A MACROMODEL OF THE MALAYSIAN ECONOMY: 1959–77

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I. INTRODUCTION

ECONOMETRIC model building has been extensively applied to the advanced countries in their use for forecasting and policy simulation (e.g., [3] and [4]). This was possible due to the existence of refined data base, availability of advanced estimation techniques, and computer facilities. However, in the developing countries, progress in this direction is at an infant stage, primarily due to the unavailability of sufficiently good data. Using a limited data base, we have attempted in this paper to construct an annual macromodel of the Malaysian economy for the period 1959–77.

Most of the earlier research on the Malaysian economy has been confined to a descriptive analysis of the data. The first attempt to construct an annual model for West Malaysia was made by Niebuhr [9] and this was mainly for the internal use of the World Bank. In this and in some other studies which followed, East Malaysia (Sabah and Sarawak) was not included. The reason for this omission was the unavailability of accurate data on East Malaysia.

In an independent extension of Niebuhr's work, a further disaggregation of the real sector was introduced by Cheong [1] in an econometric model for West Malaysia. This model included a demographic, a real, and an external sector. This was a considerable improvement on Niebuhr's model. It was an annual model constructed for the period 1948–68. It was not tested for stability properties nor was it used for simulation purposes and the monetary sector was completely ignored.

Cheong and Tillman [2] constructed a short-term forecasting quarterly model for the period 1967–74. This was an improvement on the previous model by Cheong in that a monetary sector was explicitly introduced into the model. However, it was not used for forecasting and simulation purposes.

Hayes [6] and Jaafar Ahmad [7] have constructed models representing real and monetary sectors respectively. But they made no attempt to incorporate both sectors into a macromodel for use in forecasting and simulation.

Our model extends the previous work by incorporating an explicitly specified

This paper is based on the author's Ph.D. thesis, entitled "A Macro-model of the Malaysian Economy, 1959–1977: Simulation Analysis." I would like to thank Professor Victor Argy and Dr. P. C. Ip of Macquarie University, Sydney, Professor K. W. Clements of University of Western Australia, Perth, and referees of this journal for helpful comments. The author takes the responsibility for any errors that remain.

monetary sector into the model and highlighting the role of money. This extension is of crucial importance because in a small open economy such as Malaysia international trade plays an important role and it is now widely recognized that most trade relationships have important monetary components [5] [8]. Moreover, it is the case that over the sample period, the monetary authority adopted a more active policy role by influencing interest rates and money supply. The interest rates charged by commercial banks on deposits and the lending rates for their prime customers are to be determined by themselves. However, the maximum interest rate to be charged by banks for loan to special groups or priority sectors is to be regulated by the government.[1] The instruments such as the liquidity requirement ratio and the statutory deposit ratio are constantly manipulated to maintain a target growth in the rate of money supply.[2]

The link between the real sector and the monetary sector is through three channels: (1) the influence of loan and advances on private investment; (2) the government budget constraint which includes government securities at commercial banks and the monetary base; and (3) the influence of net foreign assets of the central bank (availability of foreign exchange) on investment, i.e., the influence of the external sector on the domestic economy.

Availability of credit determines the rate of investment rather than interest rates.[3] Exchange rate management has never been used as a tool to regulate the growth of the economy. It has been the aim of the monetary authority to stabilize the exchange rate fluctuations by maintaining a competitive exchange rate in its export promotion and at the same time insulating the domestic economy from excessive liquidity induced by capital inflows. In our model the money supply does not affect the real sector through changes in the exchange rate or interest rates.

The paper is divided into five sections. Section II describes the structure of the model and discusses its main features in relation to the Malaysian economy. Section III analyzes briefly the tracking ability of the model within the sample period, while Section IV discusses some policy simulation results. Section V presents an overview of the results and summarizes the conclusions.

II. THE STRUCTURE OF THE MODEL

The model consists of nineteen behavioral equations and twenty-four identities, and was estimated by the ordinary least squares.[4] The estimates of all the be-

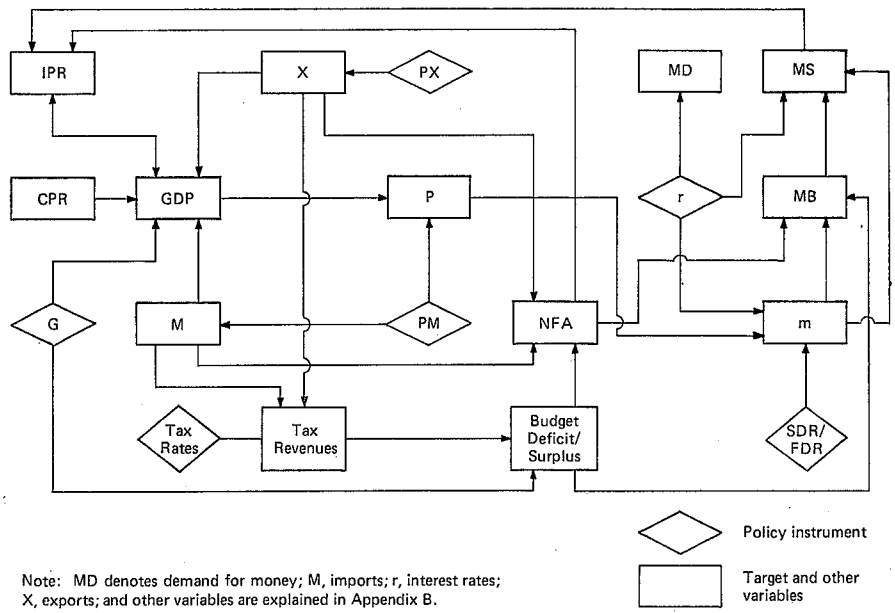
[1] Bank Negara Malaysia, *Buletin ekonomi sukutahunan* [Quarterly economic bulletin], Vol. 11, No. 4 (December 1978), p. 53.

[2] Bank Negara Malaysia, *Buletin ekonomi sukutahunan* [Quarterly economic bulletin], Vol. 11, No. 4 (December 1978), p. 54.

