CHAPTER 5

EMPIRICAL RESULTS AND ANALYSIS

5.1 Introduction

This chapter proceeds with an empirical assessment of the effectiveness of monetary policy in Malaysia. The main aim of the study is to find out between the financial variables (credit aggregates, monetary aggregates and interest rates), which variable is better in explaining the movements in income and prices during the pre and post liberalization periods.

5.2 Unit Root Tests

The Augmented Dickey-Fuller unit root tests basically involves the running of the following univariate regression:

$$\Delta y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 t + \sum_{i=1}^{n} \theta \Delta y_{t-1} + \sum \alpha_i S_i + \varepsilon_t \qquad (5.1)$$

The null hypothesis tests the presence of unit root in the selected variables. The test was carried out at two different orders namely at levels and first difference. All variables examined are in natural logarithm and in real terms except for interest rate variables. The lag length was determined after subjecting each of these regressions to a spate of Lagrangian Multiplier (LM) test for serial correlation at 5 percent significance level ranging from the first order to the fourth order. The LM test was carried out primarily to ensure no serial correlation is present in the series.

It has become a common practice in empirical framework to correct for seasonal and long run growth by including a deterministic seasonal dummies and time trend. Hence, for all variables except interest rates, ADF test was based on the inclusion of deterministic time trend and seasonal dummies. As for interest rates, deterministic time trend has been excluded. The inclusion of the deterministic terms has actually helped in reducing the number of lags required to generate the non-autocorrelated errors. Table 5.1 below summarizes the results of the ADF based unit root tests.

Table 5.1

Augmented Dickey-Fuller Unit Root Tests

Variables	Levels		First Difference	
	Lag Length	ADF; t_τ	Lag Length	ADF; t_τ
LRY	0 4	-2.2350 -2.5897	0 3	-9.4543 * -3.9735 **
LNP	0 2	-2.6576 -1.4848	0 1	-9.9416 * -5.1906 *
LRG	0 3	-7.3823 -1.9969	0 2	-19.6216 * -13.9735 *
LRM1	0 2	-1.5857 -1.0257	0 1	-7.6941 * -4.8274 *
LRM2	0 --	-1.4062 --	0 --	-8.3372 * --
LRM3	0 1	-0.9356 -1.7277	0 --	-7.3694 * --
LRCR1	0 2	-0.9299 -1.8706	0 1	-7.9679 * -4.8364 *
LRCR2	0 3	-1.3174 -2.0411	0 --	-10.4544 * --
LRCR3	0 1	-0.3070 -1.3226	0 --	-6.6524 * --
ALR	0 1	-1.4276 -2.6415	0 --	-6.6113 * --
IBR3	0	-3.4084	0	-11.4488 *
TBR3	0	-2.7289	0	-11.4105 *

Notes:

1. Unit root tests summary of statistics for sample period covering from 1973:4- 2000:1.
2. There are 106 observations.
3. All variables are in natural logarithm and real terms except for interest rates.
4. (**) And (*) Denotes rejection of the null hypothesis of the unit root at the 5% and 1% level respectively.

For all the variables examined, the null hypothesis of unit root at log-level is not rejected at the five-percent significance level. This implies that the estimated coefficients β_1 are not significantly different from zero. Therefore, the results in Table 5.1 suggest that the level of all the variables examined contain unit roots and that each of these variables has no tendency to return to its mean value.

However, the null hypothesis of unit root at the first difference level is rejected at the five-percent significance level and thus implying that the estimated coefficients β_1 are significantly different from zero. This confirms that all the variables are integrated of order one that is I (1). Consequently, the results in Table 5.1 suggest that differencing is an appropriate transformation to achieve stationarity.

The HEGY test may be administered to a series y_t estimating the following equation:

$$\Omega(B)x_{4t} = \Pi_1 x_{1t-1} + \Pi_2 x_{2t-1} + \Pi_3 x_{3t-2} + \Pi_4 x_{3t-1} + \mu_t + \varepsilon_t \qquad (5.2)$$

The results of the HEGY tests are summarized in Table 5.2. Five different auxiliary regressions for each series were estimated and the five configurations are as follows:

I. All deterministic terms are absent.
II. Only an intercept (I) is included.
III. Intercept and seasonal Dummies (SD) are included.
IV. Intercept and trend terms (T) are included.
V. All deterministic terms are present.

Table 5.2

Seasonal Unit Root Tests

(The HEGY Procedure)

Series	Auxiliary Regression	't':π_1	't':π_2	't':π_3	't':π_4	'F':$\pi_3 \cap \pi_4$
LRY		8.394	-5.079*	-2.593**	-3.104*	8.895*
	I	-0.229	-5.038*	-2.537**	-3.110*	8.765*
	I, SD	-0.029	-6.115*	-3.488*	-6.152*	31.930*
	I, T	-1.233	-5.055*	-2.114**	-3.333*	9.075*
	I, SD, T	-1.851	-6.197*	-3.513*	-6.274*	32.975*
LNP		3.845	-3.873*	-7.475*	-7.757*	117.415*
	I	-1.302	-3.760*	-7.165*	-7.643*	105.829*
	I, SD	-1.198	-3.905*	-6.681*	-7.769*	100.002*
	I, T	-1.638	-3.568*	-7.051*	-7.567*	101.369*
	I, SD, T	-1.571	-3.753*	-6.622*	-7.681*	96.794*
LRG		4.247	-0.869	-1.515	0.513	1.284
	I	-2.300	0.222	-0.163	0.618	0.207
	I, SD	-2.075	-2.764*	-3.636*	0.816	7.145*
	I, T	-2.130	1.437	1.278	0.657	1.009
	I, SD, T	-1.996	-1.686**	-2.063**	0.819	2.549**
LRM1		3.256	-3.963*	-5.875*	-6.854*	71.912*
	I	-0.734	-3.952*	-5.832*	-6.799*	70.492*
	I, SD	-0.801	-4.712*	-5.325*	-7.001*	66.112*
	I, T	-2.211	-3.761*	-5.922*	-6.469*	66.888*
	I, SD, T	-2.576	-4.618*	-5.611*	-6.533*	64.211*
LRM2		4.791	-5.136*	-5.225*	-6.984*	60.001*
	I	-1.248	-5.091*	-5.223*	-6.811*	57.576*
	I, SD	-1.197	-5.484*	-4.871*	-6.871*	54.322*
	I, T	-2.013	-4.973*	-5.916*	-6.576*	54.124*
	I, SD, T	-2.082	-5.405*	-4.901*	-6.608*	51.445*
LRM3		3.828	-5.324*	-5.108*	-7.762*	70.521*
	I	-1.783	-5.287*	-5.141*	-7.473*	66.311*
	I, SD	-1.700	-5.481*	-4.780*	-7.574*	63.052*
	I, T	-2.264	-5.213*	-5.279*	-7.141*	63.783*
	I, SD, T	-2.307	-5.446*	-4.960*	-7.200*	60.711*
LRCR1		2.815	-6.606*	-5.913*	-6.168*	56.580*
	I	-1.415	-6.574*	-5.892*	-5.915*	53.152*
	I, SD	-1.346	-5.855*	-6.248*	-6.284*	65.247*
	I, T	-2.155	-6.532*	-5.982*	-5.712*	51.952*
	I, SD, T	-2.238	-5.814*	-6.424*	-6.022*	64.423*

