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A Vector AutoRegressive (VAR) Approach to the Credit Channel for the Monetary Transmission Mechanism in Mauritius

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Abstract

This paper is an attempt to determine the presence and empirical significance of monetary policy and the bank lending view of the credit channel for Mauritius, which is particularly relevant at these times. A vector autoregressive (VAR) model of order three is used to examine the monetary transmission mechanism using quarterly data from 1985Q1 to 2006Q4. The variables Gross Domestic Product (GDP), price level, money supply and credit to private sector are considered. The results of econometric analysis show the effectiveness and relevance of monetary policy and of a credit channel in the short-run. Changes in the monetary policy variable (M2) affect the credit variable (CPS) in the short-run. Output (GDP) increases temporarily, while the effect of a monetary stimulus on prices is a persistent increase.

Key words: Monetary Transmission Mechanism, Credit Channel, VAR model.

1.0 Introduction

Monetary policy is the process by which a government, central bank or monetary authority manages the supply of money. In most countries, monetary policy is usually controlled by a central bank, and it is one method used by the government to achieve its economic aims, for example, price stability in the long term and sustainable growth.

In Mauritius, the conduct of monetary policy involves the setting and adjustments of policy instruments by the Bank of Mauritius (BOM). Monetary policy is mainly implemented through indirect monetary management, which is achieved through weekly auction of Government of Mauritius Treasury Bills/BOM Bills in the money market. BOM Bills are issued for monetary policy purposes while Treasury Bills are issued for government borrowing requirements only. Also, the BOM conducts repurchase transactions with commercial banks to provide for a more dynamic management of liquidity by the market. The Bank also conducts foreign exchange swaps transactions with commercial banks whenever required. Moreover, in December 1999, the BOM introduced a standing facility, known as the Lombard Facility, to provide overnight collateralized advances to banks. The Lombard rate was replaced by the repo rate as from December 2006. The indirect instruments of monetary control are open market operations and reserve requirements. Reserve requirements are the obligations of banks to hold a specified part of portfolios in reserves at the central bank. Every commercial bank is required by law to maintain a minimum percentage of its deposits with the central bank. Since August 2008, the minimum Cash Ratio is 6% of banks' total deposits. It may be changed by the central bank at any time, thereby affecting the money supply and credit conditions. If the reserve requirement percentage is increased, this would reduce the money supply by requiring a larger percentage of the banks, and depository institutions, demand deposits to be held by the central bank, thus taking them out of supply. As a result, an increase in reserve requirements would increase interest rates, as less currency is available to borrowers. This is not very often done since it affects money supply in a major way. On the other hand, open market operations involve the purchase and sale of financial instruments by the central bank to influence banks' liquidity positions.

The motives of open market operations are to influence the reserves of commercial banks in order to control their power of credit creation and to affect the market rates of interest so as to control the commercial bank credit. If the central bank were to buy bonds, the effect would be to expand the money supply and hence lower interest rates; the opposite is true if bonds are sold. This is the most widely used instrument in the day to day control of the money supply due to its ease of use, and the relatively smooth interaction it has with the economy as a whole.

Monetary policy is related to a number of fundamental economic indicators such as exchange rate, inflation, asset prices, credit, etc. The monetary transmission mechanism is the term used to denote the different channels through which monetary policy affects output and prices. A good understanding of the transmission mechanism is an important prerequisite for implementing a sound policy. It allows a judgment to be formed as to the extent and the timing of monetary policy decisions which are appropriate in order to meet its final objectives (maintain price stability).

The stages in the transmission mechanism are as follows:

(a) Changes in money market conditions affect financial markets as reflected in interest rates, asset prices, exchange rate and the general liquidity and credit condition in the economy;

(b) Changes in financial markets conditions affect spending and prices, and (c) The timing and strength of the various channels in each of the stages depend on the economic and financial structure of the economy.

The different channels through which monetary policy operates are the interest rate channel, asset price channel, exchange rate channel and the credit channel.

The basic idea for the interest rate channel is that an expansionary monetary policy results in the fall of the real interest rate, implying that the cost of capital is lowered. These changes in turn lead to an increase in consumption or in investment spending, and consequently, an increase in output.

The exchange rate provides an important channel through which monetary policy affects the economy for an open economy that is dependent on foreign trade. This channel also involves interest rate effects. In the short run, higher interest rates make domestic assets more attractive relative to investments in other currencies. The resultant capital inflow involves more demand for domestic currency, thus strengthening the exchange rate. Also, a decrease in the domestic real interest rates will result in a fall in the value of domestic currency relative to other currency deposits. One advantage of depreciation in domestic currency is that it makes domestic goods cheaper than foreign goods, causing a rise in net exports and consequently a rise in output.

