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# **Financial Liberalization and Money Demand in Mauritius**

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## **Financial Liberalization and Money Demand in Mauritius**

### **Abstract**

The Bank of Mauritius is considering moving to a formal inflation-targeting framework, which will require, among other things, a better understanding of the monetary policy transmission mechanism. This paper will contribute to this understanding by testing the stability of the money demand function for both M1 and M2 in Mauritius using annual data for the period 1967 to 2005. The Durbin h test and Chow test for structural stability are employed to ascertain whether the current policy framework satisfies the necessary condition for effectiveness. The results demonstrate a stable money demand function.

## **Financial Liberalization and Money Demand in Mauritius**

### **I. Introduction**

The stability of the money demand function is one of the most important recurring themes in the theory and implementation of monetary policy, with the vast majority of the research efforts directed at money demand relationships in developed countries. Relatively little systematic analysis of the behavior of money balances in less developed economies exists. Such studies are of potential importance, in that a stable money demand function ensures that the money supply has a predictable impact on other economic variables such as inflation, interest rates, national income, private investments, and so forth. (See, for example, Driscoll and Ford, 1980). Inappropriate monetary policies can deprive a country of part of the benefits of its development effort, no matter how well planned the growth program. The existence of a highly predictable money demand function is one of the necessary conditions for monetary policy to exert a significant effect upon the economy. Therefore, the stability issue in the money demand function is an interesting research area to test the effectiveness of a given monetary program.

Mauritius began its first Structural Adjustment Program with the International Monetary Fund (IMF) in the late 1970s. The second structural adjustment program took place during the period 1983-1991, laying the foundation for rapid economic development and financial liberalization. Following the liberalization of the economy in the early 1990s, the conduct of monetary policy moved gradually from administered interest rates and credit ceilings to market-based, indirect methods of implementing monetary policy (Fry and Roi, 1995). The Bank of Mauritius (BOM) currently targets

M2 to achieve an informal inflation target and is considering moving to a formal inflation-targeting framework, which will require, among other things, a better understanding of the monetary policy transmission mechanism. This paper will contribute to this understanding by testing the stability of demand for real money balances in Mauritius using annual data for the period 1967 to 2005.

## **II. Literature Review**

There are a few studies of the Mauritian money demand function which have addressed stability issues. McPherson and Rakovski (1999) test an hypothesis proposed by Ronald McKinnon regarding the complementarity of real money demand and real investment in Mauritius and Botswana. The results provide strong support for the hypothesis in the case of Mauritius. The study also finds a high income elasticity of the demand for money, pointing to a macroeconomic environment that has maintained stability in the demand for money. Khandelwal (2002) finds a stable money demand relationship for real demand, real output, domestic and foreign interest rates, and domestic inflation in Mauritius for the period 1976:Q1 to 2001:Q2. Over the long run, the study found money demand to be positively related to output and time deposit interest rates, and negatively related to inflation, treasury bill interest rates, and foreign interest rates. In a recent IMF country report on Mauritius, Schumacher (2006) finds a stable relationship among broad money, income, and a set of interest rates for the period 1977 to 2004 using annual data.

Since Goldfeld's (1976) well-known case of missing money, the stability of money demand has become a cornerstone in applied macroeconomics. Instability of the

money demand function may arise from changes in the financial sector related to financial liberalization such as exchange rate and credit ceiling deregulation in 1983 in the case of Mauritius. Hence, the importance of stability testing is reasonably founded. The Chow test has been used to analyze the stability of money demand for both developed and less developed countries. A number of studies of money demand in African countries have received attention with respect to its stability. Domowitz and Elbadawi (1987) and Ghartey (1998) consider Sudan and Ghana, respectively, while studies on the demand for money in Uganda, Cote d'Ivoire, Tanzania, and Zambia have been written by Henstridge (1999), Fielding (1999), Randa (1999), and Adam (1999), respectively.

This study considers the experience of Mauritius and contributes to the literature on the stability of the demand for money in African countries. Section III describes the model, Section IV the empirical results, and Section V concludes.

### **III. The Model**

Empirical studies of the demand for money are typically specified such that real money balances are a function of a scale variable (measured by income, wealth or expenditure), and the opportunity cost of money (Ericsson, 1998). In this study real GDP per capita is used as the scale variable. The opportunity cost of holding money is usually proxied by either the domestic inflation rate or rates of return on alternative assets, either domestic or foreign.