Series	Auxiliary Regression	't':π_1	't':π_2	't':π_3	't':π_4	'F':$\pi_3 \cap \pi_4$
LRCR2		3.352	-7.294*	-7.713*	-4.563*	61.028*
	I	-1.278	-7.221*	-7.620*	-4.258*	55.824*
	I, SD	-1.253	-7.068*	-7.820*	-4.257*	59.462*
	I, T	-2.001	-7.136*	-7.541*	-4.166*	53.699*
	I, SD, T	-2.041	-6.987*	-7.773*	-4.157*	57.509*
LRCR3		2.352	-8.311*	-4.971	-6.324*	46.900*
	I	-1.718	-8.273*	4.983	-6.067*	44.234*
	I, SD	-1.682	-7.399*	-5.277	-6.412*	53.338*
	I, T	-2.152	-8.395*	-5.104	-5.810*	43.065*
	I, SD, T	-2.448	-7.567*	-5.523	-6.087*	52.841*
ALR		-0.591	-8.012*	-2.596*	-6.483*	28.233*
	I	-2.784*	-8.073*	-2.614*	-6.128*	25.644*
	I, SD	-2.726*	-7.903*	-2.589*	-6.073*	25.202*
	I, T	-2.996*	-8.012*	-2.602*	-6.046*	25.011*
	I, SD, T	-2.935*	-7.844*	-2.578*	-5.989*	24.562*
IBR3		-1.641*	-4.880*	-4.735*	-6.342*	44.646*
	I	-3.188*	-4.228*	-3.981*	-5.972*	33.566*
	I, SD	-3.219*	-4.220*	-3.989*	-5.993*	34.264*
	I, T	-3.162*	-4.207*	-3.961*	-5.942*	33.220*
	I, SD, T	-3.193*	-4.199*	-3.968*	-5.961*	33.897*
TBR3		-0.948	-5.473*	-7.239*	-4.766*	56.825*
	I	-2.912*	-5.076*	-6.846*	-4.549*	48.883*
	I, SD	-2.932*	-5.165*	-6.749*	-4.425*	46.860*
	I, T	-3.191*	-4.968*	-6.801*	-4.511*	48.000*
	I, SD, T	-3.244*	-5.075*	-6.709*	-4.384*	46.012*

Note:

1. Seasonal unit root tests summary of statistics for sample period covering from 1973:4- 2000:1.
2. There are 106 observations.
3. All variables are in natural logarithm and real terms except for interest rates.
4. (**) And (*) denotes the critical value at 5% and 1% level respectively.

As indicated by the t-statistics of Π_1 in Table 5.2, with the exception of interest rate variables, for all the other variables examined the null hypothesis of $\Pi_1 = 0$ is not rejected at the one- percent level. This implies that the variables have a unit root at zero frequency.

The HEGY test was also carried out to test the presence of unit roots at the biannual ($\Pi_2 = 0$) and annual ($\Pi_3 = \Pi_4 = 0$) frequencies. For all the variables examined (especially for the configurations that includes the seasonal dummies), the t-statistics of Π_2, Π_3 and Π_4 and the F-statistics are significant at five percent level. Consequently, the HEGY test results denoted that the null hypotheses of unit root at the biannual and annual frequencies are rejected for all the variables. This implies that there is no seasonal unit root problem for the variables and thus need not worry about the application of the seasonal co-integration technique. Overall, both the ADF test and HEGY test suggest that the time series stationarities can be achieved simply by first order differencing.

5.3 The Long Run Relationship Of The Financial Variables With Income And Prices

This section analyzes the long run behaviour of the financial variables in order to ascertain their appropriateness as target variable in the process of formulating a policy goal. For a financial variable to be useful as an intermediate target, there should be some sort of equilibrium relationship between the selected variable and the economic activities in the long run. The long run relationship is usually examined by using the co-integration tests.

A simple bivariate co-integration test mainly involves an estimation of the following ordinary least square regression and then examining the residuals from the regression for stationarity.

$$y_t = \alpha + \beta m_t + \varepsilon_t \tag{5.3}$$

If the residuals are stationary while the variables included in the regression are non-stationary, there exist a linear combination of the variables that is stationary. According to Engel & Granger (1987), variables are said to be co-integrated if deviations from equilibrium are stationary. This means, over time the variables will not drift away from each other.

Test for the stationarity of the residuals was carried out using the Augmented Dickey-Fuller unit root test. The stationary test results for the financial variable-income relationship and financial variable-price relationship for period covering from 1973:4 to 2000:1 are summarized in Table 5.3. The lag length was determined after subjecting each regression to spate of Lagrangian Multiplier test for serial correlation at five-percent level ranging from first order to fourth order. One lag period seems to be appropriate and was used uniformly for all the variables.

Table 5.3

Tests For Stationary Financial Variable-Income And Financial Variable-Price Relationships

(Augmented Dickey- Fuller Test)

Financial Variables	Income	Price
	ADF; t_τ	ADF; t_τ
LRMI	-6.3578*	-1.8949
LRM2	-6.5128*	-2.1080
LRM3	-5.6523*	-2.0450
LRCR1	-3.2645***	-2.8768
LRCR2	-3.2019	-2.8729
LRCR3	-3.0795	-2.4459
ALR	-2.9035**	-2.8168
IBR3	-3.4036**	-3.3733***
TBR3	-2.3746	-2.3192**

Notes:

1. Unit root tests summary of statistics for residuals for sample period covering from 1973:4- 2000:1.
2. There are 106 observations.
3. All variables are in natural logarithm and real terms except for interest rates.
4. (***), (**) And (*) denotes rejection of the null hypothesis of the unit root at the 10%, 5% and 1% level respectively.

The results in Table 5.3 show that in the case of financial variable-income relationship, the ADF test statistics of the residuals for all three monetary aggregates are rejected at one-percent significance level. Further, the test statistics rejected the average lending rates (ALR) and three-month inter-bank rates (IBR3), at five-percent significance level. The empirical results thus denoted that these variables are co-integrated with income and large part of the movements in income are anchored by the long run movements of these financial variables. On the other hand, the credit aggregates and three-month treasury bill rates (TBR3) failed the significant test thus implying that the linear combination of these variables with income is not stationary and therefore are not co-integrated with income.

As in the case of financial variable-price relationship, the ADF test statistics is only significant for the IBR3 (five-percent significance level) and ALR (ten-percent significance level). The other financial variables namely monetary aggregates, credit aggregates and TBR3 failed the significance test. These variables are not co-integrated with price and thus have no tendency to return to equilibrium relationship.

Johansen co-integration test was also carried out to determine the long run relationship between the financial variables, income and price. The advantage of using the Johansen technique is that it allows for the possible existence of multiple co-integrating vectors and their identifications particularly in regressions involving more that two variables. The aim of the co-integration test is mainly to identify if the variables in question are drifting apart or together.