[3] It is stated "...the main aim of easier monetary stance was to provide sufficient growth in liquidity and to stimulate a larger flow of credit for productive purposes...," in Government of Malaysia, Ministry of Finance, *Economic Report, 1975–76* (Kuala Lumpur, 1979), p. 65.

[4] The two-stage least squares or systems method of estimation is not used here due to the

Fig. 1. Simplified Flow Chart of the Macromodel of Malaysia



Note: MD denotes demand for money; M, imports; r, interest rates; X, exports; and other variables are explained in Appendix B.

havioral equations and the identities are given in Appendix A. The description of all the variables used in the model is given in Appendix B.

The model can be divided into three main categories: (1) a domestic sector, (2) an external sector, and (3) a monetary sector, with the price equation, the government finance constraint, and the identities falling into the miscellaneous category. Figure 1 is a simplified flow chart of the model which shows the interrelationships among various sectors of the economy.

A. *Domestic Sector*

This consists of the behavioral relationships explaining consumption, investment, and taxes (equations A-1 to A-6). Money illusion effects and real balance effects on real consumption expenditures were found not to be significant. Availability of domestic credit as represented by loans and advances by commercial banks was found to be significant in the investment function. External finance represented by foreign exchange reserves (lagged two periods) is also significant. This indicates that internal and external sources of finance are used for investment in the development process of the economy. The tax functions are disaggregated into direct taxes, export, import, and other indirect tax categories.

B. *External Sector*

Exports are disaggregated into manufactured goods, raw materials, and other

very limited number of observations (nineteen) as against the number of predetermined variables (thirty-six). The two-stage least squares with principal components is not used due to the presence of nonlinearities in variables. We believe that under these circumstances the ordinary least squares provides the best estimates of the coefficients of the model.

exports (equations A-16 to A-18), while the imports are disaggregated into imports of food, raw materials, manufactured goods, investment goods, and other miscellaneous goods (equations A-11 to A-15). We estimated export supply functions[5] and found that the real output is significant in two of the equations and the lagged relative price variable is only significant (at 10 per cent significance level) in the exports of manufactured goods. The relative price variables are significant in the import demand functions for food, manufactured, and investment goods.

C. *Monetary Sector*

By definition money supply is related to the monetary base through the multiplier. The money multiplier is explained in this model by the behavioral relations of the excess reserve ratio and the currency deposit ratio (equations A-7 and A-10). These two ratios explain the role of commercial banks and the private sector in their preference for money and other assets. The demand for government securities by commercial banks is given by equation A-8. A large portion of the government securities acquired by commercial banks is due to legal reserve requirements. The rate of inflation as a proxy for returns on alternative assets is significant and it may suggest that commercial banks rearrange their portfolios over and above the legal requirements in terms of rates of return on other assets. The demand for money in the Malaysian economy is explained by the rate of inflation, the short-term interest rate, and real income (equation A-9). Equating money demand and supply implies that the balance of payments identity (equation A-23) via monetary base (equation A-24) can be used for determining changes in the short-term capital flows. This shows that money market conditions play an important role in determining the capital inflows as well as balance of payments.

The supply side of the economy is represented by the price equation (equation A-19). This is a reduced form equation derived from a disaggregated supply sector which incorporates wages, unemployment, productivity, real output, and inflation. Unavailability of data has prevented us from incorporating wages, labor productivity, and unemployment.

The government finance constraint has been included in the model where government securities in the hands of the public is treated as endogenous and as an equilibrating variable between revenues and expenditures.

III. MODEL VALIDATION USING CONTROL SIMULATION

The system of the equations of our model can be expressed as a set of nonlinear equations:

[5] Export supply rather than export demand functions are estimated because Malaysia is a small country and it is assumed that it supplies exports of raw materials, manufactured goods, and other exports at given world prices. We used other variables such as the world income, world prices (weighted) and relative prices. Details are in [13].

TABLE I

TOTAL TESTS ERRORS

Variable	*MAD*[a]	*RMSE*[b]	*SRMSE*[c]
Real consumption expenditures	1.819	2.703	4.303
Real investment expenditures	1.203	1.471	11.426
Direct taxes	56.117	94.686	7.721
Export taxes	17.875	30.497	6.958
Import taxes	19.971	25.404	6.020
Other indirect taxes	51.445	79.825	7.731
Fixed deposit rate	1.948	2.387	7.639
Excess reserve ratio	0.421	0.571	15.943
Currency deposit ratio	0.026	0.032	8.739
Imports of food	1.231	1.437	15.943
Imports of raw materials	0.986	1.268	13.161
Imports of manufactured goods	0.680	0.840	8.949
Imports of investment goods	0.732	0.917	11.680
Imports of other goods and services	0.965	1.413	10.604
Imports of manufactured goods	1.051	1.352	10.375
Exports of raw materials	2.203	2.960	7.878
Exports of other goods and services	0.366	0.462	10.435
Price level	3.526	5.168	3.948
Money supply	1363.25	2028.532	28.402
GDP at current prices	900.981	1320.184	7.728
Net foreign assets	429.497	574.655	19.879
Monetary base	410.286	521.427	27.587
Multiplier	0.104	0.129	4.222
Real output	4.912	5.843	5.558

[a] *MAD* (mean absolute deviation) $=\frac{1}{N}\sum_{i=1}^{N}|\hat{Y}_t-Y_t|$.

[b] *RMSE* (root mean square error) $=\left\{\frac{1}{N}\sum_{i=1}^{N}(\hat{Y}_t-Y_t)^2\right\}^{1/2}$.

[c] *SRMSE* (*RMSE* percentage) $=\left\{\frac{1}{N}\sum_{i=1}^{N}|(\hat{Y}_t-Y_t)Y_t|^2\right\}^{1/2}\times 100$.

$$\hat{Y}_t=F(\hat{\theta};\ X_t;\ Y_{t-i},\ X_{t-j}), \qquad (1)$$
$$t=1,\ \cdots,\ n,$$
$$i=1,\ \cdots,\ k,$$
$$j=1,\ \cdots,\ m,$$

where

$\hat{Y}$ = the vector of the estimated endogenous variables,
Y = the vector of the actual endogenous variables,
X = the vector of the exogenous variables,
$\hat{\theta}$ = the vector of the estimated parameters.