Monetary policy also affects demand through the wealth effects on consumption and investment. Wealth can be held in five different forms: money, bonds, equities, physical goods and human capital. When there is an increase in stock prices, consumers' wealth will also rise, leading to an increase in consumption and consequently, an increase in output.

The credit channel emphasizes the role that credit conditions play in monetary transmission mechanism. Banks are of high importance in the financial system as a significant number of firms and households rely mainly on banks, so that an increase in loan supply will increase investment and consequently, output (GDP).

The relative importance of the various channels depends on the particular country. For example, in a country where households do not hold a significant share of long-term assets, the wealth effects are not likely to be significant.

The monetary policy framework of Mauritius underlines the importance of the banking sector for the economy of the country. Hence, this paper studies the bank-lending view of the credit channel. This channel can be summarized as the impact of monetary policy on the amount and conditions of credit as supplied by the banking sector. Monetary policy actions get transmitted to the real economy through these changes in the loan supply behavior of banks.

In other words, the flow of causality between the variables as suggested by theory should be two folds. The changes in monetary policy should cause changes in loan supply. This in turn should have significant effect on real economic activity. Hence the major relationships for bank lending channel to be operative are:

1. Monetary Policy Instruments → Bank Credit
2. Bank Credit → Macroeconomic Activity

The success of the monetary system of a country depends upon effective and efficient monetary policy, the objectives of which differ for each country, but usually aim at economic growth (increase in GDP), price stability (works towards a no inflation economy), exchange stability, promotion of saving and investment, and income generation (increase in GDP to give more to people so as to increase standard of living).

This study is an attempt to apply the Vector Autoregression (VAR) technique to analyze the bank-lending channel in Mauritius. We are putting an emphasis on this channel, especially since no such modelling has yet been done at national level, in fact on any of the possible channels of monetary transmission mechanisms. A VAR model has the advantage of response of a variable over time to a disturbance in that variable and other variables in the system. Moreover, it uses only the observed time series properties of the data to forecast economic variables, with low forecasting errors.

There has been a growing number of studies done on the monetary transmission mechanism using the VAR approach to focus on the relationships between monetary policy and variables such as real output, inflation rate, interest rate, credit growth, exchange rate, money and price indices. Considerable research has recently examined the role played by banks in the transmission of monetary policy aiming at uncovering a credit channel and assessing the relative importance of the money and credit channels. Morsink and Bayoumi (2001) used VAR(2) models with data from 1980 to 1998, to analyze the effect of monetary shocks on the economy of Japan.

It was found that interest rate, broad money and bank loans had significant effect on business investment and private demand, confirming the crucial role of the bank-lending channel in Japan. Gunduz (2001) analyzed the bank-lending channel in Turkey using monthly data in a VAR (Vector Autoregressive) model. The findings, for the period 1986 – 1998, show that bank lending channel presented limited support to the monetary transmission mechanism. Le Viet Hung (2007) studied the monetary transmission mechanism in Vietnam, using VAR(4) with variables money, real industrial output, price, real interest rate, real exchange rate and credit from 1996 to 2005. Le Viet Hung concluded that the significance of each channel was quite weak and the credit and exchange rate channels appeared to be the most significant ones. Boughrara (2002) worked on the lending and exchange rate channels in Morocco and Tunisia. The empirical results point to the fact that the two countries' economies are endowed with different prevailing channels. It was shown that the monetary channel is the dominant one in Tunisia. It stands out also from the empirical results that the lending channel is active neither in Morocco nor in Tunisia. Gupta (2004) compared the bank-lending channel in India and Pakistan using the VAR approach. The credit channel was found to be significant in both countries since changes in the monetary policy instruments affected the credit variable (private sector claims) which in turn transmitted the shocks to output and prices.

2.0 0VAR methodology

A p^{th} order VAR, VAR (p), is defined by the system of linear equations

$$y_t = c + \phi_1 \, y_{t-1} + \phi_2 \, y_{t-2} + \ldots + \phi_p \, y_{t-p} + a_t \quad \mathrm{t} = 0, \pm 1, \pm 2, \ldots \tag{1}$$

where $y_t = [y_{1t}, \ldots, y_{nt}]'$, $c = [c_1, \ldots, c_n]'$, $a_t = [a_{1t}, \ldots, a_{nt}]'$ are (n x 1) vectors of variables, constants (intercept terms, related to mean) and error terms respectively. ϕ_i is an (n x n) matrix of coefficients. a_t should satisfy the conditions of mean zero, constant variance and no serial correlation. For suitable analytical derivations we express the VAR (p) model as a VAR(1) model yielding

$$x_t = C + Ax_{t-1} + \varepsilon_t,$$

with

$$x_t = \begin{bmatrix} y_t \\ y_{t-1} \\ \vdots \\ y_{t-p+1} \end{bmatrix}, \quad C = \begin{bmatrix} c \\ 0 \\ \vdots \\ 0 \end{bmatrix}, \quad A = \begin{bmatrix} \phi_1 & \phi_2 & \cdots & \phi_{p-1} & \phi_p \\ I & 0 & \dots & 0 & 0 \\ 0 & I & 0 & \dots & 0 \\ \vdots & \vdots & \ddots & \ddots & \vdots \\ 0 & 0 & \dots & I & 0 \end{bmatrix} \text{ and } \varepsilon_t = \begin{bmatrix} a_t \\ 0 \\ \vdots \\ 0 \end{bmatrix}.$$