Table 5.4 and 5.5 provide the results of the applications of the Johansen techniques to the identifications of long run relationships of the various financial variables with income, price level and fiscal variable along with a dummy variable D78Q4. The dummy variable D78Q4 is intended to reflect a switch in the Malaysian interest rate regime initiated in October 1978. The period of assessment is from 1973:4 to 2000:1.

Table 5.4

Summary Of Test Statistics For The Number Of Co-integrating Vectors In A Three Variable System

(Johansen Co-integration Test)

Financial Variables	r = 0	r ≤ 1	r ≤ 2	Number of CVs
LRM1	54.243 **	22.331	6.889	1
LRM2	52.892 **	21.469	7.811	1
LRM3	58.158 *	21.087	6.619	1
LRCR1	66.605 *	27.458	5.677	1
LRCR2	49.522 **	18.609	6.054	1
LRCR3	54.603 *	20.166	6.568	1
ALR	66.492 *	25.442	5.287	1
IBR3	61.041 *	22.995	5.892	1
TBR3	39.293	15.498	5.312	0

Table 5.5

Summary Of Test Statistics For The Number Of Co-integrating Vectors In A Four Variable System

(Johansen Co-integration Test)

Financial Variables	r = 0	r ≤ 1	r ≤ 2	r ≤ 3	Number of CVs
LRM1	83.571 *	41.288	14.724	4.999	1
LRM2	74.851 **	42.299	21.990	8.420	1
LRM3	87.032 *	45.782	24.487	9.903	1
LRCR1	80.291 *	41.850	23.035	6.019	1
LRCR2	82.469 *	46.029	17.481	7.409	1
LRCR3	85.023 *	48.412 *	19.268	5.535	2
ALR	91.512 *	46.869	23.061	4.928	1
IBR3	92.695 *	41.942	16.591	6.914	1
TBR3	74.068 **	40.581	15.442	5.618	1

Notes:

1. **CV** represents co-integrating vectors and **r** represents number of co-integrating vectors.
2. Three variable system includes real income, price index and financial variable along with the dummy variable D78Q4 while the four variable system includes real income, price index, financial variable and fiscal variable with D78Q4.
3. Test assumption: Linear deterministic trend in the data series.
4. The co-integrating vectors were estimated with a provision for three lags and the lag length was determined after subjecting each variable system to a spate of ARCH serial correlation LM tests.
5. Sample period covering from 1973: to 2000:1 and total number of observations are 106.
6. The critical values at 5% and 1% level for the co-integrating test are shown in table below.

Eigenvalue likelihood ratio's Critical values at 5% and 1% level

	Three-variable system and D78Q4		**Four-variable system and D78Q4**	
	5%	**1%**	**5%**	**1%**
r = 0	47.21	54.46	68.52	76.07
r ≤ 1	29.68	35.65	47.21	54.46
r ≤ 2	15.41	20.04	29.68	35.65
r ≤ 3	3.76	6.65	15.41	20.04
r ≤ 4	-	-	3.76	6.65

7. (**) and (*) denotes rejection of null hypothesis at 5% and 1% respectively.

The co-integration vector was based upon the assumption that there is a linear deterministic trend in the data series and it was estimated with a provision of three lags. The lag length was determined after subjecting each VAR (vector autoregressive model) to a span of ARCH (autoregressive conditional heteroskedasticity) serial correlation LM test. The results were based with inclusion of intercept and seasonal dummies in the restricted VAR model. All the co-integrating vectors were normalized with respect to real income (LRY).

The estimation results presented in Table 5.4, represents a three variable system that is income, price level and financial variable along with the dummy D78Q4. The results suggested that, with the exception of the TBR3, for all the other financial variables there exist one co-integrating vector based upon the eigenvalue statistics at the five- percent significance level. The results seem to indicate that a large part of the movements in these financial variables are anchored by the long run movements of other variables in the system. The existence of a co-integrating vector thus upheld the long run relationship between the financial variables and the macroeconomic variables of income and price. As for TBR3, the null hypothesis of zero co-integrating vector is not rejected at five- percent level, thus indicating that there are no linear combination relationships among the variables that are stationary. Although the TBR3, income and price are individually integrated order one series but they do not co-integrate.

The estimated results presented in Table 5.5, represent a four variable system that is income, price, fiscal variable and financial variables along with the dummy variable D78Q4. The test results suggest that, with the exception of the real domestic banks' claim on private sectors (CR3), for all the other financial variables there exists one co-integrating vector at the 5 percent significance level. As for the CR3, there exist two co-integrating vectors, which are identifiable and incorporatable into error correction terms. In the case of TBR3, when fiscal variable is included there exist a co-integrating relationship between the variables. This implies that with the inclusion of the fiscal variable in the system, there exists one linear combination among the variables that is stationary. As for all the other financial variables, with or without the inclusion of the fiscal variable, there exists one co-integrating vector, which is identifiable and thus incorporatable into the error correction term.

A necessary condition for the target indicator to be effective in the implementation of the monetary policy is that the financial variables should co-integrate with the income and price. Overall, the Johansen co-integrating results provided strong evidence of a stable long run relationship amongst most of the financial variables with income and prices. Moreover, through the co-integration technique, an error correction (EC) term was obtained. In the case of one co-integrating vector, the error correction term is normalized to real income and the equation is as follows:

I. Three variable system:

$$EC = C + LRY + \alpha_1 LNP + \alpha_2 LRX + \alpha_3 D78Q4 \quad (5.4)$$

II. Four variable system:

$$EC = C + LRY + \alpha_1 LNP + \alpha_2 LRG + \alpha_3 LRX + \alpha_4 D78Q4 \quad (5.5)$$

Table 5.6 below shows the error correction terms for all the financial variables in the three and four variables system.

Table 5.6

Error Correction Terms For The Three And Four Variables System

Three Variable System	
Financial Variable	Error Correction Equation
M1	EC=1.909 + LRY – 0.591LNP – 1.060LRM1 – 0.103D78Q4
M2	EC = 0.577 + LRY - 2.204LNP – 0.002LRM2 + 0.223D78Q4
M3	EC = 1.934 + LRY – 0.867LNP – 0.387LRM3 + 0.149D78Q4
CR1	EC = 3.834 + LRY + 0.447LNP - 0.747LRCR1 + 0.223D78Q4
CR2	EC = 2.243 + LRY – 0.851LNP – 0.389LRCR2 + 0.273D78Q4
CR3	EC = 2.619 + LRY – 0.505LNP – 0.491LRCR3 + 0.265D78Q4
ALR	EC = 18.565 + LRY + 0.284LNP + 0.794ALR – 1.033D78Q4
IBR3	EC = -1.606 + LRY - 2.569LNP - 0.153IBR + 0.761D78Q4
Four Variable System	
M1	EC = 1.014 + LRY + 1.341LNP – 0.483LRG1 - 1.054LRM1 – 0.015D78Q4
M2	EC = 0.155 + LRY – 1.021LNP – 0.437LRG1 – 0.156LRM2 – 0.264D78Q4
M3	EC = 2.370 + LRY – 0.674LNP + 0.057LRG1 - 1.054LRM3 – 0.123D78Q4
CR1	EC = 1.099 + LRY – 2.226LNP + 0.193LRG1 – 0.104LRCR1 + 0.281D78Q4
CR2	EC = 2.929 + LRY – 1.286LNP + 0.319LRG1 – 0.408LRCR2 – 0.213D78Q4
CR3	EC_1 = -5.603 + LRY – 2.128LRG1 +0.248LRCR3 + 0.665D78Q4 EC_2 = -10.412 + LNP – 2.817LRG1 + 0.892LRCR3 + 0.527D78Q4
ALR	EC = -2.725 + LRY – 6.122LNP + 1.828LRG1 – 0.257ALR + 0.419D78Q4
IBR3	EC = 1.729 + LRY – 4.375LNP + 1.236LRG1 – 0.062IBR + 0.280D78Q4
TBR3	EC = 1.270 + LRY – 2.932LNP + 0.452LRG1 – 0.031TBR – 0.207D78Q4