The equation (1) consists of the estimated behavioral equations which are either linear or nonlinear and the identities of the model. The process of simulation requires that the equation (1) be solved simultaneously for total tests (one period simulation) and final tests (dynamic simulation).

TABLE II

FINAL TESTS ERRORS

Variable	*MAD**	*RMSE**	*SRMSE**
Real consumption expenditures	3.483	3.946	5.830
Real investment expenditures	4.733	5.743	52.391
Direct taxes	92.191	132.125	13.295
Export taxes	24.144	35.085	8.354
Import taxes	32.636	41.072	9.656
Other indirect taxes	86.738	121.262	13.319
Fixed deposit rate	5.406	6.524	16.864
Excess reserve ratio	0.410	0.568	14.473
Currency deposit ratio	0.046	0.054	12.672
Imports of food	3.205	3.351	37.598
Imports of raw materials	0.983	1.267	13.169
Imports of manufactured goods	0.967	1.084	12.214
Imports of investment goods	2.905	3.585	37.211
Imports of other goods and services	1.462	1.888	13.706
Exports of manufactured goods	1.616	1.895	16.023
Exports of raw materials	2.203	2.960	7.878
Exports of other goods and services	0.365	0.455	10.792
Price level	6.629	9.118	7.234
Money supply	3042.177	3784.794	78.272
GDP at current prices	1544.067	2008.245	13.297
Net foreign assets	968.176	1167.899	54.538
Monetary base	871.210	1061.721	74.826
Multiplier	0.157	0.177	6.390
Real output	7.173	7.397	8.059

* The explanations are given in the note to Table I.

Tables I and II provide summary statistics for most of the endogenous variables of the model. The results in the two tables relates simulation of the model over the time period of the estimation of the model (1959–77). Table I gives the summary statistics for total tests while Table II presents similar statistics for final tests. Both tables give statistics that describe the percentage errors between actual and predicted values of the endogenous variables.

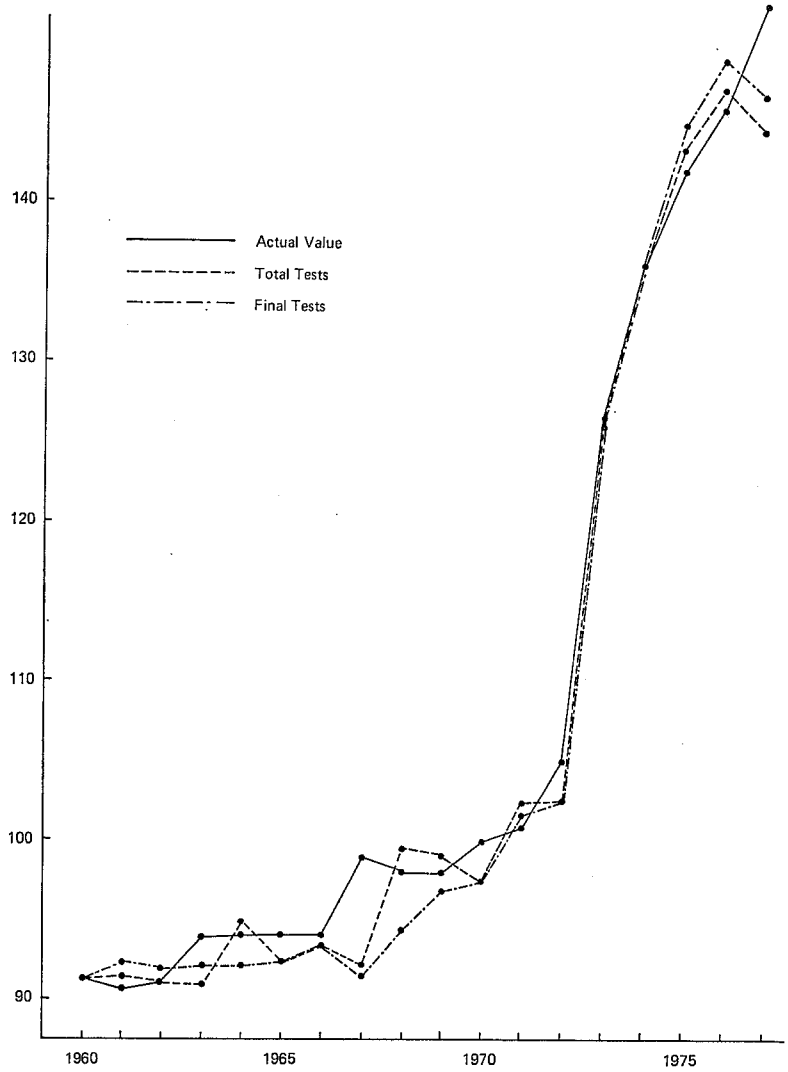
As expected, the final tests errors are larger than the total tests errors. The error statistics of imports of food and imports of investment goods have increased considerably over time.

However, we may be interested in a more detailed analysis of the simulation, such as the tracking ability of the model in reflecting the turning points in the historical values. Results of total and final tests for major variables and actual values are presented in Figures 2 to 5.

For imports of food, the final tests values tend to diverge from the actual values by a larger margin but appear to follow the turning points closely. For other variables both tests values follow the actual values very closely.

There is no clear indication as to whether financial or real variables perform better. Both sets of variables appear to perform well given the limitation of data and the very short simulation period.

