A STUDY OF THE DETERMINANTS OF MORTGAGE INTEREST RATES IN NAMIBIA THROUGH CO-INTEGRATION AND ERROR CORRECTION MECHANISMS

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Abstract

Discussions concerning interest rates, especially mortgage rates are increasingly being given a lot of attention in the literature. Indeed, in realisation of this fact, the study attempted to establish the factors that influence the behaviour of mortgage rates in Namibia, for the period 1994 to 2012. More specifically, it explored the extent to which perturbations in mortgage rates are explained by repo rate, real interest rate and risk premium. We invoked and subsequently applied co-integration and error correction mechanisms in order to investigate the issue under consideration. The result of the study suggested that approximately 68% of the systematic variation in Namibia's mortgage rates' swings could be attributed to changes in the three explanatory variables that were used in our econometric model. The bank rate in particular was observed to have a stronger influence on mortgage rates in Namibia. In addition, a long-run relationship was found between mortgage rates and bank rates. Therefore, the need for the Bank of Namibia to rely heavily on the use of the repo rate as a way of controlling, monitoring and influencing developments in the Namibian mortgage market cannot be overstressed.

Keywords: Namibia, Mortgage Rate, Error Correction Model, Co-integration, Time Series Data, Causality, Long-run

INTRODUCTION

Housing, which is often used interchangeably with the term shelter by development economists, is unquestionably, one of the basic needs of all human beings. In Namibia, affordability remains a fundamental challenge, when it comes to owing or buying a house. Indeed, everyone, including the government is worried about the continual upward price movements regarding houses in Namibia. The prevailing mortgage rate is also not helping matters, as far as; the issue

of owning a house in Namibia is concerned. In this study, therefore, we attempt to investigate the important factors influencing mortgage rates in Namibia. This study is considered to be of value in light of the following interrelated reasons. Firstly, it would enable those soliciting for home or mortgage loans to appreciate the dynamics taking place in the real estate market in Namibia, especially the continual perturbations concerning mortgage rates that do occur in this market. Secondly, borrowers will be better placed to make informed decisions concerning home loans. Thirdly, the study will contribute to the literature concerning mortgage rates in Namibia in various ways. To the best knowledge of the authors of this research, this study is the first of its kind in Namibia. Further, relevant regulatory authorities and policy makers will be able to exercise a more effective control in respect of the developments in the Namibian mortgage market. The rest of the research article is structured in the following way. The next section highlights upon important facts concerning Namibia. This is followed by literature perspectives. The sources of data, research method, model construction and specification follow in that order. Afterwards, the econometric results are discussed. Finally, the policy implications arising from the study, conclusions, as well as, final comments are presented.

Namibia is often described as a mineral paradise (Ogbokor, 2002). This is because of the presence of a huge number of valuable solid minerals. Diamond, gold, copper, uranium and zinc constitute the major solid minerals found in Namibia. Namibia is heavily dependent on the extraction and processing of these minerals for export. The mining sector is the main propeller of its economy. The mining sector alone accounts for about 50% of the revenue accruing to the government treasury. However, its contribution of about 8% to the country's total gross domestic product (GDP) is rather low. The sector also employs only about 3% of the country's total labour force. Namibia is classified as an upper middle-income country. It has an estimated annual per capita income of USD5,293 (Government Annual Economic Development Report, 2013). Concomitantly, the country also manifests extreme inequalities in terms of income distribution, standard of living and quality of life. Over the past twelve years or so, the Namibian economy grew at 10% based on average figures, while simultaneously inflation rate remains a single digit figure. Exports from the economy of Namibia are principally dominated by the primary sector (mining, aquaculture and agriculture). More recently, it has been observed that the contribution of the primary sector to GDP has been diving, while the secondary sector's contribution has slightly increased. It is, however, pertinent to note that the tertiary sector remains the largest contributor to GDP. The situation is not likely to change in the near future given the current developments in Namibia. In Namibia, the public sector is the largest employer of labour accounting for about 60% of those gainfully employed. The economic system of Namibia is anchored on the principles of market forces. As earlier alluded to, the economy of Namibia has

on the average expanded consistently to the tune of 10% over the past twelve years (Government Budget Statement, 2014). The graph 1.1 below is a demonstration of this fact.