These error correction terms represent the co-integration relationship and are interpreted as deviations from the long run equilibrium. The error correction models as noted by Engle and Granger, is a model which forces gradual adjustments of the dependent variables towards some long run value with explicit allowance made for the short run dynamics.

5.4 Information Content Of The Financial Variables

The previous section concludes that the concept of co-integration provides a firm theoretical foundation for a dynamic modeling of a long run properties of data while the error correction mechanism captures the short run dynamic structure of the model. The short run components are allowed to have flexible dynamic specifications while the long run components obey the equilibrium constraints. The aim of this section is mainly to focus on the short run relationship connecting the growth rate of financial variables to the growth rate of income and prices.

The error correction model (ECM) is used particularly to test the significance of the financial variable in providing information about the future movements in output or prices beyond the information contained in the additional variables. The ECM tests apply the least square method. The model is estimated based on the general autoregressive distribution with an error correction term formed by the relevant estimated co-integrating vector and seasonal dummies. In order to investigate the predictive relationship of monetary aggregates, credit aggregates and interest rates to economic activity, the following equations (5.6) to (5.9) were estimated nine times, for each sub-periods. They are the three monetary aggregates (M1, M2 and

M3), the three credit aggregates (CR1, CR2 and CR3) and the interest rates (ALR, IBR3 and TBR3).[31]

$$\Delta y_t = \alpha EC_{t-1} + \sum_{i=1}^{n} \beta_i \Delta x_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta p_{t-i} + \sum_{i=1}^{n} \delta_i \Delta y_{t-i} +_t \sum \theta_i S_i + \varepsilon_t \tag{5.6}$$

$$\Delta y_t = \alpha EC_{t-1} + \sum_{i=1}^{n} \beta_i \Delta x_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta p_{t-i} + \sum_{i=1}^{n} \lambda_i \Delta_i g_{t-i} + \sum_{i=1}^{n} \delta_i \Delta y_{t-i} + \sum \theta_i S_i + \varepsilon_t \tag{5.7}$$

$$\Delta p_t = \alpha EC_{t-1} + \sum_{i=1}^{n} \beta_i \Delta x_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta p_{t-i} + \sum_{i=1}^{n} \delta_i \Delta y_{t-i} + \sum \theta_i S_i + \varepsilon_t \tag{5.8}$$

$$\Delta p_t = \alpha EC_{t-1} + \sum_{i=1}^{n} \beta_i \Delta x_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta p_{t-i} + \sum_{i=1}^{n} \lambda_i \Delta_i g_{t-i} + \sum_{i=1}^{n} \delta_i \Delta y_{t-i} + \sum \theta_i S_i + \varepsilon_t \tag{5.9}$$

The error correction term EC_{t-1} is constructed by using the coefficients from the co-integration regressions. The first difference terms in the above equations captures the short run dynamics while the error correction terms captures the adjustments towards long run equilibrium.

The lag length for the models was determined after subjecting each model to a spate of ARCH correlation LM test ranging from the first order to fourth order. A three-lag period seems to be appropriate and was therefore used uniformly in the multivariate ECM models.

Table 5.7 below shows the t-statistics of the coefficients of the error correction term (α) and the coefficient of determination (R^2) of the real income equation (5.6) and (5.7) for each sub-periods. In all estimations of real income equation, the t-statistics of the coefficient of the error correction (EC) term shows a significant level. This

[31] The description of the variables can be obtained form Table 1.1 in Chapter One while the descriptions for the equations can be obtained from Chapter Four under sub-section 4.6 .

implies that, there is a high tendency for the income to adjust towards some long run values with explicit allowance made on the short run dynamics. Moreover, the coefficient of determination R^2 is also reasonably high, where more than 80-percent of the variation in the dependent variable real income can be explained through the models.

Table 5.8 shows the t-statistics of the coefficients of the error correction term (α) and the coefficient of determination (R^2) of the price equation (5.8) and (5.9) for each sub-periods. In all estimates of price equation, the t-statistics of the coefficient of the error correction (EC) terms are insignificant and thus indicating that there is low tendency for the price to adjust towards an equilibrium relationship. However, it is not our main concern because the aim of this section is mainly to test the information content of the financial variable in explaining the movements in the economic activity. Coefficient of determination R^2 is also not very high. The price equation models can only explain about 40 to 50 percent of the variation in price.

Table 5.7

Summary Of The t-statistics Of The Coefficient of Error Correction Term (α) And The Coefficient Of Determination (R^2) In Real Income Equation

Financial Variables	Sample Period															
	1973:4 to 2000:1				1973:4 to 1989:4				1978:4 to 2000:1				1990:1 to 2000:1			
	3 Variable System		4 Variable System		3 Variable System		4 Variable System		3 Variable System		4 Variable System		3 Variable System		4 Variable System	
	t-stats	R^2	t-stats	R^2	t-stats	R^2	t-stats	R^2	t-stats	R^2	t-stats	R^2	t-stats	R^2	t-stats	R^2
ΔLRM1	-3.781*	0.866	-4.110*	0.872	-4.477*	0.914	-4.572*	0.920	-3.497*	0.870	-4.282*	0.882	-2.659**	0.874	-2.941*	0.881
ΔLRM2	-3.463*	0.815	-4.383*	0.832	-3.197*	0.888	-4.311*	0.901	-3.887*	0.814	-5.196*	0.841	-3.229*	0.837	-2.221**	0.847
ΔLRM3	-3.589*	0.824	-4.405*	0.830	-3.213*	0.891	-4.503*	0.907	-4.003*	0.810	-5.254*	0.839	-2.908*	0.825	-2.339**	0.837
ΔLRCR1	-3.372*	0.822	-4.211*	0.828	-2.624**	0.926	-4.337*	0.903	-4.125*	0.809	-5.127*	0.836	-2.930*	0.801	-2.537**	0.823
ΔLRCR2	-4.085*	0.823	-4.710*	0.837	-3.824*	0.894	-4.243*	0.904	-4.299*	0.815	-5.443*	0.847	-2.862*	0.828	-2.981*	0.846
ΔLRCR3	-3.727*	0.817	-2.891*	0.831	-3.409*	0.888	-1.510	0.900	-4.073*	0.809	-3.375*	0.845	-3.158*	0.808	-0.121*	0.804
ΔALR	-4.652*	0.838	-3.629*	0.833	-3.422*	0.889	-3.586*	0.895	-5.449*	0.843	-4.611*	0.845	-3.485*	0.848	-3.711*	0.871
ΔIBR3	-4.786*	0.835	-4.606*	0.843	-4.225*	0.901	-4.263*	0.907	-5.336*	0.841	-5.808*	0.861	-3.504*	0.856	-3.818*	0.878
ΔTBR3	-	0.787	-4.226*	0.828	-	0.864	-4.510*	0.908	-	0.765	-5.217*	0.839	-	0.772	-2.921*	0.838

Note:

1. Three variable system and four variable system are represented by real income equation 5.6 and 5.7 respectively.
2. (**) and (*) denotes rejection of the null hypothesis at 5% and 1% respectively.