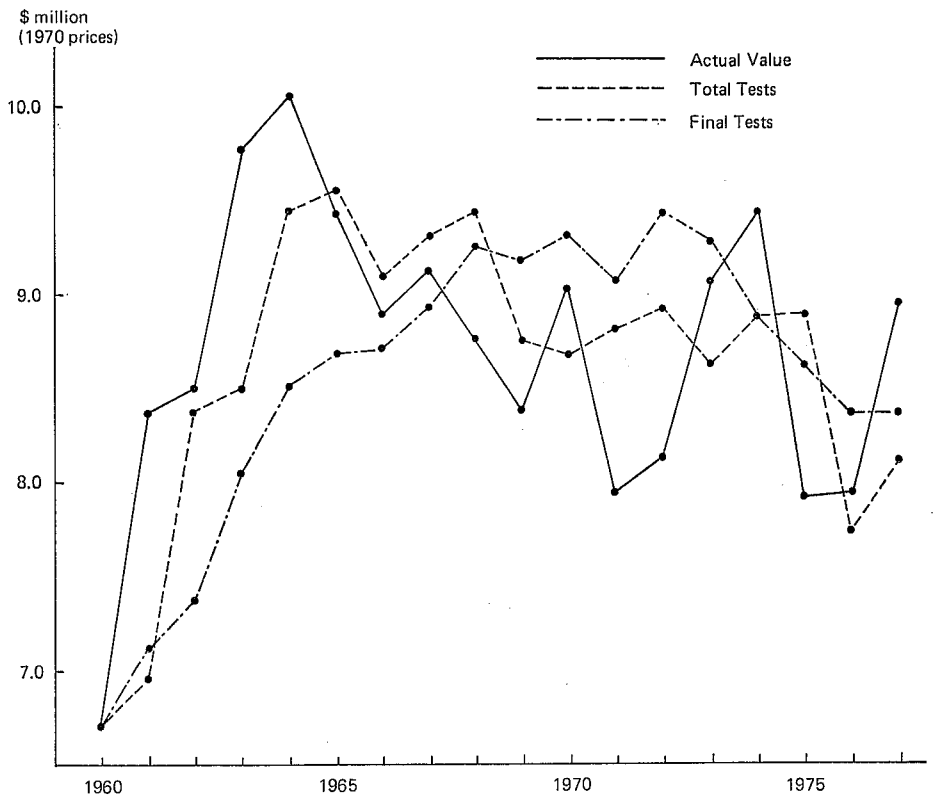
Fig. 2. Price Level



IV. POLICY SIMULATIONS

The estimated model of the previous section consists of a set of simultaneous nonlinear difference equations. As in any model the variables of the system can be partitioned into endogenous, lagged endogenous, and exogenous variables. If the model is stable (the control simulation results suggest that it is) and if all the exogenous variables are held at constant levels, then endogenous variables will over time attain their long-run equilibrium values and remain there. The direct magnitude and time path of the response of the endogenous variables to changes

Fig. 3. Imports of Food



in the exogenous variables are important propositions of the estimated model and are relevant to the full application of the estimated system.

We have used three distinct policy instruments. Policy variables are those which can readily be altered by activities of the government or the central bank or imposed by external conditions.

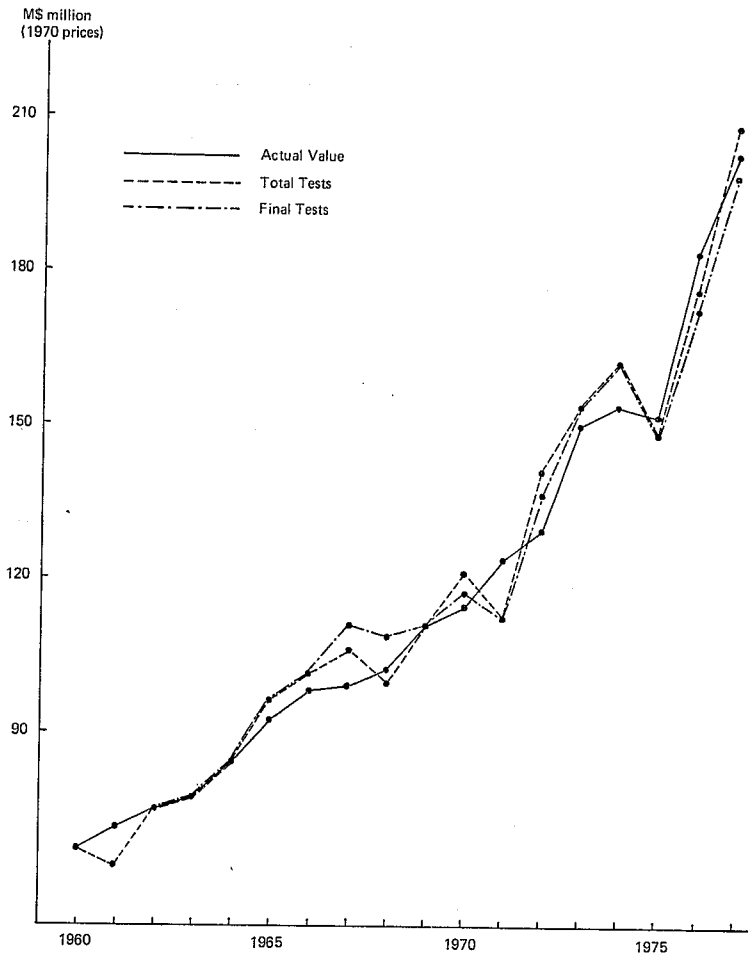
An exogenous change in a policy has direct as well as indirect effects on the endogenous variables. The direct effects of policy changes can be identified from the structure of the model, but the total effect of such changes can only be obtained by simulation of the complete system. The time path of total response to a policy change can only be obtained by full model simulation.

For the purpose of evaluating policy implications, three types of simulation exercises are performed for the period 1967–76.[6]

Case A: The central bank's credit to the government is increased by 20 per cent from the historically observed values.

[6] The choice of 1967 is not arbitrary. The central bank was set up in 1959 and by 1967 the bank assumed full control of the monetary system including the issue of currency.

Fig. 4. Real Output



Case B: The exchange rate is increased (depreciation) by 10 per cent from the actual rate.[7]

Case C: The statutory deposit ratio was increased by 20 per cent from the historical data.[8]

Cases A, B, and C represent the changes in the fiscal policy, the exchange rate policy, and the monetary policy respectively.

