CHAPTER 5

MODEL STRUCTURE AND SIMULATION ANALYSIS

5.1 The Complete Model.

The complete model presented below contains a total of 22 equations, of which 10 are behaviorals and 12 are identities.

(1) Real Private Consumption

$$\log RCP_t = \underset{(1.8061)}{0.2751} + \underset{(7.8670)}{0.5649} \log Yd_t + \underset{(2.0481)}{0.0242} \log \left(\frac{NLA}{P}\right)_{t-2}$$

$$\underset{(-4.1475)}{-0.1091} \log RSD_t + \underset{(4.4706)}{0.3739} \log RCP_{t-1}$$

$$\bar{R}^2 = 0.9956 \qquad h = 0.9946$$

(2) Real Private Investment

$$RIN_t = \underset{(-0.2857)}{-10.142} + \underset{(4.9962)}{0.1912} (RGDP_t - RGDP_{t-1}) + \underset{(3.4724)}{0.0604} \left(\frac{M2}{P}\right)_t$$

$$+ \underset{(3.6499)}{0.6445} \left(\frac{KP}{P}\right)_t - \underset{(-1.992)}{0.2874} RIG_{t-1} + \underset{(5.4292)}{0.7519} RIN_{t-1}$$

$$\bar{R}^2 = 0.9883 \qquad h = 0.0025$$

(3) Real Government Consumption

$$\log RCG_t = \underset{(2.9705)}{1.5042} + \underset{(3.2735)}{0.4425} \log \left(\frac{GRV}{P}\right)_t + \underset{(1.9688)}{0.3757} \log RCG_{t-1}$$

$$\bar{R}^2 = 0.9907 \qquad h = 0.3800$$

(4) Real Government Investment

$$RIG_t = -815.387 + 0.4434\left(\frac{GRV}{P}\right)_t + 03969\left(\frac{KG}{P}\right)_t + 0.09803RIG_{t-1}$$
$$(-2.2278) \quad (7.6676) \qquad (5.4976) \qquad (0.7940)$$

$\bar{R}^2 = 0.989$ $\qquad$ $h = 0.5795$

(5) Real Imports

$$\log RMM_t = -1.4056 + 0.3583 \log RGDP_t - 0.8127 \log\left(\frac{PM}{P}\right)_t$$
$$(-3.8560) \quad (3.3077) \qquad (-2.9561)$$

$$+ 0.1588 \log\left(\frac{NFA}{PM}\right)_t + 0.5071 \log RMM_{t-1}$$
$$(1.3137) \qquad (6.8289)$$

$\bar{R}^2 = 0.9942$ $\qquad$ $h = 1.0429$

(6) Real Exports

$$\log RXX_t = -1.0966 + 0.2933 \log YW_t - 0.2492 \log\left(\frac{PX}{WCP}\right)_t$$
$$(-1.9353) \quad (2.3072) \qquad (-3.6804)$$

$$+ 0.8602 \log RXX_{t-1}$$
$$(13.498)$$

$\bar{R}^2 = 0.9925$ $\qquad$ $h = 0.073$

(7) Direct Tax

$$\log DTX_t = -3.974 + 1.1021 \log GDP_t$$
$$(-4.3643) \quad (12.920)$$

$\bar{R}^2 = 0.9904$ $\qquad$ $DW = 1.9661$

(8) Currency-deposit Ratio

$$\log Cr_t = 0.9557 - 0.0890 \log RGDP_t - 0.1690 \log RFD12_t$$
$$(1.6679) \quad (-1.4131) \qquad (-3.0466)$$

$$+ 0.9160 \log (P_t - P_{t-1}) + 0.8271 \log Cr_{t-1}$$
$$(2.2974) \qquad (11.115)$$

$\bar{R}^2 = 0.9853$ $\qquad$ $h = 0.0527$

(9) Excess-reserve Ratio

$$\log Ex_t = 3.5733 - 0.4285 \log RGDP_t - 0.4984 \log RPL_t + 0.4424 \log Ex_{t-1}$$
$$(2.9517)\ (-2.5986) \qquad (-1.4981) \qquad (2.6313)$$

$$\bar{R}^2 = 0.9106 \qquad h = 1.8756$$

(10) Price level

$$\log P_t = -1.5372 + 0.0405 \log M2_{t-1} + 0.0977 \log GDP_t$$
$$(-5.1931)\ (1.8206) \qquad (2.7894)$$

$$+ 0.1317 \log PM_t + 0.4435 \log P_{t-1}$$
$$(5.0137) \qquad (6.6114)$$

$$\bar{R}^2 = 0.9979 \qquad h = 1.0786$$

Identities

(11) Real Income or Output

$$RGDP_t \equiv RCP_t + RIP_t + RCG_t + RIG_t + STCK_t + RXX_t - RMM_t$$

(12) Nominal Income

$$GDP_t \equiv (RGDP_t)^* P_t$$

(13) Disposable Income

$$Yd_t \equiv \left(\frac{GDP_t - DTX_t}{P_t} \right)$$

(14) Total Government Expenditures

$$G_t \equiv (RIG_t + RCG_t)^* P_t$$

(15) Total Government Revenue

$$GRV_t \equiv DTX_t + IDRTX_t + OTX_t + NTXR_t$$

(16) Government Deficit or Budget Constraint

$$GDEF_t \equiv G_t - GRV_t$$

(17) Balance of Payments

$$BOP_t \equiv (RXX_t * PX_t) - (RMM_t * PM_t) + KG_t + KP_t + TRANF_t + ERR1_t$$

(18) Net Foreign Assets

$$NFA_t \equiv NFA_{t-1} + BOP_t + ERR2_t$$

(19) Monetary Base

$$MB_t \equiv NFA_t - NFA_{t-1} + GDEF_t - GDEF_{t-1} + OIF_t + ERR3_t$$

(20) Money Multiplier

$$m_t \equiv \left(\frac{1 + Cr_t}{Cr_t + Ex_t + S_t} \right)$$

(21) Money Stock

$$M2_t \equiv m_t * MB_t$$

(22) Net Liquid Asset

$$NLA_t \equiv M2_t - LA_t$$

LIST OF VARIABLES

ENDOGENOUS VARIABLES

RCP	Private consumption in 1985 constant prices, in RM million
Yd	Disposable income in 1985 constant prices, in RM million
NLA	Net liquid assets in RM million
P	Consumer price index (1985=1.00)
RIN	Private investment in 1985 constant prices, in RM million
RGDP	Gross domestic product in 1985 constant prices, in RM million
M2	Private sector liquidity (money supply) in RM million
RIG	Government investment in 1985 constant prices, in RM million
RCG	Government consumption in 1985 constant prices, in RM million
GRV	Total government revenue in 1985 constant prices, in RM million
RMM	Total imports of goods in 1985 constant prices, in RM million
RXX	Total exports of goods in 1985 constant prices, in RM million
DTX	Direct tax revenue in RM million
GDP	Nominal gross domestic product in RM million

Cr	Currency-deposit ratio in RM million
Ex	Excess reserve ratio in RM million
G	Total government expenditures in RM million
GDEF	Government deficit in RM million
BOP	Balance of payments in RM million
NFA	Net foreign assets of the Central Bank in RM million
MB	Monetary base in RM million
m	Money multiplier

EXOGENOUS VARIABLES

RSD	Rate of interest on savings deposit
KP	Foreign private capital inflow in RM million
KG	Net government foreign borrowing in RM million
PM	Unit value of imports (1985=1.00)
YW	Gross domestic product of OECD countries in 1985 constant prices, in US$ million
PX	Unit value of exports (1985=1.00)
WCP	World consumer price index (1985=1.00)
RFD12	Rate of interest on 12-month fixed deposit
RPL	Prime lending rate of commercial banks
STCK	Change in stock
IDRTX	Indirect tax revenue in RM million
OTX	Other indirect tax revenue in RM million
NTXR	Non-tax revenue in RM million
TRANF	Net transfer abroad (private sector) in RM million
ERR1	Residual defined so that balance of payments identity holds in the data
ERR2	Residual defined so that the net foreign assets identity holds in the data

ERR3	Residual required to make the monetary base holds in the data
OIF	Other net contribution to the monetary base in the data
	in RM million
S	Statutory deposit ratio
LA	Total loans and advances by commercial banks in RM million

Note that some of the coefficients in the equations selected for incorporation into the model are statistically insignificant. This is inevitable to secure a complete structural model. An individual equation may possess a good statistical fit and a high statistical significance (like large adjusted $\bar{R}^2$, small standard errors, etc.). However when simulated together with other equations as a multi-equation model, the possibility still remains that it does not reproduce the historical series well due to the dynamic structure of the model. The converse may be true for an equation of poor statistical fit and low in statistical significance as it may perform well approximating the actual data trend when subject to the same simulation process[1].

The model links the monetary sector to the real sector via three channels, namely via its influence on private investment and private consumption; government budget constraint and price level. The influence of external sector upon the real sector not only via its direct link to aggregate demand or output, but also through its direct links to monetary sector via the net foreign assets. Figure 5.1 is a simplified flowchart of the model depicting the interrelationships among various sectors of the economy.

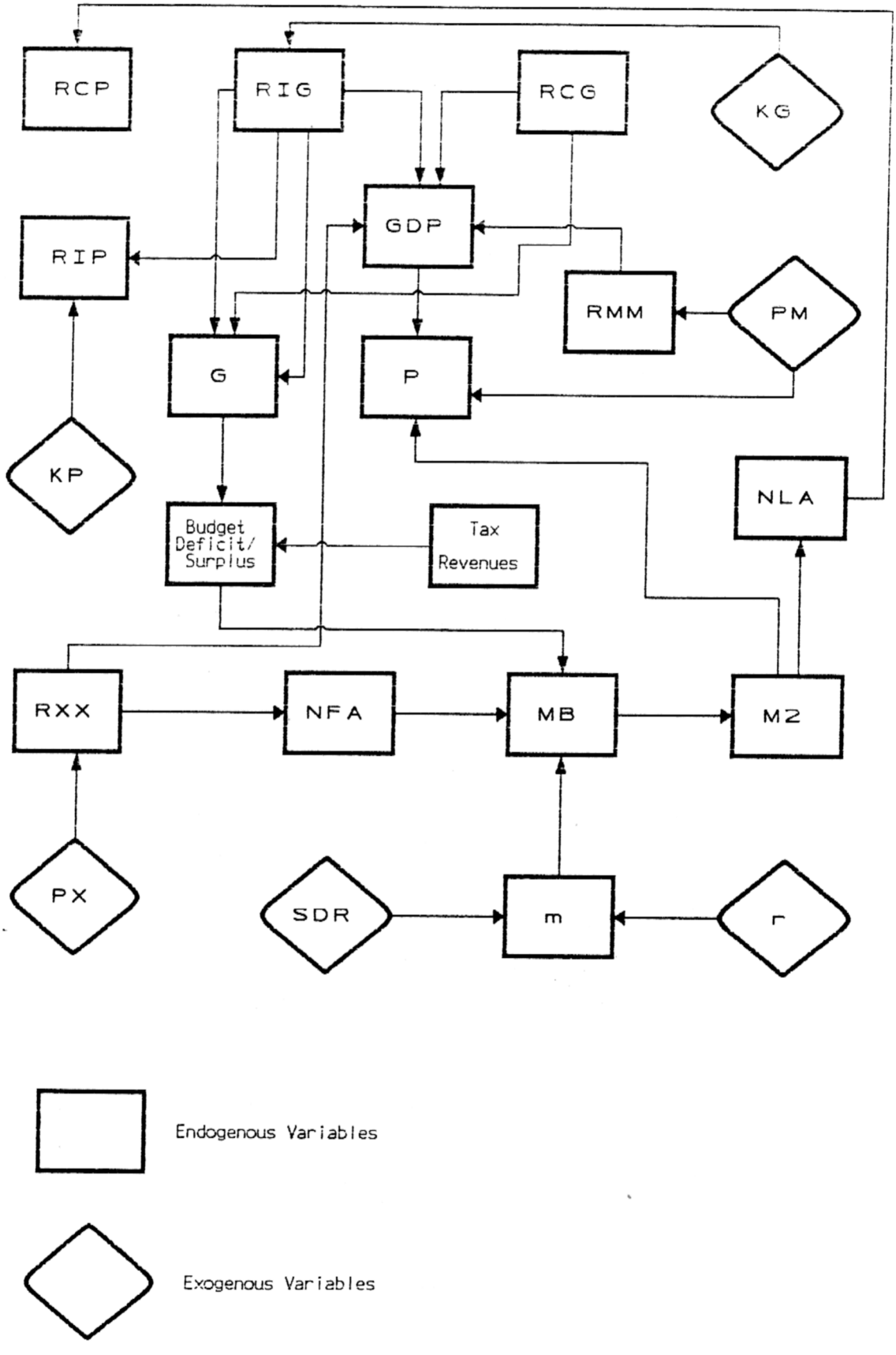
5.2 Simulation of the model.

