

# 'Interest rate spread determination in an error correction model

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## Abstract

*Using time series data over the period 1975-2006, this study investigates the determinants of interest rate spreads in Mauritius using a cointegration and error correction model. Results from the study show that, at the micro level, banks sustain a widening spread when the profit margin is threatened by increased operating costs. Rising credit risk due to distress borrowing are also associated higher risk premiums on banks lending rates. Increase in non-interest bearing reserve requirements are observed to result in a widening of banking spread as banks face reduced liquidity. At the macro level, it is observed that banks tend to profit in inflationary environment as the spreads widen with banks charging higher risk premium. Reducing operating costs, financial taxation and inflation and improving loan quality and liquidity are key issues in an attempt to narrow the banking interest rate spread.*

## **I. Introduction**

Over the past two decades, the determinants of interest rate spreads have attracted much interest of academic research as well as of bank management and supervisors. Banking researches have ensured that the determinants of interest margins or spreads remain empirically well explored. The vast majority of studies included industry or market-specific, bank-specific and macroeconomic determinants and showed that such determinants tend to vary enormously across countries and among regions of the world. Most studies carried out on banking systems of developed countries revealed that interest spreads were positively and significantly correlated to the bank's level of capital, the loan loss provision, reserve requirements, implicit taxation and interest volatility (Dermirgüç-Kunt and Huizinga, 1999; Saunders and Schumacher, 2000). Scholars usually consider such results as benchmarks since banking systems of such countries are referred to as mature and stable ones. However, studies carried out in other parts of the globe, for instance across Latin America by Brock and Rojas-Suarez (2000) and across low and middle income countries by Tennant and Folawewo (2006), reached diverging conclusions and even contradicted some of the benchmark results whereby negative and sometimes insignificant relationships were observed between the alleged determinants and interest margins.

Thus, this study attempts to supplement the literature by bringing new evidence from an emerging African economy namely Mauritius and aims at investigating the effect of bank-specific and macroeconomic determinants on interest rate spreads using time series data over the period 1975-2006 in a cointegration and error correction framework. The choice of the determinants has been made based on the availability of data. The set of bank-specific variables includes the aggregate credit risk and liquidity risk, the operational efficiency and the opportunity costs of holding required reserves while the macroeconomic set of variables comprises of economic activity, inflation rate, discount rate and regulatory changes made within the observed period. Therefore, by considering a

wide pool of alleged determinants, this study would attempt to establish a time path of banking spreads in Mauritius and the main factors influencing their evolution.

Mauritius remains an interesting case study as it is one of the best performers and boasts itself to have one of the best financial systems of the continent as well. Moreover, like in many developing countries, is mainly bank-based and this implies that commercial banks are highly responsible for the financing of both private and public investments and expenditures. Hence, it is of great importance that this work of intermediation is carried out with minimal possible costs so as to achieve greater social welfare; and it follows that the lower the banking interest spread, the lower the social costs of intermediation would be. Interest rate spread in Mauritius was around 3.3 per cent in the early 1970s and it peaked at around 6.7 per cent in 1993 to reach 3.9 per cent in 2005 and is presently among one of the lowest in Africa. This reduction in the interest margin during the past decade can be interpreted as a result of increasing competition in the Mauritian banking sector; but, however, there are other determinants that have depicted the variation of spreads over the years.

The results would be highly significant in the sense that they would either aver or disprove the arguments postulated by commercial bank managers that the typically wide spreads in most developing countries are prompted by market-specific and macroeconomic factors outside of their control.

The structure of the paper is organized as follows: Section 2 reviews the literature on interest rate spread and its determinants and enquires about the various empirical studies carried out. Section 3 examines the Mauritian economy, its banking sector, the various financial reforms enforced and the behaviour of interest spreads in the country. Section 4 discusses the econometric modelling and specification, and describes the variables used and the data set. Section 5 presents and discusses the estimation results and section 6 concludes.

## **II. Related Literature**

Various studies have shown that the magnitude of the spreads greatly varies across the globe. The variations in the magnitude of Interest Rate Spread (IRSs) can be explained by the apparent differences in the nature, structure and efficiency of the financial sectors of various countries worldwide. This is because the different banking systems around the globe vary greatly in their size, operations and they have individually specific features, such as regulatory and taxation regimes, different macroeconomic growth 'boosters', different financial market conditions, legal and institutional realities and different policy priorities (Dermirgüç-Kunt and Huizinga, 1999). According to studies carried out by Briguglio (1995), Randall (1998), Gelbard and Leite (1999) and Jayaraman and Sharma (2003), the banking interest margins in Latin America, Sub-Saharan Africa, and the Caribbean are wider or higher than most developed countries.

### **Interest Rate Spread Determinants**

In the opinion of some authors, the internal characteristics of banks themselves, such as their tendency to maximize profits in an oligopolistic market, are the main causes of high spreads; while many others tend to concentrate on the macroeconomic, institutional and regulatory features of the operating environment as the possible reasons behind the widening of IRSs globally (Tennant and Folawewo, 2006). In fact, it has often been coined that spreads are explained by micro-structural market features, endemic to a particular banking system, and the policy issues in the economic, institutional and legal environment. By differentiating, the pure spread from the actual spread, Ho and Saunders (1981) postulated that the pure spread is typically a microstructure phenomenon under the influence of factors such as: the efficiency of risk management, the size and nature of banks' transactions and the interest rate variability and elasticity. The actual spread, according to the same authors, comprises of the pure spread, but is largely influenced by macroeconomic variables including monetary and fiscal policy issues.

Many studies in the literature have used a common approach, which consists of categorizing the determinants of commercial banking interest rate spreads according to

whether they are bank-specific, industry-specific and macroeconomic in nature (see Tennant and Folawewo, 2006 for a detailed discussion). However, research works carried out by Brock and Franken (2002) have noted that many other studies have concluded that individual bank-specific characteristics are not always highly correlated with interest rate spreads and have, instead, shown that spreads are largely determined at industry level.