Table 5.8

Summary Of The t-statistics Of The Error Correction Term (α) And The Coefficient Of Determination In Price Equation

Financial Variables	Sample Period															
	1973:4 to 2000:1				1973:4 to 1989:4				1978:4 to 2000:1				1990:1 to 2000:1			
	3 Variable System		4 Variable System		3 Variable System		4 Variable System		3 Variable System		4 Variable System		3 Variable System		4 Variable System	
	t-stats	R^2	t-stats	R^2	t-stats	R^2	t-stats	R^2	t-stats	R^2	t-stats	R^2	t-stats	R^2	t-stats	R^2
ΔLRM1	2.172**	0.408	2.101**	0.423	1.529	0.564	1.539	0.577	2.010**	0.384	1.013	0.409	2.514**	0.431	2.212**	0.471
ΔLRM2	1.021	0.460	0.905	0.431	0.747	0.568	1.120	0.618	0.824	0.400	-0.575	0.437	1.833**	0.339	1.426	0.378
ΔLRM3	1.091	0.401	0.965	0.428	0.555	0.563	1.022	0.608	0.959	0.340	-0.070	0.424	1.967**	0.341	1.506	0.379
ΔLRCR1	1.888**	0.427	1.620	0.443	1.109	0.593	1.322	0.617	2.053*	0.423	0.804	0.452	1.918**	0.365	1.490	0.409
ΔLRCR2	1.449	0.428	1.593	0.463	0.837	0.582	0.869	0.613	1.637	0.388	0.800	0.411	2.744*	0.434	4.054*	0.631
ΔLRCR3	1.344	0.445	-1.382	0.466	0.755	0.588	-1.136	0.623	1.463	0.397	-0.584	0.561	1.989**	0.385	-2.174**	0.457
ΔALR	1.396	0.411	1.686	0.418	1.837	0.541	1.725	0.561	2.047**	0.381	0.796	0.409	2.501**	0.483	1.820	0.487
ΔIBR3	2.487*	0.413	2.345**	0.453	1.814	0.556	2.042**	0.608	2.206**	0.364	0.942	0.414	2.667**	0.566	2.863*	0.611
ΔTBR3	-	0.367	1.932**	0.409	-	0.512	1.772	0.569	-	0.338	0.882	0.397	-	0.339	2.275**	0.475

Note:

1. Three variable system and four variable system are represented by price equation 5.8 and 5.9 respectively.
2. (**) and (*) denotes rejection of the null hypothesis at 5% and 1% respectively.

Testing the significance of coefficients of the selected financial variables assesses the information content of these variables. In this study, the F-statistics are obtained form the Wald test which tests the null hypothesis that the coefficients of the financial variables indicated are zero and the H_0 is as follows:

$H_0 : \beta_i = 0$

H_1 : At least one coefficient is not zero.

The results of the F-statistics, which are obtained from the Wald test, are reported in Tables 5.9, 5.10, 5.11 and 5.12.

Table 5.9

F-Statistics For The Significance Of The Financial Variables In The Three Variable Real Income Equation

Financial Variables	Sample Period							
	1973:4 to 2000:1		1973:4 to 1989:4		1978:4 to 2000:1		1990:1 to 2000:1	
	F-Statistics	Probability	F-Statistics	Probability	F-Statistics	Probability	F-Statistics	Probability
ΔLRM1	11.0434 ***	0.0000	5.4534 ***	0.0026	11.6745 ***	0.0000	5.9011 ***	0.0029
ΔLRM2	0.8523	0.4691	0.4672	0.7065	0.7877	0.5046	2.3879 *	0.0893
ΔLRM3	0.6931	0.5587	0.9651	0.4171	0.2503	0.8609	1.5453	0.2239
ΔLRCR1	0.3599	0.7821	0.6465	0.5891	0.0416	0.9886	0.2747	0.8431
ΔLRCR2	0.5303	0.6626	1.5059	0.2249	0.5085	0.6776	1.0179	0.4001
ΔLRCR3	0.2260	0.8780	0.6433	0.5909	0.2084	0.8902	0.6487	0.5901
ΔALR	4.0897 ***	0.0091	0.8303	0.4838	5.4206 ***	0.0020	3.2578 **	0.0363
ΔIBR3	3.7872 **	0.0131	2.6094 *	0.0622	5.2296 ***	0.0025	3.7233 **	0.0227
ΔTBR3	0.0745	0.9735	0.9725	0.4133	0.2002	0.8959	0.4717	0.7043

Notes:

1. The Error Correction Models were estimated with a provision of three lags and the lag length was determined after subjecting each variable to a spate of ARCH serial correlation LM tests.
2. The F-statistics was obtained from the Wald Test and was tested for the null hypothesis that all the coefficients of the financial variable indicated are zero.
3. (***), (**) and (*) denotes the rejection of the null hypothesis at 1%, 5% and 10% respectively.

Table 5.10

F-Statistics For The Significance Of The Financial Variables In The Four Variable Real Income Equation

Financial Variables	Sample Period							
	1973:4 to 2000:1		1973:4 to 1989:4		1978:4 to 2000:1		1990:1 to 2000:1	
	F-Statistics	Probability	F-Statistics	Probability	F-Statistics	Probability	F-Statistics	Probability
ΔLRM1	9.9896 ***	0.0000	4.5016 ***	0.0076	9.5471 ***	0.0000	9.2826 ***	0.0008
ΔLRM2	0.9220	0.4338	0.7557	0.5249	1.1686	0.3279	1.8676	0.1609
ΔLRM3	0.4053	0.7495	1.6847	0.1837	0.4736	0.7016	1.2641	0.3080
ΔLRCR1	0.2684	0.8480	0.9879	0.4070	0.3275	0.8054	0.4168	0.7424
ΔLRCR2	0.5743	0.6334	1.2245	0.3118	0.7204	0.5432	1.1164	0.3619
ΔLRCR3	0.1351	0.9388	0.6169	0.6077	0.8272	0.4834	0.8048	0.5035
ΔALR	3.2895 **	0.0245	0.5715	0.6366	4.6084 ***	0.0053	3.4128 **	0.0329
ΔIBR3	2.9438 **	0.0374	1.7273	0.1749	4.7386 ***	0.0046	4.4009 **	0.0128
ΔTBR3	0.2718	0.8456	1.8797	0.1466	0.7594	0.5206	1.2236	0.3220

Notes:

1. The Error Correction Models were estimated with a provision of three lags and the lag length was determined after subjecting each variable to a spate of ARCH serial correlation LM tests.
2. The F-statistics was obtained from the Wald Test and was tested for the null hypothesis that all the coefficients of the financial variable indicated are zero.
3. (***), (**) And (*) denotes the rejection of the null hypothesis at 1%, 5% and 10% respectively.