Figure 1: Line graph regarding Namibia's GDP, 1990 to 2012
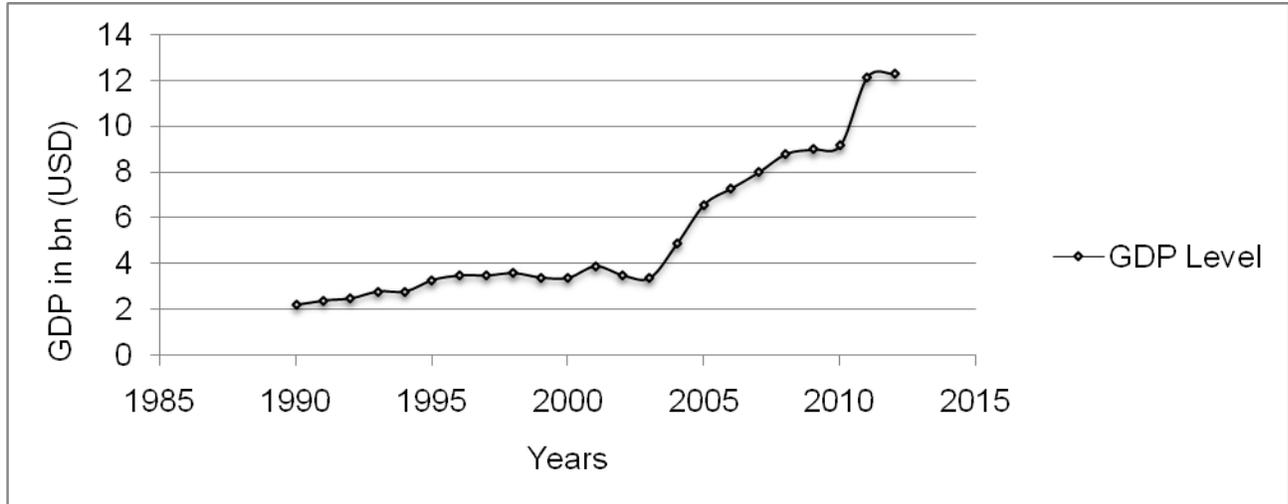
Source: GDP data (1990 to 2012) obtained from the Annual Reports of the Bank of Namibia (BoN)

Nonetheless, access to basic needs of life, such as, food (nutrition), clealiness (sanitation), clean water, education, nutrition, as well as, housing (shelter), just to mention some of them remains a key challenge in Namibia.

LITERATURE REVIEW

A huge amount of empirical studies focussing generally on interest rates, as well as, those that considers mortgage rates in specific terms are found in the literature. The study unequivocally acknowledges this fact. However, any attempt to exhaustively present and review such vast amount of literature in any single study is practically not feasible. Indeed, it would tantamount to an exercise in futility. Therefore, such an exercise is beyond the scope of this research article. In this section, we make an attempt to present and review related studies in a selective fashion, without necessarily compromising the quality of the study. In addition, it is pertinent to note that the related studies reviewed are presented in a chronological order.

Sørensen and Lichtenberger (2007) investigated the dispersion of mortgage interest rates in the Euro Area. The authors relied upon a combination of demand and supply factors in carrying out their study. These factors to a large extent were able to explain existing differences in the Euro Area, when it comes to the issue of prevailing rates in their mortgage markets. Further, this result is an indication that diverse fiscal and monetary regulatory frameworks in various mortgage markets could be the source of the dispersion. It is instructive to note that, Namibia's membership of the Common Monetary Area (CMA) makes it highly susceptible to

external shocks, especially, perturbations arising from the economy of the Republic of South Africa.

In similar fashion, (Milano: 2010) using the Euro Area as a case study analysed the 10-year benchmark interest rate on government bonds. He made use of the following variables: Interest Rate Swap, benchmark interest rate on treasuries, as well as, the Eurobor rate. Correlation tests that were carried out indicated that all the three variables under discussions are highly related. To prevent co-linearity, the Swap rate and the Eurobor were removed from the analysis model. Results indicate that the 10-year benchmark interest rate on government bonds has a significant positive impact on both fixed and variable mortgage interest rates.