### **Empirical Review**

Angbazo (1997) investigated the significance of default risk, interest rate risk and off-balance sheet banking activities on interest margins for a sample of 286 US banks for the period 1989-1993 using monthly data. The main findings of this study were that credit risk, interest rate premiums, the opportunity cost of keeping non-interest bearing reserves, leverage and management efficiency were positively correlated to spreads. However, the author noted that liquidity risk, under ratio of liquid assets to total assets as a proxy, showed an inverse relationship to spreads while the other variables were not statistically significant. Furthermore, he studied the effect of off-balance sheet activities on the size and volatility of interest margins and on the portfolio risks faced by banks, and concluded that the margins of all banks types except regional banks were affected by such activities.

Barajas *et al.* (1999) documented the causes of large interest rate spreads in the Columbian banking sector during both the pre-liberalisation period of 1974-1988 and the post-liberalisation period of 1988-1996 using quarterly and monthly data. The author showed that though spreads did not decline with the financial liberalisation measures set up in the early 1990's, the significance of the different components of spreads were affected by such measures.

One of the major studies on banks' performance and its determinants in emerging markets included the work of Afanasieff, Lhacer and Nakane (2001) trying to uncover the main determinants of bank interest spreads in Brazil for the period 1997-2000 for a sample of 142 banks. They reported that large banks tend to operate on higher spreads, maybe due to evidence of either exercised market power by such banks or else as evidence of diseconomies of scale, and that operating costs, off-balance sheet activities

and reserves costs were all significant and positively related to interest margins. The authors also found that increases in real interest rates and inflation rates raised the IRSs, while output growth reduced the spread. The high significance and relevance of macroeconomic coefficients revealed that macroeconomic factors are the main determinants of interest rate spreads in Brazil.

Among the few studies on the African economy features Ben Naceur and Goaid (2003) who documented on the performance of Tunisian banks, in terms of profitability, and on the determinants of the banking interest margins for the 1980-2000 time-period. Using panel data approach they showed that firstly, individual bank-specific characteristics were significantly responsible for both the within-country differences among commercial banking margins and profitability. Banks with high capital levels and large overheads tend to have larger spreads. The results also emphasized on the impact of loan quality on the spreads; showing a positive relationship between the two variables. Macroeconomic indicators such as GDP were found to be uncorrelated to variations in bank margins, while inflation impacted positively on spreads.

Recently Chirwa and Mlachila (2004) studied the impact of financial sector reforms, comprising of the removal of credit controls, of the abolition of interest rate ceilings and of the restructuring and revision of the legal and regulatory framework, on the commercial banking interest margin in the Malawi using monthly data from 5 Malawian commercial banks for the period of 1989-1999. It was surprisingly found that interest rate spreads widened significantly despite financial reforms being undertaken and that interest rate spreads in Malawi increased because of the rise in nonfinancial costs, upward movement in provision for doubtful debts, rigid and excessive implicit financial taxation, varying discount rate and high inflation rates.

Lieberg and Schwaiger (2006) also investigated how the behaviour and determinants of the Austrian interest rate margins for the period 1996-2005. The study revealed that interest margins could be narrowed by decreasing operating costs, by encouraging competition, by increasing foreign currency lending and by diversifying to fee-income

generating activities. Deeper analysis of spreads fluctuations also revealed that the reduction in the extent relationship banking and the growing importance of the non-interest revenues drove margins downwards.

A number of studies have also been conducted on samples of countries. For instance Randall (1998), for the case of Eastern Caribbean countries, revealed that like other countries operating expenses and reserves costs had a large impact on spreads while loan loss provisioning reduced bank margins rather than increasing it and also concluded that bank spreads in that region were persistently high as compared to other low-inflation countries.

Dermirgüç-Kunt and Huizinga (1999) also studied the determinants of interest rate spreads on an international basis and concluded that interest margins were commonly high in developing countries as opposed to spreads in developed countries. They also found that the variations in spreads globally were due to diverse factor which included bank characteristics, macroeconomic conditions, explicit and implicit bank taxation, deposit insurance regulation, overall financial structure, and underlying legal and institutional indicators. Dermirgüç-Kunt *et al.* (2004) subsequently reported that tighter banking regulations on banks entry and bank activities boost financial intermediation and noted that inflation also played an important role on banks' efficiency by impacting on bank margins and overhead costs.

### **III. An Overview of the Mauritian Banking Sector**

#### **Banking in Mauritius**

Mauritius has an open, efficient and competitive financial system which presently incorporates of more two-thirds of the banking sector and that has firmly settled as the four economic pillar of the island. Unlike in most African counterparts, domestic bank assets constitute almost 100 per cent of GDP, revealing that Mauritius has an adequately developed domestic financial system. The financial sector underwent a number of reforms in the above quest and these are summarised in appendix A. Consolidating and

re-engineering of the banking system still remains a major priority of the Mauritian government in its quest towards optimal economic efficiency. However, the banking sector in Mauritius is highly oligopolistic, with two of the largest domestic banks controlling 75 per cent of the total assets.

### **Interest Rate Spreads In Mauritius, 1975-2006.**

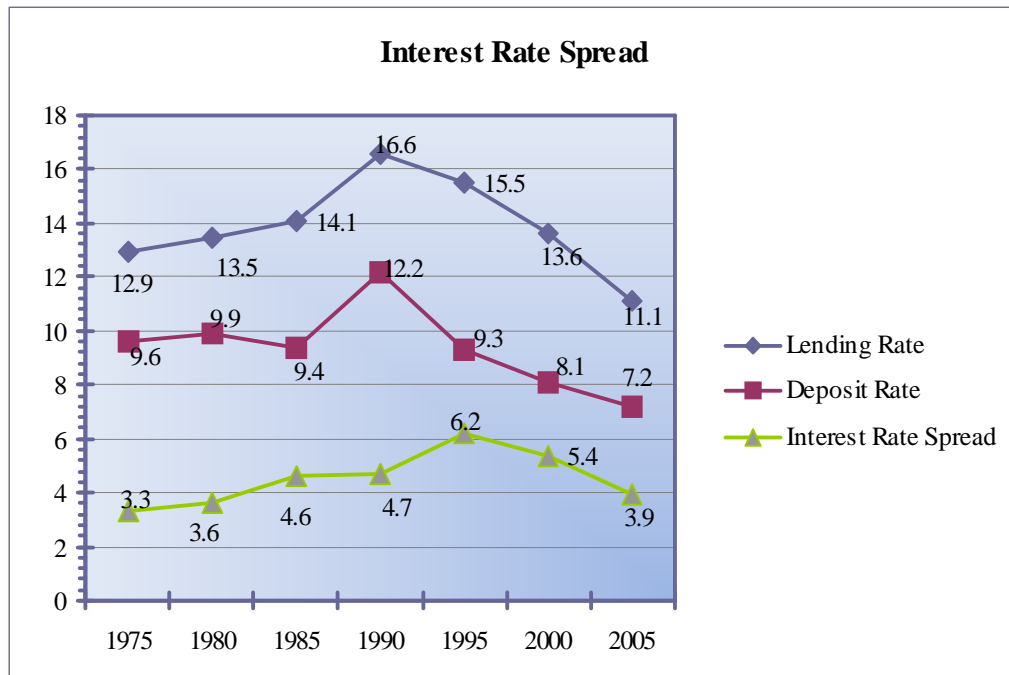
Interest rate spreads in Mauritius are among the lowest in Africa and as compared to other developing countries around the world. However, the banking interest rate spreads have witnessed much fluctuation over the past decades and have shown a general downward trend over the last ten years.