Table 5.11

F-Statistics For The Significance Of The Financial Variables In The Three Variable Price Equation

Financial Variable	Sample Period							
	1973:4 to 2000:1		1973:4 to 1989:4		1978:4 to 2000:1		1990:1 to 2000:1	
	F-Statistics	Probability	F-Statistics	Probability	F-Statistics	Probability	F-Statistics	Probability
ΔLRM1	1.2007	0.3141	1.1354	0.3438	1.3229	0.2733	1.9347	0.1453
ΔLRM2	1.0719	0.3604	1.2502	0.3015	2.0170	0.1187	0.2659	0.8493
ΔLRM3	0.7526	0.5237	1.0280	0.3882	1.2538	0.2964	0.2562	0.8563
ΔLRCR1	2.1746 *	0.0964	2.3495 *	0.0836	3.0617 **	0.0332	0.6272	0.6030
ΔLRCR2	1.4731	0.2271	1.8251	0.1545	0.6861	0.5633	0.2908	0.8316
ΔLRCR3	3.2213 **	0.0263	2.0998	0.1120	1.8594	0.1437	0.9811	0.4147
ΔALR	1.1933	0.3168	0.1267	0.9438	1.0931	0.3573	2.9736 **	0.0473
ΔIBR3	1.5337	0.2111	0.8044	0.4973	0.5266	0.6653	5.7007 ***	0.0032
ΔTBR3	0.4174	0.7408	0.2701	0.8466	0.7820	0.5076	1.6825	0.1910

Notes:

1. The Error Correction Models were estimated with a provision of three lags and the lag length was determined after subjecting each variable to a spate of ARCH serial correlation LM tests.
2. The F-statistics was obtained from the Wald Test and was tested for the null hypothesis that all the coefficients of the financial variable indicated are zero.
3. (***), (**) and (*) denotes the rejection of the null hypothesis at 1%, 5% and 10% respectively.

Table 5.12

F-Statistics For The Significance Of The Financial Variables In The Four Variable Price Equation

Financial Variable	Sample Period							
	1973:4 to 2000:1		1973:4 to 1989:4		1978:4 to 2000:1		1990:1 to 2000:1	
	F-Statistics	Probability	F-Statistics	Probability	F-Statistics	Probability	F-Statistics	Probability
ΔLRM1	1.0641	0.3685	0.6224	0.6040	0.9519	0.4202	1.7195	0.1868
ΔLRM2	1.5699	0.2023	2.3653 *	0.0829	2.0541	0.1140	0.1329	0.9395
ΔLRM3	1.3407	0.2663	1.8610	0.1491	1.5821	0.2011	0.1099	0.9535
ΔLRCR1	2.1582 *	0.0957	2.3303 *	0.0863	2.8732 **	0.0421	0.6098	0.6144
ΔLRCR2	1.8383	0.1461	2.1347	0.1084	0.9269	0.4323	1.0461	0.3887
ΔLRCR3	3.2526 **	0.0254	2.5585 *	0.0662	1.8778	0.1409	1.1464	0.3482
ΔALR	1.2089	0.3112	0.2244	0.8789	1.0459	0.3760	2.3140 *	0.0983
ΔIBR3	2.8109 **	0.0440	1.9189	0.1394	1.1655	0.3289	5.6232 ***	0.0039
ΔTBR3	0.3906	0.7600	0.3145	0.8147	0.4583	0.7122	1.8161	0.1680

Notes:

1. The Error Correction Models were estimated with a provision of three lags and the lag length was determined after subjecting each variable to a spate of ARCH serial correlation LM tests.
2. The F-statistics was obtained from the Wald Test and was tested for the null hypothesis that all the coefficients of the financial variable indicated are zero.
3. (***), (**) and (*) denotes the rejection of the null hypothesis at 1%, 5% and 10% respectively.

Tables 5.9 and 5.10 summarize the F-statistics for the significance of the financial variables in real income equation.

I. Monetary Aggregates

As shown in the two tables above, real M1 is found to be significantly related even at one-percent level with real income through out the sample periods. The result seems to be consistent with the results obtained in some of the earlier studies such as Mulayana (1995) and Farizah (1999). The F-statistics also indicates that real M2 is significant at 10% during the major post reform period. However, real M3 has failed to reject the null hypothesis throughout the period of study.

Though M2 and M3 are inherently co-integrated with economic activity in the long run, in the short run they failed to provide the necessary information about the future income movements. Moreover, as reported by Bank Negara, the annual growth of M2 and M3 was extremely volatile during the period of large capital flows. The large swings in the monetary aggregates thus reduced the viability of these monetary aggregates as intermediate targets. This bears strong negative implications for many familiar monetary policy frameworks that centered on the implementation of policy on money.

The money-income relationship actually does not satisfy the stringent condition that would be required to render the strict use of broad money as intermediate target. Therefore, among the monetary aggregates, only M1 emerged as the most important variable that contains information on the movement of income throughout the period under review. Even in the presence of fiscal variable (Table 5.10), only M1 seems to have a predictive relationship with income.

II. Credit Aggregates

The null hypothesis of $\beta_i = 0$ for all three credit aggregates are not rejected even at ten-percent level throughout the period of study. Thus it shows that credit aggregates do not contain statistically significant information about future fluctuations in income and therefore are not useful variables in forecasting income. Even with the inclusion of fiscal variable as a control variable in the error correction model, did not have any effect on the significance level. The aggregates still failed the significance test.

III. Interest Rates

Both ALR and IBR3 contained statistically significant information about the future fluctuations in income especially in the post liberalization periods. The result also seems to be consistent with the inclusion of the fiscal variable. However, for the sample period covering 1973 to 1989, both interest rates failed the significant test at 5% level. This shows that during the pre major reform period, interest rates do not contain statistically significant information about the future fluctuations in income. Interest rates only played important role after the major reform in the financial sectors. Moreover, the move towards a liberalized financial system has actually enhanced the role of interest rates in the monetary transmission mechanism. As for TBR3, the F-statistics is insignificant throughout the sample period because the development of the market for these bills is still shallow and thus could not provide the necessary information needed to predict income.

Table 5.11 and 5.12 provide the summary of the F-statistics for the significance of the financial variables in the price equations.