The qualitative effects of these policy changes on major endogenous variables are given in Table III. The relative effectiveness of the policy instruments is

[7] This is done by raising the actual values of import prices by 10 per cent for the period of simulation. In addition, the net foreign assets of the central bank at the beginning of the simulation period is also increased by 10 per cent to reflect the value in terms of local currency. Similar policy experiments were carried out on the Korean economy [10].

[8] The increase in the statutory deposit ratio is in terms of percentage change rather than percentage points.

Fig. 5. Multiplier

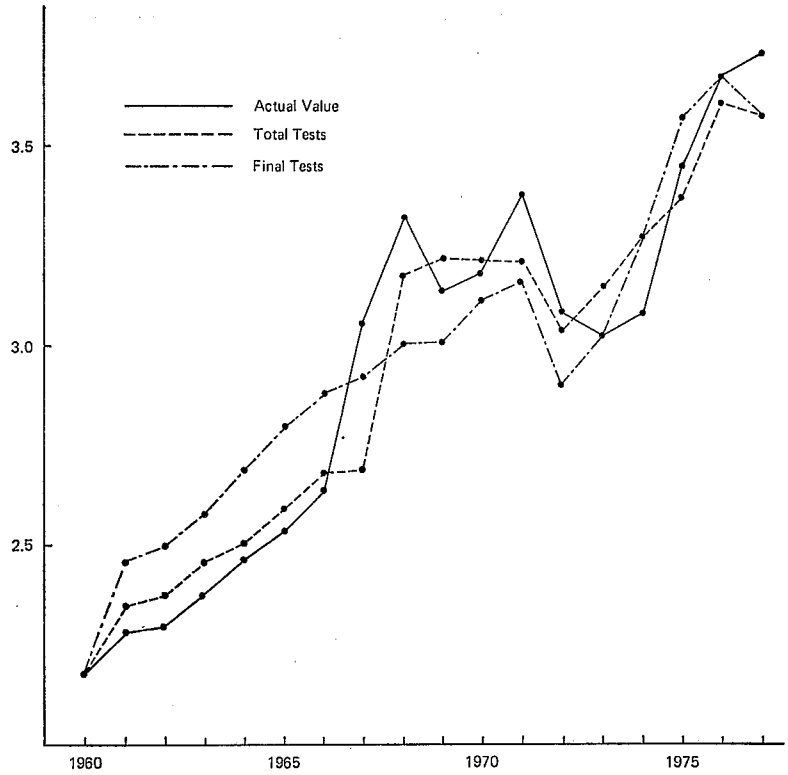


TABLE III

QUALITATIVE EFFECTS OF CHANGES IN EXOGENOUS VARIABLES

Variable	Case A	Case B	Case C
1. Price level (*P*)	+	+	−
2. Stock of money (*MS*)	+	+	−
3. Real income (*RGDP*)	+	+	−
4. Nominal income (*GDP*)	+	+	−
5. Net foreign assets (*NFA*)	− → +	+	+
6. Multiplier (*m*)	0	0	−
7. Imports of investment goods (*RMI*)	+	+	−
8. Imports of food (*RMF*)	−	−	−
9. Imports of manufactured goods (*RMM*)	−	+	−
10. Real investment (RIPR)	+	+	−

Note: In this table, an increase (+) or a decrease (−) refers to the position of the simulation results relative to those of the control solution. (− → +) denotes decreases at the beginning and increases in the later years of the simulation period.

influenced not only by the magnitude of policy changes but also by the initial conditions and the time lags. Therefore any empirical results must be interpreted with these elements in mind. Rather than trying to evaluate the most effective policy instruments, it is more useful to examine factors that affect the relative

TABLE IV

RELATIVE EFFECTIVENESS OF ALTERNATE POLICY INSTRUMENTS

	Case A	Case B	Case C		Case A	Case B	Case C
(1) Elasticity of Price				(2) Elasticity of Real Income			
1967	0.012	0.429	−0.0061		0.0004	0.076	0
1968	0.008	0.940	−0.0052		0.0006	0.103	0
1969	0.010	1.646	−0.0064		0.0007	0.241	0
1970	0.010	2.265	−0.0100		0.0012	0.071	−0.0004
1971	0.011	2.579	−0.0094		0.0004	0.042	−0.0004
1972	0.013	2.702	−0.0272		0.0014	0.251	−0.0025
1973	0.021	2.837	−0.0369		0.0038	0.401	−0.0064
1974	0.015	2.806	−0.0588		0.0029	0.447	−0.0105
1975	0.032	1.614	−0.0224		0.0026	0.435	−0.0064
1976	0.030	4.740	−0.0010		0.0053	0.784	−0.0028
(3) Elasticity of Money				(4) Elasticity of Net Foreign Assets			
1967	0.102	1.213	−0.0540		−0.0004	0.916	0.0092
1968	0.069	2.990	−0.0442		−0.0068	2.128	0.0202
1969	0.092	6.869	−0.0579		−0.0069	4.527	0.0326
1970	0.066	6.756	−0.0617		−0.0033	4.992	0.0365
1971	0.063	6.880	−0.0541		−0.0014	4.679	0.0422
1972	0.055	4.183	−0.1166		0.0006	3.303	0.0501
1973	0.068	3.341	−0.1182		0.0029	2.861	0.0623
1974	0.049	2.826	−0.1612		0.0061	0.665	0.0750
1975	0.102	3.584	−0.0685		0.0058	0.389	0.1041
1976	0.123	5.535	0		0.0079	1.050	0.0927
(5) Elasticity of Real Investment				(6) Elasticity of GDP			
1967	0.033	0.339	−0.033		0.011	0.508	−0.0063
1968	0.017	0.769	−0.029		0.008	1.052	−0.0053
1969	0.027	1.887	−0.030		0.010	1.928	−0.0063
1970	0.026	2.307	−0.035		0.009	2.353	−0.0095
1971	0.012	2.750	−0.028		0.010	2.632	−0.0087
1972	0.012	2.401	−0.069		0.011	2.384	−0.0249
1973	0.017	1.666	−0.072		0.018	2.322	−0.0303
1974	0.009	1.022	−0.079		0.015	2.232	−0.0484
1975	0.023	1.054	−0.019		0.029	2.722	−0.0166
1976	0.025	1.684	0.016		0.024	3.585	−0.0017

impact of policy instruments. Table IV indicates the various elasticities of selected macroeconomic variables with respect to the policy instruments.

