

## The Relationship between the Term Structure of Interest Rates and Nigeria Economic Growth and Inflation Rate

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**ABSTRACT:** The paper examined the relationship between term structure of interest rate and economic activity and also investigated the relationship between term structure of interest rate and inflation rate in Nigeria. This was with a view of providing additional evidence on the predictive power of term structure of interest rate in Nigeria. The study employed quarterly time series data, from 1986-2008. The period was chosen based on the availability of one of the data used (14 years government bond). The study employed Dynamic Ordinary Least Square (DOLS) techniques in the analysis. The diagnostics test conducted showed that the results obtained are valid and reliable. The estimated result shows that term structure of interest rate being the difference between interest rates of different maturities had positive and long run relationship with economic activity and inflation rate in Nigeria. The study concluded that the positive and significant of term structure of interest rate indicated that, term structure of interest rate in Nigeria does contain information about future inflation rate and economic activities. The study suggested that monetary authority should be consistent in interest rate policy formulation and Government should also bolster its activity in the Government securities market, as all these will improve the predictive ability of term structure of interest rate about future activities in Nigeria.

**KEYWORDS:** Interest rate, Economic Activity, Growth, Monetary Indicator,

### 1 BACKGROUND TO THE STUDY

Term structure of interest rate is defined as the difference between long term interest rate and short term interest rate. There is a consensus among economists that the term structure of interest rate is positively correlated with future economic activity and has been used by policy makers as a complement to the information in monetary aggregate. Within the range of indicators considered by the Eurosystem as possible drivers of economic activities, special attention was given to term structure of interest rate that has been traditionally considered a channel for the transmission of monetary impulses to the real variables.

The predictive content of the term structure of the interest rates for future economic growth is crucial at least for four reasons, first it is essential for private businesses as it assists them in deciding how much capacity will be required to meet future demand. Second, predicting economic activity is important for government to forecast budgetary surplus or deficits more accurately. Third, it also aids the central banks in deciding the stance of current monetary policy. Fourth, if the interest rate spread is sizeable and it contains predictive power for real GDP growth foreign investment will be attracted [58].

Using information about expectation of future macroeconomic variable as summarized in the current term structure of interest rates is attractive since high quality financial data is typically available in real time, monetary policy rule based on this information, therefore may be better suited for dealing with immediate economic conditions, rather than rules based on more slowly gathered macroeconomic data [52].

The term structure of interest rates is generally conceded to contain some information that may be of use to both market participants and to the monetary authority. The use of interest rates as predictor of the business cycle dates back to Burns and Mitchell [9] who included them in a list of useful variables to forecast real economic activity. Later, Kessel [33] provided

evidence, for the first time about the co-movement between the term structure and the business cycle, and the slope of the term structure of interest rates associated with economic downturns or recoveries.

In the course of the 1990s numerous empirical studies have provided evidence that gives compelling empirical support for that notion in a number of countries. The long list includes {Caporale[10]; Dotsey[14]; Ducker[15]; Estrella and Hardouvelis[21]; Haubrich and Dombrosky [29]; Hu [30]; Kozicki[36]; Peel and Taylor[49]; Plosser and Rouwenhust[48]}.

Although the literature on the term structure is extensive very few studies have been carried out in less developed countries (Nigeria inclusive). For example, Teriba[57] in his study examined the information content of interest rates spread on industrial output and GDP, but his analysis did not examine the effect of this term structure on inflation rate for Nigeria and his study covers mainly the period of interest rate regulation. It is against this background and given the fact that policy on interest rate is not stable in Nigeria that this study will analyse the effect of term structure of interest rates on economic activity in Nigeria.

The rest of the paper is divided into five sections, summary of literature is presented in section two, model specification is presented section three, measurement of variable is presented in section four, while section five cover the analysis of the estimated results and section six is conclusion.

