explaining variable.

The results of the regression of non-monetary liabilities on gross national product are such that it may not be necessary after all to disaggregate the non-monetary liabilities of the banking system. The coefficient estimate, the correlation coefficient and the standard error of estimate are all equally satisfactory.

D. *Aggregate Sector*

On the whole, the three regression equations that comprise the aggregate sector give the best results. All the estimated coefficients are statistically significant and carry the correct signs. The correlation coefficients are high while the standard errors, with the possible exception of that for the equation explaining real investments by real private commercial bank credits, are low.

In summary, while we can say that the least squares regressions show generally favorable results, the model still needs a great deal of modification and refinement before it can be used for prediction purposes. There is first of all the fact, which is readily evident from the charts, that most of the variables used in the equation show a common smooth upward trend. A time trend can adequately explain the movements of all the

TABLE III

BANKING SECTOR EQUATIONS

(All absolute values in million pesos)

Equation Number	Explained Variable	Explanatory Variable	Coefficient of explanatory variable	Constant term	Correlation Coefficient	Standard error of estimate as % of mean	Durbin-Watson test	Fitting period
7	Central Bank domestic credit to the local & semi-gov't sector	Time	28.3 (2.46)	-3.13 (13.47)	0.941	23.1	0.96[a]	1949-67
8	Commercial Bank domestic credits to the local & semi-gov't. and private sectors	Currency in circulation plus commercial bank deposits with the Central Bank	4.69 (0.298)	-2,905.6 (363.3)	0.967	21.4	1.26[b]	1949-67
9	Currency in circulation plus commercial bank deposits with the Central Bank.	a) Gov't. operating expenditures b) Current account receipts	0.42 (0.155) 0.02 (0.071)	382.1	0.963	7.8	1.82	1957-67
10	Non-monetary liabilities of the banking system	Current GNP[c]	0.22 (0.027)	-1,187.1 (373.9)	0.993	10.0	0.94[a]	1949-67

(a) Falls between the lower and upper bounds of the 1 per cent significant points.
(b) Falls between the lower and upper bounds of the 5 per cent significant points.

endogenous variables of the model. As the Durbin-Watson test statistics also indicate, the close fit obtained for some of the regression equations is vitiated by the existence of positive serial correlation in the residuals. It may therefore be necessary to proceed to using differences rather than annual data for the regressions. In the meanwhile, it may still be useful to show how the model can be used to forecast and evaluate the effects of monetary measures.

IX. Application of the Model

As constructed, the model can be solved to determine the values of the twelve (12) jointly dependent variables once the values of the pre-determined variables are known. Since the latter are all "time-determined", the model provides no apparent mechanism whereby the Central Bank can influence the value of any of the endogenous variables. In other words, the model has been so constructed that time alone is sufficient to determine the values of the jointly dependent variables.

One obvious way which the Central Bank can influence the behavior of the model is to relate any of three time—dependent variables to a variable over with the Central Bank can exert an influence. For example, foreign exchange receipts under current account, E_t, can be linked to Central Bank policy on the exchange rate. However, in view of its commitments as an IMF members, it is not as easy for the Bank to revise the exchange rate to bring about desired changes in export earnings. Similarly, government expenditures,G_t, can be considered as subject to Central Bank manipulation, depending on its willingness to buy government securities or lend to the government. More often than not, however, the amount of credit which the Central Bank extends to the government is a decision which is made not at the Board room but in Malacañang. Finally, due to the present composition of the Bank's Monetary Board, the third variable may also be treated as being essentially

TABLE IV

AGGREGATE SECTOR EQUATIONS

(All absolute values in million pesos)

Equation Number	*Explained Variable*	*Explanatory Variable*	*Coefficient of explanatory variable*	*Constant term*	*Correlation Coefficient*	*Standard error of estimate as % of mean*	*Durbin-Watson test*	*Fitting period*
11	Current GNP[b]	Money stock	6.71 (0.19)	−741.7 (408.36)	0.993	5.5	1.05[a]	1949-67
12	Real GNP[b]	Cumulated real investments [a]	0.37 (0.015)	8,786.3 (153.41)	0.991	2.6	0.72	1955-67
14	Real investments [b]	Private commercial bank credit (deflated)	0.62 (0.026)	65.1 (59.0)	0.986	11.0	1.00*	1949-67

[a] Falls between the lower and upper bounds of the .1 per cent significant points

[b] Based on the old NEC series.

beyond the Bank's pale of influence. This is the level of credits which the Central Bank extends to local and semi-government entities like the DBP and RCA.

As an alternative to making one of the three time-dependent variables a policy variable, one of the endogenous variables can be cut off from its present linkage with another variable and in turn tied up with a Central Bank policy instrument. Take for example the variable, D^{BPI}, or private commercial bank credits. In the original formulation of the model, commercial bank credits are dependent on credit base while credit base is linked to government expenditures and current account receipts. It is possible that a third influence on credit base can be exercised by the Central Bank through its rediscounting or open market operations. For projection purposes, we can therefore treat D^{BPL} as being exogenously determined by the Central Bank replace equation (8) by:

$$(8) \qquad D_t^{BPI.} = D_o^{BPI.}$$

As thus revised, the model can be used to show how the Central Bank can influence the behavior of the model by determining the level of F and therefore of $D^{BPI.}$.