Rewriting the VAR as a moving average (MA) process yields,

$$x_t = \tilde{\mu} + \sum_{j=0}^{\infty} A^j \varepsilon_{t-j}$$

and

$$y_t = Jx_t = J\tilde{\mu} + \sum_{j=0}^{\infty} JA^j J'J\varepsilon_{t-j} = \mu + \sum_{j=0}^{\infty} \Psi_j a_{t-j},$$

with $J = [I \quad 0 \quad \cdots \quad 0]_{K\times Kp}, \Psi_j = JA^j J'$ and $J\varepsilon_t = a_t,\ \mathrm{E}(y_t) = J\tilde{\mu}$.

2.1 Stationary Process

The VAR(1) process is stationary if $\det(I - Az) \neq 0$ for $|z| \leq 1$, z contains the eigenvalues of A, or equivalently, if all the roots of the characteristic polynomial $\mathrm{Det}(I - \phi_1 z - \phi_2 z^2 - \cdots - \phi_p z^p) = 0$ lie outside the unit circle. A forecast k-step ahead at time origin t is $\hat{y}_t(k) = \hat{c} + \hat{\phi}_1\, \hat{y}_t(k-1) + \ldots + \hat{\phi}_p\, \hat{y}_t(k-p)$.

Non-stationarity of data may be due to non-constant mean, non-constant variance or both. When there is non-constant variance, the variance is stabilized using transformations. The process of differencing is used to make the mean constant where the d^{th} order differenced x_t is $\Delta^d x_t = (1-B)^d x_t$, with Δ the difference operator and *B* the lag operator.

2.2 Causality

The concept of causality deals with the fact that a cause cannot come after the effect. We assume that $y_t = (w_t, v_t)$ is partitioned into two subvectors. For a VAR(p) process,

$$y_t = \begin{bmatrix} w_t \\ v_t \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \end{bmatrix} + \begin{bmatrix} \phi_{11,1} & \phi_{12,1} \\ \phi_{21,1} & \phi_{22,1} \end{bmatrix} \begin{bmatrix} w_{t-1} \\ v_{t-1} \end{bmatrix} + \ldots + \begin{bmatrix} \phi_{11,p} & \phi_{12,p} \\ \phi_{21,p} & \phi_{22,p} \end{bmatrix} \begin{bmatrix} w_{t-p} \\ v_{t-p} \end{bmatrix} + \begin{bmatrix} a_{1t} \\ a_{2t} \end{bmatrix}.$$

v_t fails to Granger cause w_t if lagged coefficients of v_t in the equation for w_t $(\phi_{12,i}$ for $i = 1,2,\ldots p)$ are zero.

2.3 Variance Decomposition

Variance decompositions show the portion of variance in the prediction for each variable in the system that is attributable to its own shocks and shocks to other variables in the system. To analyse the contribution of the error terms a_t to the total forecast error variance, the system is orthogonalized. If $\mathrm{E}[a_t a_t'] = \Sigma$ and $R\Sigma R' = I$, where *R* is lower triangular, then $\mathrm{E}[Ra, a', R'] = \mathrm{E}[\eta_t\, \eta_t'] = I$. η_t are the orthogonalized white noise innovations. Using the MA form, $y_{t+k} = \sum_{j=0}^{\infty} \Psi_j a_{t+k-j}$, of the VAR process, the error of the optimal *k*-step forecast is

$$y_{t+k} - \hat{y}_{t+k} = \sum_{j=0}^{k\text{-}1} \Psi_j a_{t+k-j} = \sum_{j=0}^{k-1} \Psi_j R^{-1} R a_{t+k-j} = \sum_{j=0}^{k-1} C_j \eta_{t+k-j} \ . \tag{2}$$

2.4 Impulse Response

To analyse the dynamic behaviour of the target variables due to unanticipated shocks in the policy variables we use the impulse response functions. We are interested in the effect of a shock a_{it} onto the variable $y_{l,t+k}$. Using the MA representation given by equation (2), the impact of a_t onto y_{t+k} is Ψ_k. η_t are orthogonalized so that $a_t = R^{-1}\eta_t$ and particularly, $a_{1t} = r_{11}\eta_{1t}$. The impact of a_{1t} onto y_{t+k} is therefore $\left[\Psi_k R^{-1}\right]_{\bullet,1}$.