Figure 1 illustrates the behaviour of the bank interest spread in Mauritius for the period 1975–2005. From 1975 to 1990, interest rate controls mechanisms were in force and as a result, the banking interest rate spread was ‘manageable’. It can be noted from figure 3.6 that the interest spreads were relatively higher in the 1990s as compared to the 1980s. The spreads rose from an average 3.8 per cent in the eighties to an average 5.4 per cent in the nineties; implying the interest rate spreads have thus increased in the post-liberalisation period notwithstanding the efforts of policy makers to induce competition in the banking sector and to develop the financial market. Among the main arguments advanced for the failure of interest rate spreads in Mauritius to decline in the context of financial liberalisation include i) Lack of changes in the structure and institutional behaviour of the banking system ii) High reserve requirements, which act as implicit financial tax iii) Adverse selection and adverse incentive (moral hazard) effects, which could result in mounting non-performing loans and provision for doubtful debts iv) High operation costs and vi) costs incurred to develop and effectively implement technological changes were passed on to customers.

However, in 2006, the interest rate spread has recorded a significant decline from 5.4 per cent in 2000 to 3.7 per cent. This can be partly explained by the increasing number of banks present in the system implying escalating competition and innovation in terms of products and services offered. This is also because of the removal of licensing differences

between the offshore and onshore banks with the enactments of the Banking Act 2004 and the Bank of Mauritius 2004; thereby ensuring similar banking regulations and enhancing overall intermediation efficiency. Furthermore, the decreasing spread is associated to the high nominal broad money growth over the past years.

**Figure 1: Interest Rate Spreads in Mauritius.**



*Source: Central Statistical Office, Mauritius, Annual Digests and Bank of Mauritius Annual Reports, various issues.*

#### **IV. Econometric Modelling and Analysis**

The main theoretical models which try to explain and determine the dynamics of such spreads include the Profit Maximisation Model (extended by Klein, 1971 and Monti, 1972), the Dealership Model (Ho and Saunders, 1981), and the Accounting Identity Approach (Dermirgüç-Kunt and Huizinga, 1999). For the sake of this study, we derive our econometric specification from the Demirgüç-Kunt and Huizinga (1999) approach. Thus in an attempt to assess the impact of the market structure, bank-specific characteristics and the macroeconomic environment on variations in the Mauritian

banking interest margins, the following semi-log (more specifically Lin-Log models) model have been specified.

$$\text{IRS}_t = \alpha_1 + \beta_1 \text{LOGOC}_t + \beta_2 \text{LOGLIQ}_t + \beta_3 \text{LOGCRDRSK}_t + \beta_4 \text{LOGRRES}_t + \beta_5 \text{LOGEA}_t + \beta_6 \text{LOGINF}_t + \beta_7 \text{LOGDISRATE}_t + \varepsilon_{1t}; \quad (1)$$

Where  $t$  represents the time periods,  $\alpha$  represents the intercept and  $\varepsilon$  is the error term.

Note that the model was linearized by taking logarithms for ease of interpretation. The error term can be viewed as a convenient device that caters for any measurement errors arising when consolidating data from the different the financial statements and it also cares for any omitted explanatory variable and any random and unpredictable influences that cannot be modelled.

### **Dependent Variable**

The *ex-post* approach is used in calculating the interest rate spread. Thus, the dependent variable, bank interest rate spread is defined as being the difference between the weighted average rate charged on loans and the weighted average rate paid on deposits ( $\text{IRS}_t$ ). The weighted average lending rate is obtained dividing the total interest income expected to be received on granting loans and credits by the total number of loans and credits granted; while the rate paid on deposits is averaged by dividing the total interest expense by the total number of deposits. As argued by Dermirgüç-Kunt and Huizinga (1999), the IRS is ideally measured as the difference between the average interest rate earned on loans and the average interest paid on deposits for individual commercial banks. However, instead of focusing on the customary spreads or margins of individual banks, this work examines the banking sector spreads in order to better understand the broad state of financial intermediation in the Mauritian economy.

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<sup>1</sup> This study does not include the impact of stock market development on Mauritian banking interest rate spreads since the Mauritius Stock Market was established only in 1989

Therefore, the bank interest rate spread is calculated as:

$$\text{IRS}_t = \text{Weighted Commercial Bank Lending Rate} - \text{Weighted Commercial Bank Deposit Rate.}$$

### Independent Variables.

Determinants from previous studies have been used as a guide to the choice of independent variables. Based on the availability of data, focus has been laid on bank-specific and macroeconomic determinants of spreads. The explanatory variables included in both econometric models are summarized in the table below. The supporting literature can be referred to for addition insights and rationales.