In several developing countries, the absence of alternative financial assets to money means that there is not enough variation in interest rates for them to be of any

significance. Instead, the exchange rate is a widely used measure of the return on foreign asset holdings. Although Khandelwal (2002) includes the weighted average yield of treasury bills along with the annualized three-month London interbank rate (LIBOR), the exchange rate may be a better measure of alternative assets in Mauritius, since individuals and non-financial corporations were not allowed to purchase treasury bills until 1998. In this study the opportunity cost of holding money is measured by the depreciation rate of the Mauritian rupee rather than the Treasury bill rate. Domowitz and Elbadawi (1987) state that if foreign money is a substitute for domestic money, the omission of a variable that measures the return to foreign currency in the demand for real money may bias the model towards overstating the influence of inflation. While previous studies (Khandelwal, 2002 and Schumacher, 2006) have discussed the significance of the exchange rate in influencing domestic prices in Mauritius, this study is the first to include the exchange rate in the money demand function for Mauritius.

In addition to the exchange rate, inflation is a common measure of the opportunity cost of holding money in developing countries, as an acceleration in inflation will erode the currency's purchasing power. Given the existence of underdeveloped monetary and financial systems and non-market determined interest rates in developing countries, physical assets represent a hedge against inflation and an alternative asset in the portfolio of the non-bank public. In Mauritius, financial assets are mainly in the form of financial institution deposits or government securities. This means that agents put their wealth in the real sector which is a substitute for money for speculative and precautionary motives (Adam, 1992). Therefore, this study includes the rate of inflation as another measure of the cost of holding money.

The standard money demand specification is given as follows (Ericsson 1998):

$$(M/P) = f(Y, R) \quad (1)$$

It is assumed that in the long run, the money market is in equilibrium: the money supply (M) deflated by the price level (P) is equal to the real demand for money (M/P). Y is the scale variable and R is a vector of expected rates of return. The function f (Y, R) is assumed to be increasing in Y and decreasing in the elements of R that represent rates of return on alternative assets.

This study considers the Mauritian rupee measured both by M1 and broad money, M2. M1 is the sum of M0 and demand deposits, while M2 is the sum of M1 and quasi-money. The rate of return is proxied by domestic inflation (INF), measured by the GDP deflator, and the depreciation rate of the Mauritian rupee per U.S. dollar (EX). The scale variable (Y) is proxied by the logarithm of real gross domestic output. All series are annual (1967-2005) and taken from the International Financial Statistics Database.

Following the standard money demand approach, equation (1) is specified in log-linear form, with the exception of the rate of inflation:

$$(m - p)_t = \alpha_0 + \alpha_1(y - p)_t + \alpha_2 INF_t + \alpha_3 ex_t + \varepsilon_t \quad (2)$$

where variables in lower case denote natural logarithms and  $\varepsilon_t$  is the error term. Real GDP (the transactions demand variable) is hypothesized to have a positive impact on the real money holdings where  $\alpha_1 > 0$ . The size of income elasticity can vary from 0.5 to just over unity depending on the structure of the economy. The long run elasticity or semi-elasticity of money with respect to opportunity cost variables is expected to be negative. The elasticity of money with respect to inflation is usually estimated to lie in



the range from 0.5 to 3.0 (Schumacher, 2006). As inflation goes up, the opportunity cost of holding money increases and as a result people substitute from holding money to holding physical assets. Therefore, the sign on inflation is expected to be negative. An increase in  $ex_t$  reflects depreciation of the rupee against the dollar. So as  $ex_t$  increases the rupee depreciates, meaning the domestic currency value of foreign assets held by domestic residents will increase. If residents expect further depreciation, they will hold less domestic currency and the sign on  $\alpha_3$  will be negative. On the other hand, if the increase in the value of foreign assets is perceived as an increase in wealth the demand for the domestic currency should increase, causing  $\alpha_3$  to be positive.

#### **IV. Empirical Results**

Given the economic reforms implemented since 1983 and the changes in the conduct of monetary policy since the Banking Act of 1991, the structural stability of the demand for money function should be examined. The exchange rate regime has moved toward fewer controls which may lead to a change in the real money demand function. A number of tests can be used to estimate the stability of the money demand function. First the model is tested for serial correlation using the Durbin-h statistic. Then the Chow test is used to test for structural breaks in the data.