An increase in the central bank's credit to the government or purchasing of government securities in the open market by the central bank (case A) has positive effects on the stock of money and thus the price level. The increase in the overall price level has come about through the increase in the domestic price level relative to import prices. This makes foreign goods cheaper than domestic goods. The increase in imports is only temporary and this is shown in the marginal decline of net foreign assets for the first five years. The overall impact of this policy measure is very minimal on all the endogenous variables.

An increase in the exchange rate (case B) of the Malaysian dollar per U.S. dollar (depreciation) tends to increase the consumer price index, the stock of

money, the real income, net foreign assets, imports of investment goods, food and manufactured goods.

The depreciation of the currency is expected initially to increase the local currency value of the existing net foreign assets of the central bank. The immediate impact of changes in import prices is an increase in the consumer price index, and this reduces the relative price effects in the import functions (equations A-11, A-13, and A-14). The import of food and manufactured goods are price inelastic (the elasticity is 0.512 and 0.912 respectively) in the short run and with exports remaining the same there occurs a positive trade balance in the current account resulting in positive net foreign assets of the central bank. The initial increase in the net foreign assets is M$158 million in 1967 (beginning of the simulation period). By the end of 1970 the assets have increased to M$2,180 million, but by the end of the simulation period the assets have dropped to M$1,213 million.

The increase in net foreign assets has significant effect on private investment. Real net foreign assets as a proxy for the availability of foreign exchange has a two-year lagged effect on private investment (equation A-2). In terms of elasticities (Table IV-5) the immediate impact of exchange rate changes on real investment is 0.339 rising to a maximum of 2.750 in 1971.

Apart from having the largest impact on net foreign assets, changes in import prices have equally strong effects on the money stock. The elasticity ranges from 1.213 (initial impact in 1967) to a maximum of 6.880 (in 1971). Such a large impact is expected in situations where there is no sterilization of net foreign assets and is thus preventing its full impact on the monetary base. There is no change in the multiplier because the components of the multiplier are in no way connected to changes in import prices in this model.

An increase in the statutory deposit ratio by 20 per cent (case C) implies the increase of this ratio from 3.5 per cent to 4.2 per cent in 1967. This small increase in the statutory deposit ratio decreases the multiplier and thus the money stock and the price level. By definition the loans and advances of commercial banks are reduced as a result of this increase in the statutory deposit ratio. The reduction in loans reduces the private investment expenditures (equation A-2) and therefore reduces the nominal and real income. Table IV-2 shows that the effect of a change in the statutory deposit ratio on the real income is in fact zero for the first three years and negative for the rest of the simulation period. The reduction of investment and the increase in the relative price level has depressing effects on the imports of investment goods, food, and manufactured goods. The simulation results in case C indicate that any substantial effect on the endogenous variables requires a large change in the statutory deposit ratio. Historically the ratio has changed only by 2.5 per cent from 3.5 per cent in 1967 to 6.0 per cent in 1977. There is the unorganized money market [14] [15] in many developing countries including Malaysia which can frustrate the intended monetary restraint imposed on the part of commercial banks by the manipulation of the statutory deposit ratio.

It can be interpreted that the higher the elasticity, the more effective the policy

TABLE V

ELASTICITY OF PRICE LEVEL AND REAL OUTPUT WITH RESPECT TO MONEY STOCK

Year	Case A		Case B		Case C	
	Price	Real Output	Price	Real Output	Price	Real Output
1967	0.114	0.003	0.205	0.062	−0.112	0
1968	0.118	0.008	0.314	0.034	−0.118	0
1969	0.108	0.007	0.239	0.035	−0.112	0
1970	0.151	0.018	0.335	0.010	−0.162	0.006
1971	0.174	0.006	0.386	0.016	−0.173	0.007
1972	0.236	0.025	0.645	0.060	−0.233	0.021
1973	0.308	0.055	0.849	0.120	−0.312	0.054
1974	0.306	0.059	0.992	0.158	−0.364	0.062
1975	0.313	0.025	0.450	0.121	−0.327	0.087
1976	0.243	0.043	0.856	0.141	−0.040	0

Note: The elasticities of a variable with respect to the stock of money can be obtained by dividing the elasticities of the variable with respect to policy instruments by the elasticities of the stock of money with respect to the corresponding policy instruments.

variable would be with respect to that particular endogenous variable. In a limited sense, the exchange rate policy seems to have greater impact on prices, the money stock, the real income, net foreign assets and imports of investment goods in comparison to other instruments. Changes in the central bank's lending to the government has the least impact on the variables under consideration.

The real income and prices seem to have been most sensitive to changes in the exchange rate compared to other policy instruments throughout the simulation period.

The fiscal policy (case A) has the least effect on the macrovariables among policy instruments. This is so mainly because the central bank's credit to the government forms a relatively small component of the base money in Malaysia.

The relatively large influence of the exchange rate policy (changes in the import prices) on the economy reflects the openness of the Malaysian economy. As trade improves with ASEAN and the rest of the world, this policy becomes more relevant to the economy. This is very evident particularly in the 1970s when the increases in oil prices had tremendous impact on the domestic prices.

Another interesting result that emerges out of the simulation exercises is the different effects on prices and output due to a monetary or fiscal impulse.

A 20 per cent increase in the central bank's credit to the government led to 1.0 per cent increase in the stock of money in 1967, 0.6 per cent in 1970, and 1.2 per cent in 1976. The increase in the stock of money tends to have larger effects on the price level than the real income (Table V). The price will be affected with an elasticity of 0.108 to 0.313 during the simulation period, while the real output elasticities range from 0.003 to 0.059.

Similar analysis of the responses of the price and the real income to changes in the stock of money induced by other policy instruments is also given in Table V. Induced changes in the money supply due to the policy changes in government

borrowings from the central bank (case A), and in the statutory deposit ratio (case C) appear to have stronger effects on prices than the real output during the simulation period.