3.0 Data Analysis – Results and Discussions

Quarterly data from 1985Q1 to 2006Q4 for variables Gross Domestic Product (GDP), Consumer Price Index (CPI), Broad Money (M2) and Credit to Private Sector (CPS) has been used. GDP and CPI were the target variables, M2 (currency outside banks + private deposits), the money supply aggregate that plays the main role in monetary policy and CPS accounted for the credit variable. These data were obtained from the Bank of Mauritius and the Central Statistics Office of Mauritius. All numerical experiments were performed using the statistical software Microfit 4.0. Each variable was seen to have an exponential trend and since Microfit gives results only for data containing a linear trend or no trend at all, we take logarithm of all the variables before proceeding with any tests. GDP was found to contain seasonality and in order to care for this when doing the estimation and structural analysis of the VAR model, four (because of quarterly data) seasonal dummy variables, S_i, i = 1,…,4, were introduced in the model where S_1 takes values 1 for 1^{st} quarter and 0 otherwise, S_2 = 1 for second quarter and 0 otherwise, and so on. These dummy variables were treated as exogenous.

3.1 Unit Root Test for Stationarity

The first step is to check the stationarity of the data by performing the unit root test using the Augmented Dickey Fuller (ADF) command. The results are shown in Tables 1a and 1b.

95% critical value for data in log levels is - 2.8976 for a model with no trend and - 3.4659 for one with linear trend, while for differenced series critical values are - 2.8981 and -3.4666 respectively. '*' denotes "not rejecting" the null hypothesis at 5% significance level, that is, there is the presence of a unit root and hence, the series is non-stationary.

From Table 1a we observe non- stationarity for all variables, but they are stationary after only one difference (Table 1b). Hence, the variables are integrated of order 1. This denotes that there exists the possibility that they share long-run equilibrium relationships and therefore cointegration tests are important before results can be considered reliable. The tests used are: the Cointegration LR Tests based on maximal eigenvalue and trace, and the Schwarz Bayesian model selection Criterion (SBC). The results from all the five deterministic models for the number of cointegrating relations are shown in Table 2a. There is evidence of minimum two and maximum four cointegrating relations. The lag length of the VAR model, using the SBC, was found to be of order three.

3.2 Estimation of VAR model

Before estimating the VAR model, following Gupta (2004), a simple OLS regression was run to identify the relationship between monetary policy instrument and credit, with LCPS as the dependent variable and LM2 as explanatory variable. The procedure was repeated using LGDP as dependent and LCPS as explanatory variable so as to see the effect of changes in the credit variable on economic activities. The results are shown in Table 2b.

The coefficient of relationship between money and private sector claims is significant, and has a very high explanatory power (based on R-squared statistics). The coefficient of private sector loans on production is significant and highly explains the variations in the output. These findings show that a relationship between monetary policy variable and credit variable exists. Also, credit affects output, showing a relationship between economic activity and credit variable. This indicates that bank lending channel is present in Mauritius as a monetary policy transmission mechanism. The OLS regression in Table 2b is a preliminary investigation, to first of all establish the presence of a credit channel in the Mauritian economy. These results will be more thoroughly investigated using the Granger- Causality tests, variance decomposition and Impulse Response Functions.

The VAR model was estimated using the unrestricted VAR option of the Microfit software. The OLS method was used to estimate all parameters since each equation of the model contains the same number of lagged variables.

Our model contains 4 macro-economic and 4 seasonal dummy variables and therefore the total number of parameters to be estimated in each equation is

16. Since the VAR model should be stationary for the estimation process, the first differencing of the levels is used.

4.0 Application of VAR Model

The VAR model DLM2 DLCPS DLCPI DLGDP was used for the sample period 1985Q1 to 2005Q4. The forecasts are shown in the Figures 1a – 1d, in which the beginning of the forecasting period is shown by a vertical line. High peaks may be observed in Figure 1d, but they are of low significance since the difference between the actual and predicted values are quite low (< 0.06). The closeness of the fitted values to the observed ones for each variable has been shown by the plots. This indicates a satisfactory model.

5.0 Structural Analysis – Results and Discussions

5.1 Granger – Causality Tests

For a more thorough analysis of our VAR model, the Granger Causality tests are performed. Microfit computes the log-likelihood ratio statistic for testing the null hypothesis that the coefficients of a subset of jointly determined variables in the VAR are zero (the Block- Granger Non-Causality Test). The null hypothesis is:

H_0: Coefficients of lagged values of the first column in the block of equations explaining the variable(s) in the other columns are zero; i.e. variable(s) in first column of the tables 3a, 3b and 3c do not Granger-cause variable(s) in remaining columns.