Simulation analysis is usually used to test the performance of a model. According to Pyndick and Rubinfeld (1991), simulation is the mathematical solution of a simultaneous set of difference equations (p.332).

The goodness of the model has to be tested or the model has to be evaluated. The evaluation of the model would depend on, among other factors, the purpose for which the model was built. If the model has been constructed primarily for forecasting purposes, then priority has to be given to obtaining as small a standard error of forecast as possible.

The evaluation criteria becomes more complicated in a multi-equation simulation model. High statistical significance for some equations may have to be balanced against low statistical significance for other equations. Even in the case where all the individual equations fit the data well and are statistically significant, it is still not certain that the model as a whole when simulated, will reproduce those same data series closely. It is entirely possible that same data in an ex-post (historical) simulation, some of the endogenous variables will track the original data series closely while others will not. They are several statistical methods to evaluate a model which will be described further in the next section of this chapter.

Figure 5.1 : A Simplified Flowchart of the Structural Model of Malaysia



5.2.1 Method of Simulation

Our model here is subject to three types of simulations exercise.

i) Dynamic simulation

ii) One-time shock simulation

iii) Sustained-push policy simulation.

Dynamic simulation is basically performed to evaluate how well the model simulate or capture the turning points of the actual data series of all the endogenous variables. It is another criteria to evaluate the performance of the model. In dynamic simulation, the lagged endogenous variables will take the simulated value of the corresponding period. In this respect, the error in dynamic simulation are usually expected to be larger. However, its usefulness is wider in scope and the technique is more frequently used in economic analysis.

The one-time shock simulation exercise is performed to examine the stability of the model. It is done through the administration of a once and for all exogenous shock to the system to ascertain whether the system will revert to the original equilibrium condition that exist prior to the administration of the shock. Stability of the model is virtually important when the model is invoked to analyze various aspects of the economy. Without prior confirmation of it stability, any economic implications drawn from the model could lose their significance.

The sustained-push policy simulation experiment will enable us to assess the dynamic response of all the endogenous variables to sustained changes in policy variables. Policy variables refer to government or the central Bank or imposed by external conditions. Policy implication of the model are conventionally drawn from this simulation run.

5.2.2 Summary Statistics of Model Performance

A number of quantitative measures or summary statistics are often used to evaluate the simulation fit of a model in a multi-equation context. A common measure is called root-mean-square simulation error for the variable Y_t is defined as:

$$\text{RMSE} = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(Y_t^s - Y_t^a\right)^2}$$

Where Y_t^s = simulated value of Y_t

Y_t^a = actual value

T = number of periods in the simulation.

The RMSE is thus a measure of the deviation of the simulated variable from its actual time path. The magnitude of this error can be evaluated only by comparing it with the average size of the variable in question.

Another simulation error statistics is the root mean square error percent, define as

$$\text{RMPSE} = \sqrt{\frac{1}{T}\sum_{t=1}^{1}\left(\frac{Y_t^s - Y_t^a}{Y_t^a}\right)^2} * (100)$$

The RMPSE is also a measure of the deviation of the simulated variable form its actual time path but in percentage terms.

The mean error (ME) defined as

$$\text{ME} = \frac{1}{T}\sum_{t=1}^{T}\left(Y_t^s - Y_t^a\right)$$

The problem with using mean error is the values may be close to zero if large positive errors cancel large negative errors.

A useful simulation statistics related to RMSE is Theil's inequality coefficient, is defined as

$$U = \frac{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(Y_t^s - Y_t^a)^2}}{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(Y_t^s)^2} - \sqrt{\frac{1}{T}\sum_{t=1}^{T}(Y_t^a)^2}}$$

U will always assume a value between zero and unity. If U=0, then $Y_t^s - Y_t^a$, which means that there is a perfect fit between simulated and actual value series. If U=1, then the predictive performance of the model is as bad as it possibly could be. When U=1, it could mean that the simulated values are always zero when actual values are non zero, or simulated values are positive (negative), when actual values are negative (positive).

5.2.3 Results of the Simulations

The above summary statistics for the endogenous variables are calculated and presented in table 5.1. The statistics are based on the historical dynamic simulations from 1975-1991. Graphs are plotted for the actual and dynamic simulated values. They are given in figures 5.2-I through 5.2-XVIII

From Table 5.1 we can observe that the RMSE values are larger than that of ME, since they penalize individual errors more heavily (Pyndick, 1991, p.338). Of the 18 endogenous variables, except the price level, excess reserve ratio and currency deposit ratio and money multiplier, most of the variables display the larger RMSE. But if we refer to the RMSPE, most of the variables except for net foreign assets (NFA) and balance of payments (BOP) are less than 10 per cent. Values of the Theil's inequality coefficient,

U , are less than 0.10 in all cases, except the BOP and NFA which have the U value of 0.2633 and 0.1483 respectively. The results indicate that the overall predictive performance of the model is quite satisfactory.

As noted earlier, another criterion for judging model performance is its capability to duplicate turning points in the historical data. A model that has a larger RMSE but that duplicates major turning points could be judged a better model than one with a lower RMSE but that fails to pick up the turning points (Pyndick and Rubinfeld, 1991, pp. 338-339).

The ability of the model to replicate turning points is best illustrated by graphical representations of the actual and simulated values are plotted in figures 5.2-I through 5.2-XVIII. It can be seen that, the model manage to track the historical data quite well and able to reproducing the turning points particularly for the endogenous variables which have a relatively large RMSE. These include Real GDP, at current prices, real private investment, real private consumption, disposable, real imports, real exports, direct taxes and balance of payments. In most cases, the simulated values are quite close to their actual series and their upward time trend are generally reflected.

However the performance for the Net Foreign Assets (NFA), Money Stock (M2) and Monetary Base (MB), to a lesser degree, but still reasonably well traced by the model. Though the NFA manage to capture some turning points at the beginning of the simulation periods, but also shows marked divergence between the actual and simulated values particularly from 1983 towards the end of the simulation periods. As for the MB and M2, the simulated values are quite erratic and fail to produce the long term trend of the historical values. But it is inessential since both variables are merely by definition . As Coats and Khatkhate (1980) put it, "The money supply generally proves the more challenging variable to predict in Less Developed Countries due to more volatile currency and excess reserve behavior and the dominance of the government deficits and the balance of payments in the

behavior of the monetary base. Yet even here important and useful (for policy) regularity is generally found".

As for the excess reserve ratio the performance is rather disappointing . It could be seen that the values from the simulation only managed to produce a general long-term trend of the actual data, with almost all the turning point evidently missing. On the whole, variables that have comparatively low RMSE, are observed to have simulated turning points quite well. These include currency deposit ratio, money multiplier and price level.

Despite the fact that some of the primary or intermediate variables show poor performance, any economic implications of policy changes on real income (RGDP), price level and balance of payments (BOP) drawn from the model can still justifiably be given some degree of credibility. This is by virtue the fact that the actual time series of these variables are generally well-tracked by the model. Hence, the model is capable of serving the purpose of its construction, i.e. to assess the impact of monetary and fiscal policies as well as the exchange rate policy upon the Malaysian economy, of which the main economic indicators are real income or output, prices and the balance of payments.

TABLE 5.1

SUMMARY STATISTICS OF THE DYNAMIC SIMULATIONS

	RMSE	RMSPE	ME	U
RCP	183.82	2.9	44.582	0.0005
RIN	938.87	4.295	-227.71	0.0089
RCG	96.27	3.09	23.349	0.0010
RIG	239.34	1.66	-58.05	0.0034
RMM	2168.16	3.735	525.85	0.0076
RXX	432.906	3.33	-104.99	0.0013
RGDP	2996.00	2.36	-726.63	0.0048
GDP	1478.54	1.233	-358.59	0.0025
Yd	1278.87	1.136	-310.172	0.0023
DTX	199.61	2.767	48.412	0.0056
BOP	2670.51	10.11	-647.69	0.2633
NFA	4428.8	6.267	-3464.33	0.1483
P	3.4	2.213	-0.83	0.0046
Ex	0.0055	1.832	0.0013	0.0364
Cr	0.00556	1.764	-0.0014	0.0036
MB	2378.77	2.6311	-576.93	0.0348
M2	6638.4	1.8221	-3307.8	0.039
m	0.0743	1.0901	-0.018	0.0018

FIGURE 5.2-I : REAL PRIVATE CONSUMPTION (RCP_t)

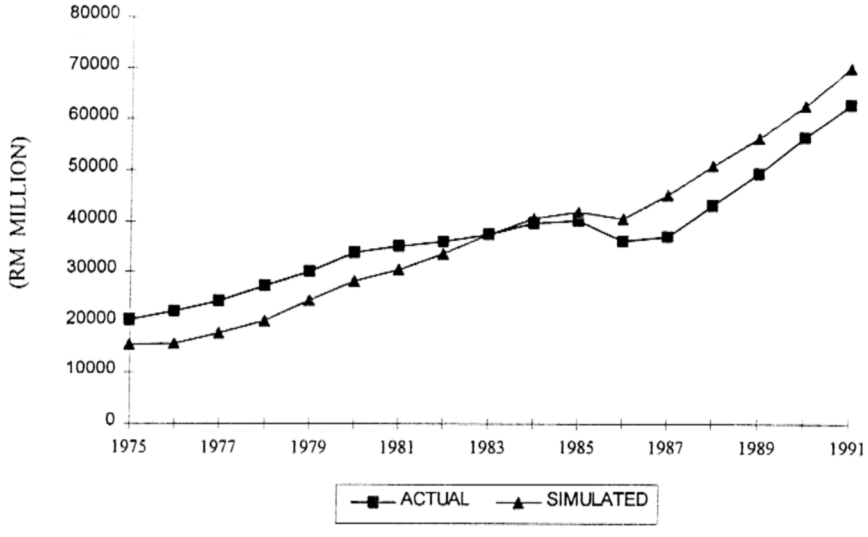


FIGURE 5.2-II : REAL PRIVATE INVESTMENT (RIN_t)