I. Monetary Aggregates

The empirical results shown in both the tables clearly highlighted the poor performance of the monetary aggregates in explaining the movements in prices. The null hypothesis that the coefficients of the monetary aggregates are not significantly different from zero is not rejected even at ten-percent significance level. The inclusion of fiscal variable also did not improve the predictive power of the monetary aggregates. Only in the case of real M2, with the inclusion of fiscal variable, the F-statistics is significant at ten-percent level for the sub-period 1973:4 to 1989:4. Overall, the three monetary aggregates are found to be insignificantly related to price especially in the 1990s .

II. Credit Aggregates

As for credit aggregate, the real CR1 and CR3 are statistically significant at 1% and 5% respectively for the entire period of study. With the exception of the sub-period 1990:1 to 2000:1, in all the other sub-periods, the real CR1 and CR3 are statistically significant and thus upheld their role in forecasting future price movements. However, in the 1990s that is after the major financial reform, both credit aggregates failed the significant test, hence indicating that credit aggregates do not provide the required information needed to explain the future movements of prices. The presence of fiscal variable in the error correction model also showed that the coefficients of both CR1 and CR3 credit aggregates were significant during the pre major reform period, while in the 1990s the aggregates failed the significant test.

III. Interest Rates

On the contrary, the F-statistics of the ALR and IBR3 are statistically significant in the 1990s and thus highlights the growing importance of the interest rates in the monetary transmission mechanism. However during the period before 1990s, the coefficients of these interest rates failed the significant test and therefore were not useful in forecasting price. The result is also consistent with the inclusion of fiscal variable.

Overall, one of the striking findings that emerged from the empirical analysis was the outstanding effect of interest rates in influencing the movement in income or prices especially in the 1990s. This could be due to the financing pattern of the economy in 1990s, whereby the structural changes in the late 1980s shifted the financial market towards an interest sensitive markets.

Another interesting thing to note is the insignificance of broad monetary aggregates M2 and M3 with respect to movement in prices and income. Though the co-integrating test showed evidence of long run relationship between these aggregates with income, in the short run both aggregates do not contain information about future fluctuations in real income and prices. This posed the major question of their reliability and usefulness as an intermediate target.

5.5 Estimates Of Variance Decompositions

In this section, the bivariate variance decomposition (VD) method is used to investigate the dynamic effects of output or price to monetary policy shocks. The VD results are used to evaluate the direction of influence in the relationship between the financial variables and the policy objectives. In the ensuing analysis, the VD method is used to make comparisons between the financial variables for the purpose of identifying a suitable intermediate target.

Since the Choleski decomposition is used, the order of the variables is important. Hence, the order of the variables is determined based on the Granger causality test. The causality testing is needed to check whether the targeting financial variable is a leading or a lagging indicator in the income-financial variable and price-financial variable relationships. The results of the Granger causality test and the causal patterns are shown in the Tables 5.13 and 5.14 below.

Table 5.13

Bivariate Granger Causality Tests Summary Of Statistics For Real Income For Period Covering From 1973:4-2000:1

	Sample Period					
	1973:4 to 1989:4		1978:4 to 2000:1		1990:1 to 2000:1	
Null Hypothesis	**F-Statistics**	**Casual Pattern**	**F-Statistics**	**Casual Pattern**	**F-Statistics**	**Casual Pattern**
DLRM1 does not Granger Cause DLRY DLRY does not Granger Cause DLRM1	13.174 6.731	Bidirectional	28.500 11.216	Bidirectional	11.177 6.082	Bidirectional
DLRM2 does not Granger Cause DLRY DLRY does not Granger Cause DLRM2	2.792 4.373	Bidirectional	5.361 6.470	Bidirectional	2.634 2.401	Bidirectional
DLRM3 does not Granger Cause DLRY DLRY does not Granger Cause DLRM3	2.332 4.250	Bidirectional	4.362 5.634	Bidirectional	2.805 2.569	Bidirectional
DLRCR1 does not Granger Cause DLRY DLRY does not Granger Cause DLRCR1	0.496 1.476	Independent	1.168 5.381	Reverse Unidirectional	0.844 6.525	Reverse Unidirectional
DLRCR2 does not Granger Cause DLRY DLRY does not Granger Cause DLRCR2	0.350 1.120	Independent	0.813 3.077	Reverse Unidirectional	1.010 2.545	Reverse Unidirectional
DLRCR3 does not Granger Cause DLRY DLRY does not Granger Cause DLRCR3	0.367 2.971	Reverse Unidirectional	0.456 2.861	Reverse Unidirectional	0.465 2.670	Reverse Unidirectional
DALR does not Granger Cause DLRY DLRY does not Granger Cause DALR	2.306 0.972	Unidirectional	2.937 2.223	Unidirectional	1.822 3.705	Reverse Unidirectional
DIBR3 does not Granger Cause DLRY DLRY does not Granger Cause DIBR3	1.949 1.787	Independent	2.534 1.969	Unidirectional	0.923 2.425	Reverse Unidirectional
DTBR3 does not Granger Cause DLRY DLRY does not Granger Cause DTBR3	0.226 0.352	Independent	0.562 0.497	Independent	1.219 0.879	Independent

Table 5.14

Bivariate Granger Causality Tests Summary Of Statistics For Price Index For Period Covering From 1973:4-2000:1

	Sample Period					
	1973:4 to 1989:4		1978:4 to 2000:1		1990:1 to 2000:1	
Null Hypothesis	**F-Statistics**	**Casual Pattern**	**F-Statistics**	**Casual Pattern**	**F-Statistics**	**Casual Pattern**
DLRM1 does not Granger Cause DLNP DLNP does not Granger Cause DLRM1	3.229 3.136	Bidirectional	1.931 3.007	Reverse Unidirectional	2.276 5.219	Bidirectional
DLRM2 does not Granger Cause DLNP DLNP does not Granger Cause DLRM2	2.465 2.078	Unidirectional	4.240 4.621	Bidirectional	0.526 2.446	Reverse Unidirectional
DLRM3 does not Granger Cause DLNP DLNP does not Granger Cause DLRM3	2.157 3.651	Reverse Unidirectional	2.627 5.096	Bidirectional	0.247 4.089	Reverse Unidirectional
DLRCR1 does not Granger Cause DLNP DLNP does not Granger Cause DLRCR1	1.591 2.792	Reverse Unidirectional	4.411 2.366	Bidirectional	0.451 4.648	Reverse Unidirectional
DLRCR2 does not Granger Cause DLNP DLNP does not Granger Cause DLRCR2	2.231 0.281	Independent	2.011 0.554	Independent	0.345 3.424	Reverse Unidirectional
DLRCR3 does not Granger Cause DLNP DLNP does not Granger Cause DLRCR3	6.098 1.817	Unidirectional	4.998 1.353	Unidirectional	1.425 2.483	Reverse Unidirectional
DALR does not Granger Cause DLNP DLNP does not Granger Cause DALR	0.263 8.503	Reverse Unidirectional	1.256 0.141	Independent	4.723 6.029	Bidirectional
DIBR3 does not Granger Cause DLNP DLNP does not Granger Cause DIBR3	3.881 3.222	Bidirectional	0.762 3.921	Reverse Unidirectional	5.591 2.889	Bidirectional
DTBR3 does not Granger Cause DLNP DLNP does not Granger Cause DTBR3	0.795 0.555	Independent	0.908 0.900	Independent	2.748 1.434	Unidirectional

The following hypothesis was set up to determine the causal pattern:

Ho: Independent variable do not "Granger Cause" the dependent variable

H_1: Independent variable do "Granger Cause" the dependent variable

From the hypothesis, four types of causal pattern can be detected and they are as follows:

I. Unidirectional : Financial variable "Granger Caused" income or price.

II. Reverse Unidirectional : Income or price "Granger Caused" financial variable.

III. Bidirectional : Financial variable "Granger Caused" income or price and Income or price "Granger Caused" financial variable.