Granger Causality test from Microfit indicates whether a variable or set of variables is influenced by the other variables in the model. We proceed by taking all possible combinations of the four variables included in the VAR model. We start with the smallest model possible (2 variables) and the effect of one variable on the other is analysed, assuming the third and fourth variables are absent.

Next we add one more variable to our two-variable model and the changes in the results are observed. Finally, we build up to a model consisting of all four variables. Tables 3a, 3b and 3c show models containing combinations of two, three and four variables respectively.

For the 2 variable case, critical values are $\chi^2(3) = 7.815$ and 11.345 at 5% and 1% significance level respectively. The rejection of the null hypothesis in Row 3 Column 1 of Table 3a implies that money supply Granger causes GDP in a model consisting of DLM2 and DLGDP. The same interpretation is applied for other combinations where the null hypothesis is rejected. The opposite holds for combinations where H_0 is not rejected, for example, the test statistic in Row 2 Column 3 of Table 3a shows that inflation does not Granger cause money supply in a model of DLCPI and DLM2.

Critical values for Table 3b are $\chi^2(6) = 12.592$ and 16.812 at 5% and 1% significance level respectively. Not rejecting the null hypothesis in Row 3 Column 5 implies that money supply does not Granger cause the subset of variables credit and inflation in a VAR model consisting of money supply, credit and inflation.

For Table 3c critical value is $\chi^2(9) = 16.916$ at 5% significance level. A chi-square test statistic of 66.1864, in Row 3 Column 2, represents the hypothesis that coefficients of lagged values of DLM2 in the block of equations explaining the variables DLGDP, DLCPI and DLCPS are zero.

A group of variables represented by X is said to be block exogenous, in the time series sense, with respect to the variables in Y if the elements in Y are of no help in improving a forecast of any variables in X that is based on lagged values of all elements of X alone. Using the above statement and tables, we find that DLCPS is block exogenous at only 1% significance level and consequently, we will not treat this variable as exogenous in our model.

We therefore observe that, for a basic model consisting of GDP, inflation and money supply, growth in money supply Granger causes GDP and inflation. There exists a bidirectional relationship between GDP and money supply but a uni-directional relationship between money supply and inflation. When adding CPS to our basic model, the bi-directional relationship between money supply and GDP is still present and we observe a uni-directional relationship between credit and GDP, between money supply and credit and between money supply and inflation. These results confirm the evidence of cointegrating relations in the VAR model. The uni-directional causality from money supply to inflation suggests that inflation is a monetary phenomenon. There seems to be no relationship between credit and inflation. These results seem to suggest that the credit channel has some significance since credit is affecting GDP, but it might be weak because of no effect on the other target variable, inflation. In order to confirm the degree of significance of this channel, we need to proceed with the variance decomposition and impulse response functions. Here the condition of stationarity of the VAR model does not apply, hence the levels will be used.

5.2 Variance Decomposition

In order to obtain the relative importance of the response of the variables in the model to shocks we require variance decomposition.

From Table 4, the variance decomposition exercise suggests that, over the years, credit seemed to be a moderate source of shocks in money supply; accounting for 15.4% and 19% of the shocks in the fourth and fifth year respectively. GDP contributed significantly to the shocks in M2 in the short-run; 5% in the first year and increasing to 15% in the second year and to 24% after five years. On the other hand CPI amounted to only 3.4% for the shocks in money supply in the long-run. Shocking the equation for credit showed that GDP contributed to 12 - 14% of the shocks in the fourth and fifth year, whereas contribution of CPI was insignificant overall. Money supply was highly significant in the variation of credit over the years; varying between 30 - 35% over the five years.

Money supply contributed to a low extent in the variation of price level; only about 7% in the long-run. GDP appeared to be a determinant of inflation in the long-run since it accounted for 12% of the shocks in price level. The contribution of CPS to inflation was insignificant throughout the five years (< 2%). When the equation for GDP was shocked, 13% of the shocks after one quarter were due to shocks in money supply and increased to 25% for the next two years, before decreasing very gradually. The contribution of CPS to output was moderate over the 5 years; accounting for 14.5% in the first quarter, decreasing by approximately 5% for the next two years and increased to attain 15% in the fifth year. By taking into account the various observations, it is found that credit contributes moderately to money supply in the long-run and GDP in the short-run, while insignificantly to CPI over time. Thus the results of no relationship between credit and inflation obtained by the Granger-Causality tests seem to be confirmed. We observe that money supply contributes significantly to credit in both the short-run and long-run, being more significant in the short term. Money supply also accounts for a significant part in GDP in the short-run. Innovations to CPS explain a quite significant portion of the forecast error variance in GDP in the long-run, while only a very small part of that in inflation. Hence, CPS must have some impact on the economy. An important increase in the forecast error variance of GDP is explained by shocks to money supply, thus showing the significance of monetary policy on the economic activity of Mauritius in the short term.