**2 SUMMARY OF LITERATURE**

*Table 1: Summary of Empirical Findings in Developed Countries*

Author/Year	Country	Data type and Frequency	Methodology	Results/Conclusions
Mishkin (1990)	USA	1953-1987 (monthly data)	Econometric model, OLS	Suggests that the shorter maturity term does not contain a great deal of information about future path of inflation. But at longer maturities, the term structure of interest rate can be used to help assess future inflationary pressures
Robertson (1992)	UK	1955-1975 (quarterly data)	Cointegration techniques, OLS	At maturities of up to about four year, term structure reflect future inflation.
Frankel and Lown (1994)	USA	1960-1991 (quarterly data)	OLS	Term structure of interest rates performed better in predicting inflation over the period of study.
Engsted(1995)	OECD	1962-1993 (quarterly data)	Cointegration techniques, VAR	Long term interest rates reflect expected future inflation
Estralla and Mishikin(1997)	USA, France, Germany, Italy, UK	1973-1995 (quarterly data)	Probit model, VAR, OLS	The study used different variables to capture future economic situation, and concludes that term structure of interest rates can be used for prediction of economic activities and inflation
Davis and Fagan(1997)	European union countries	1970-1992 (quarterly data)	Ordinary least square	The longer maturity term is statistically significant for output and inflation in all except Spain, Italy, and France.
Chen(1991)	USA	1954-1988 (quarterly data)	Forecasting model, OLS	The term structure of interest rates can predict future growth rate of GNP up to five quarters ahead.
Estrella and Hardouvelis(1991)	USA	1973-1990 (quarterly data)	Econometric model, OLS	Term structure of interest rates can predict cumulative changes in GNP for up to sixteen quarters.
Harvey(1997)	Canada	1958-1995 (quarterly data)	CCPA model, OLS	The term structure of interest rates in Canada contain important information about economic growth
KimandLimpaphayom(1997)	Japan	1975-1991 (quarterly data)	Generalised method of moment(GMM)	The term structure of interest rates is useful for discovering the expectations of market participants in Japan during the deregulation period.
Alles(2001)	Australia	1976-1993 (quarterly data)	Regression model, OLS	There is positive relationship between term spread and GDP growth in Australia.
Peel and Loannidis (2002)	USA, Canada	1972-1999 (quarterly data)	Output growth forecasting model, OLS	The spread has a significant predictive content for real GDP change
Alonso et al(2001)	Spain	1973-1995 (quarterly data)	OLS	The study found little information content pertaining to the predictive ability of the term spread.
Martinez-serna and Navarro-Aribas(2003)	Spain	1993-2001 (quarterly data)	OLS	Using consumer confidence indicator(CCI) and economic sentiment indicator(ESI), the results indicated that Spanish term structure contains useful information to predict the expected economic growth.
Valadkani(2004)	European union countries	1980-2002 (quarterly data)	Output growth model, OLS	The study found that increase in the interest rates spread results in rise in GDP growth over the succeeding seven time quarters.

Table 2: Summary of Empirical Findings in Developing countries

Author/ Year	Country	Data type and frequency	Methodology	Main Results and Conclusion
Neil(1996)	South Africa	1974-1993 (quarterly data)	Econometric model, OLS	The yield curve is positively related to the growth in real GDP.
Modman(2002)	South Africa	1979-2001 (quarterly data)	Probit model, Ordinary Least Square(OLS)	The term structure successfully predicts the turning points of the business cycle in South Africa
Castelanos(2003)	Mexico	1970-2000 (quarterly data)	Ordinary Lest Square(OLS)	A positive relationship between interest rate differential and economic activity is detected.
Sahinbeyoglu and yalcin(2002)	Turkey	1991-1999 (quarterly data)	Econometric technique, OLS	The term structure of nominal interest rates have a significant but negative impact on the future path of inflation
Sheile(2006)	South Africa	1987-1995 (quarterly data)	Econometric technique, Generalised method of moment(GMM)	The term structure successfully predicted real economic activity during the entire research period
Teriba(2006)	Nigeria	1997-1995 (quarterly data)	Econometric technique, OLS	The term structure spread does predict real activity in Nigeria.

## 2.1 CONCLUSION

From the above, it can be concluded that empirical literatures on the effect of term structure of interest rates on economic activity and inflation are very few in developing countries especially the effect of the term structure on future inflation rate, Nigeria is also inclusive. Therefore this study will empirically study the relationships between term structure of interest rates and future inflation rate as well as economic activity in Nigeria

## 3 MODEL SPECIFICATION

To investigate the relationship between term structure and economic activities, the study adopted a model formulated by Kim and Limpaphayom[34]. Therefore this study uses the following equations (using real GDP and Inflation rate as proxy for Economic activities);

$$rgdp_t = \alpha + \theta_1 term_t + \theta_2 M_{2t} + \theta_3 ASI_t + \mu_t \quad (1)$$

$$infr_t = \alpha + \alpha_1 m_{2t} + \alpha_2 rgdp_t + \alpha_3 term_t + \mu_t \quad (2)$$

From equation (1)  $rgdp$  is Gross domestic Product Growth at market prices,  $\alpha$  is Intercept term, Term is the term structure of interest rates,  $M_2$  represents broad money supply, and  $ASI$  represent Nigeria stock exchange all share index. A priori, a positive relationship is expected between term structure, Money supply( $m_2$ ), all share index( $ASI$ ) and real GDP.