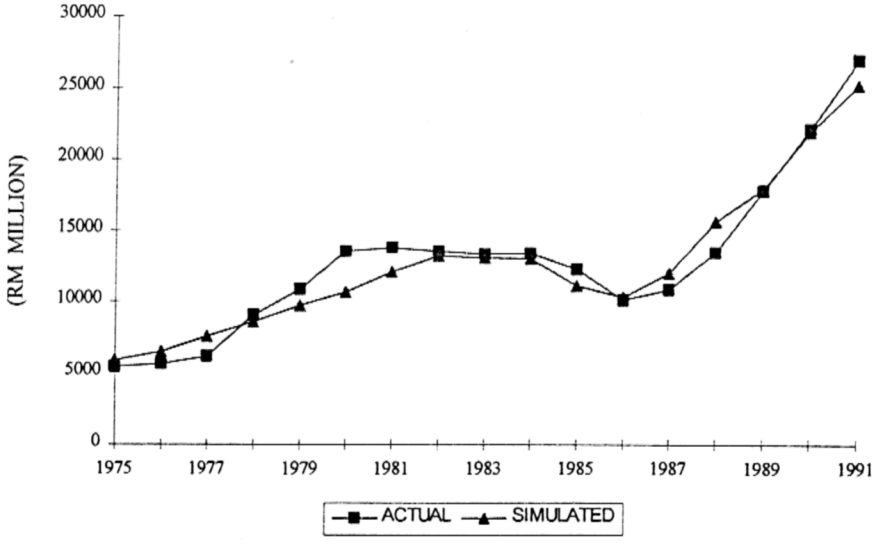


FIGURE 5.2-III : REAL GOVERNMENT CONSUMPTION (RCG_t)

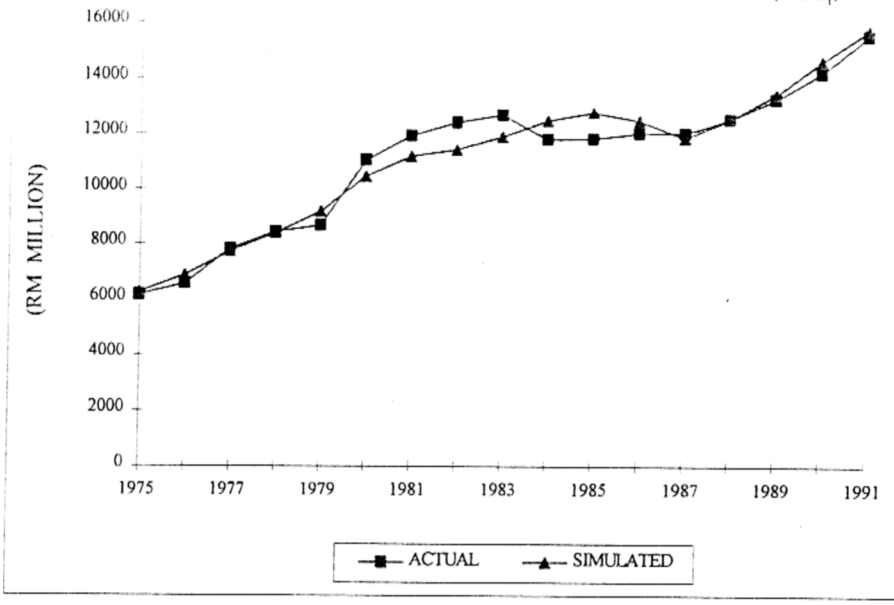


FIGURE 5.2-IV : REAL GOVERNMENT INVESTMENT (RIG_t)

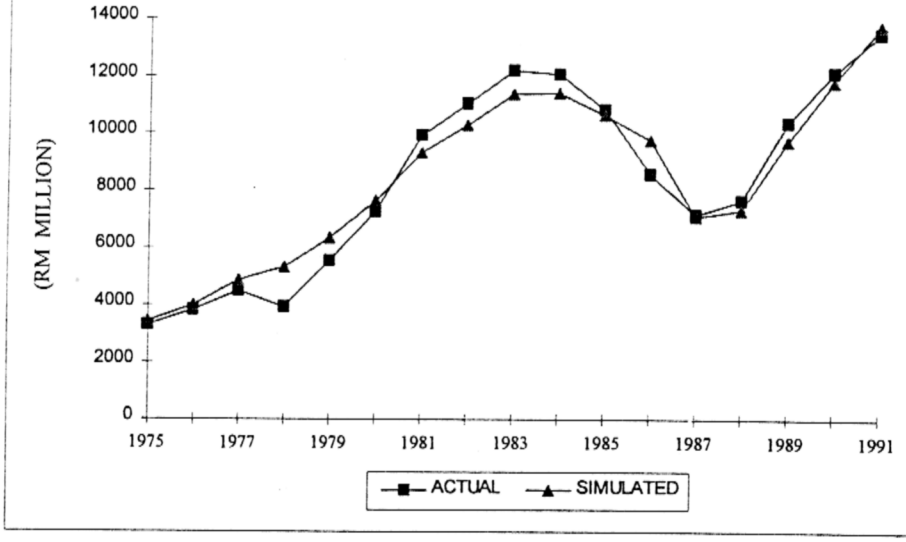


FIGURE 5.2-V : REAL IMPORTS (RMM_t)

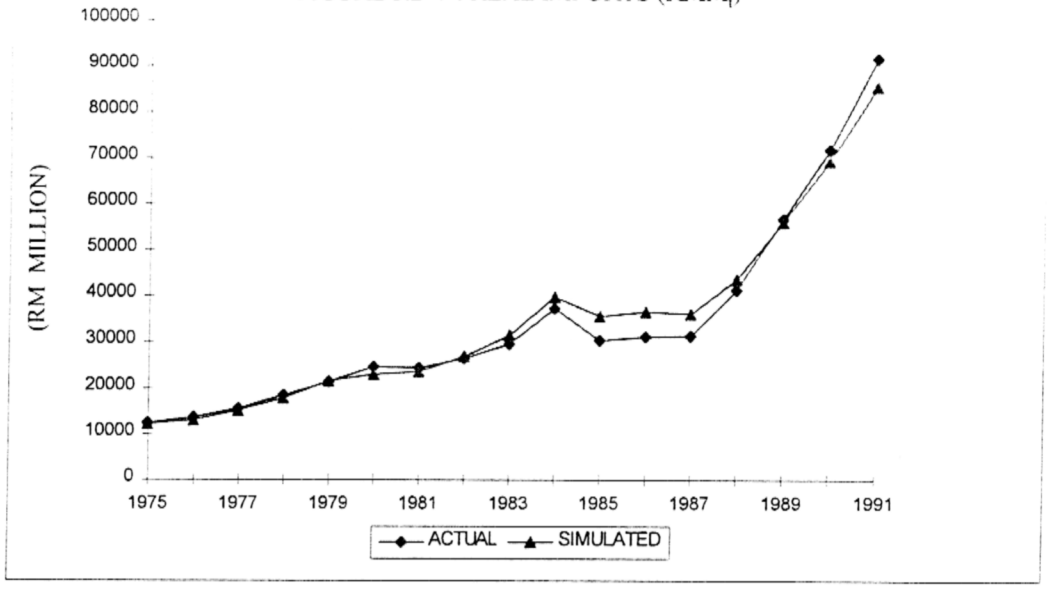


FIGURE 5.2-VI : REAL EXPORTS (RXX_t)

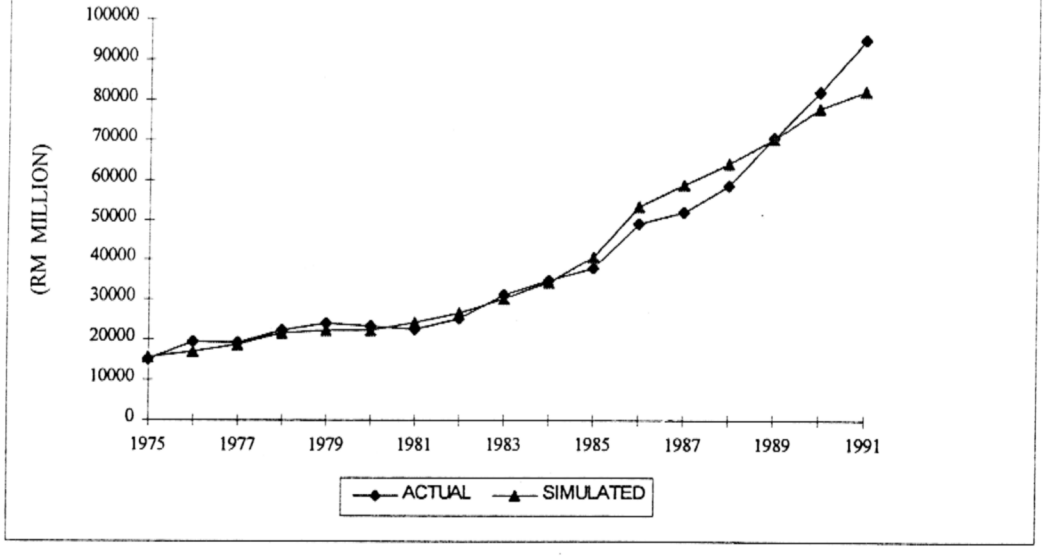


FIGURE 5.2-VII : REAL INCOME ($RGDP_t$)

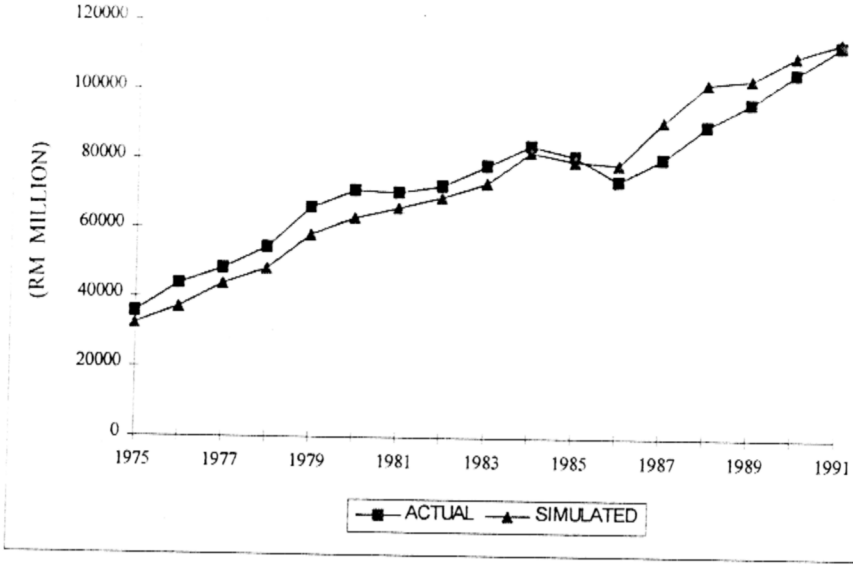


FIGURE 5.2-VIII : NOMINAL INCOME (GDP_t)