IV. Independent : Predominantly independent without any feedback or causality being detected.

As shown in the above two tables, the results of the partial F-test vary considerably among the variables. Among the financial variables, three different measures of monetary policy shocks were chosen to investigate the effect of income and price. Based on the Granger causality test, the monetary aggregate M1, credit aggregate CR3 and average lending rate (ALR) were chosen to investigate the effect of income to policy shocks. As for price, the monetary aggregate M1, credit aggregate CR3 and three-month inter-bank rate (IBR3) were chosen.

In the case of real income, the F-statistics shows that ALR "Granger caused" real income while for real CR3, there exists a reversal causal link from real income to the credit aggregate. As for real M1, there exist a bidirectional causal relationship with real income. Consequently, in the bivariate VD estimation of income with the real M1 and ALR, the real income is ordered first. This means, the two monetary policy shocks are assumed to have no instantaneous impact on output. In the bivariate estimation of output with real CR3, the CR3 is ordered first as it is assumed to have an instantaneous impact on output.

In the case of price level, although for both real M1 and IBR3 there exist a bidirectional causal link with price, in the bivariate estimation of price with the monetary policy shocks, these financial variables are ordered first. In the bivariate estimation of price level with the CR3, the price is ordered first.

Tables 5.15 and 5.16 given below shows the fractions of the variance of the forecast errors of income and price respectively due to the three monetary policy shocks at different forecast horizon. A lag of three periods was used. To simplify the presentation, only eight horizons of the forecast errors are reported. First to fourth quarter ahead is represented as short term, while fifth to tenth quarter ahead as medium term and fifteen to twentieth quarter ahead as long term.

Table 5.15

Bivariate Estimation Of Income Level With Each Monetary Policy Shocks

Quarter	Sample Period								
	1973:4 to 1989:4			1978:4 to 2000:1			1990:1 to 2000:1		
	Fraction Of Output, % due to			Fraction Of Output, % due to			Fraction Of Output, % due to		
	M1	CR3	ALR	M1	CR3	ALR	M1	CR3	ALR
1	0.000	17.895	0.000	0.000	21.939	0.000	0.000	22.189	0.000
2	0.068	14.914	0.503	0.220	21.116	0.985	0.205	20.993	0.580
3	26.500	15.397	4.092	29.409	18.857	2.635	24.664	19.022	0.645
4	26.647	15.372	4.148	29.964	18.770	6.685	27.639	19.161	7.826
5	27.862	16.152	5.139	31.603	18.055	10.191	26.852	18.718	12.078
10	27.440	16.325	5.372	31.695	17.972	10.894	27.400	18.831	12.806
15	29.203	16.273	5.785	34.004	17.739	11.450	28.712	18.747	13.443
20	29.651	16.446	5.935	34.723	17.708	11.705	29.017	18.749	13.703

Note:

The variance decomposition in the bivariate model was ordered as follows:

I. Real Income, Monetary Aggregate M1

II. Credit Aggregate C3, Real Income

III. Real Income, Average Lending Rate

Table 5.16

Bivariate Estimation Of Price Level With Each Monetary Policy Shocks

Quarter	Sample Period								
	1973:4 to 1989:4			1978:4 to 2000:1			1990:1 to 2000:1		
	Fraction Of Price, % due to			Fraction Of Price, % due to			Fraction Of Price, % due to		
	M1	CR3	IBR3	M1	CR3	IBR3	M1	CR3	IBR3
1	1.146	0.000	0.003	4.868	0.000	5.514	10.127	0.000	0.909
2	13.326	4.383	5.589	8.555	8.802	6.949	10.168	9.010	6.016
3	14.039	19.765	10.642	7.493	13.167	8.954	9.675	9.909	7.454
4	16.530	20.084	10.635	7.514	14.069	10.016	16.581	9.777	19.374
5	17.316	22.351	10.121	7.638	16.791	9.916	17.495	10.642	25.422
10	17.504	22.646	10.083	7.649	17.340	9.913	17.563	10.786	25.608
15	17.655	22.847	10.038	7.649	17.877	9.913	18.060	10.903	25.743
20	17.683	22.836	10.029	7.649	18.008	9.913	18.120	10.943	25.754

Note:

The variance decomposition in the bivariate model was ordered as follows:

I. Monetary Aggregate M1, Price

II. Price, Credit Aggregate C3

III. Three Month Inter-bank Rate, Price

The results in the above two tables can be used as way of comparing the shares (proportion) of the total forecast error variance of a given variable (that is the ultimate goal variables of income and price) that is attributable to the orthogonalized independent movements in the innovations of the targeted variables (financial variables). The greater the responsiveness of the indicator, greater will be the area-share of the forecast error variance. Meanwhile, stronger the association between the intermediate target and the goal variable, the faster the "ignition" of the error will be triggered before constancy is achieved.

The findings in Table 5.15 shows that to have an effect on output, the money shocks account for about 28% in the medium term in the first sub-period while interest rate shocks account for about 5% and credit shocks about 16%. The results clearly suggest that money innovations had an important role in the monetary policy transmission mechanism in all the sub-periods. Interest rates innovations also seem to account for 12% of output variability throughout the forecast horizons in the third sub-period. Hence there is a strong evidence to support the presence of the interest rate as another potential channel of monetary policy transmission mechanism during the post major reform period. In fact it is also interesting to note that the variance decomposition results seems to be quite consistent with the result obtained in error correction model, whereby the F-statistics results also shows that both monetary aggregate M1 and interest rates played significant role in forecasting income.

Table 5.16 represents the bivariate estimation of price level with each monetary policy shocks. All three shocks seem to play an important role in the price-forecast error. In the first sub-period, the money shocks account for about 17% in the medium term while interest rate shocks account for about 10% and credit shocks about 22%. However in the third sub-period, the money shocks still account for about 17% in the medium term while interest rate shocks account for about 25% and credit shocks about 10%. These results also seems to be consistent with F-statistics obtained in the error correction model, whereby during the pre major reform period, the credit aggregate played significant role in forecasting price while interest rates showed high significance in the post major reform period.

Therefore, overall it can be concluded that, the variance decomposition results revealed that two potential channels of monetary policy during the pre major reform period (prior to 1990) that is monetary aggregate and credit aggregate. Since monetary shocks are transmitted to the real sector through liberalized interest rates, it further supports the importance of short-term interest rate in the monetary policy transmission mechanism especially in the post reform period. Therefore, in the 1990s, the variance decomposition results revealed that both monetary aggregate and interest rate are important channels of monetary policy.