**Table 1: Explanatory Variables and the Expected Impact on Interest Rate Spreads.**

VARIABLE	VARIABLE	PROXIED AS	PREDICTED COF. SIGN	SUPPORTING LITERATURE	RATIONALE
$OC_t$	Aggregate Operating Costs	$\frac{\text{Total Advances} + \text{Total Deposits}}{\text{Total Assets}}$	Positive	Randall, 1998; Barajas <i>et al.</i> 1999 ;AfanasiEFF <i>et al.</i> , 2001	$OC \uparrow$ , Operating efficiency $\downarrow$ , Margins $\uparrow$
$LIQ_t$	Aggregate Liquidity	$\frac{\text{Cash Balances}}{\text{Total Assets}}$	Negative	Demirguc-Kunt <i>et al.</i> (2004)	$LIQ \uparrow$ , Liquidity risk $\downarrow$ , Margins $\downarrow$
$CRDRSK_t$	Aggregate Credit Risk	$\frac{\text{Total Advances}}{\text{Total Assets}}$	Positive	Angbazo (1997) and Brock and Franken (2002)	$CRDRSK \uparrow$ , Credit risk + Costs of bad debts written off $\uparrow$ , Margins $\uparrow$

<b>RRES<sub>t</sub></b>	Aggregate Required Reserves	<b>Non – interest Bearing Reserve</b> <b>Total Assets</b>	Positive	Angbazo, 1997; Saunders & al, 2000	<b>RRES</b> ↑, Opportunity costs↑, Margins↑
<b>EA<sub>t</sub></b>	Economic Activity	Real GDP Growth	Negative	Randall (1998)	<b>EA</b> ↑, Risk of loan defaults↓, Margins↓
<b>INF<sub>t</sub></b>	Inflation	Inflation Rate	Positive	Dermirgüç-Kunt and Huizinga (1999); Saunders and Schumacher (2000); Ben Naceur & Goaid (2003) & Dermirguc-Kunt <i>et al.</i> (2004)	<b>INF</b> ↑, Risk premium↑, Margins↑
<b>DISRATE<sub>t</sub></b>	Discount Rate	Discount rate	Positive	Chirwa and Mlachila (2004) & Tennant and Folawewo(2006)	<b>DISRATE</b> ↑, Costs of fund borrowed↑, Margins↑

(Source: Computed).

### Data Collection and Measurement.

The data sample was constructed by using both consolidated and individual bank data from all the commercial banks operating in Mauritius during the period 1975 to 2004. To focus on the intermediary role of banks, only commercial banks were considered. Data at bank level was derived from consolidated income statements and balance sheets of commercial banks, and was aggregated as per accounting framework to avoid cross-bank differences. Macroeconomic and market-specific data have been sourced from Central Statistical Office, Mauritius, Annual Digests and Bank of Mauritius Annual Reports. The

final data set, which consisted of 240 observations for 8 variables for a 30 year period. The descriptive statistics and graphs are available in Appendices B and C respectively.

## Results, analysis and discussions

### *Preliminary results: Correlation Matrix*

From the Correlation Matrix (refer to Appendix D), it can be seen that nearly all the regressors exhibit low pairwise correlation coefficient, thus, implying that multicollinearity is not an issue in the following estimations. The highest positive pairwise correlation coefficient was  $\text{Cor}(\text{LIQ}, \text{CRDRSK}) = 0.49478$  and this can be explained by the fact that as the aggregate credit risk increases aggregate liquidity risk would increase since the banks would be facing reduced liquidity. The largest negative pairwise correlation coefficient was  $\text{Cor}(\text{LIQ}, \text{RRES}) = -0.46582$  and it reveals that as required reserves increases the aggregate liquidity of banks falls. A pairwise correlation coefficient of 0.45225 between credit risk and operating costs reveals that banks are liable to face additional costs as credit risk exposure increases since they need to engage in extensive monitoring and screening of advances.

### *Unit Root Test And Stationarity Of Time-Series.*

The data series are initially subjected to stationarity test, an element often ignored by past researchers. The following table summarizes the results of the ADF Test performed.

**Table 2: Summary of ADF Test Results.**

VARIABLES	ADF <sub>COMPUTED</sub>	ADF <sub>CRITICAL</sub>	I(0)
IRS <sub>t</sub>	2.9945	2.985	Yes
OC <sub>t</sub>	2.9934	2.985	Yes
LIQ <sub>t</sub>	3.0623	2.985	Yes
CRDRSK <sub>t</sub>	3.6956	2.985	Yes
RRES <sub>t</sub>	3.2223	2.985	Yes
EA <sub>t</sub>	3.3823	2.985	Yes
INF <sub>t</sub>	3.3776	2.985	Yes
DISRATE <sub>t</sub>	2.9934	2.985	Yes

(Source: Computed).

From table 2, it can be observed that all series are stationary in their level form, that is they are I(0). This implies that the OLS estimation technique can be validly used to regress both econometric models without the possibility of obtaining spurious regression. Table 3 summarizes the OLS regression results obtained<sup>2</sup>

**Table 3: Summary of Regression Results.**

VARIABLES	COEFFICIENT	T-RATIO	
$\alpha_1$	2.2434	2.345	<b>R<sup>2</sup>:</b> 0.821
LOGOC <sub>t</sub>	11.32	5.533	
LOGLIQ <sub>t</sub>	-8.356	-2.432	<b>D.W-statistics:</b> 1.953
LOGCRDRSK <sub>t</sub>	8.235	3.432	
LOGRRRES <sub>t</sub>	7.343	6.434	<b>F-statistics:</b> (7, 24) 15.23
LOGEA	-4.453	-1.243	
LOGINF <sub>t</sub>	2.53	2.354	
LOGDISRATE <sub>t</sub>	0.0234	1.435	

(Source: Computed)

The very existence of a positive intercept term is indicative that a difference between the bank lending rate and deposit taking rate should exist due to the presence of fixed costs, depreciation costs and taxation costs; and its significance also reveals that it incorporates aggregate after profit margin of the banking sector. The positive and significant coefficient value of 11.32 for the variable OC<sub>t</sub>, reveals that an increase of 1 per cent in the aggregate operating costs, on average, increases the banking interest spread increasing by about 0.1132 *ceteris paribus*. The regression results confirm the strong influence of operating costs on interest margin as judged by the magnitude of its coefficient. This finding converges to theory, which argues that as operating costs incur by banks rise, the

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<sup>2</sup>Diagnosis tests indicate that there are no problems of autocorrelation, functional form and heteroscedasticity (as confirmed by D.W statistics). The Lagrange Multiplier test statistic of residual serial correlation indicates that there is no autocorrelation while the Ramsey's Reset test statistic shows that the model is well specified and that there is no functional form problem.

interest margins widens to shift these costs onto customers. As operating costs increasingly eat into banks' profits, commercial banks are compelled to widen their interest spreads to remain profitable. Such results converge towards the findings of Randall (1998); Barajas *et al.* (1999) and Afanasieff *et al.* (2001). The prime components of operating costs include operating overheads and staffs costs. In fact, high operating costs reflect operating inefficiencies and lack of competition within the Mauritian banking sector.