Results before the adjustment for serial correlation are shown in Table 1. The first three columns of Table 1 show results for M1, with a lag dependent variable to capture the partial adjustment of real money holdings to the desired level, and with a dummy variable (dsap) for the period of structural adjustment from 1983 to 1994. The next three columns show the results for M2. The dependent variables,  $(m_1-p)_t$  and  $(m_2-p)_t$  represent  $\log(M/Y)$  for M1 and M2 respectively. The coefficients of all the variables in

the first two columns are significantly different from zero at the 1 percent significance level except for inflation. Column A of Table 1 shows the income elasticity of money demand to be 1.33. A one percent increase in income will increase real money demand by 1.33 percent. This result appears low compared to other studies (Khandelwal, 2002 and Schumacher, 2006) that found income elasticity of money demand to be between 2.0 and 2.5. Inflation is not found to be significant but the coefficient on the exchange rate is significant at the 1 percent significance level. A one percent increase in  $ex$ , which means depreciation of the rupee, will decrease real money demand by 0.76 percent. Therefore, as the rupee depreciates, agents will hold less domestic currency. The exchange rate appears to be a better indicator of the opportunity cost of holding money than inflation. When a lag is added to the model (column B) the income elasticity of money demand declines to 0.77 and the effect of inflation becomes negative (-0.142) but is still insignificant at the 10 percent level. Adding a dummy ( $dsap$ ) to account for the period of structural adjustment from 1983-1991 when exchange rates moved from a fixed to managed float system and indirect methods of implementing monetary policy, is found to have no significant impact on the demand for real narrow money balances.

When the model is estimated for M2, income elasticity of money demand becomes 1.39 and is significant at the 1 percent level. Inflation and the exchange rate are not statistically significant as shown in column D. Adding a lag of the dependent variable decreases the income elasticity of demand to 0.34 and the semi-elasticity of inflation becomes -0.44, which is significant at the 1 percent level. It is interesting to note that when the model is estimated using M1, the exchange rate is significant, whereas in the model using M2, inflation is significant while the exchange rate is insignificant.

Exchange rate depreciation is more likely to affect demand deposits while changes in inflation are more likely to affect quasi-money. Adding a dummy (dsap) to the model for M2 to capture the effect of the structural adjustment period does not have a large effect on the estimated coefficients, but *ex* becomes significant at the 5 percent level and the coefficient on the dummy is significant. This indicates that there is a significant difference in the demand for M2 during the period of structural adjustment as opposed to demand for M2 over the entire period.

Since the model has a lagged dependent variable, the DW statistic is likely to be close to 2 even when the errors are serially correlated. Of course, one could simply look at the DW statistic as an indicator of serial correlation when the DW statistic is low, but this approach is strongly biased against finding serial correlation. An alternative test is the Durbin h statistic (Durbin, 1970). The Durbin h statistic is a modification of the DW statistic and is approximately normally distributed with unit variance. The Durbin h statistic is defined as

$$h = \hat{\rho} \sqrt{\frac{T}{1 - T(\text{Var}(\hat{\beta}))}} \quad (3)$$

where  $\text{Var}(\hat{\beta})$  is the square of the standard error of the coefficient of the lagged endogenous variable,  $T$  is the number of observations, and  $\hat{\rho}$  is the estimated first-order serial-correlation coefficient.  $\hat{\rho}$  can be estimated directly from the DW statistic, since  $DW \approx 2(1 - \hat{\rho})$ . Solving for  $\hat{\rho}$  and substituting, we find that

$$h = \left(1 - \frac{DW}{2}\right) \sqrt{\frac{T}{1 - T(\text{Var}(\hat{\beta}))}} \quad (4)$$

The test for first-order serial correlation can be undertaken as follows: for  $(m1-p)_t$ , DW = 1.549 and Durbin h = 1.955 with normal distribution. Therefore, the null hypothesis of no serial correlation is rejected. Similar results are found for  $(m2-p)_t$ , with DW = 1.444 and Durbin h = 2.569. Again, the null of no serial correlation is rejected. Serial correlation is corrected using an autoregressive procedure.

Finally, a Chow test is used to test for a structural break in the data and can be estimated as follows:

$$F_{k,n+m-2k} = \frac{(RSS_R - RSS_{UR}) / k}{(RSS_{UR}) / (n + m - 2k)} \quad (5)$$

The Chow test is an application of the F-test, and it requires the sum of squared errors from three regressions. The data set is divided into two periods. The first period is from 1967-1985 and the second period is 1985-2005. The model is estimated for each period and for the whole period 1967-2005 using both M1 and M2 (See Table 2). An F test is used to test for stability of the model. For M1, the F statistic is 1.1625, which fails to reject the null hypothesis of parameter stability between the two periods. Therefore, the model appears stable over the period 1967-2005 and we can assume that the same model parameters apply equally to both groups. For M2, the F statistic is 1.88, which also fails to reject the null hypothesis of no structural break over this period. The conclusion is that the log-linear model with a lagged dependent variable reveals no evidence of a structural change due to financial liberalization.