5.3 Impulse Response

The impulse response functions give a better understanding of the dynamic behaviour of the model, more precisely, the behaviour of a variable due to a random shock or innovation in other variables. Orthogonalized innovations in each of the variables are required and this is done using the Choleski decomposition. This method imposes an ordering of the variables in the model. The ordering used was LM2 LCPS LCPI LGDP. The response of GDP when shocks are introduced in the equation for LM2 and LCPS is illustrated in Figure 2.

The impulse response functions show that shocking money causes the graph of GDP to increase in the first, and second to fourth quarters, before decreasing gradually. A shock to credit produces a decrease in GDP for the first two quarters, a slight growth in the second quarter and a decrease again as from the fourth to twentieth quarter, before very gradually starting to move back to the baseline.

Figure 3 shows the dynamic response of the target variable CPI to one standard deviation shock in variables CPS and M2 separately. The graph for

M2 is initially negative, becomes increasing after two quarters and stabilizes with time. A shock to CPS decreases inflation from the second to fourth quarter increases it slightly from fourth to ninth quarter and starts to decrease again up to the thirtieth quarter. Afterwards the graph very slowly starts to move back to the baseline. The expected movement to baseline in Figures 2b and 3b is observed when taking a time period of 100 quarters.
Response of credit to shocks in the equation for money supply is shown in Figure 4. The graph illustrates that credit increases from first to second quarter when a shock is introduced in the equation for money supply, decreases slightly over approximately the next seven quarters before stabilizing. Since credit is responding to monetary policy impulses, the banking system of Mauritius can be considered as strong in the short-run.

6.0 Conclusions

In the last decade or so, there have been a significant number of studies applying the Vector Autoregression (VAR) technique for macroeconomic modelling. This paper represents an attempt to apply such a method to Mauritian data for four key variables. The results of the study indicate that all variables are interlinked and influence each other. The Granger Causality tests show a bi-directional relationship between money and GDP. There is also evidence of uni-directional causality from money supply to credit and from money supply to inflation whilst no relationship is depicted between credit and inflation. Impulse response and variance decomposition analysis suggest that money plays an active role in the transmission of monetary policy in Mauritius.

The impulse response functions showed that a shock to money supply decreases price level in the short-run and stabilizes it in the long-run, while it increases GDP temporarily. These results support the view of monetarists that monetary policy usually aims at economic growth and price stability. On the other hand, credit reacts to changes in money supply and increases GDP temporarily in the short-run, and reduces inflation in the first year. These results indicate that both monetary policy and the credit channel are significant in the short-term since most of the graphs show important changes in the first 15 quarters. According to the data available and taking into account that no fixed monetary policy was adopted during that period, some theoretical aspects may not be observed in the short-term. However there is enough result showing a possible significance in the short-run as far s the credit channel is concerned.

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Table 1a: ADF Statistics for log level.

Log level	Trend	*k*	No trend	*k*
LGDP	-3.0985*	1	-1.4766*	1
LCPI	-1.6950*	1	-1.3329*	1
LM2	-5.7070	1	-2.7693*	5
LCPS	-3.4337*	3	-3.7623	4

First difference	Trend	*k*	No trend	*k*
DLGDP	-4.8231	6	-3.2710	3
DLCPI	-3.8395	4	-3.2391	7
DLM2	-4.3145	5	-3.1460	6
DLCPS	-3.6417	7	-3.7093	7

Table 1b: ADF Statistics for first difference

Test Type	Model 1[1]	Model 2[2]	Model 3[3]	Model 4[4]	Model 5[5]
Maximal Eigenvalue	3	4	4	4	4
Trace	3	4	4	4	4
Maximum SBC value	2	4	4	4	4

Table 2a: Selected number of cointegrating relations for different models.

[1] **Model 1**: Cointegration with no intercepts or trends.

[2] **Model 2**: Cointegration with unrestricted intercepts and no trends.

[3] **Model 3**: Cointegration with restricted intercepts and no trends.

[4] **Model 4**: Cointegration with unrestricted intercepts and restricted trends.

[5] **Model 5**: Cointegration with unrestricted intercepts and unrestricted trends.

Table 2b: OLS results for the effect of (a) monetary policy on credit and (b) credit on output

Dependent variable	Explanatory variable	Coefficient	R^2
(a) LCPS	LM2	0.98033 [0.000]	0.98038
(b) LGDP	LCPS	0.97317 [0.000]	0.87388

Table 3a: Granger-Causality results: χ^2 - statistics and p-values for 2-variables model.