Let us therefore assume that the Central Bank adopts measures so as to induce commercial banks to increase private credit by December 1968, to 2 per cent of the level as of September 30, 1968. What will be the effects of this action on the balance of payments, real output and prices? Such an action will also have an effect on the other jointly dependent variables of the model but our primary interest is only in these three variables.

In examining the effects of an increase in private commercial bank credits, it would be convenient to derive the reduced form equation for each of the jointly dependent variables in which we are interested. A reduced form equation

expresses the jointly dependent variable as a function solely of exogenous variables (and of the structural parameters of the model). In order to simplify the calculation, we shall further assume that:

1) net capital movements will equal the average of the two previous years' levels; i.e.,

$$(4)' \qquad R_t = \frac{R_{t-1} + R_{t-2}}{2} = R_o$$

2) current account receipts will follow the same linear trend observed for 1962-1967, not for 1949-1967,

$$(2)' \qquad E_t = e^*_o + e^*_1 t = 3{,}219 + 468.4\, t$$

We first show how the reduced form equation for Y_t is derived.

From equation (11), we have:

$$(11) \qquad Y_t = y_o + y_1 M_t$$

Substituting for M_t in equation (1), we get:

$$(11)a. \qquad Y_t = y_o + y_1 [(E_t - I_t + R_t) + (G_t - T_t) + (D_t^{CL} - D_{t-1}^{CL}) + (D_t^{BPL} - D_{t-1}^{BPL}) - (N_t - N_{t-1}) + M_{t-1}]$$

Then, after making use of the various equations (as amended) for each of the terms enclosed and by transferring all terms with Y_t to the left side, we get:

$$(11)b. \qquad Y_t + y_1 i_1 Y_t + y_1 t_1 Y_t + y_1 n_1 Y_t = [e^*_o + e^*_1 t - i_o + R_o + g_o + g_1 t - t_o + d_o + d_1 t - D_{t-1}^{CL} + D_o^{BPL} - D_{t-1}^{BPL} - n_o + N_{t-1} + M_{t-1}]$$

or,

$$(I) \qquad Y_t = \frac{[A_o + A_1 t + A_2 + y_1 b_1 F_o]}{\Delta}$$

where $A_o = y_o + y_1 e^*_o + y_1 g_o + y_1 d_o + y_1 D_o^{BPL} - y_1 n_o - y_1 i_o - y_1 t_o$

$A_1 = (y_1 e^*_1 + y_1 g_1 + y_1 d_1)\, t$

$A_2 = y_1 R_o - y_1 D_{t-1}^{CL} - y_1 D_{t-1}^{BPL} + y_1 N_{t-1} + y_1 M_{t-1}$

$\Delta = 1 + y_1 i_1 + y_1 t_1 + y_1 n_1$

The reduced form equation for y_t is more easily calculated because after two substitutions, real income becomes a function only of exogenous variables. Thus,

$$(II) \quad y_t = h_o + h_1 K$$

$$= h_o + h_1 \sum_o^t V_t$$

$$= h_o + h_1 \left[\sum_o^{t-1} V_t + V_t \right]$$

$$= h_o + h_1 \left[\sum_o^{t-1} V_t + v_o + v_1 \left(\frac{D_o^{BPL}}{P_t} \right) \right]$$

$$= h_o + h_1 \left[\sum_o^{t-1} V_t + v_o + v_1 \left(\frac{D_o^{BPL}}{\frac{Y_t}{y_t}} \right) \right]$$

$$= h_o + h_1 \sum_o^{t-1} V_t + h_1 v_o + \frac{h_1 v_1 D_o^{BPL}}{Y_t} \cdot y_t$$

$$= \frac{h_o + h_1 \sum_o^{t-1} V_t + h_1 v_o}{1 - \frac{h_1 v_1 D_o^{BPL}}{Y_t}}$$

The derivation of the reduced form equations for the price level (P_t) and the balance of payments ($Q_t = E_t + R_t - I_t$) will not be shown but they can also be easily derived by making use of the reduced form equations for Y_t and y_t.

The estimated or projected impact on the balance of payments, real income and the price level of raising private commercial bank credits to 102 per cent of the Sept. 30, 1968 level are shown in Table V.

TABLE V

PROJECTIONS FOR 1968 COMPARED WITH ACTUAL VALUES IN 1966-67

(In million pesos)

Variable	1966	1967	1968
1. Current GNP	22,856	24,930	27,493
2. Current Account Receipts	5,093	5,516	6,029[a]
3. Current Account Payments	4,462	5,644	5,651[b]
4 Net Capital Outflow	411	121	266
5. Balance of Payments Surplus (Deficit)	220	(249)	112
6. Real GNP	15,165	16,050	17,500
7. % of Real GNP in previous year	105.5	105.8	109.0
8. Price level	150.7	155.3	157.1

[a] This would have been smaller if we had used the 1949-1967 data as a base for our linear trend projections.

[b] Based on tentative data, this will be below the actual figure for 1968. Apparently there has been an increase in the propensity to import.

X. CONCLUSION

What we have done here is to present a simplified picture of the money creation process and its linkage with the real sector of the economy as represented by the variables, real income and real investments. Because of the linkage, the model may be used to predict how monetary changes affect only the balance of payments but also the growth of real income and of the price level. However, it may be useful to repeat for the third time that because of data limitations and the use of simple estimation methods (which were used precisely in view of the nature of the data), the present model should only be considered as an interim version.