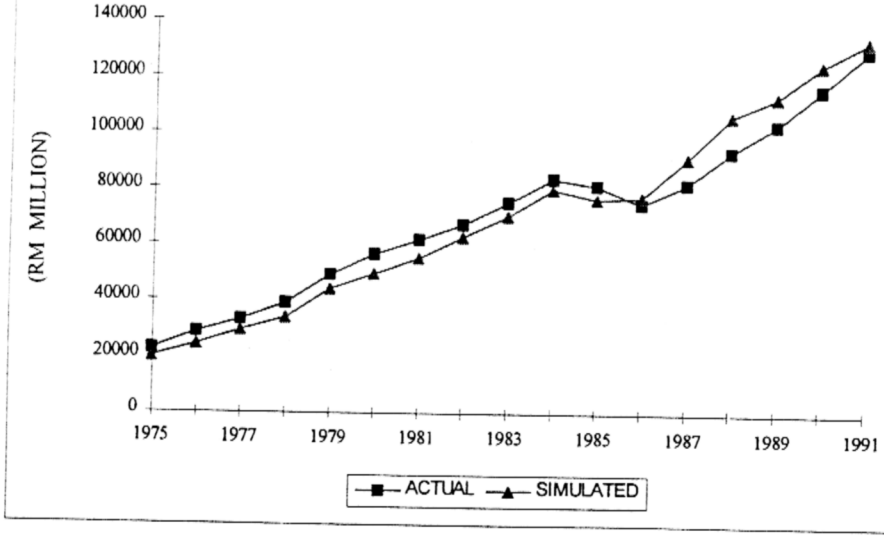


FIGURE 5.2-IX : DISPOSABLE INCOME (Yd_t)

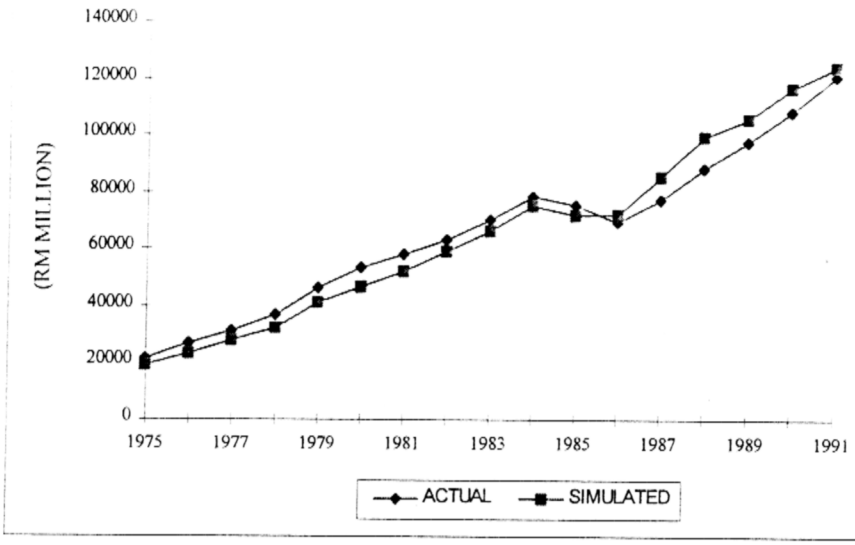


FIGURE 5.2-X : DIRECT TAX (DTX_t)

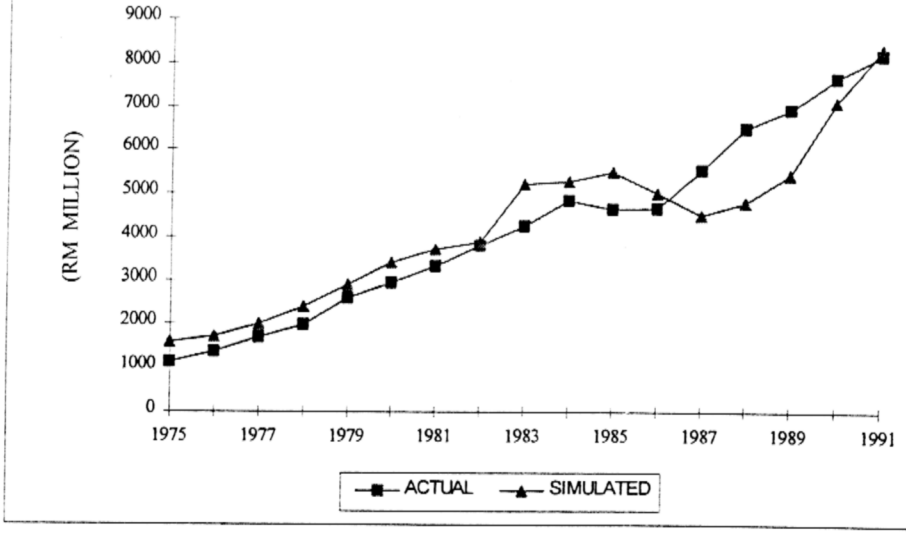


FIGURE 5.2-XI : BALANCE OF PAYMENTS (BOP_t)

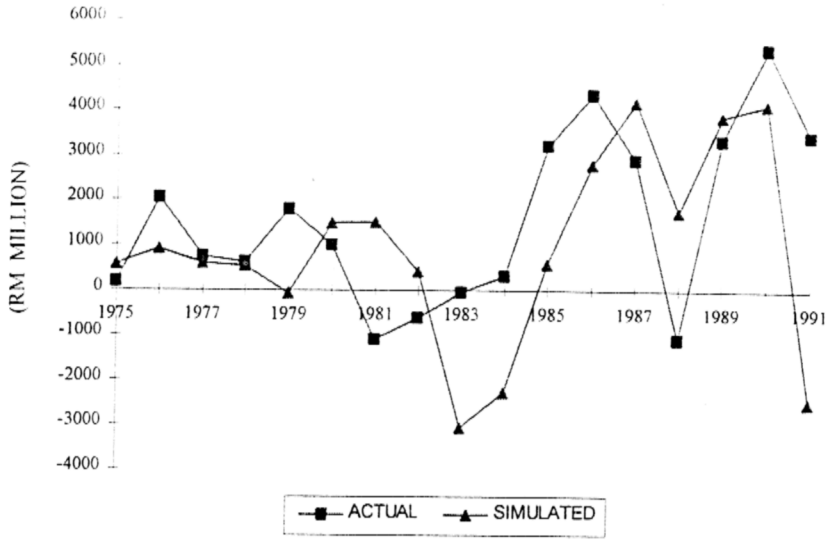


FIGURE 5.2-XII : NET FOREIGN ASSETS (NFA_t)

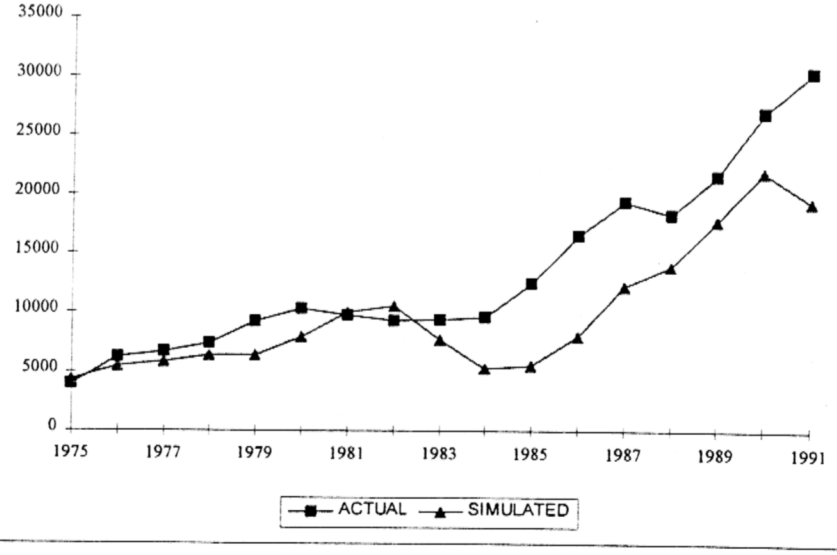


FIGURE 5.2-XIII : PRICE LEVEL (P_t)

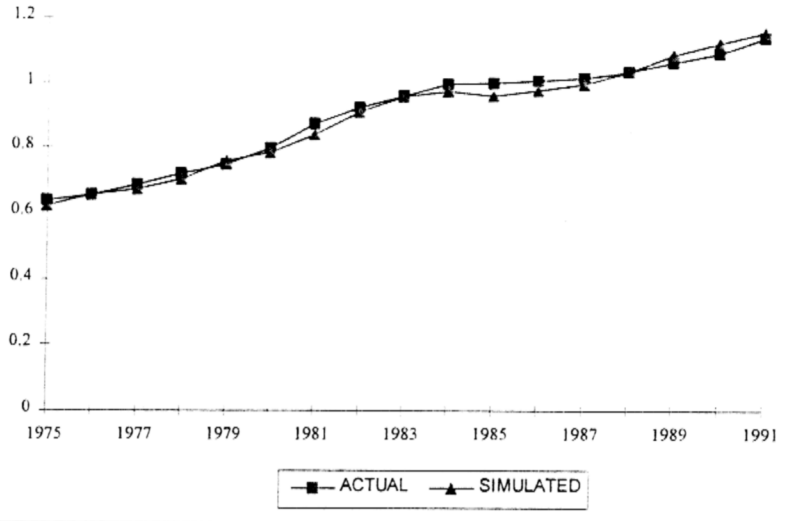


FIGURE 5.2-XIV : EXCESS RESERVE RATIO (Ex_t)

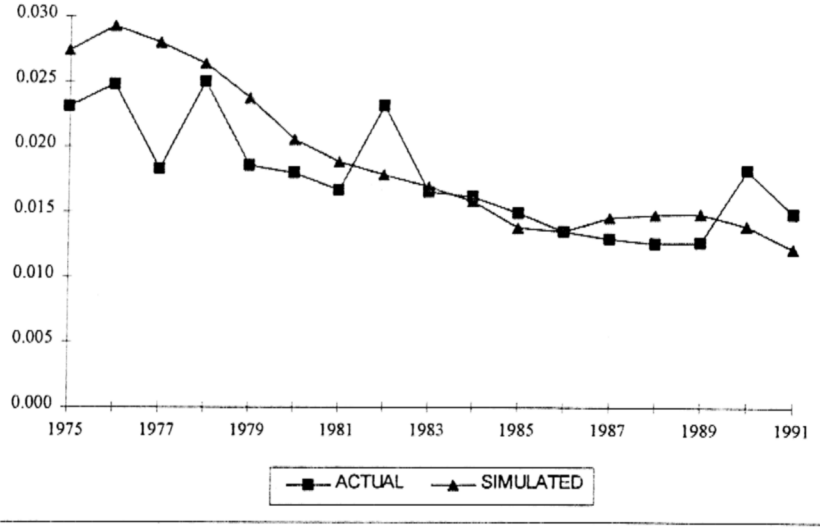


FIGURE 5.2-XV : CURRENCY DEPOSIT RATIO (Cr_t)