*Ceteris paribus* a 1 per cent increase in liquidity, on average, has the effect of decreasing the Mauritian banking interest rate spread by about 0.0835. This significant negative relationship between liquidity and interest rate spreads suggests that as predicted when banks' liquidity increases the banks face decreasing liquidity risk and this reduced exposure would cause the interest margin to narrow. Thus as liquidity increase banks are better able to meet their short term obligations, which mainly includes the 'withdrawals of demand-deposits, the provision of new loans and catering for operating and other expenses; thus, they are able to work on narrower spreads. These results support the empirical finding of Dermirguc-Kunt *et al.* (2004).

It is also observed that a 1 per cent increase in the aggregate credit risk faced by Mauritian banks would, on average, cause the interest rate margin to rise by about 0.0824. Such results could suggest that banks incur additional operating costs as they intensify the monitoring and screening of loans and bear increased expenses for working out or selling those loans. In addition, banks would tend to charge additional risk premium for the financial costs of forgone interest revenue and rising illiquidity problems. Thus, banks usually recoup losses by increasing the spread, that is, by either charging more on loans or paying less to depositors or some combination of the two. Such results corroborate to the findings of Angbazo (1997) and Brock and Franken (2002).

This significant positive relationship (0.0734) between required reserve and interest rate spread is consistent with Angbazo' s (1997) and Saunders and Schumacher' s (2000)

findings. It implies that interest margin would increase as required reserves held at the Bank of Mauritius rise. Since such reserves are non-interest bearing, banks can face reduced revenues and tend to charge higher spreads. In addition, keeping excessive reserves can instigate liquidity problems, banks charge higher liquidity premiums.

A negative relationship is obtained on the impact of economic activity on interest rate margin. It rejoins the established literature (See Randall, 1998) that economic growth or activity is expected to be negatively correlated to interest margins. However, the coefficient is insignificant.

A 1 per cent increase in inflation rate would, on average, cause the interest margin to rise by 0.025, *ceteris paribus*. The positive and significant correlation between inflation and interest margin is according to both theory and certain empirical findings ( see Dermirgüç-Kunt and Huizinga, 1999; Saunders and Schumacher, 2000; Ben Naceur and Goaid, 2003 and Dermirguc-Kunt *et al.*, 2004). Since, as inflation increases, banks charge higher risk premium through the widening of their interest spread. Inflation rise also implies higher interest rate volatility, and thus, an increase in spreads.

An increase of 1 per cent in the discount rate, on average, has the effect of increasing the interest margin. This confirms that higher discount rate would imply additional costs incurred by banks which are passed onto customers by charging higher margins. Discount rate is traditionally viewed as a benchmark interest rate in the economy, and a lowering of this rate is expected to have a signalling effect, precipitating a lowering of interest rates by other stakeholders. The insignificance of this variable suggests that this signalling effect, in the Mauritian context, has less of an impact on interest spreads than that perceived in literature. Thus, it can be argued that ‘soft’ measures by the Government, such as signalling and moral suasion, will have little, if any, impact on spreads in environments where there are persistent factors causing spreads to be high. It should be noted that such results contradict the findings of Chirwa and Mlachila (2004) and Tennant and Folawewo (2006).

In order to assess the economic significance of the various factors explaining the observed interest rate spreads, elasticities were computed. Table 5 provides a summary of computed slopes and computed elasticities for each variable.

**Table 4: Slope and Elasticity of Coefficients.**

COEFFICIENT	SLOPE	ELASTICITY
$\beta_1$	9.23	2.34
$\beta_2$	-316.23	-1.85
$\beta_3$	16.21	1.67
$\beta_4$	95.12	1.47
$\beta_5$	-0.66	-0.854
$\beta_6$	0.2345	0.4346
$\beta_7$	$5.434 \times 10^{-3}$	0.0436

(Source: Computed).

Overall, the operating costs, incurred by banks, are the most important variable that explains the widening of spreads in Mauritius. An elasticity value of 2.34, which exceeds unit elasticity, shows that a 1 per cent increase in the variable  $OC_t$  should, on average, lead to a more than 1 percent increase, i.e. 2.34 per cent increase, in the intermediation spread. Furthermore, spreads are also highly positively elastic to credit risk exposure and required reserves and highly negatively elastic to liquidity (-1.85). In addition, spreads are relatively negatively elastic to economic growth (-0.854) and relatively positively elastic to inflation (0.435) but however, spreads are relatively inelastic to discount rate (0.044) in the Mauritian context. The low elasticity value for the variable inflation suggests that anti-inflationary measures would have to be stringent if they are to cause an appreciable reduction in interest rate spreads.

### **Cointegration and Error Correction Model.**

Since, all variables are integrated of same order ( $I(0)$ ), a suspicion of cointegrating relationships exists, and this increases the reliability of the model. To confirm the

suspected possibility of cointegration, the Augmented Engle-Granger (AEG) Test<sup>3</sup> was used. This test involves applying ADF unit root test to the residuals and the following results were obtained.

**Table 5: Summary of ADF Test Results for Regression Residuals.**

VARIABLE	ADF <sub>COMPUTED</sub>	ADF <sub>CRITICAL</sub>	I(0)
Residuals, $\varepsilon_1$	3.435	2.985	Yes

(Source: Computed).

