

Interest rate spread determination in an error correction model

Binesh Seetanah, RMIT University

Boopen Seetanah, University of Mauritius

Navneet Seetaram, University of Technology, Mauritius

Shalini Ramessur, University of Technology, Mauritius

Rojid Sowkut, The World Bank

Purpose of Study

- Increasing interest in the area
- Results differ between developed and developing countries
- Developed countries positive correlation between the bank's level of capital, the loan loss provision, reserve requirements, implicit taxation and interest volatility and interest rate spreads ((Dermirgüç-Kunt and Huizinga, 1999; Saunders and Schumacher, 2000)
- Developing countries –some negative and insignificant relationships noted (Brock and Rojas-Suarez, 2000, Tennant and Folawewo, 2006)

Significance of study

- Attempt to bring new evidence from an emerging African country – Mauritius
- Investigating effect of bank-specific and macroeconomic determinants on IRS
- Bank-specific variables (pure spread)- aggregate credit risk and liquidity risk, operational efficiency and opportunity cost of holding reserves
- Macroeconomic variables (actual spread)– economic activity, inflation rate, regulatory changes and discount rate
- Mauritius one of the best performers having one of the best financial systems in the continent.

Literature Review

- Nature, structure and efficiency of financial sectors worldwide may explain variations in interest rates spread
- Latin American and less developed countries have wider spreads than developed countries (Briguglio, 1995, Randall, 1998, Gelbard and Leite, 1999, and Jayaraman and Sharma, 2003)
- Bank-specific characteristics are not always correlated with interest rate spreads and are more at industry level (Brock and Franken, 2002)