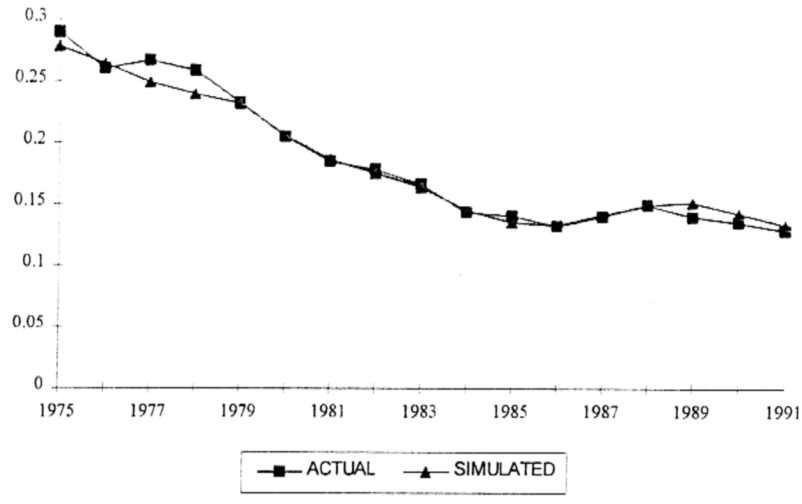


FIGURE 5.2-XVI : .MONETARY BASE (MB_t)

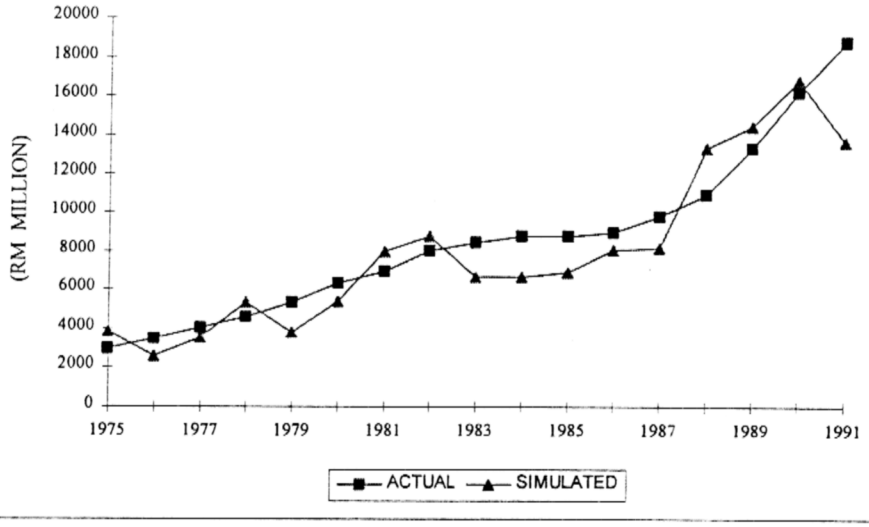


FIGURE 5.2-XVII : MONEY SUPPLY ($M2_t$)

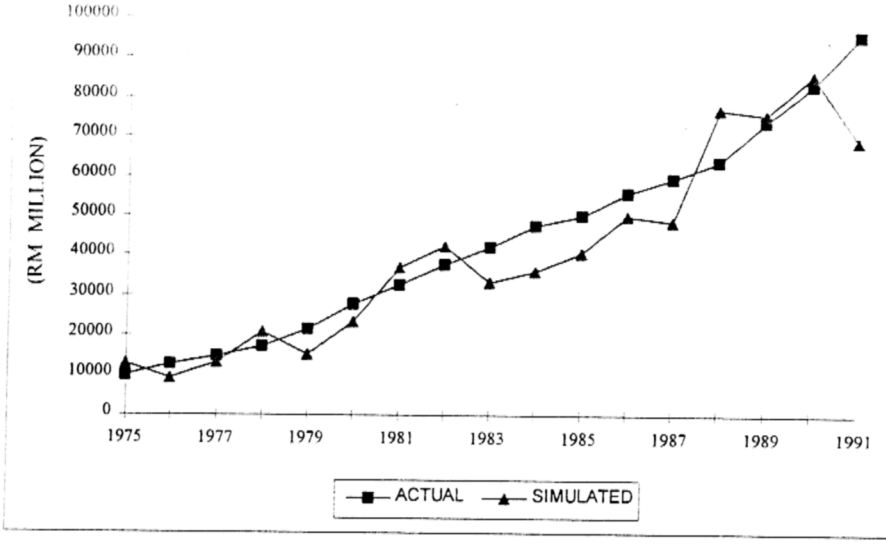
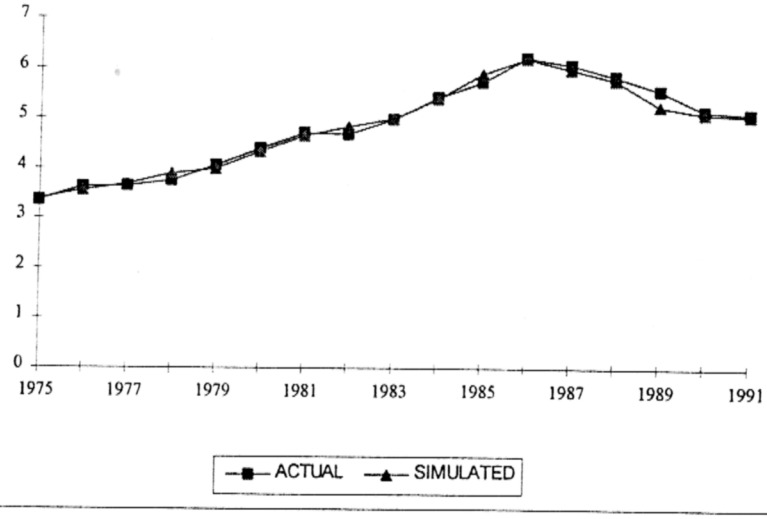


FIGURE 5.2-XVIII : MONEY MULTIPLIER (m_t)



5.2.4 One-Time Shock Simulation

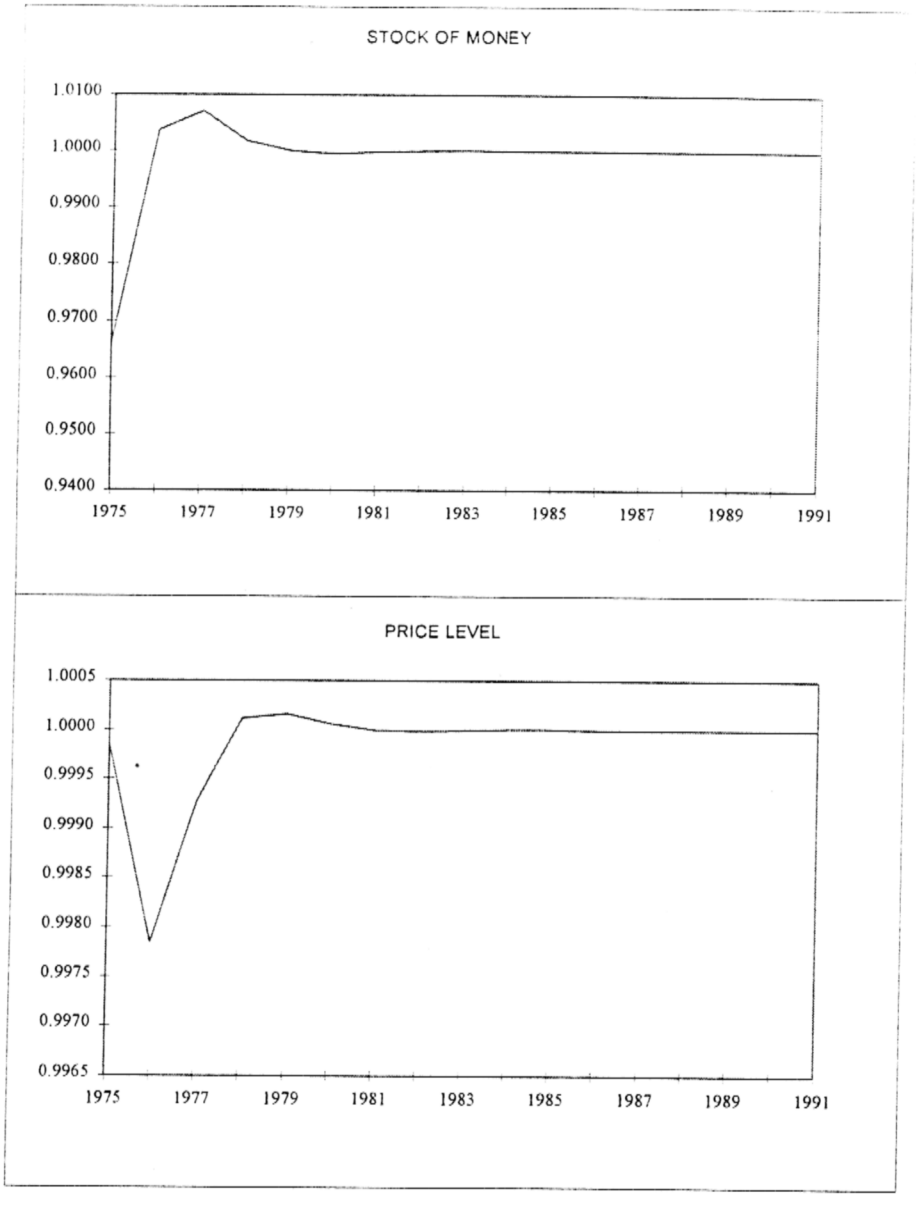
Stability of the model is important when the model is used to analyzed various aspect of the economy. Without ascertaining that a model is stable, any economic implications drawn from the model would lose their significance. For the purpose of examining the stability of the model a once and for all exogenous shock is given to the system for just one period. This is done by raising the statutory deposit ratio (one of the component embodied in the money multiplier; see identity 19) by 10 per cent from the historical observed value in 1975, and for the subsequent years until 1991, the historically observed are retained for the simulation. The actual values of all the exogenous variable are left intact.

The outcome of this exercise is compared with the outcome of the dynamic simulation (hereinafter known as base run) attempted earlier. The results for the selected endogenous variables are shown in figure 5.3. The solid lines for each of the macrovariable represent the ratio of the simulated values with once and for all shock to those of the base run.

An increase in the statutory reserve ratio decreases the real private investment, real and nominal income, stock of money, and the price level as expected. Depending upon the macrovariables, such direction of the changes lasts for a varied duration ranging from one year to eight years, the system tends to return to the original equilibrium state that existed before the shock was given. All of the solid lines for the corresponding variables show slight oscillation around the value of unity. This is perhaps due to the nature of the highly non-linear system of the model. Nonetheless, the model is stable and hence non-explosive as both simulated values tend to converge over time.