Since the computed ADF is greater than the critical ADF, the residuals from the regression are I(0), that is, they are stationary thus cointegrated. Given the dynamics of our model, a simple Error Correction Model has been developed to correct for short term equilibrium by reconciling the short run behaviour of the variables with their long run behaviour. Thus, an “Engle-Granger” type ECM has been derived as follows:

$$IRS_t = \alpha_1 + \beta_1 LOGOC_t + \beta_2 LOGLIQ_t + \beta_3 LOGCRDRSK_t + \beta_4 LOGRRRES_t + \beta_5 LOGEA_t + \beta_6 LOGINF_t + \beta_7 LOGDISRATE_t + \varepsilon_{1t}; \quad (1)$$

Given the fact that the dependent variable  $IRS_t$  and that the other explanatory variables are not always in equilibrium, it follows that long term relationship cannot be observed directly. Only a disequilibrium relationship can be observed involving the lagged values of  $IRS_t$  and of the explanatory variables. The disequilibrium relationship is denoted as follows:

$$IRS_t = \alpha_1 + \beta_1 LOGOC_t + \beta_8 LOGOC_{t-1} + \beta_2 LOGLIQ_t + \beta_9 LOGLIQ_{t-1} + \beta_3 LOGCRDRSK_t + \beta_{10} LOGCRDRSK_{t-1} + \beta_4 LOGRRRES_t + \beta_{11} LOGRRRES_{t-1} + \beta_5 LOGEA_t + \beta_{12} LOGEA_{t-1} + \beta_6 LOGINF_t + \beta_{13} LOGINF_{t-1} + \beta_7 LOGDISRATE_t + \beta_{14} LOGDISRATE_{t-1} + \mu IRS_{t-1} + \varepsilon_t; \quad (2)$$

Equation (2) can be further re-arranged and re-parameterized as follows:

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<sup>3</sup> The Johansen (1988) cointegration method confirmed the results.

Subtracting  $IRS_{t-1}$  from either side yields:

$$\begin{aligned}
IRS_t - IRS_{t-1} = & \alpha_1 + \beta_1 LOGOC_t - \beta_1 LOGOC_{t-1} + \beta_1 LOGOC_{t-1} + \beta_8 LOGOC_{t-1} + \\
& \beta_2 LOGLIQ_t - \beta_2 LOGLIQ_{t-1} + \beta_2 LOGLIQ_{t-1} + \beta_9 LOGLIQ_{t-1} + \beta_3 LOGCRDRSK_t - \\
& \beta_3 LOGCRDRSK_{t-1} + \beta_3 LOGCRDRSK_{t-1} + \beta_{10} LOGCRDRSK_{t-1} + \beta_4 LOGRRRES_t - \\
& \beta_4 LOGRRRES_{t-1} + \beta_4 LOGRRRES_{t-1} + \beta_{11} LOGRRRES_{t-1} + \beta_5 LOGEA_t - \beta_5 LOGEA_{t-1} + \\
& \beta_5 LOGEA_{t-1} + \beta_{12} LOGEA_{t-1} + \beta_6 LOGINF_t - \beta_6 LOGINF_{t-1} + \beta_6 LOGINF_{t-1} + \\
& \beta_{13} LOGINF_{t-1} + \beta_7 LOGDISRATE_t - \beta_7 LOGDISRATE_{t-1} + \beta_7 LOGDISRATE_{t-1} + \\
& \beta_{14} LOGDISRATE_{t-1} + \mu IRS_{t-1} - IRS_{t-1} + \varepsilon_t;
\end{aligned} \tag{3}$$

Or

$$\begin{aligned}
\Delta IRS_t = & \alpha_1 + \beta_1 \Delta LOGOC_t + (\beta_1 + \beta_8) LOGOC_{t-1} + \beta_2 \Delta LOGLIQ_t + (\beta_2 + \beta_9) LOGLIQ_{t-1} + \\
& \beta_3 \Delta LOGCRDRSK_t + (\beta_3 + \beta_{10}) LOGCRDRSK_{t-1} + \beta_4 \Delta LOGRRRES_t + (\beta_4 + \beta_{11}) LOGRRRES_{t-1} \\
& + \beta_5 \Delta LOGEA_t + (\beta_5 + \beta_{12}) LOGEA_{t-1} + \beta_6 \Delta LOGINF_t + (\beta_6 + \beta_{13}) LOGINF_{t-1} + \\
& \beta_7 \Delta LOGDISRATE_t + (\beta_7 + \beta_{14}) LOGDISRATE_{t-1} - (1 - \mu) IRS_{t-1} + \varepsilon_t;
\end{aligned} \tag{4}$$

Where  $\Delta$  denotes the first difference of each variable.

On re-parametrizing;

$$\begin{aligned}
\Delta IRS_t = & \beta_1 \Delta LOGOC_t + \beta_2 \Delta LOGLIQ_t + \beta_3 \Delta LOGCRDRSK_t + \beta_4 \Delta LOGRRRES_t + \\
& \beta_5 \Delta LOGEA_t + \beta_6 \Delta LOGINF_t + \beta_7 \Delta LOGDISRATE_t + (1 - \mu) [IRS_{t-1} - \gamma_0 \\
& - \gamma_1 LOGOC_{t-1} - \gamma_2 LOGLIQ_{t-1} - \gamma_3 LOGCRDRSK_{t-1} - \gamma_4 LOGRRRES_{t-1} - \gamma_5 LOGEA_{t-1} - \\
& \gamma_6 LOGINF_{t-1} - \gamma_7 LOGDISRATE_{t-1}] + \varepsilon_t;
\end{aligned} \tag{5}$$

Where  $\gamma_0 = \alpha_1 / (1 - \mu)$ ,

$$\gamma_1 = (\beta_1 + \beta_8) / (1 - \mu),$$

$$\gamma_2 = (\beta_2 + \beta_9) / (1 - \mu),$$

$$\gamma_3 = (\beta_3 + \beta_{10}) / (1 - \mu),$$

$$\gamma_4 = (\beta_4 + \beta_{11}) / (1 - \mu),$$

$$\gamma_5 = (\beta_5 + \beta_{12}) / (1 - \mu),$$

$$\gamma_6 = (\beta_6 + \beta_{13}) / (1 - \mu),$$

$$\gamma_7 = (\beta_7 + \beta_{14}) / (1 - \mu),$$

The two-steps procedure as proposed by Engle and Granger is applied to estimate the Error Correction Model, i.e. OLS estimation is apply to the cointegrating regression and the residual  $U_{t-1}$  is fitted in place of the disequilibrium error. Note that the cointegration regression is as follows:

$$\text{IRS}_{t-1} = -\gamma_0 - \gamma_1 \text{LOGOC}_{t-1} - \gamma_2 \text{LOGLIQ}_{t-1} - \gamma_3 \text{LOGCRDRSK}_{t-1} - \gamma_4 \text{LOGRRES}_{t-1} - \gamma_5 \text{LOGEA}_{t-1} - \gamma_6 \text{LOGINF}_{t-1} - \gamma_7 \text{LOGDISRATE}_{t-1} - \beta_{15} U_{t-1} + \varepsilon_t; \quad (6)$$