Of the three policies, exchange rate changes (case B) has the greatest effect on the money stock (Table IV-3). As a result of this, the effect on prices is stronger than on the output when compared to other induced changes in the money supply.

V. CONCLUSIONS

Before presenting the conclusions of our study, it is important to review some of the fundamental characteristics and limitations of the methodology adopted. A macroeconometric model of nineteen behavioral equations and twenty-four identities is constructed within a consistent framework and has been estimated by the ordinary least squares. The individual equations specified in the model are found to be statistically significant both in terms of explanatory power and the significance of the coefficients.

The performance of the model as a whole was satisfactory in tracking the actual endogenous variables over the period of study, judged in terms of the size of errors of each variable and the success of the model capturing the turning points over the period.

In addition to the overall statistical evaluation, the model was also subjected to some policy simulation analysis and the following are some of the conclusions.

(1) Of the policy variables investigated, import prices (devaluation) appear to have the strongest impact on many of the endogenous variables. Import prices have a greater effect on consumer prices than does the statutory deposit ratio. They also have a greater impact on the money stock in contrast to the other policies, namely, the statutory deposit ratio and government borrowings from the central bank.

(2) Among the three policy instruments dealt with, government borrowings from the central bank has the least effect on any of the endogenous variables.

(3) Imposition of the budget constraint alters the results considerably. Exclusion of the budget constraint overestimates the effects of three policy instruments used. It is suggested that the budget constraint be included in any model when policy effects are evaluated.

(4) Induced changes in the money supply due to various policy instruments have a greater impact on price levels than on the real output in all cases. When changes in the money supply are due to import price variations, the effect on prices is more pronounced than on the real output.

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APPENDIX A

THE MODEL EQUATIONS

The estimates of the complete model are given below. The values in parentheses are *t*-values. Other descriptive statistics given are $\bar{R}^2$, Durbin-Watson statistics (*DW*), and Durbin's *h* statistics wherever they are applicable. All equations are estimated by the ordinary least squares and corrected for autocorrelated errors. The program used was "Autoreal" [12]. The model is dynamically simulated [11], with the system of equations being solved by a simple iterative technique (Gauss-Siedel algorithm). Due to unavailability of data on the required deflators, we used *P, PM,* and *PX* as deflators for a number of variables. For example, the consumer price index was used as a deflator of *GDP* and *IRP.*

A-1. $$RCPR = \underset{(1.7996)}{0.2464} + \underset{(4.4289)}{0.2089}RYD - \underset{(0.8144)}{0.5256}PR + \underset{(7.4691)}{0.6624}RCPR_{-1}$$
$$\bar{R}^2 = 0.988, \quad h = 1.260$$

A-2. $$RIPR = -\underset{(3.3442)}{0.6110} + \underset{(1.8719)}{0.1976}RLOANS + \underset{(2.4334)}{0.0820}RGDP_{-1} + \underset{(2.9326)}{0.3214}(NFA/PM)_{-2} + \underset{(0.4143)}{0.0826}RIPR_{-1}$$
$$\bar{R}^2 = 0.980, \quad h = 1.861$$

A-3. $DTX = -547.1120 + 0.1039GDP$
(7.4291) (20.3214)
$\bar{R}^2 = 0.958, \quad DW = 1.566$

A-4. $ETX = -128.6839 + 0.0834(XM + XR + XO)$
(3.4289) (16.0881)
$\bar{R}^2 = 0.935, \quad DW = 1.317$

A-5. $MTX = 247.3972 + 0.0318(MF + MR + MM + MI + MO)$
(11.1314) (12.2061)
$\bar{R}^2 = 0.954, \quad DW = 1.688$

A-6. $OTX = -163.5649 + 0.0676GDP$
(3.3180) (20.8895)
$\bar{R}^2 = 0.988, \quad DW = 1.702$

A-7. $CC/TD = 0.2892 - 0.0457FDR + 0.0129PR + 0.7961(CC/TD)_{-1}$
(1.1691) (1.2444) (1.5270) (6.1554)
$\bar{R}^2 = 0.870, \quad h = 0.959$

A-8. $GSTBCB = -152.4490 - 11.9253PR + 0.2067TD + 0.4322GSTBCB_{-1}$
(3.3807) (1.8753) (4.7104) (2.5245)
$\bar{R}^2 = 0.992, \quad h = 1.118$

A-9. $MS/P = -4.5537 - 1.9126TBR + 0.2744RGDP - 0.2954PR$
(1.2125) (2.5179) (3.9248) (2.0151)
$+ 0.6809(MS/P)_{-1}$
$\bar{R}^2 = 0.994, \quad h = -0.175$

A-10. $EX = 6.1323 - 0.6428FDR + 0.4144EX_{-1}$
(3.3328) (3.1237) (3.9887)
$\bar{R}^2 = 0.862, \quad h = -1.063$

A-11. $RMF = 7.1156 - 5.2705\ (PM/PF) + 1.0289\ (GDPNA/GDPA)$
(2.4733) (1.6492) (1.5363)
$+ 0.5823RMF_{-1}$
(3.7747)
$\bar{R}^2 = 0.640, \quad h = 1.020$

A-12. $RMR = 0.2578 + 0.0289RGDP + 0.6683RMR_{-1}$
(0.5078) (2.7543) (5.1027)
$\bar{R}^2 = 0.916, \quad h = 1.120$

A-13. $RMM = 3.3136 - 3.2643(PM/P)_{-1} + 0.1133RCPR + 0.1488RMM_{-1}$
(1.7531) (1.5196) (4.0566) (0.7861)
$\bar{R}^2 = 0.868, \quad h = 1.324$

A-14. $RMI = 7.9167 + 0.6568RIPR - 7.2473(PM/P)_{-1} + 0.1262RMI_{-1}$
(3.1179) (6.0925) (2.7532) (0.8074)
$\bar{R}^2 = 0.968, \quad h = 1.167$

A-15. $RMO = -1.7889 + 0.0612RGDP + 0.5062RMO_{-1}$
(2.1341) (3.8913) (3.4734)
$\bar{R}^2 = 0.901, \quad h = 2.078$