FIGURE 5.3

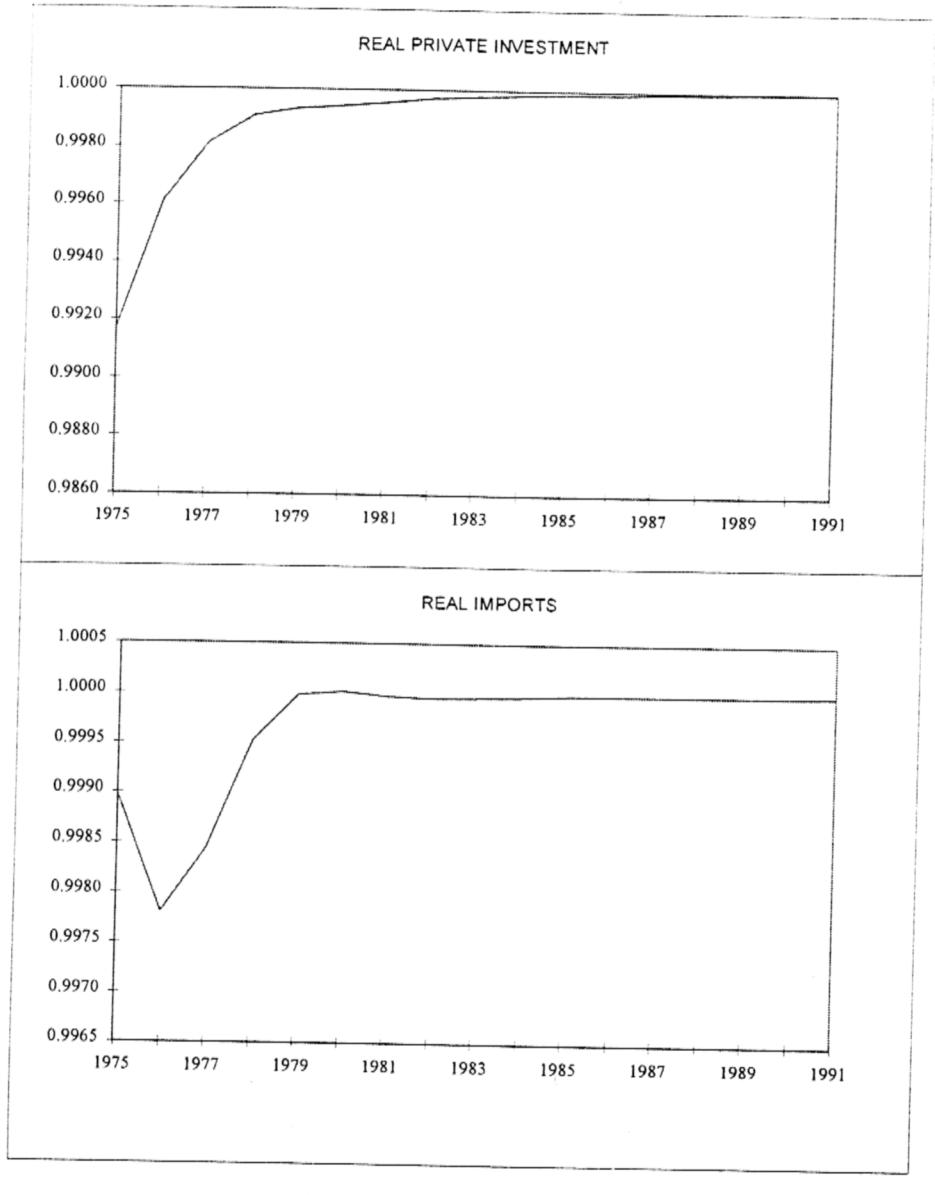
EFFECTS OF A ONE-PERIOD*, 10 PERCENT INCREASE IN STATUTORY DEPOSIT RATIO IN 1975 ON SELECTED ENDOGENOUS VARIABLES.



*Implemented by decreasing the statutory deposit ratio (S_t) in 1975, then allowing it to return to its actualvalues thereafter--also refers as one-time shock.

FIGURE 5.3

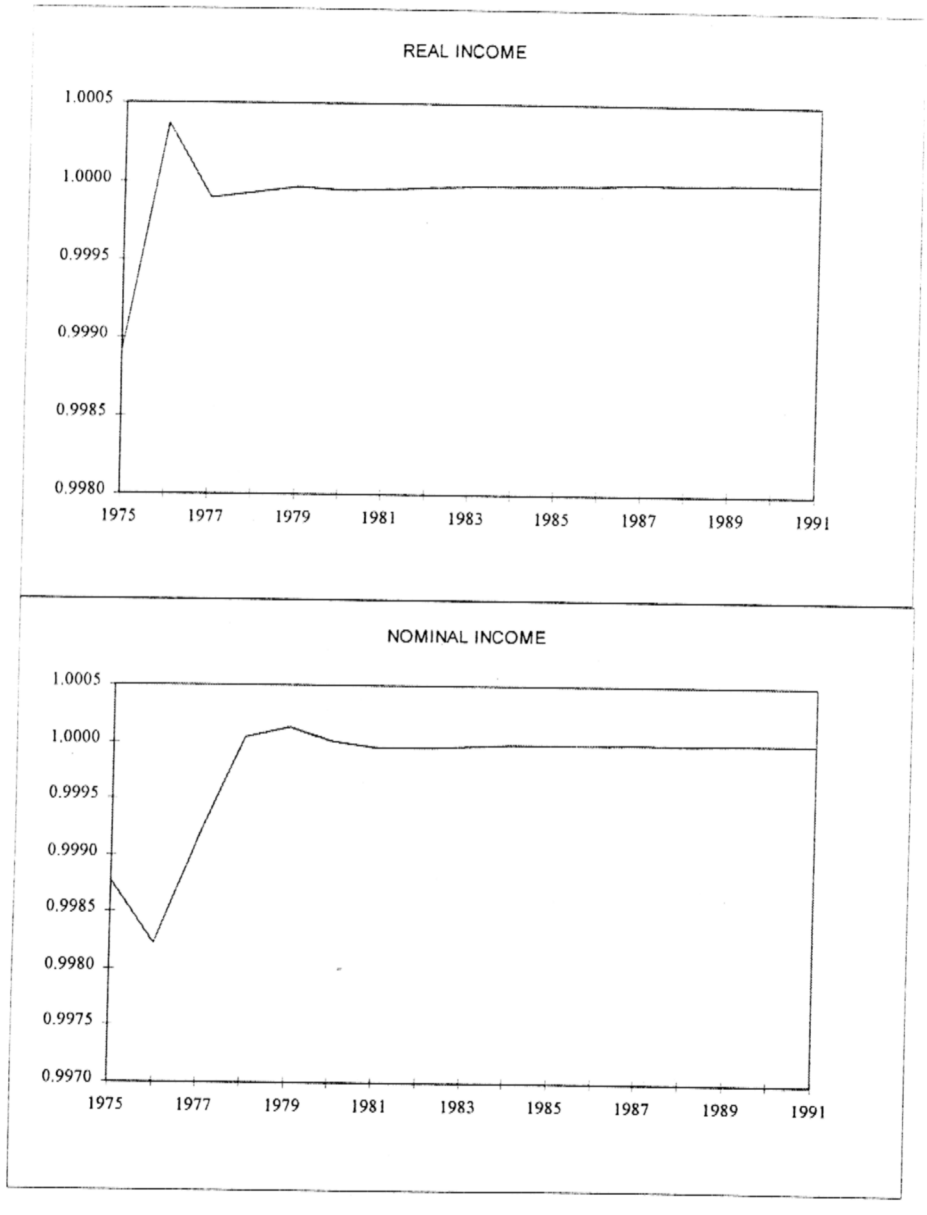
EFFECTS OF A ONE-PERIOD*, 10 PERCENT INCREASE IN STATUTORY DEPOSIT RATIO IN 1975 ON SELECTED ENDOGENOUS VARIABLES (CONTINUED.)



*Implemented by decreasing the statutory deposit ratio (S_t) in 1975, then allowing it to return to its actual values thereafter--also refers as one-time shock.

FIGURE 5.3

EFFECTS OF A ONE-PERIOD*, 10 PERCENT INCREASE IN STATUTORY DEPOSIT RATIO IN 1975 ON SELECTED ENDOGENOUS VARIABLES (CONTINUED.)



*Implemented by decreasing the statutory deposit ratio (S_t) in 1975, then allowing it to return to its actual values thereafter--also refers as one-time shock.

5.2.5 Policy Simulations

Any exogenous change in a policy has direct as well as indirect effects on the endogenous variables. The direct effects of the 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 (hereinafter refer as SIM) exercise are performed for the period 1975-1991.

SIM 1 : The statutory deposit ratio (SRD) is increased by 20 percent from the historical data[2].

SIM 2 : The real government investment expenditures is increased by 10 percent from the historically observed values[3].

SIM 3 : The exchange rate is increased (depreciation) by 10 percent from the actual rate[4].

SIM 1, 2 and 3 represent the changes in the monetary policy, the fiscal policy and the exchange rate policy respectively. The implications of such policy changes can be evaluated base on the comparison between the policy simulation solutions (S) and the base run solutions (B), S-B. From this comparison, we can know to what extent the particular change in the policy can affect the endogenous variables. Table 5.2 tabulates the qualitative effects of these policy changes on major endogenous variables.

The impact of an increase in the statutory deposit ratio by 20 percent is shown in Table 5.3. The increase in the ratio initially contracts the money multiplier and thus the money supply (M2). The M2 decreases by RM443 million in the first period until to RM2104 million at the end of the simulation period. This results in a fall in the general price levels that diverts demand towards domestic product as foreign-made goods have become

relatively more expensive. Hence the real imports drops from RM12 million in the first period to RM482 millions at the end of the simulation period. The decrease in imports improve the balance of payments position and hence the net foreign assets of the central bank. The balance of payments recorded a consistent surplus throughout the simulation period, from

TABLE 5.2

QUALITATIVE EFFECTS OF CHANGES IN EXOGENOUS VARIABLES

Major Endogenous Variables	SIM 1	SIM 2	SIM 3
Real Income (RGDP)	–	+ → – → +	+
Nominal Income (GDP)	+ → –	+ → – → +	+
Price Level (P)	–	+ → – → +	+
Net Foreign Assets (NFA)	+	–	+
Stock of Money (nominal) (M2)	–	+ → – → + → – → + → –	+
Monetary Base (MB)	–	+ → – → + → – → + → –	+
Real Imports (RMM)	–	+ → – → +	–
Real Private Investment (RIN)	–	+ → –	+

Note: In this table, (+ → –) denotes the succession of an increase by a decrease and vice-versa over a stretch of the simulation period.

RM8.4 million in the first period to about RM528 million at the end of the simulation period. Although the net foreign assets position shows consistent improvement from RM8 million in the first period to RM2684 million in the last period, never has it gained the necessary momentum to offset the repressive effect of an increase in the SDR on the money supply. The tighter liquidity condition might have also checked the private demand. As such the private investment expenditures decreases by RM49 million in the first period to RM406 million at the end of the simulation period. Whereas, the effect of a change in statutory deposit ratio has a two-year lagged effect on the real private consumption.. The change in the real private consumption is in fact zero for the first two years and negative for the rest of the simulation period. As a results, the real income (RGDP) also decreases from RM36 million in 1975 to RM55 million in 1991. But the nominal income (GDP) show a mixed results. The GDP increases by about RM12253 million in the first period to about RM173 million in thirteenth period before decreasing from RM3683 million in the fourthteenth period to RM18231 million at the end of the simulation period. Hence, the falls in income is another possible reason for the decrease in imports.

An increase in the real government investment level by 10 percent leads to the increase in income[6]. From Table 5.4 the real income increases by RM308 million in the first period and accelerates to RM405 million in the seventh period before decreases by RM125 million to RM22 million in the twelfth to thirteenth period. By the end of the simulation period, the real income merely increases by about RM192 million. The nominal income also shows the same pattern as the real income with an exception during the eleventh to fourteenth period, which the nominal income decreases by RM63 million to RM72 million before increase to about RM329 million at the end of the simulation period.