From equation two,  $infr$  is Inflation rate,  $M_2$  is Broad money supply, term is Term structure of interest rate and  $rgdp$  is real gross domestic product. A priori, a positive sign is expected for the term structure,  $Rgdp$  and money supply.

## 4 MEASUREMENT OF VARIABLE

The variables employed in this study are measured as follows;

$Rgdp$  which is the dependent variable measured as change in real gross domestic product, the term structure is measure as the spread between 14year federal government bond and three month treasury bill rate. The inflation rates are measured by percentage change in consumer price indices(200=100). The data on the entire variables used in the empirical study are obtained from secondary sources. These sources include the various issues of central banks of Nigeria (CBN) publications namely: statistical bulletin, Annual reports and Statement of Accounts, Economic and Financial Review and International Financial Statistics.

The quarterly data used covers the period 1986:1- 2008:4. The choice of 1986 is because it marks the era of financial deregulation in Nigeria and we chose 2008 because the study used 14years government bond to constructed term structure which no longer available after this time. For consistence purpose we decided to use this period to see if within this period the main variable which is term structure predicted economic activities. The two models in the study was estimated by Dynamic Ordinary Lest Square(DOLS) econometric technique.

**5 ECONOMETRIC ANALYSIS AND RESULTS**

**5.1 DESCRIPTIVE STATISTICS**

For the purpose analyzing the effect of term structure of interest rate on economic activity in Nigeria, this section initially examines the descriptive statistics of data series employed in this study. The descriptive statistics of data series gives information about sample statistics such as mean, median, minimum value, maximum value and distribution of the sample measured by the skewness, kurtosis and the Jaque-Bera statistic. Table 3 reports the descriptive statistics of data employed in this study.

Table 3 shows that all the series display a high level of consistency as their mean and median values are perpetually within the maximum and minimum values of these series. Moreover, the low standard deviation of nearly all the data series indicates the deviations of actual data from their mean value are very small. The skewness and kurtosis statistics provide useful information about the symmetry of the probability distribution of various data series as well as the thickness of the tails of these distributions respectively. These two statistics are particularly of great importance since they are used in the computation of Jarque-Bera statistic, which is used in testing for the normality or asymptotic property of a particular series.

**Table 3: Descriptive statistics of data(Sample 1986:1-2008:4)**

Variables	RGDP	M2	ASI	INFR	TERM
Mean	9.8059	11.5812	8.1634	4.8531	1.6946
Meadian	9.7312	11.5817	8.6566	3.6256	1.7650
Maximum	10.7781	14.7239	11.0512	20.1273	2.5300
Minimum	8.9752	8.6429	4.9473	-4.7953	-1.5700
Std. Dev	0.4672	1.7513	1.8220	5.5142	0.6212
Skewness	0.40780	-0.0771	-0.3178	0.9621	-3.0714
Kurtosis	2.2020	1.9024	1.8680	3.4653	15.3493
Jarque-Bera	4.9918	4.7089	6.4608	15.0216	729.2427
Probability	0.0824	0.0949	0.0395	0.0005	0.0000
Observations	92	92	92	92	92

This table reports the summary statistics of the main regression variables

**5.2 TIME SERIES PROPERTIES OF DATA**

To examine the effect of term structure of interest rate on economic activity proxy by real gross domestic product and inflation rate in Nigeria, it becomes crucial to examine the time-series properties of our data. To actually test for unit root this study employed the Augmented-Dickey Fuller tests. Table 4, shows that the real GDP, all share index(asi) and broad money supply are non-stationary in level. However, at first difference variables became stationary. This means that the null-hypothesis of unit root is rejected at 1% level of significance after first difference.

**Table 4 Augmented Dickey-Fuller Test**

variables	Level		First difference	
	Intercept	Intercept with trend	Intercept	Intercept with trend
RGDP	-1.6244	-3.3866***	-4.2480*	-4.1364*
ASI	-1.6664	-1.3989	-3.1572**	-3.3122***
M2	-1.0088	-27875	-4.3102*	-4.1493*
TERM	-3.9842*	-3.9823**	-14.7763*	-14.7456*
Inflr	-2.8311***	-3.1800***	-10.0585*	-10.0161*

Notes: (\*)(\*\*)(\*\*\*) means that unit root (non-stationarity) is rejected at the 1%, 5%, 10% level of significance.