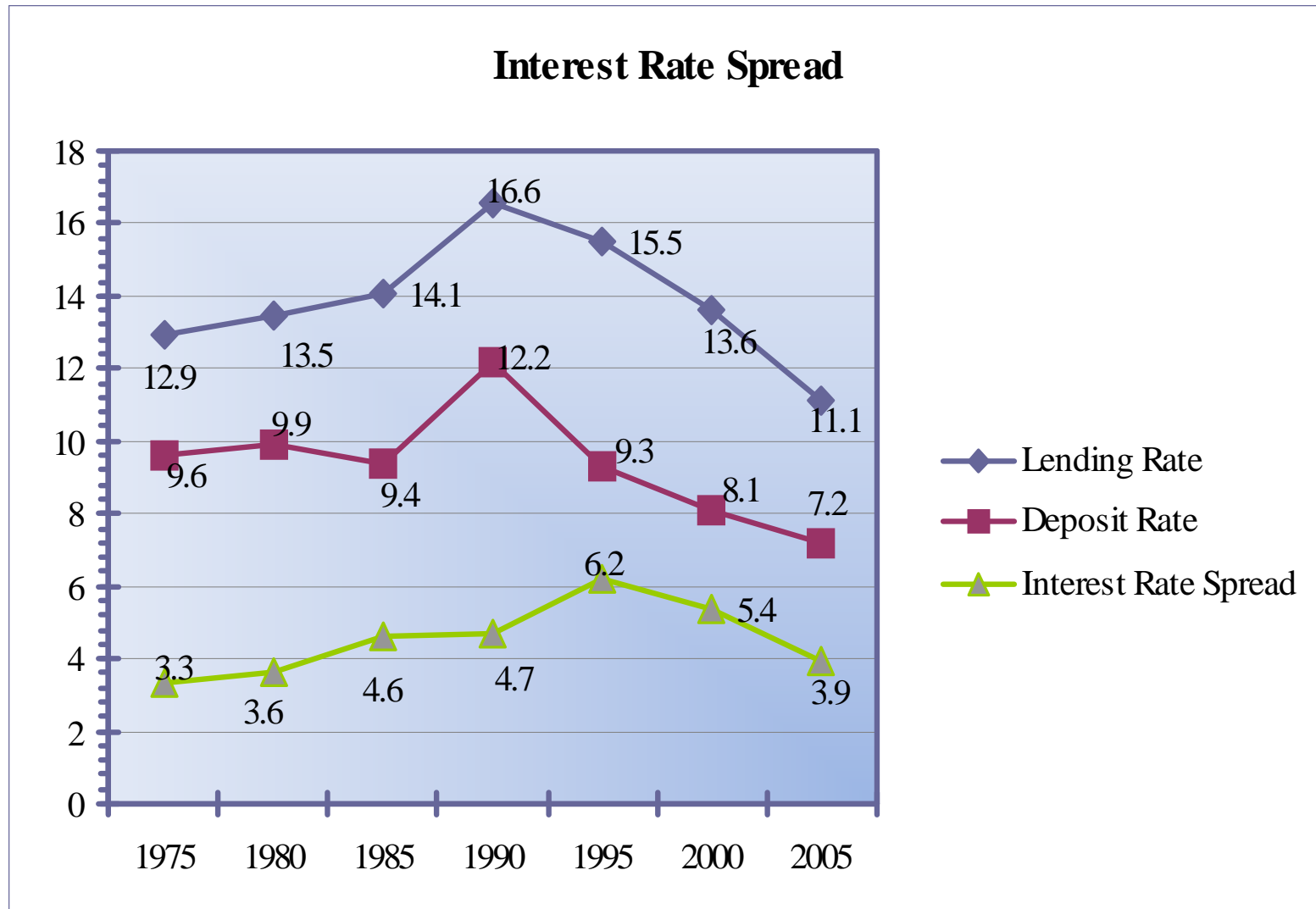
Literature Review – Empirical Studies

- Afanasieff, Lhacer and Nakane (2001) macroeconomic factors are the main determinants in Brazil
- Angbazo (1997) – negative correlation between liquidity risk (liquid assets/total asset) and spreads.
- Ben Naceur and Goaid (2003) – Tunisia – banks with large capital levels and overheads have bigger spreads
- Chirwa and Mlachila (2004) – looked at the effect of financial sector reforms effects in Malawi and found that interest spreads widened because of rise in non financial costs among others.
- Dermiguc-Kunt and Huizinga (1999) – spreads are higher in developing countries as opposed to developed.
- Dermiguc-Kunt and Huizinga (2004) – tighter banking regulations boost financial intermediation.

Case of Mauritius

- Open, efficient and competitive financial system
- Interest rate spreads are among the lowest in Africa
- Banking interest spreads fluctuated over the last decades
- Spreads higher in the 1990s – post-deregulation on the market and induced competition through government actions
- Fall in 2006 to 3.7% - more banks in the sector along with new delivery channels of products.
- Removal of licensing differences between offshore and onshore banks = overall intermediation efficiency.

Interest Rate Spreads in Mauritius.



Econometrics modelling

- Accounting Identity Approach (Dermiguc-Kunt and Huizinga, 1999) was used for the study
- Attempt at assessing the impact of macro-economics, and bank-specific characteristics impact on banking interest rates

$$\text{Irst} = \alpha_1 + \beta_1 \text{LOGOc}_t + \beta_2 \text{LOGLiq}_t + \beta_3 \text{LOGCrdRsk}_t + \beta_4 \text{LOGRRes}_t + \beta_5 \text{LOGEa}_t + \beta_6 \text{LOGInf}_t + \beta_7 \text{LOGDisRate}_t + \varepsilon_{it}$$

- Interest rate spread being the independent variable in the equation
- 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

Econometrics modelling (dependent variables)

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 ;Afanasiieff <i>et al.</i> , 2001	Oc ↑, Operating efficiency↓, Margins↑
Liq_t	Aggregate Liquidity	$\frac{\text{Cash Balances}}{\text{Total Assets}}$	Negative	Dermirguc-Kunt <i>et al.</i> (2004)	Liq ↑, Liquidity risk↓, Margins↓
$CrdRsk_t$	Aggregate Credit Risk	$\frac{\text{Total Advances}}{\text{Total Assets}}$	Positive	Angbazo (1997) and Brock and Franken (2002)	CrdRsk ↑, Credit risk + Costs of bad debts written off↑, Margins↑
$RRes_t$	Aggregate Required Reserves	$\frac{\text{Non - Interest Bearing Reserves}}{\text{Total Assets}}$	Positive	Angbazo, 1997; Saunders & al, 2000	RRes ↑, Opportunity costs↑, Margins↑
Ea_t	Economic Activity	Real GDP Growth	Negative	Randall (1998)	Ea ↑, Risk of loan defaults↓, Margins↓
Inf_t	Inflation	Inflation Rate	Positive	Dermirgüç-Kunt and Huizinga (1999); Saunders and Schumacher (2000); Ben Naceur & Goaid (2003) & Dermirguc-Kunt <i>et al.</i> (2004)	Inf ↑, Risk premium↑, Margins↑
$DisRate_t$	Discount Rate	Discount rate	Positive	Chirwa and Mlachila (2004) & Tennant and Folawewo(2006)	DisRate ↑, Costs of fund borrowed↑, Margins↑

DATASET

- Consolidated and individual bank data from all commercial banks
- Macroeconomic and market-specific data have been sourced from Central Statistical Office, Mauritius, Annual Digests and Bank of Mauritius Annual Reports
- Final data set made up of 240 observations for 8 variables for a 30 year period

Preliminary analysis

- 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

Preliminary analysis (contd)

- **Observations**

- 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
- 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.