The expansion in income leads to an increase in the real imports and thus deteriorates the balance of payments and net foreign assets (foreign reserves) position of the central bank. Throughout the simulation period, real imports expands to about RM105 million in the first period to about RM285 million in the end of the simulation period with an exception during the twelfth to fourteenth period. As a result of this, the balance of payments shows a deficits of RM72 million in the first period and the accumulative deficit of RM1725 million for the seventeen-year period which leads to the fall in foreign reserves or net foreign assets of the central bank. In the first year, the loss of foreign reserves is about RM72.3 milion. As foreign reserves is a main component of the monetary base, the decline in foreign reserves tends to offset the initial increase in the monetary base and money supply (M2). This only occurs in the second to fourth year; eighth to twelfth year and sixteenth to the end of the simulation period, which the accumulative decline in money supply are RM590.8 million, RM2959.2 million and RM823.6 million respectively. It is also expected that an increase in real government investment tends to reduce the private investment expenditures[7] (see equation 2) but with a one-year lagged effect. From Table 5.5 the real private investment does not instantaneously response to the increase in the real government investment but the effect only occurs in the second period, that it decreases by about RM25 million and to RM937 million for the entire experiment period. Though the expansion in government investment also raises the price level except for certain periods, thereafter it shows a trend of declining. This is so since there is a strong link between the money supply and the income with the price level associated with the government investment expansion through the government budget constrict or fiscal deficit (see equation 10, identities 15 and 18 to 20). Even though this might suggest that the expansionary in the government spending

has a deflationary effect on the economy, yet we could not rule out that the economy still experience a mild inflation.

A depreciation of the exchange rate by 10 percent tend to increase real income and nominal income, prices, net foreign assets, money stock but decreases real imports as expected. Initially, the depreciation leads to an increase in the local currency value of the existing net foreign assets of the central bank. The immediate impact of the change in the import prices is an increase in the domestic price and this reduces the relative price effect in the import function. The real import falls from RM862 million in the first period to RM7000 million in the end of the simulation period (see Table 5.5). Bearing in mind that relative price of exports fall with currency depreciation, exports are also simulated in the process. Hence, there occurs a positive trade balance in the current account resulting in the surplus of the balance of payments. The balance of payments recorded a sustained surplus from RM336.7 million in the first period to about RM565.5 million at the end of the simulation period. This further reinforces the initial impact of a depreciation on the net foreign assets of the central bank, thus affecting monetary base and money supply positively. The money supply increases by RM1091 million in the first period to about RM3504 million at the end of the simulation period. The increase in money supply further exerts upwards pressure on domestic prices thus moderating the positive impact of a depreciation on relative price of imports intended to discourage imports.

The increase in money stock also tends to boost the real private investment expenditures as well as private consumption. from RM242 million in the first period to about RM529 million at the end of the simulation period. As a result of this, the real and nominal income increase from RM779 million in the first period to about RM1399 million at the end of the simulation. The growth in the real income further enhances the initial

impact of a depreciation and the expanded money supply on the domestic prices or inflation.

Relating to relative impact of the effectiveness of the policy instruments on major macroeconomic variables, they are influenced not only by the magnitude of policy changes but also by the initial conditions and the time lags. Hence, any empirical results must be interpreted with this element in mind. Rather than trying to evaluate the most effective policy instruments, it is more useful to examine factors that affect the relative impact of policy instruments. Table 5.6 indicates the various elasticities of the selected major macroeconomic variables with respect to the policy instruments. It can be interpreted that the greater is the absolute figure of the elasticity, the more effective the policy 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, money stock, real income and net foreign assets compared with other policy changes throughout the simulation period which reflects the relative openness of the Malaysian economy[8]. Net foreign assets seems to have been most sensitive to changes in the exchange rate compared to other policy instruments throughout the simulation period. Apart from having the largest impact on net foreign assets, changes in import prices (the exchange rate changes) have equally strong effects on money stock[9].

Between fiscal policy (SIM 2) and statutory reserve requirement as instrument of monetary policy (SIM 1), the former exhibits greater influence upon net foreign assets and real income but has less influence on prices and has similar influence as monetary policy on the money stock. Whereas the monetary has the least effect on the net foreign assets and real income but has relatively more influence on prices and has almost similar effect as fiscal policy on the money stock or money supply. Thus as a whole, as the model seems to suggest, fiscal policy relatively has the greater impact than the

monetary policy upon major macroeconomic variables under the period consideration[10].

Another interesting result that emerges out of the simulation exercise is the different effect on prices and output due to monetary impulse. Such analysis will permit us to see the response due to the changes in money supply. However, a cautious interpretation of this analysis is called for as different policy-induced changes in the money supply may yield quite distinct impacts on prices and real output or income[11]. Table 5.7 shows the relationship (in terms of elasticity) between these major macro variables and changes in the money supply induced by three different policy instrument, namely, monetary policy (SIM 1), fiscal policy (SIM 2) and exchange rate policy (SIM 3).

A sustained 20-percent increase in the SRD leads to the decline in the stock of money. The decline in money supply tends to have larger effect on price level than the real income or output except for the first period. (Table 5.7). The price will be affected with an elasticity of 0.004 to 0.164 while the real income range from 0.007 to 0.046 for the period under consideration. On the other hand, induced changes in the money supply due to the policy changes in government investment (SIM 2) appears to have stronger effect on real income than the price level except for 1985-88 and 1990 during the simulation period. The elasticities of the real income and prices with respect to the stock of money are estimated to range from -0.015 to 0.995 and -0.988 to 0.287 respectively. Induced changes in the supply of money due to the increase in 10 percent of exchange rate appears to have stronger effect on prices than real income except for the first period. The elasticities of the price level and the real income with respect to stock of money are estimated to range from 0.033 to 0.870 and 0.108 to 0.285 respectively during the simulation period.

From the above analysis, the model seems to suggest that, an expansionary fiscal policy can be pursued to boost real income without fear of any "excessive" hike in the rate of inflation as real income is more susceptible than price level to induced changes in money supply throughout the simulation period. In addition, the exchange rate policy tends to increase price level and thus may cause excessive hike in the inflation rate eventhough it also tends to increase real income as well.

TABLE 5.3

THE EFFECT OF 20 PERCENT INCREASE IN
STATUTORY DEPOSIT RATIO ON SELECTED ENDOGENOUS VARIABLES

YEAR	RGDP	GDP	PD	M2	NFA
1975	-35.73	12253.64	-0.008	-443.32	8.41
1976	-8.82	12773.09	-0.146	-255.14	33.80
1977	-11.36	14322.48	-0.184	-318.10	76.02
1978	-23.12	14270.04	-0.196	-421.27	134.59
1979	-5.95	13983.70	-0.188	-229.31	204.49
1980	-19.87	13608.77	-0.161	-482.39	284.14
1981	-46.03	10541.23	-0.190	-949.22	388.49
1982	-59.79	6115.35	-0.245	-1044.53	527.99
1983	-48.30	3006.49	-0.267	-659.62	690.07
1984	-49.49	2195.56	-0.245	-807.08	852.90
1985	-48.41	3181.43	-0.246	-806.93	1017.71
1986	-70.87	1859.27	-0.240	-946.51	1171.87
1987	-42.50	173.35	-0.230	-750.76	1326.50
1988	-70.80	-3682.90	-0.212	-1544.16	1510.06
1989	-94.50	-9376.40	-0.245	-2199.98	1770.16
1990	-100.59	-13946.30	-0.326	-3028.44	2156.74
1991	-55.00	-18231.30	-0.409	-2104.89	2684.47

YEAR	BOP	MB	RCP	RIN	RMM
1975	8.41	9.19	0.00	-49.34	-12.19
1976	25.39	12.51	0.00	-56.11	-35.75
1977	42.23	36.61	-19.26	-70.50	-58.66
1978	58.57	56.40	-33.22	-89.41	-79.14
1979	69.90	67.65	-36.04	-83.29	-87.37
1980	79.65	79.92	-31.43	-102.48	-83.85
1981	104.35	97.59	-28.75	-148.62	-95.73
1982	139.50	128.89	-32.90	-182.56	-127.99
1983	162.01	154.22	-39.55	-178.48	-155.72
1984	162.82	166.99	-42.55	-186.68	-185.02
1985	164.82	165.30	-36.46	-192.70	-164.83
1986	154.15	159.40	-34.93	-208.38	-173.20
1987	154.64	164.02	-34.11	-199.39	-154.35
1988	183.56	187.55	-36.14	-244.79	-176.00
1989	260.11	249.47	-35.80	-311.80	-243.55
1990	386.63	364.41	-44.61	-398.89	-353.13
1991	527.72	496.82	-68.08	-406.58	-481.94

TABLE 5.4

THE EFFECT OF 10 PERCENT INCREASE IN REAL GOVERNMENT INVESTMENT ON SELECTED ENDOGENOUS VARIABLES

YEAR	RGDP	GDP	PD	M2	NFA
1975	308.39	214.37	0.069	431.47	-72.30
1976	198.67	207.45	0.207	-125.24	-167.74
1977	209.16	173.02	0.074	-181.10	-259.23
1978	82.99	52.05	-0.013	-284.49	-311.25
1979	234.52	154.31	-0.039	273.87	-380.26
1980	269.44	274.54	0.098	200.55	-510.92
1981	405.86	443.19	0.148	233.08	-736.80
1982	338.25	419.88	0.157	-326.00	-991.05
1983	327.82	369.23	0.074	-427.21	-1229.50
1984	205.71	182.88	-0.020	-806.38	-1376.93
1985	51.13	-63.04	-0.141	-898.53	-1393.31
1986	-125.50	-291.27	-0.219	-501.26	-1285.55
1987	-147.49	-314.39	-0.183	352.77	-1132.00
1988	-22.60	-72.00	-0.047	1156.72	-1037.42
1989	203.00	328.91	0.102	1259.55	-1144.64
1990	180.59	407.50	0.184	-136.93	-1413.82
1991	192.20	329.41	0.094	-686.72	-1726.36

YEAR	BOP	MB	RCP	RIN	RMM
1975	-72.30	126.44	0.00	95.72	104.79
1976	-95.43	-33.91	0.00	-25.81	134.41
1977	-91.50	-52.26	17.68	-114.84	127.10
1978	-52.03	-79.90	-7.77	-230.45	70.31
1979	-69.01	61.29	-17.59	-214.66	86.28
1980	-130.67	42.30	-20.55	-265.37	137.54
1981	-225.88	44.37	8.88	-324.84	207.23
1982	-254.25	-74.91	11.01	-501.19	233.25
1983	-238.45	-94.40	9.23	-656.84	229.28
1984	-147.46	-160.20	-7.34	-846.02	167.60
1985	-16.38	-165.94	-19.50	-1002.86	16.38
1986	107.76	-96.71	-31.62	-1077.52	-121.08
1987	153.55	44.91	-37.08	-1009.52	-153.25
1988	94.61	195.69	-27.44	-859.02	-90.73
1989	-107.24	243.38	-0.21	-735.11	100.44
1990	-269.07	-19.90	23.65	-818.32	245.62
1991	-312.57	-136.72	38.67	-937.60	285.48