### 5.3 EMPIRICAL ANALYSIS

The study employed Dynamic OLS in estimating the parameters in equation (1). That is the relationship between term structure of interest rates and economic growth in Nigeria. The beauty of the DOLS technique stems from the fact that it is a robust single estimation approach that eliminate regressors endogeneity problem and correct for serially correlated error. In applying the DOLS technique, various information criteria [Akaike Information Criterion, Schwartz Bayesian Criterion and Hannan Quinn Criterion] are initially employed in determination of the number of lags to be included in the model. The study employed 4-lags and 4-leads in the estimation process. Table 5 shows results of the estimated model. To arrive at table 5, a parsimonious result was obtained by specifying a model with regressors of four lags and four leads. This was done with the intention of choosing the best specified model. Therefore, the study reports the results of parsimonious Dynamic OLS specification in table 5

The diagnosis of the regression results indicates that the R-squared and adjusted-R-squared of 0.91 implies that 91% of the real gross domestic product is explained by the various regressors included in the model. This also means that the model display goodness of fit. The D.W statistics of 1.88 as well as the Breusch-Godfrey LM test [F=1.313, P>0.05], also indicates that the regression model does not suffer from the problems of autocorrelation. Table 5 also shows that the estimated parameters conform to their apriori signs. The diagnostic statistics in table 6 as well as the estimated parameters therefore implies that the model can be relied upon in making useful inference about the relationship between term structure of interest rates and real gross domestic product in Nigeria.

From Table 5, it is evident that a positive and long-run relationship exists between real gross domestic product and term spread. This relationship is positive and statistically significant at the 5 percent level. The significance of the term spread in the DOLS regression model implies that the term spread can be used in predicting real activity in Nigeria.

**Table 5: Relationship between Term Structure and GDP  
(Dependent Variable is Real GDP)**

Regressor	Coefficient	S. E	T-Ratio {prob}
C	6.7306	0.56067	12.00471{.000}
LOGMS	0.51215	0.080372	6.37231 {.000}
LOGASI	0.26145	0.062715	4.1688 {.000}
TERM	0.051605	0.021082	2.4478{.012}
DLOGM2[-1]	-0.30095	0.22322	-1.3482[.182]
DLOGM2 [-2]	-0.37218	0.21756	-1.71707[.092]
DLOGM2 [-3]	-0.24779	0.20910	-1.1851[.240]
DLOGM2[-4]	-0.57514	0.21504	-2.6746[.009]
DLOGM2[+1]	0.26313	0.20217	1.3015[.197]
DLOGM2[+2]	0.46025	0.19990	2.3024[.024]
DLOGM2[+3]	0.32815	0.19855	1.65271[.103]
DLOGASI[-1]	0.23825	0.13260	1.7968[.077]
DLOGASI[-4]	0.15723	0.13398	1.1735[.245]
DLOGASI[-2]	-0.083818	0.12444	-1.67356[.503]
PIDUM	0.15483	0.68602	2.2569[.027]
R-Squared	0.91190	R-Bar-Squared	0.89246
S.E.R	0.10891	Fstart.F[15,68]	46.9221[.000]
R.S.S	0.80654	DW-Statistic	1.8845

Author compilation

**Table 6: Diagnostic Test on Estimated Results Presented in Table 5**

Test Statistics	LM Version	F Version
A: Serial correlation	CHSQ[4]= 7.9437[.195]	F[4, 59] = 1.3132[.219]
B: Functional form	CHSQ[1]= 9.2113[.089]	F[1,62]= 6.9097[.079]
C: Heteroscedasticity	CHSQ[1]= 4.0125[.189]	F[1,81]= 3.0548[.364]

A: Lagrange multiplier test of residual serial correlation

B: Ramsey's RESET test using the square of the fitted values

C: Based on the regression of squared residuals on squared fitted values

Another objective of this paper is to investigate the relationship between term structure of interest rates and inflation. The study also employ the Dynamic Ordinary Least Squares{ DOLS} economics technique. Table 7 Shows that the regression model has a good fit; this is indicated by the coefficient of multiple determination{R-Squared} of 0.56898. The R-Square of approximately 57 percent indicates that almost 57 percent of variation in inflation rate {Infr} is explained by various regressors included in the model. Moreover, the D.W statistic of approximately 2, means that the regression model does not suffer from the problem of autocorrelation. This result is further corroborated by the Breusch-Godfrey LM test {F=1.2102}, P-Value >0.05}, which suggest the estimated regression does not suffer from serial correlation of residuals. With respect to the Ramsey’s Regression Equation Specification Error Test {RESET}, presented in table 8, the result from the model shows that it does not suffer from specification error such as omitted variable, incorrect functional form or correlation between the regressors and the residuals.