Regression Analysis (Long Run)

VARIABLES	COEFFICIENT	T-RATIO	
α_1	2.2434	2.345	R²: 0.821
LOGO _{it}	11.32	5.533	
LOGLI _{it}	-8.356	-2.432	DWstatistics: 1.953
LOGCRD _{it}	8.235	3.432	
LOGRR _{it}	7.343	6.434	F-statistics: (7, 24) 15.23
LOGEA	-4.453	-1.243	
LOGINF _{it}	2.53	2.354	
LOGDIS _{it}	0.0234	1.435	

Regression Results: Findings

- Positive and significant coefficient value of 11.32 for the variable Oct, 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*.
- As operating costs increasingly eat into banks' profits, commercial banks are compelled to widen their interest spreads to remain profitable (Randall, 1998; Barajas *et al.* 1999 and Afanasieff *et al.* 2001))
- *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.
- banks' liquidity increases the banks face decreasing liquidity risk and this reduced exposure would cause the interest margin to (Dermirguc-Kunt *et al.* 2004).

Regression analysis (contd)

- 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
- A negative relationship is obtained on the impact of economic activity on interest rate margin. It rejoins the established literature (Randall, 1998)

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 was used
- Evidence of cointegration was established. The Johansen (1988) cointegration method confirmed the results.
- 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 and the final equation is as follows
- $$\Delta Irs_t = \beta_1 \Delta LOGOc_t + \beta_2 \Delta LOGLiq_t + \beta_3 \Delta LOGCrdRsk_t + \beta_4 \Delta LOGRRes_t + \beta_5 \Delta LOGEa_t + \beta_6 \Delta LOGInf_t + \beta_7 \Delta LOGDisRate_t + (1-\mu) [Irs_{t-1} - \gamma_0 - \gamma_1 LOGOc_{t-1} - \gamma_2 LOGLiq_{t-1} - \gamma_3 LOGCrdRsk_{t-1} - \gamma_4 LOGRRes_{t-1} - \gamma_5 LOGEa_{t-1} - \gamma_6 LOGInf_{t-1} - \gamma_7 LOGDisRate_{t-1}] + \epsilon_t$$

- The two-steps procedure as proposed by Engle and Granger is applied to estimate the Error Correction Model, i.e. OLS estimation is applied to the cointegrating regression and the residual U_{t-1} is fitted in place of the disequilibrium error.
- cointegration regression
- **$\Delta I_{rst} = \beta_1 \Delta t \Delta \text{LOG} O_{ct} + \beta_2 \text{LOG} L_{iq} + \beta_3 \Delta \text{LOG} C_{rd} R_{skt} + \beta_4 \Delta \text{LOG} R_{Rrest} + \beta_5 \Delta \text{LOG} E_{at} + \beta_6 \Delta \text{LOG} I_{nft} + \beta_7 \Delta \text{LOG} D_{is} R_{atet} - \beta_{15} U_{t-1} + \epsilon_t$;**
- **$U_{t-1} = I_{rst-1} - \gamma_0 - \gamma_1 \text{LOG} O_{ct-1} - \gamma_2 \text{LOG} L_{iqt-1} - \gamma_3 \text{LOG} C_{rd} R_{skt-1} - \gamma_4 \text{LOG} R_{Rrest-1} - \gamma_5 \text{LOG} E_{at-1} - \gamma_6 \text{LOG} I_{nft-1} - \gamma_7 \text{LOG} D_{is} R_{atet-1}$**
- U_{t-1} is the disequilibrium term from the last period

Summary of Regression Results for ECM

Variables	Coefficient	T-ratio	
$\Delta \text{LOGO}c_t$	9.3483	2.7585	R²: 0.40911
$\Delta \text{LOG}Liq_t$	- 5.3117	-2.0831	
$\Delta \text{LOG}CrdRsk_t$	4.3630	2.1681	D.W-statistics: 2.1075
$\Delta \text{LOG}RRes_t$	3.6613	2.8942	
$\Delta \text{LOG}Ea$	-0.39477	-0.24617	F-statistics: (8, 20) 1.7309
$\Delta \text{LOG}Inf_t$	0.55860	0.18552	
$\Delta \text{LOG}DisRate_t$	0.64055	0.61689	
U_{t-1}	-0.68021	-3.0175	

Analysis of the ECM

- The regression indicates that short run changes in the explanatory variables and in the 'disequilibrium error' in the previous period have significant effects on I_{rst} . In this case, ΔLOG_{Oct} captures short run disturbances in Oct (while ΔLOG_{Liq} , ΔLOG_{CrdRsk} , and ΔLOG_{RRest} capture short run disturbances in Liq , $CrdRsk$, and in $RRest$ 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 I_{rst} in one period that is adjusted in the next period.

Analysis of ECM (Contd)

- 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.

Conclusion

- Positive correlation between operating costs and interest rate margins
- Credit risk exposures increase interest margins
- High levels of liquidity by the central bank will result in a lower liquidity premium and lower spreads.
- Inflation is the only macroeconomic variable which has a positive and significant effect.
- Variations in bank interest margins are at micro-level

Recommendations

- Lower spreads achieved if :
 - 1) Increased level of competition and development of alternative distribution channels
 - 2) Banks' efforts to reduce their average costs and to improve efficiency levels
 - 3) Establishing a climate of financial stability to reduce risk exposure of commercial banks