TABLE 5.5

THE EFFECT OF 10 PERCENT INCREASE IN EXCHANGE RATE ON SELECTED ENDOGENOUS VARIABLES

YEAR	RGDP	GDP	PD	M2	NFA
1975	778.72	541.75	0.173	1091.11	336.73
1976	689.54	969.24	1.365	1441.86	657.74
1977	494.89	1289.00	2.159	1162.99	911.61
1978	455.64	1455.12	2.324	795.51	1131.18
1979	516.56	1735.37	2.296	1274.18	1453.08
1980	566.04	2032.28	2.494	1709.72	1800.26
1981	627.34	2311.27	2.679	1718.69	2122.10
1982	652.88	2525.75	2.765	1718.45	2454.24
1983	726.19	2780.23	2.815	2091.48	2835.68
1984	725.24	3137.85	2.934	2826.35	3337.13
1985	788.84	3196.70	3.028	2814.50	3810.94
1986	696.23	3126.66	3.073	2769.81	4275.70
1987	749.73	3556.06	3.049	3682.78	5012.43
1988	849.20	4239.50	3.248	5045.50	5844.62
1989	1111.80	4806.00	3.424	4578.50	6577.85
1990	1226.10	5309.80	3.507	4131.87	7250.53
1991	1398.60	5722.50	3.528	3503.61	7816.00

YEAR	BOP	MB	RCP	RIN	RMM
1975	336.72	319.60	0.00	241.71	-862.30
1976	321.01	425.93	0.00	289.09	-1060.96
1977	253.87	357.41	42.60	259.96	-1212.68
1978	219.56	255.50	129.37	208.38	-1420.66
1979	321.89	342.75	110.81	239.72	-1785.64
1980	347.18	423.47	55.53	271.44	-1893.53
1981	321.78	401.46	83.60	264.41	-1938.02
1982	332.13	371.06	78.04	242.57	-2246.19
1983	381.31	420.25	49.49	274.68	-2657.30
1984	501.42	524.53	32.83	323.38	-3356.66
1985	473.82	478.44	50.13	361.94	-2951.21
1986	464.80	443.54	67.42	342.33	-3032.37
1987	736.70	603.69	68.15	411.05	-3054.76
1988	832.11	857.27	58.87	493.82	-3662.69
1989	733.39	847.07	90.92	556.86	-4612.60
1990	672.69	774.43	91.92	538.62	-5659.85
1991	565.51	655.17	89.54	528.81	-6949.69

TABLE 5.6

RELATIVE EFFECTIVENESS OF ALTERNATIVE POLICY INSTRUMENTS

Elasticity of Real Income (RGDP) with Respect to Policy Instruments				Elasticity of Price Level (P) with Respect to Policy Instruments			
Year	SIM 1	SIM 2	SIM3	Year	SIM 1	SIM 2	SIM3
1975	-0.0055	0.0952	0.2396	1975	-0.0006	0.0112	0.0278
1976	-0.0012	0.0536	0.1855	1976	-0.0111	0.0316	0.2081
1977	-0.0013	0.0481	0.1130	1977	-0.0137	0.0111	0.3210
1978	-0.0024	0.0176	0.0942	1978	-0.0139	-0.0019	0.3300
1979	-0.0005	0.0404	0.0891	1979	-0.0124	-0.0051	0.3026
1980	-0.0016	0.0426	0.0897	1980	-0.0103	0.0124	0.3181
1981	-0.0035	0.0606	0.0951	1981	-0.0113	0.0175	0.3191
1982	-0.0043	0.0485	0.0944	1982	-0.0134	0.0171	0.3036
1983	-0.0033	0.0444	0.0990	1983	-0.0139	0.0077	0.2937
1984	-0.0030	0.0250	0.0882	1984	-0.0126	-0.0021	0.3016
1985	-0.0030	0.0064	0.0989	1985	-0.0128	-0.0147	0.3155
1986	-0.0045	-0.0162	0.0882	1986	-0.0123	-0.0226	0.3150
1987	-0.0023	-0.0160	0.0821	1987	-0.0115	-0.0184	0.3056
1988	-0.0035	-0.0022	0.0828	1988	-0.0102	-0.0045	0.3137
1989	-0.0045	0.0195	0.1070	1989	-0.0112	0.0093	0.3143
1990	-0.0045	0.0163	0.1106	1990	-0.0145	0.0163	0.3118
1991	-0.0024	0.0168	0.1218	1991	-0.0176	0.0081	0.3046
Elasticity of Money Supply (M2) with Respect to Policy Instruments				Elasticity of Net Foreign Assets (NFA) with Respect to Policy Instruments			
Year	SIM 1	SIM 2	SIM3	Year	SIM 1	SIM 2	SIM3
1975	-0.1707	0.3369	0.8404	1975	0.0097	-0.1658	0.7772
1976	-0.1391	-0.1361	1.5726	1976	0.0307	-0.3010	1.1953
1977	-0.1220	-0.1413	0.8922	1977	0.0651	-0.4327	1.5610
1978	-0.1004	-0.1458	0.3792	1978	0.1054	-0.4539	1.7710
1979	-0.0754	0.1586	0.8375	1979	0.1600	-0.5357	2.2746
1980	-0.1028	0.0802	0.7290	1980	0.1788	-0.5945	2.2660
1981	-0.1281	0.0609	0.4637	1981	0.1934	-0.7242	2.1134
1982	-0.1229	-0.0805	0.4044	1982	0.2491	-0.9758	2.3159
1983	-0.0987	-0.1352	0.6262	1983	0.4475	-1.7896	3.6780
1984	-0.1118	-0.2337	0.7828	1984	0.8020	-3.1524	6.2763
1985	-0.0991	-0.2287	0.6916	1985	0.9214	-2.9212	6.9009
1986	-0.0943	-0.1075	0.5519	1986	0.7281	-1.6048	5.3134
1987	-0.0770	0.0618	0.7551	1987	0.5424	-0.9099	4.0992
1988	-0.1002	0.1480	0.6546	1988	0.5409	-0.7458	4.1873
1989	-0.1448	0.1689	0.6025	1989	0.4969	-0.6658	3.6932
1990	-0.1759	-0.0165	0.4800	1990	0.4914	-0.6706	3.3041
1991	-0.1513	-0.1011	0.5038	1991	0.6904	-0.9099	4.0202

TABLE 5.7

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

Year	SIM 1		SIM 2		SIM 3	
	Price	Real Output	Price	Real Output	Price	Real Output
1975	0.0038	0.0322	0.0331	0.2827	0.0331	0.2851
1976	0.0799	0.0085	-0.2326	-0.3938	0.1323	0.1180
1977	0.1124	0.0106	-0.0784	-0.3402	0.3598	0.1267
1978	0.1384	0.0238	0.0127	-0.1204	0.8702	0.2486
1979	0.1644	0.0068	-0.0323	0.2548	0.3613	0.1064
1980	0.0999	0.0153	0.1550	0.5306	0.4363	0.1230
1981	0.0883	0.0272	0.2870	0.9952	0.6881	0.2050
1982	0.1094	0.0352	-0.2124	-0.6024	0.7508	0.2333
1983	0.1413	0.0333	-0.0571	-0.3287	0.4691	0.1581
1984	0.1128	0.0269	0.0088	-0.1069	0.3853	0.1127
1985	0.1295	0.0306	0.0643	-0.0281	0.4562	0.1429
1986	0.1306	0.0476	0.2102	0.1506	0.5708	0.1598
1987	0.1497	0.0302	-0.2984	-0.2590	0.4048	0.1087
1988	0.1022	0.0344	-0.0307	-0.0149	0.4793	0.1264
1989	0.0777	0.0314	0.0553	0.1153	0.5216	0.1776
1990	0.0824	0.0258	-0.9887	-0.9876	0.6496	0.2305
1991	0.1166	0.0158	-0.0802	-0.1660	0.6047	0.2417

Note : The elasticity of a variable with respect to money supply is computed by dividing the elasticity of the variable with respect to policy instrument by the elasticity of money supply with the corresponding policy instruments.

Notes to Chapter 5

1. All these aspects will be discussed in the following section in this chapter.

2. The increase in SRD is in terms of percentage change ratio rather than the percentage points.

3. This increase is consider as an increase in government budget deficit and it is assume financed by central bank or regarded as central bank's credit to the government.

4. This is done by raising the unit values of import prices by 10 per cent and deflating the relative export price term (PX/WCP) by similar percentage to reflect enhanced competitiveness of Malaysian export prices. In isolation, the PX is inflated by 10 percent as each unit of exports is worth more in terms of local currency after depreciation Additionally, the net foreign assets of the central bank at the beginning of the simulation period is raised by 10 percent to reflect their increased value in terms of local currency. Similar policy experiment were conducted by Otani and Park (1976) for the Korean economy, Semudram (1980) and Tan (1987) for the Malaysian economy.

5. In the remainder of this chapter, an increase (+) or a decrease (-) refers to the position of the simulation results relative to the position of those of the 'base-run'.

6. In a general way the impact of changes in government expenditure on the economy can be studied in terms of direct impacts and feedback responses to government expenditure changes. Direct impacts refer to the initial or first-round impact of the change in government expenditure and the associated changes due to the way the government expenditure is financed. One may distinguish three types of direct impacts : (a) the direct fiscal impact which is the impact of a change in government expenditure on the level of income in view of the fact that government expenditure is a component of aggregate expenditure; (b) the direct wealth impact,... (c) the direct portfolio impact,... (Arestis and Hadjimatheou, 1981, p.196). As far as our model is concerned, we only analyze case (a), whereas case (b), (c) and the feedback responses are beyond our scope of analysis. For more details on this analysis, please see Arestis and Hadjimatheou (1981), Chapter 9.

7. This is the notorious "crowding-out" thesis of private expenditure by fiscal actions known to Friedman, and for Keynes known as "diversion". In the debate of "crowding-out" issue between the Monetarists and the Keynesians, the issue is more focus on the impact of the method of financing government expenditure. It is apparent that, government spending financed by either taxation or borrowing from the public is mainly a resource transfer from the private sector to government, with little net effect on total spending. It can have a strong stimulative influence on the economy if, and only if, the increased government expenditure is financed by monetary expansion (Arestis and Hadjimatheou, 1981, p.196). As far as our

analysis is concern, we only assumed that the increase in government investment is financed by central bank's credit (see footnote no.3). Moreover, the way we constructed private investment function (see Chapter 4) and the government budget constraint (see Chapter 4,) in the model may affect our policy simulation results.

8. Similar results were obtained by Semudram (1980) and Tan (1987). The relative large influence of the exchange changes on the economy reflects the openness of the Malaysian economy.

9. Such a large impact is expected in situation where there is no sterilization of net foreign assets and 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.

10. This could be that because government budget deficit is one of the main component source of the money base in our model. Hence, when the share increases (increase in government investment), its effectiveness tends to increase.

11. It is important however, to point out that these responses are quite different from those analyzed earlier. In other word, policy-induced changes in the stock of money may have quite different impacts on price, real income, etc., depending upon policy instruments. This is so because price, real income, etc., are influenced by both the policy instruments and the stock of money, among other endogenous variables, but not by the money alone. Therefore, it is quite meaningless to discuss the effects of money on prices or income without knowing what the policy instrument is.