From the result in Table 7, it is evident that most of the estimated parameters have the a prior signs. The results indicates that a positive and long-run relationship exist between money supply and inflation. This means that an increase in money supply will bring about increase in the general price level. This relationship is not only positive but statistically significant at the 5 percent level. This is indicated by the probability value {p-value} of 0.029. The result therefore implies that increase in money supply is one of the basic factors causing inflation in Nigeria. The result also shows that a negative and significant long-run relationship exist between real gross domestic product and inflation {t-value = -0.16718, p-value <0.05}. This indicates that increase in output proxied by real gross domestic product{rgdp} would mitigating inflation. With respect to the relationship between inflation and term structure, Table 7, indicates that the term spread {term}, which is the difference between the long and short term interest rate is positively related to inflation. This means that the higher the term spread the lower the rate of inflation and vice-versa. This result, however, is also statistically significant at the 5 percent level. The significance of the term structure of interest rate in the regression model can be attributed to the financial sector reforms. For a very long time, the structure of interest rate in Nigeria was fixed and under administrative control. This result corroborates that of sahinbeyoglu and Yalcin[53] who found that a positive relationship exist between term structure of interest rates and future path of inflation in Turkey.

**Table 7: Relationship between Term Structure and Rate of Inflation (dependent Variable is Inflation rate)**

Regressor	Coefficient	Standard Error	T Ratio [prob]
C	-0.53051	0.50649	-1.0474{.299}
LOGMS	0.25472	0.012029	2.1175{.029}
LOGRGDP	-0.16718	.55441	-3.01541{.003}
TERM	-0.056624	0.015025	3.7687[.001]
DLOGM2[-1]	0.37922	0.10282	3.6884[.000]
DLOGM2 [-2]	0.17493	0.097400	1.7960 [.077]
DLOGM2 [-4]	0.16348	0.96253	1.6984 [.094]
DLOGM2 [+1]	-0.3667	0.098861	-3.6685 [.001]
DLOGM2 [+2]	-0.21262	0.094052	-2.2607[.027]
DLOGRGDP [-3]	-0.24773	0.18218	-1.3598 [.179]
DLOGRGDP [-4]	-0.60386	0.14434	-4.1836 [.000]
DLOGRGDP [+1]	0.15558	0.16018	0.971261[.335]
DLOGRGDP [+4]	0.31402	0.098305	3.1943 [.002]
DTERM [-2]	-0.016085	0.010682	-1.5058 [.137]
DTERM [-3]	-0.021360	0.010585	-2.0180 [.048]
DTERM [+1]	0.034343	0.018204	1.8866 [.064]
DTERM [+2]	0.015772	0.016264	0.969731[.336]
DTERM [+3]	0.023810	0.013081	1.8202 [.073]
DTERM[+4]	0.016584	0.012307	1.3475 [.183]
PIDUM	0.063316	0.021403	2.9585 [.018]
R- Squared	57	R- Bar-Squared	44
S.E.R	.04998	F-stat. F [ 19, 63 ]	4.3771 [.000]
R.S.S	0.15720	DW- Statistic	1.6871

Author compilation

Table 8: Diagnostic Test on Estimated Results Presented in Table 7

Test Statistics	LM Version	F Version
A: Serial correlation	CHSQ {4} = 6.2937{.178}	F {4, 59} = 1.2102{.316}
B: Functional form	CHSQ{1}= 7.2111{.008}	F{1, 62} = 5.8096{.019}
C: Heteroscedasticity	CHSQ{1}= 2.0435{.153}	F{1, 81}= 2.0446{.1571}

A: Lagrange multiplier test of residual serial correlation

B: Ramsey's RESET test using the square of the fitted values

C: Based on the regression of squared residuals on squared fitted values

## 6 CONCLUSION

This study examined the relationship between term structure of interest rate and proxy for economic activities which GDP and inflation rate. The study used Dynamic Ordinary Least Squares (DOLS) techniques to analysed the relationship. The study fund term structure of interest rate, being the difference between interest rates of different maturities incorporates an element of expected change in rates and thus indicative of changes in real economic activity and inflation rates. The results indicated that, term structure of interest rate in Nigeria does contain information about future inflation rate and economic activities. Based on these findings, the study suggests that term structure of interest rate could be used to predict future economic activity and inflation rate in Nigeria. However, unstable pattern of interest rates due to inconsistency in policy formulation affect the information content of term structure of interest rate. Therefore, the monetary authority should be consistent in their policy formulation and Government should also, bolster its activity in the Government securities market. All these will improve the predictive ability of term structure of interest rate about future activities in Nigeria.

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