	DLGDP Column 1	**DLCPI** Column 2	**DLM2** Column 3	**DLCPS** Column 4
DLGDP Row 1	-	16.0710 (0.001) Reject	13.6764 (0.003) Reject	3.5835 (0.310) Do not reject
DLCPI Row 2	43.8775 (0.000) Reject	-	2.9946 (0.392) Do not reject	6.4205 (0.093) Do not reject
DLM2 Row 3	122.9036 (0.000) Reject	9.7448 (0.021) Do not reject*	-	10.7721 (0.013) Do not reject*
DLCPS Row 4	61.8807 (0.000) Reject	5.3595 (0.147) Do not reject	0.96594 (0.809) Do not reject	-

Table 3b: Granger-Causality results: χ^2 - statistics and p-values for 3-variables model.

	DLGDP DLCPI Column 1	**DLGDP DLM2** Column 2	**DLCPI DLM2** Column 3	**DLCPS DLGDP** Column 4	**DLCPS DLCPI** Column 5	**DLCPS DLM2** Column 6
DLGDP Row 1	-	-	22.74(0.001) Reject	-	13.34 (0.038) Do not reject*	15.54(0.016) Do not reject*
DLCPI Row 2	-	27.51(0.00) Reject	-	23.44(0.001) Reject	-	6.963 (0.32) Do not reject
DLM2 Row 3	105.68(0.00) Reject	-	-	62.69(0.000) Reject	12.44(0.05) Do not reject	-
DLCPS Row 4	41.43(0.00) Reject	2.423 (0.88) Do not reject	2.050(0.92) Do not reject	-	-	-

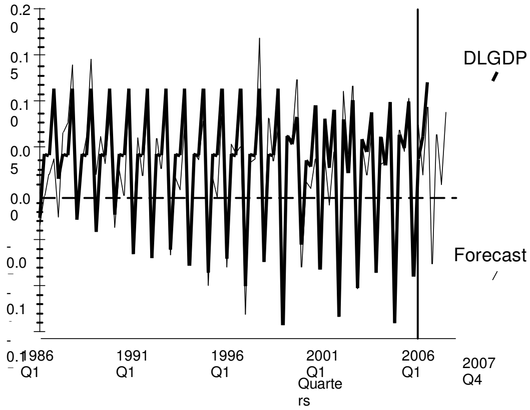
Table 3c: Granger-Causality results: χ^2 - statistics and p-values for 4-variables model.

	DLGDP, DLCPI & DLM2 Column 1	**DLGDP, DLCPI & DLCPS** Column 2	**DLGDP, DLM2 & DLCPS** Column 3	**DLCPI, DLM2 & DLCPS** Column 4
DLGDP Row 1	-	-	-	24.445 (0.004) Reject
DLCPI Row 2	-	-	31.056 (0.000) Reject	-
DLM2 Row 3	-	66.186 (0.000) Reject	-	-
DLCPS Row 4	2.633 (0.977) Do not reject	-	-	-

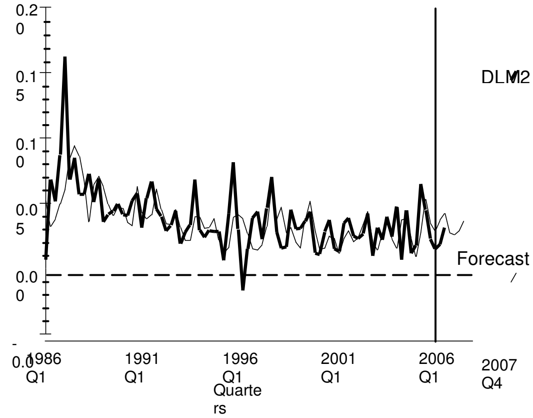
Tables 3a, 3b and 3c show the chi-square statistics at 5% significance level. However, '*' denotes not rejecting H_0 at 1% significance level (i.e. reject H_0 at 5% level).

Table 4: variance decomposition (%) for variables in VAR model

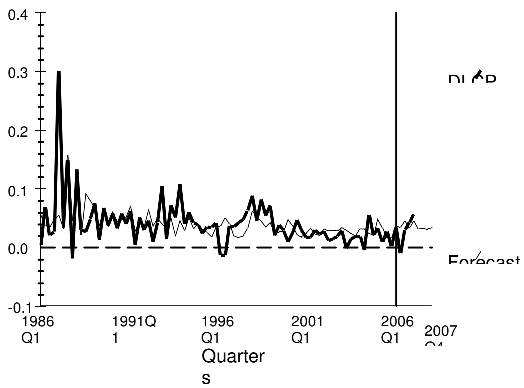
Horizons		LM2	LCPS	LCPI	LGDP
	1	98.82	0.009	0.213	0.858
	4	92.22	0.011	2.831	**4.939**
LM2	8	78.85	3.126	3.049	**14.98**
	12	67.09	9.948	2.507	20.45
	16	58.99	**15.49**	2.746	22.78
	20	53.57	**18.99**	**3.428**	**24.01**
	1	**35.77**	64.22	0.175	0.469
	4	30.77	66.24	0.896	2.086
LCPS	8	29.56	63.19	0.921	6.325
	12	30.20	59.22	0.917	9.665
	16	30.70	56.20	1.020	**12.08**
	20	**30.77**	54.16	1.238	**13.85**
	1	0.124	0.020	99.76	0.098
	4	0.226	0.153	96.90	2.720
LCPI	8	1.228	0.320	93.69	5.310
	12	3.718	0.405	88.71	7.165
	16	5.878	0.811	83.55	9.766
	20	**7.423**	1.726	78.81	**12.05**
	1	**12.86**	**14.51**	0.479	72.16
	4	20.46	**9.907**	2.369	67.26
LGDP	8	**24.67**	8.793	4.071	62.46
	12	25.49	10.54	5.268	58.71
	16	25.24	13.08	6.128	55.55
	20	24.73	**15.48**	6.78	53.01