Kalili (2011) in his assessment of property prices in Namibia implicated the behaviour of first bonds in the lower and upper price segments as the main factor responsible for driving upwards the mortgage credit growth in Namibia, as far as, mortgage advances are concerned. He made use of the northern, southern, coastal and central regions as case studies in his analysis.

Also, contributing to the literature, Gathungu, Matanga and Joshua (2012:) used Ordinary Least Squares (OLS) method to probe into the determinants of mortgage interest rates in Kenya. The Researchers made use of both fixed and adjustable mortgage rates in their study. They observed a combination of uni-directional and bi-directional relationships among the dependant and independent variables used in their study. Further, the monetary authority (Central Bank) was perceived to have a major influence on mortgage interest rates' movements in the national economy.

Sirmans, Sirmans and Smith (2012) contested the validity of past studies, which maintains that the ten-year treasury rate is the primary determinant of 30-year mortgage interest rates. They further proposed the LIBOR swap rate as a more appropriate substitute to mortgage rates. They stated that the ten-year Treasury rate has long been considered the primary determinant of 30-year mortgage rates. This is rather misleading. Most probably, lenders use the Ten Treasury Bond rate to price mortgage interest rates in order to avoid the possibility of under-pricing loans, as well as, to be assured of long-term profits.

Goggin et al (2012) examined movements in the interest rates charged on variable rate mortgages in Ireland. Their empirical study is one of the few that focussed explicitly on determinants of variable mortgage rates. Their analysis suggests that costs relating to increased credit risk are likely to become an important aspect in setting variable rates.

While the empirical literature presented, so far, cannot be considered as huge; it nevertheless provides some useful and thought-provoking information concerning the determinants of mortgage rates in the national economy.

RESEARCH METHODOLOGY

Design & Data Source

The study invoked and applied time series annual macroeconomic secondary data-set stretching from 1994 to 2012. The specific macroeconomic variables used in this study consist of flexible mortgage rate, repo rate (bank rate), real interest rate and risk premium. These datasets were sourced from the World Bank database, First National Bank of Namibia website, and the annual reports of the Bank of Namibia (BoN).

Econometric Approach

A time series econometric technique involving unit root test, co-integration procedures, error correction mechanisms, as well as, causality tests are used in the study in light of the nature of the issue under investigation.

Unit Root Test

The first principle in econometric time series studies is to check the dataset used for the absence or presence of non-stationarity. This is necessary, since time series data are often characterised by the issue of non-stationarity. Running regression based on datasets that are non-stationary will provide nonsensical results. Indeed, forecasting and economic policies based on such results will most likely not yield any fruitful result. In the face of non-stationary dataset, the need to perform a procedure popularly referred to in econometric literature as "first, second, third etc differencing" on the variables embedded in the regression model used in the study cannot be overemphasized. A variety of stationarity tests are suggested in the literature. However, in this study, we relied upon the Augmented Dickey-Fuller (ADF) test because of its technical superiority over most of the other suggested tests in the literature.

Co-Integration Test

The idea behind this test is to enable the researcher to check for the presence of a long-run equilibrium among the variables used in the study. Thus, co-integration between variables would imply that, there is a long-run equilibrium relationship or co-integration vectors among the variables under consideration. Once co-integration is established, there will be a strong possibility for these variables to converge overtime. Econometric literature presents a number of tests for co-integration. However, in this study, we made use of the Johansen's Maximum Likelihood Test for the following interrelated reasons: Firstly, it is simple to appreciate. Secondly, econometric literature widely supports its use in empirical studies. Thirdly, and more fundamentally, it eliminates the prejudices often associated with the use of the Ordinary Least Squares technique.

Error Correction Procedure and Causality Test

Upon obtaining, at least, one co-integrating vector among the variables used in the study, we shall proceed to specify and subsequently estimate an Error Correction Model (ECM). This procedure will allow us to correct for disequilibrium. The Granger-Causality Test will be used to gauge the possibilities of uni-directional and bi-directional relationships among the variables utilised in the study. Causality test procedures involve estimating two regression equations which are constructed through the use of variables that are related in some ways. Assuming that the two variables under consideration are inflation and economic growth; a causality test would want to know, if inflation causes economic growth or economic growth causes inflation (uni-directional) or the relationship is both ways (bidirectional relationship). The Granger Causality Test was employed in order to determine the nature of the relationship among the variables used in the study.