Equation (6) can be reproduced as follows:

$$\Delta \text{IRS}_t = \beta_1 \Delta_t \text{ALOGOC}_t + \beta_2 \text{LOGLIQ}_t + \beta_3 \text{ALOGCRDRSK}_t + \beta_4 \text{ALOGRRES}_t + \beta_5 \text{ALOGEA}_t + \beta_6 \text{ALOGINF}_t + \beta_7 \text{ALOGDISRATE}_t - \beta_{15} U_{t-1} + \varepsilon_t; \quad (7)$$

Where

$$U_{t-1} = \text{IRS}_{t-1} - \gamma_0 - \gamma_1 \text{LOGOC}_{t-1} - \gamma_2 \text{LOGLIQ}_{t-1} - \gamma_3 \text{LOGCRDRSK}_{t-1} - \gamma_4 \text{LOGRRES}_{t-1} - \gamma_5 \text{LOGEA}_{t-1} - \gamma_6 \text{LOGINF}_{t-1} - \gamma_7 \text{LOGDISRATE}_{t-1} \quad (8)$$

$$\beta_{15} = (1 - \mu)$$

$U_{t-1}$  is the disequilibrium term from the last period. The next step is to apply OLS to equation (7) and the results are shown below.

**Table 6: Summary of Regression Results for ECM.**

VARIABLES	COEFFICIENT	T-RATIO	
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$\Delta \text{LOGOC}_t$	9.435	2.66	<b>R<sup>2</sup>:</b> 0.43
$\Delta \text{LOGLIQ}_t$	-5.43	-2.067	
$\Delta \text{LOGCRDRSK}_t$	4.11	2.75	<b>D.W-statistics:</b> 2.23
$\Delta \text{LOGRRES}_t$	3.324	2.856	
$\Delta \text{LOGEA}$	-0.39	-0.26	<b>F-statistics:</b> (8, 20) 1.856
$\Delta \text{LOGINF}_t$	0.564	0.17	
$\Delta \text{LOGDISRATE}_t$	0.67	0.6134	
$U_{t-1}$	-0.61	-3.534	

(Source: Computed).

The regression indicates that short run changes in the explanatory variables and in the ‘disequilibrium error’ in the previous period have significant effects on  $\text{IRS}_t$ . In this case,  $\Delta \text{LOGOC}_t$  captures short run disturbances in  $\text{OC}_t$  (while  $\Delta \text{LOGLIQ}_t$ ,  $\Delta \text{LOGCRDRSK}_t$ , and  $\Delta \text{LOGRRES}_t$  capture short run disturbances in  $\text{LIQ}_t$ ,  $\text{CRDRSK}_t$ , and in  $\text{RRES}_t$  respectively) and  $U_{t-1}$  captures adjustment towards long-run equilibrium. The short run results validate to a large extent the previous reported results. The implication of such regression results suggests that commercial banking spread in Mauritius is affected to a greater extent by bank-specific determinants than by macroeconomic determinants. Since, the coefficient of  $U_{t-1}$  is highly significant, it indicates the proportion of disequilibrium in  $\text{IRS}_t$  in one period that is adjusted in the next period. Table 8 results suggest that the initial cointegrating regression model mimics a short run profit model where bank profitability is defined by the nature of the credit market (which is the source of bank income - possibly the after profit margin) and caters incurred operating costs, the level of credit risk and liquidity risk faced by banks and implicit tax, in the form of required reserves, that squeezes the ability of the bank to earn income.

## V. Summary

This study contributes to the already well documented literature on the determinants of interest spread by using the ex-ante spreads to examine the bank-specific and macroeconomic determinants of banking sector spreads in Mauritius using time series

analysis. Empirical results depict a major positive correlation between operating costs and interest rate margins in Mauritius. This relationship reveals the impact of size and of diseconomies of scale on the operations of commercial banks. Such banks also tend to widen their interest margins as their credit risk exposure increases. Since loans and advances are the most risky and cost-intensive assets, it follows that more lending would result in higher spreads and reflects banks' ability to integrate risk and cost considerations in their loans pricing behaviour. In addition to operating costs and credit risk exposure, the findings of this study reveal that liquidity and reserves requirements also have significant impacts on the Mauritian banking interest margin and implies that banks with high levels of liquidity assets in cash and government securities are able to work at lower liquidity risk premium and thus, can charge lower spreads. It is further revealed that of the three potential macroeconomic policy variables widely touted in literature, only inflation has a significant impact. In fact inflation has a consistently positive and significant impact on interest spread and indicates that banks charge higher premium mainly due to higher volatility of interest rates as inflation goes up..

The main conclusion of this study is that the variation of bank interest margin in Mauritius predominately emanates from the micro level. In the light of the evidence obtained, the continuity of the process of reduction of margins will be conditioned firstly, by the implementation of measures to incentivise above all the increase in the degree of competition, possibly by greater penetration by foreign banks or by fostering the development of alternative distribution channels for banking services such internet banking thereby making markets more 'contestable'; secondly, by banks' effort to reduce their average costs and to improve their efficiency levels, and lastly by achieving a climate of financial stability that will reduce the risk exposure of commercial banks in Mauritius. Thus, macroeconomic stability with low inflation and volatility on financial markets, with relatively low prevailing risk exposure, reduced financial taxation and together with a growing and competitive environment are the key features required to potentiate an environment fostering reduction in interest rate margins.