(a)



(b)



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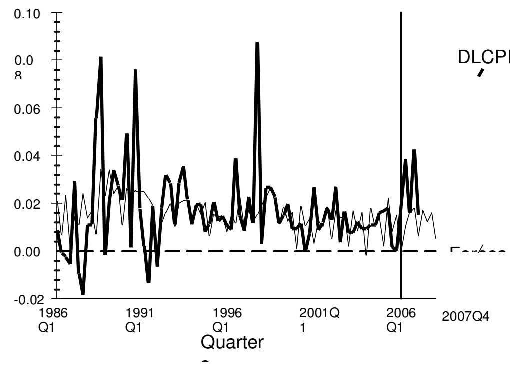
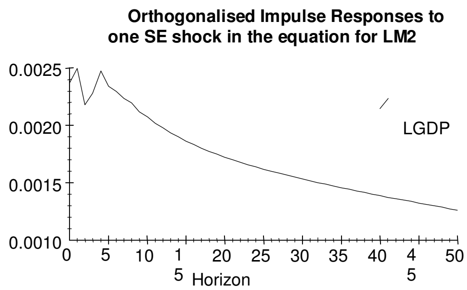


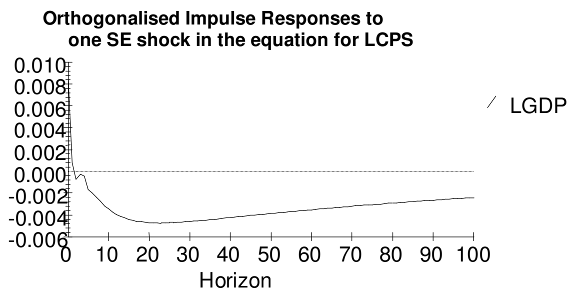
(d)

Figure1: Forecasts using VAR model v/s actual values for four variables:
(a) DLGDP (b) DLM2 (c) DLCPS and (d) DLCPI.

Figure 2: Orthogonalised impulse response of GDP to shocks in (a) M2 and (b) CPS

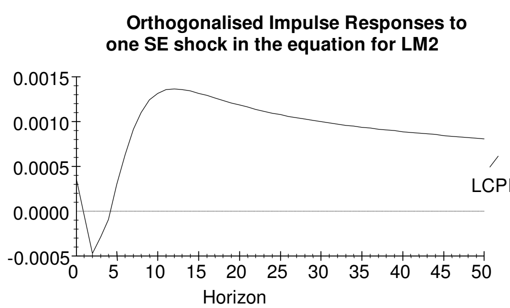
(a)



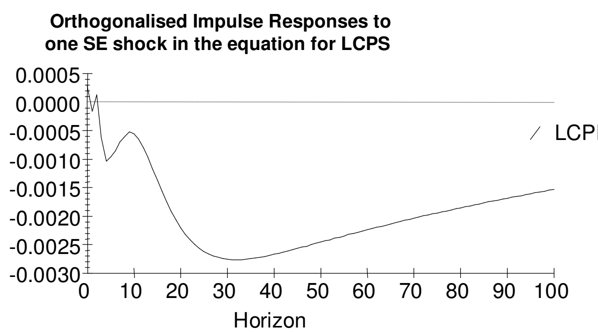


(b)

Figure 3: Orthogonalised impulse response of CPI to shocks in (a) M2 and (b) CPS



(a)



(b)

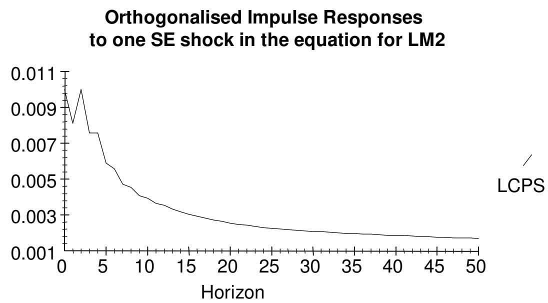


Figure 4: Orthogonalised impulse response of credit to shocks in M2