## **V. Conclusion**

The existence of a highly predictable money demand function is one of the necessary conditions for monetary policy to exert a significant effect upon the economy. Therefore, the stability issue in the money demand function can be used to test the effectiveness of the structural adjustment programs undertaken in Mauritius beginning in the late 1970s. The second structural adjustment program took place during the period 1983-1991, laying the foundation for rapid economic development and financial liberalization. Through the use of the Chow test for structural stability, this study finds the demand for money balances to be stable over the period 1967-2005.

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**Table 1****Money Demand in Mauritius**

	Dependent variable: $(m_1-p)_t$			Dependent variable: $(m_2-p)_t$		
	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>
Constant	-1.87780 (0.25333) <sup>a</sup>	-1.18162 (0.26423) <sup>a</sup>	-1.4497 (0.27549) <sup>a</sup>	-2.86940 (0.29883) <sup>a</sup>	-0.56284 (0.41291)	-0.77360 (0.38934) <sup>c</sup>
$(y_t-p_t)$	1.32697 (0.07405) <sup>a</sup>	0.77108 (0.14447) <sup>a</sup>	0.75151 (0.15042) <sup>a</sup>	1.39034 (0.08736) <sup>a</sup>	0.34159 (0.17400) <sup>c</sup>	0.49057 (0.17037) <sup>a</sup>
INF	0.15417 (0.16046)	-0.14177 (0.14852)	-0.16526 (0.15624)	0.03349 (0.18928)	-0.44678 (0.14852) <sup>a</sup>	-0.42313 (0.13729) <sup>a</sup>
ex	-0.76816 (0.08647) <sup>a</sup>	-0.48016 (0.09803) <sup>a</sup>	-0.51075 (0.11398) <sup>a</sup>	-0.01759 (0.10201)	-0.02523 (0.06912)	-0.21938 (0.09805) <sup>b</sup>
$(m_t-p_t)_{t-1}$		0.47057 (0.11106) <sup>a</sup>	0.50356 (0.12763) <sup>a</sup>		0.75669 (0.11806) <sup>a</sup>	0.70283 (0.11084) <sup>a</sup>
dsap			0.03995 (0.07353)			0.15314 (0.05877) <sup>b</sup>
<i>F-value</i>	316.71	360.47	282.27	829.91	1366.45	1286.34
<i>Adj. R<sup>2</sup></i>	0.97	0.97	0.97	0.98	0.99	0.99
<i>N</i>	39	39	39	39	39	39
<i>DW</i>	1.307	1.549	1.619	0.506	1.444	1.655
<i>Durbin h</i>		1.955	1.969		2.569	1.49

The numbers in parentheses are standard errors. a, b, and c denote statistical significance at the 1%, 5% and 10% levels, respectively.



**Table 2****Chow Test for Structural Stability**

	Dependent variable: $(m_1-p)_t$			Dependent variable: $(m_2-p)_t$		
	1967-1985	1986-2005	1967-2005	1967-1985	1986-2005	1967-2005
Constant	-0.5368 (0.9584)	-0.9935 (0.3262)	-1.1051 (0.2643) <sup>a</sup>	0.2064 (0.9383)	-0.4342 (0.2452)	-1.2856 (0.4380) <sup>a</sup>
$(y_t-p_t)$	0.7275 (0.3758)	0.6582 (0.1531)	0.7412 (0.1300) <sup>a</sup>	0.1784 (0.3886)	0.4619 (0.1189)	0.6398 (0.1799) <sup>a</sup>
INF	-0.0453 (0.2904)	-0.3665 (0.1898)	-0.1626 (0.1373)	0.0129 (0.2732)	-0.5872 (0.1264)	-0.3299 (0.1338) <sup>b</sup>
ex	-0.4851 (0.2121)	-0.4903 (0.1353)	-0.4520 (0.0909) <sup>a</sup>	0.0195 (0.1248)	0.0090 (0.0928)	-0.0413 (0.0847)
$(m_t-p_t)_{t-1}$	0.3627 (0.3056)	0.6045 (0.1277)	0.4786 (0.1084) <sup>a</sup>	0.7465 (0.2698)	0.5935 (0.1111)	0.5628 (0.1262) <sup>a</sup>
$R^2$	0.86	0.99	0.98	0.94	0.99	0.99
$N$	18	18	39	18	18	39
$DW$	1.815	2.135	1.997	1.626	2.062	1.628
$SSR$	0.1182	0.0260	0.1731	0.0973	0.0101	0.1423

The numbers in parentheses are standard errors. a, b, and c denote statistical significance at the 1%, 5% and 10% levels, respectively. F test for M1: 1.16, F test for M2: 1.88. Both tests fail to reject the null hypothesis of no structural change.