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## Appendix

### A. Timeline of Financial Sector Reforms in Mauritius.

<b>JULY 1988</b>	Liberalisation of interest rates
<b>JULY 1991</b>	Issue of Bank of Mauritius bills
<b>NOVEMBER 1991</b>	Auctioning of bills
<b>JULY 1992</b>	Abolition of ceilings on credit to priority sectors
<b>JULY 1993</b>	Abolition of ceilings on credit to non-priority sectors Imposition of a credit-deposit ratio Minimum risk-weighted capital adequacy ratio of 8%

<b>NOVEMBER 1993</b>	Capital Adequacy Ratio increased to 10% as per BOM Guidelines
<b>FEBRUARY 1994</b>	Setting up of the Secondary Market Cell at the Bank of Mauritius
<b>JUNE 1994</b>	Bank Rate linked to weighted average yield on Treasury Bills over preceding 12 weeks plus a margin
<b>JULY 1994</b>	Suspension of Exchange Coontrol Act Establishment of the Interbank Foreign Exchange market
<b>JULY 1995</b>	Bank rate linked to overall age yield on Treasury Bills at most recent auction plus a margin
<b>JULY 1996</b>	Abolition of credit-deposit ratio Imposition of 15% limit on the overall foreign exchange exposure
<b>DECEMBER 1996</b>	Bank rate linked to overall age yield on Treasury Bills at most recent auction plus a margin
<b>JULY 1997</b>	Cash ratio brought down to 6% and non-cash liquid asset ratio brought down to 0%
<b>JULY 1998</b>	Issue of 728-days Treasury Bills
<b>DECEMBER 1998</b>	Over The Counter (OTC) sales to individuals and non-financial institutions
<b>DECEMBER 1999</b>	Issue of 30-days Treasury Bills Introduction of Reversed REPO Transactions Introduction of Lombard facility
<b>NOVEMBER 2000</b>	Introduction of Swap Transactions
<b>DECEMBER 2000</b>	Establishment of the Mauritius Automated Clearing and Settlement System (MACSS)
<b>FEBRUARY 2002</b>	Introduction of the Primary Dealer System
<b>DECEMBER 2003</b>	Trading of Treasury/Bank of Mauritius Bills on the Stock Exchange of Mauritius
<b>JULY 2004</b>	Both onshore and offshore banks operate under single banking licence as per Banking Act 2004.
<b>DECEMBER 2006</b>	Establishment of a new framework to conduct Monetary Policy

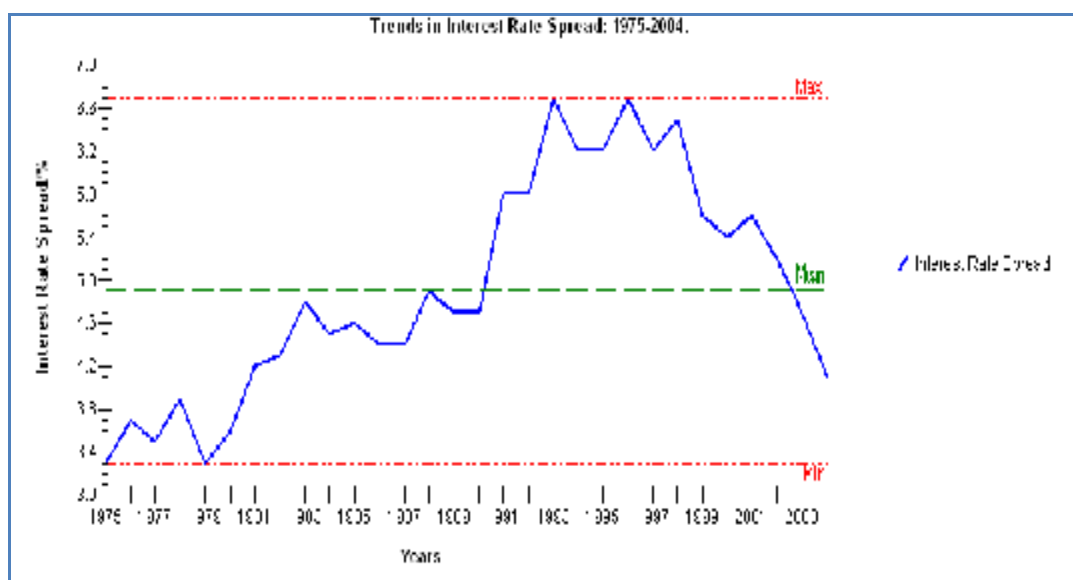
*(Source: Bank of Mauritius Annual Report, various issues).*

## **B. Descriptive Statistics: Sample period: 1975 to 2004**

Variable	IRS	OC	LIQ	CRDR SK	RRES	EA	INF	DISR ATE
<b>Maximum</b>	6.700	1.4070	0.0500	0.5940	0.1048	16.20	33.00	17.190
<b>Minimum</b>	3.300	1.0700	0.0190	0.3740	0.0326	-10.10	0.7000	6.000
<b>Mean</b>	4.9167	1.2604	0.0281	0.4844	0.0735	5.5600	9.0167	10.602
<b>Std. Deviation</b>	1.0276	0.0736	0.0070	0.0419	0.0246	4.3064	6.5861	2.1678
<b>Skewness</b>	0.1880	-0.4590	1.2050	0.4439	0.0216	0.9496	2.2068	0.2155
<b>Kurtosis-3</b>	-1.0368	0.1919	1.4316	1.6714	-1.6437	5.2319	5.3032	2.0669
<b>Coeff. of Variation</b>	0.2090	0.0584	0.2491	0.0865	0.3341	0.7745	0.7304	0.2045
<b>No. of observations</b>	30	30	30	30	30	30	30	30

(Source: Computed).

### C. Descriptive Graphs:



**Figure 5: Trends in Interest Rate Spreads: 1975-2004.**

(Source: Central Statistical Office, Mauritius, Annual Digests and Bank of Mauritius Annual Reports, various issues).

#### **D. Estimated Correlation Matrix:**

Variable	Oc	LIQ	CRDRSK	RRES	EA	INF	DISRATE
Oc	1.0000	0.21126	0.45225	0.44991	0.19279	0.26733	-0.29895
LIQ	0.21126	0.21126	0.49478	-0.46582	-0.14881	0.30712	-0.34225
CRDRSK	0.45225	0.49478	1.0000	0.10314	0.058832	0.070558	-0.11775
RRES	0.44991	-0.46582	0.10314	1.0000	-0.18408	-0.29906	0.38350
EA	0.19279	-0.14881	0.058832	-0.18408	1.0000	-0.35327	-0.34484
INF	0.26733	0.30712	0.070558	-0.29906	-0.35327	1.0000	-0.08187
DISRATE	-0.29895	-0.34225	-0.11775	0.38350	-0.34484	-0.08187	1.0000

(Source: Computed).