Econometric Model Building and Specification

Bearing in mind the driving objective of this study, as well as, the empirical and theoretical literature reviewed, we settled for the following general economic model for purposes of the study:

$$Mrt = f(Brt, Rrt, Prt) \qquad \textbf{(1)}$$

The term appearing on the left hand side of the equation 1 is mortgage rate, while the three terms on the right hand side of equation 1 are repo (bank) rate, real interest rate and risk premium.

Explicitly, the general economic model in equation (1) above can be re-specified as an econometric model in the following way:

$$Mrt = Z_0 + Z_1 Br_t + Z_2 Rr_t + Z_3 Pr_t + U_t \qquad \textbf{(2)}$$

The theoretical literature suggests a positive relationship between mortgage rates and repo rate. This is because repo rate is regarded as the benchmark for all other interest rates in the economy, and therefore influences the behaviour of almost all the other interest rates in the economy of Namibia. A positive relationship is also expected between mortgage rates and real interest rates. Based on a priori expectations, we also expect a negative relationship between mortgage rates and risk premium.

ECONOMETRIC MODEL ESTIMATION, RESULTS & DISCUSSIONS

Unit Root Test Results

For reasons already discussed, we relied upon the Augmented Dickey-Fuller (ADF) test in order to establish if the variables used in the study are stationary. The Table 1 below are results arising from the ADF unit root test, using EVIEWS software.

Table 1: ADF Unit Root Test Results

Variables	Included in Test Equations: Intercept		Included in Test Equations: Intercept and Trend		Included in Test Equations: Non		1st Difference*		2nd Difference*		Order of Integra-tion
	Optimum lag	ADF t-stat	Optimum lag	ADF t-stat	Optimum lag	ADF t-stat	Optimum lag	ADF t-stat	Optimum lag	ADF t-stat	
Mr	3	-0.7701	3	-2.9563	3	-0.9822	3	-3.2341	3	-4.3442	I(2)
Br	3	-0.6361	3	-2.8490	3	-1.3314	3	-3.1100	3	-3.4455	I(2)
Rr	3	-3.7152	3	-4.6344	3	-2.3707	3		3		I(0)
Pr	3	-3.3598	3	-4.4402	3	-1.0316	3		3		I(0)

The variables Mr and Br, indicated non-stationarity in levels, as their ADF test statistics were less than the critical values. This was consistent even after 1st differencing with a trend and intercept. Also,

Tables 2 and 3 appearing next indicates that the variables Rr and Pr are stationary in levels, and require no differencing. Hence the conclusion is that Rr and Pr are stationary series, integrated of order zero, *I(0).*

Table 2: ADF Unit Root Test Results

Unit Root Test: Rr

Null Hypothesis: RR has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 2 (Automatic - based on SIC, maxlag=3)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.634377	0.0106
Test critical values:	1% level	-4.667883	
	5% level	-3.733200	
	10% level	-3.310349	

*MacKinnon (1996) one-sided p-values.

Warning: Probabilities and critical values calculated for 20 observations

and may not be accurate for a sample size of 16

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(RR)

Method: Least Squares

Date: 10/05/13   Time: 00:49

Sample (adjusted): 1997 2012

Included observations: 16 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RR(-1)	-1.827033	0.394235	-4.634377	0.0007
D(RR(-1))	0.830874	0.311850	2.664335	0.0220
D(RR(-2))	0.629174	0.214821	2.928830	0.0137
C	16.12232	4.422971	3.645133	0.0039
@TREND(1994)	-0.619202	0.280017	-2.211297	0.0491

R-squared	0.714077	Mean dependent var	-0.362156
Adjusted R-squared	0.610105	S.D. dependent var	7.735396
S.E. of regression	4.830103	Akaike info criterion	6.237919
Sum squared resid	256.6288	Schwarz criterion	6.479353
Log likelihood	-44.90335	Hannan-Quinn criter.	6.250282
F-statistic	6.867975	Durbin-Watson stat	2.187522
Prob(F-statistic)	0.005035		

Table 3: ADF Unit Root Test Results

Unit Root test: Pr

Null Hypothesis: PR has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=3)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.440217	0.0128
Test critical values:	1% level	-4.571559	
	5% level	-3.690814	
	10% level	-3.286909	

*MacKinnon (1996) one-sided p-values.