A-16. $RXM = -4.5653 + 0.0290RGDP + 3.3041(PX/P)_{-1} + 0.9026RXM_{-1}$
(1.4852) (0.8738) (1.4451) (3.9494)
$\bar{R}^2 = 0.982, \quad h = -0.238$

A-17. $RXR = -0.6638 + 0.3201RGDP$
(0.4047) (23.4160)
$\bar{R}^2 = 0.969, \quad DW = 1.886$

A-18. $RXO = -0.0184 + 0.0207RGDP_{-1} + 0.4523RXO_{-1}$
(0.0361) (1.7263) (1.6771)
$\bar{R}^2 = 0.860, \quad h = -1.578$

A-19. $PR = -1.8988 + 0.0272RGDP + 0.3468(\Delta PM/PM)_{-1} \times 100$
(1.3211) (1.9914) (5.9954)
$+ 0.0225PR_{-1}$
(0.1737)
$\bar{R}^2 = 0.825, \quad h = -0.953$

A-20. $MS = m \cdot MB$

A-21. $m = \dfrac{1 + CC/TD}{CC/TD + EX/100 + SDR/100}$

A-22. $GDP = CPR + IPR + G + XM + XR + XO - MF - MR - MM - MI - MO + ERR1$

A-23. $NFA = NFA_{-1} + XM + XR + XO - MF - MM - MR - MI - MO + TRA + NGFB + NLPC + NSC + ERR2$

A-24. $MB = GSTBBN - GDEPBN + NFA$

A-25. $YD = GDP - DTX$

A-26. $LOANS = TD - EX \cdot TD/100 - SDR \cdot TD/100 - GSTBCB$

A-27. $TD = MS - CC + GDEPCB$

A-28. $G = DTX + ETX + MTX + OTX + \Delta GSTBP + \Delta GSTBEN + \Delta GSTBCB + \Delta MB + ERR3$

A-29. $GDPNA = GDP - GDPA$

A-30. $RGDP = GDP/P$

A-31. $CPR = RCPR \cdot P$

A-32. $IPR = RIPR \cdot P$

A-33. $MF = RMF \cdot PM$

A-34. $MR = RMR \cdot PM$

A-35. $MM = RMM \cdot PM$

A-36. $MI = RMI \cdot PM$

A-37. $MO=RMO \cdot PM$

A-38. $XR=RXR \cdot PX$

A-39. $XM=RXM \cdot PX$

A-40. $XO=RXO \cdot PX$

A-41. $RYD=YD/P$

A-42. $RLOANS=LOANS/P$

A-43. $PR=\frac{P-P_{-1}}{P_{-1}} \times 100$

APPENDIX B

SYMBOLS USED IN THE MODEL

The variable with * is an endogenous variable.

*CC**	Currency in circulation in M$ million
*CPR**	Personal consumption expenditures in M$ million
*DTX**	Direct tax revenue from corporations and households in M$ million
*ERR*1	Residual defined so that GDP identity holds in the data
*ERR*2	Residual defined so that the balance of payments identity holds in the data
*ERR*3	Residual required to make the government finance restraint hold in the data
*EX**	Excess reserve ratio, i.e., (excess reserves/total deposits)×100
*ETX**	Indirect tax revenue from exports in M$ million
FDR	Fixed deposit rate (twelve monthly) in per cent
G	Total government expenditures (including interest payments on total debt) in M$ million
*GDP**	Gross domestic product in M$ million
*GSTBCB**	Government securities at commercial banks in M$ million
*GDPNA**	Gross domestic product (nonagricultural) in M$ million
GDPA	Gross domestic product (agricultural) in M$ million
GSTBBN	Government securities at the central bank in M$ million
GDEPBN	Government deposits at the central bank in M$ million
GDEPCB	Government deposits at commercial banks in M$ million
*GSTBP**	Government securities held by the private sector in M$ million
GSTBEN	Government securities at the employees provident fund and the national savings bank in M$ million
*IPR**	Private investment expenditures in M$ million
*LOANS**	Total loans and advances by commercial banks in M$ million
*MF**	Imports of food (SITC 0, 1, 4) in M$ million
*MR**	Imports of raw materials (SITC 2, 3, 5) in M$ million

*MM**	Imports of manufactured goods (SITC 6, 8) in M$ million)
*MI**	Imports of investment goods (SITC 7) in M$ million
*MO**	Imports of other goods (SITC 9) in M$ million
*MS**	Money supply (currency in circulation plus demand, time, and savings deposits at commercial banks) in M$ million
*MTX**	Indirect tax revenue from imports in M$ million
*MB**	Monetary base (or revenue money) in M$ million
*m**	Money multiplier
*NFA**	Net foreign assets of the central bank in M$ million
NGFB	Net government foreign borrowing in M$ million
NLPC	Net long-term private capital inflow in M$ million
NSC	Net short-term private capital inflow in M$ million
*OTX**	Indirect tax revenue from other sources in M$ million
*P**	Consumer price index (1970=100)
*PR**	Rate of inflation
PF	Retail price index of food (1970=100)
PX	Export price index (1970=100)
PM	Import price index (1970=100)
*RCPR**	Real consumption expenditures
*RIPR**	Real private investment expenditures
*RYD**	Real disposable income
*RLOANS**	Real loans and advances by commercial banks
*RGDP**	Real gross domestic product
*RMF**	Real imports of food
*RMR**	Real imports of raw materials
*RMM**	Real imports of manufactured goods
*RMI**	Real imports of investment goods
*RMO**	Real imports of other goods
*RXM**	Real exports of manufactured goods
*RXR**	Real exports of raw materials
*RXO**	Real exports of other goods
*SDR**	Statutory deposit ratio in per cent
*TD**	Total deposits at commercial banks in M$ million
TBR	Treasurer bill rate
*TRA**	Net transfers abroad (private sector) in M$ million
*XM**	Exports of manufactured goods in M$ million
*XO**	Exports of other (miscellaneous) goods in M$ million
*XR**	Exports of raw materials in M$ million
*YD**	Disposable income in M$ million