Warning: Probabilities and critical values calculated for 20 observations

and may not be accurate for a sample size of 18

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(PR)

Method: Least Squares

Date: 10/05/13   Time: 00:47

Sample (adjusted): 1995 2012

Included observations: 18 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PR(-1)	-1.081174	0.243496	-4.440217	0.0005
C	5.121363	1.260880	4.061738	0.0010
@TREND(1994)	-0.090037	0.038414	-2.343887	0.0333
R-squared	0.570850	Mean dependent var		-0.144143
Adjusted R-squared	0.513631	S.D. dependent var		0.956546
S.E. of regression	0.667097	Akaike info criterion		2.179249
Sum squared resid	6.675277	Schwarz criterion		2.327645
Log likelihood	-16.61324	Hannan-Quinn criter.		2.199711
F-statistic	9.976426	Durbin-Watson stat		2.021488
Prob(F-statistic)	0.001756			

Estimated Model

The estimation of the parameters in our econometric model in equation **(2)** yielded the following results:

$$Mr_t = 5.06 + 0.68Br_t - 1.22Rr_t - 0.071Pr_t$$

(3)

(0.0500)   (0.0069)   (0.411)   (0.0517)

The estimated results displayed above shows a positive relationship between mortgage rates and repo rates as per theoretical expectations. Contrary to theoretical knowledge, the empirical results indicate a negative relationship between mortgage rates and real interest rates. In addition, a negative relationship was observed between risk premium and mortgage rates. A coefficient of 0.68 implies that a 1% increase in the repo rate will lead to a 0.68% increase in flexible mortgage rates. Also, a 1% percentage increase in real interest rate will result in a 1.22% decline in Mortgage Rates. Similarly, a 1% increase in risk premium will lead to a 0.071% decline in mortgage rates. Further, while Pr and Br indeed passed the significance test, Rr failed the test. The coefficient of determination (R^2) value is above 60% suggesting that the explanatory variables taken together are able to account for, at least, 60% of the systematic variation with respect to mortgage rates in the national economy. The DW statistic suggests that the estimated model is free of serial correlation.

Co-integration: Johansen's Maximum Likelihood Test

The co-integration results obtained upon the application of the Johansen's Maximum Likelihood Test are displayed in Tables 4 and 5 below:

Table 4: Johansen ML Results (Trace Test)

H_0	H_1	*Trace t-Statistic*	*5% Critical Value*
r =0	r ≥1	31.957	15.495
r ≤1	r =2	11.986	3.841

Table 5: Maximum Eigen-value Test Results

H_0	H_1	*Trace t-Statistic*	*5% Critical Value*
r =0	r =1	19.971	14.265
r =1	r =2	11.986	3.841

The Trace test statistic values in both tables are consistently greater than their corresponding critical values at 5% level. Hence we infer that mortgage rate and repo rate are co-integrated. This implies that mortgage rates and repo rates have a long-term (or equilibrium) relationship.

Vector Error Correction Model (VECM)

The detection of, at least, one co-integration vector provides a basis for the estimation of VECM. In this particular situation, the Mr and Br variables were observed to have co-integration relationship as detailed in tables 4 and 5, hence the ECM to be estimated was specified as:

$$ddMr_t = \beta_0 + \beta_1 ddBr_t + \beta_2 \mu_{t-1} + \varepsilon_t$$

(4)

Where **Mr** and **Br** are the 2nd differenced variables; β_0 is the intercept, β_1 is the short run coefficient and β_2 is the error correction coefficient. ε_t is the white noise error term. μ_{t-1} is the equilibrium error term of one period lag and is also the error correction term that guides the variables (Mr and Br) to restore back to equilibrium. β_2 indicate the rate at which the previous disequilibrium of the system is corrected. The sign of the error correction term is expected to be negative. When β_2 is significant and negative, it validates that a long run relationship exists between Mr and Br. The estimation of the ECM equation yielded the following results:

D(DMR) = C(1)(DMR(-1) - 0.561616243711*DBR(-1) + 0.201200709896) + C(2)*D(DMR(-1)) + C(3)*D(DMR(-2)) + C(4)*D(DBR(1)) + C(5) *D(DBR(-2)) + C(6)*   (5)

Table 6: ECM Coefficient Results

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	*-3.551260*	*1.256496*	*-2.826320*	*0.0198**
C(2)	1.488626	0.928933	1.602512	0.1435
C(3)	0.481547	0.541661	0.889019	0.3971
C(4)	-0.816821	0.664293	-1.229609	0.2500
C(5)	-0.188706	0.449447	-0.419863	0.6844
C(6)	0.201110	0.568754	0.353598	0.7318

*Significant at 5%

The above result conforms to a priori expectations, as the coefficient of the error correction model, C(1), is negative and significant. The coefficient value of 3.55 is the speed of adjustment towards equilibrium. The literature has pointed out that the higher this value, the better the model. Therefore, the value of 355% implies that the model is indeed adjusting extremely fast towards a long-run equilibrium.

Granger Causality Test

A causality test was done to assess the nature of the relationship between Mr and Rr though the estimation of the following pair of regression models:

$$Rr_t = \sum_{i=1}^{n} \alpha_i \, Mr_{t-i} + \sum_{j=1}^{n} \beta_j \, Rr_{t-j} + \mu 1_t$$

(6)

$$Mr_t = \sum_{i=1}^{n} \gamma_i \, Mr_{t-i} + \sum_{j=1}^{n} \delta_j \, Rr_{t-j} + \mu 1_t$$

(7)

Equation **(6)** suggests that current Rr is related to past values of itself, as well as, those of Mr. That is, Rr granger causes Mr (Rr→Mr). Equation **(7)** proposes a related tendency for Mr, which is that Mr granger causes Rr (Mr→Rr).

Table 7: Granger Causality Test Results

Null Hypothesis:	Obs	F-Statistic	Prob.
DDMR does not Granger Cause DDBR	15	0.18164	0.8366
DDBR does not Granger Cause DDMR		0.49908	0.6214

The two causality models were found to be statistically insignificant. There was also no reason to suspect any causality between Mr and Rr given the Granger Causality Test results obtained, which are displayed in Table 7 above.

CONCLUSION

The principal objective of this research article was to determine the factors influencing the behaviour of mortgage rates In Namibia. In this regard, an econometric model incorporating the following explanatory factors were used to carry-out this study for Namibia. The study relied upon selected datasets covering the years, 1994 to 2012. In addition, the study attempted to establish the exact nature of causality among the variables investigated. The results obtained through the estimation of the econometric model suggested that the three explanatory variables used were able to reasonably account for the systematic variations in Namibia's mortgage rates' swings. The bank rate (repo rate) in particular was observed to have a stronger influence on mortgage rates in Namibia in relation to the other two regressors used in the study. In addition, our results also confirmed that mortgage rates and bank rates are co-integrated; and hence, the existence of a long-run relationship between these two variables. From the policy point of view, it would be necessary for the Bank of Namibia (Central Bank of Namibia) to rely heavily on the

use of the repo rate as an instrument for controlling, monitoring and influencing developments in the Namibian mortgage market.

The limitations of this study are mainly related to data availability, time factor, sample size in terms of the number of countries considered in the study, as well as, the number of variables included in the general economic model used in the study. In realisation of these weaknesses, the following proposals/recommendations are put forward:

Firstly, there is an ultimate need for upcoming studies to rely on quarterly datasets as against annual datasets. Secondly, we suggest the inclusion of more explanatory variables in the econometric model. Thirdly, it would also be advisable for forthcoming studies concerning mortgage rates' determinants to explore the possibility of including more countries belonging to the Southern African Development Community (SADC) in their investigation for purposes of comparative analysis.

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