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Testing for Gibson's Paradox: Evidence from Nigeria

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Abstract
This paper is set to investigate the existence of a significant long-run relationship between nominal interest rates and price levels and examine the possible causal link between the variables of interest using quarterly data on Nigeria for the periods of 1970 – 2012. Maximum likelihood method of co-integration, suggested by Johansen (1988, 1991) and Granger causality in an ADL model with p and q lags suggested by Koop (2005) are implemented to determine the number of co-integrating vectors and verify the nature and direction of causality between nominal interest rates and the price levels in Nigeria respectively. The co-integration results show that the null hypothesis of no significant long-run stable relationship between nominal interest rates and the price levels is rejected for Nigeria with the identification of one co-integrating vector. This result fines support for Gibson Paradox in Nigeria which supports the view that nominal interest rates and the price levels trend together over a long period of time and on the positive note too. When the ADL models were estimated to gauge the extent of both long and short run causality between the variables of interest, the results suggest the existence of a very strong causal link from nominal interest rates to price levels, in the long run while no causality was identified in the short run. This portrays nominal interest rate as a veritable tool for the moderation of general price level in Nigeria. This by implication puts forward the fact that supply rather than demand side dominates in determining the level of consumer price index in Nigeria. Therefore policy efforts to drop inflation while keeping the nominal interest rate high may prove ineffective in Nigeria as the two share strong positive correlation.
Keywords: Nominal interest rates, price level, Gibson paradox, cointegration, Nigeria

1. Introduction

An economic observation made by J. M. Keynes during the period of the gold standard, indicates a correlation between interest rates and the general price level. Keynes discussed this finding in his work "A Treatise on Money" (1930). The designation of this result as a paradox stem from the fact it expressed a contrary view to that generally held by economists at the time, which was that interest rates were correlated to the rate of inflation. The result of Keynes' study showed that interest rates were highly correlated to wholesale prices but had little correlation to the rate of inflation. In effect, this paradox hypothesizes that interest rate movements are significantly linked to the level of prices rather than the rate of change in prices. It is on the strength of the above observation that this study intends to investigate the possible long-run relationship between nominal interest rates and the price levels. Furthermore, we test for direction of short term and long-run causal relationship between nominal interest rates and the price level dynamics over the period of 1970 – 2012 using quarterly data on Nigeria,. In effect, this study hypothesizes that the rate of interest is the cause of inflation in Nigeria. The study employs money deposit banks lending interest rates and inflation rates for the period under review in investigation of the hypothesis.The remaining part of this paper is structured as follows: In section 2, brief review of related literature is presented; section 3 presents Data and Econometric methodology; section 4, empirical results and section 5, the concluding remarks.

2. Empirical Review

Irving Fisher writing by1896 expressed a view that interest rate is a function of the rate of price changes rather than the price level. He further characterized real interest rate as the observed nominal market rate of interest as adjusted for the anticipated rate of change of prices. But writing in 1930, J. M. Keynes expressed a divergent view from the fisher's effect. Keynes was rather of the believe that price levels and interest rates tend to rise together and to fall together, a phenomenon he described as "Gibson Paradox" and one of the most completely established empirical facts within the whole field of quantitative economics. Fisher in an attempt to reconcile the empirical generalization with his theory interpreted the Gibson phenomenon as the manifestation the slow adjustment of anticipations of inflation to actual changes in prices. This account was not acceptable to Keynes who in 1930 offered a very different explanation. He was of the opinion that the Gibson phenomenon reflected the delayed reaction of commercial banks to changes in the real rate of interest. This equally did not command general acceptability and satisfaction among economists. To this effect, "Gibson paradox" appears to be an empirical phenomenon without a theoretical explanation (see King & Watson, 1997). There is plethora of empirical investigations on the Gibson phenomenon as summarized below.

Shiller & Siegel (1977) analyze the correlation between interest rates and prices which has persisted for the past quarter of a millennium and has been termed the Gibson Paradox. Using Spectral techniques they confirmed the correlation between long-term interest rates and prices for very long-term swings (the Gibson Paradox), but indicate a significant short cycle correlation only for short-term interest rates, which they termed the Kitchin Phenomenon. Past explanations of these correlations have often failed to distinguish cycle lengths and term of interest rates involved. The result of their analysis rejects Irving Fisher's "price expectation" explanation and the Sargent-Wicksell velocity of money explanations. Based on this result they articulated alternative explanations which in part relate to the characteristic behavior of governments during wartime and in part to distributional effects of unanticipated inflation. Their result strongly suggests that prior to World War I nominal long and short rates of interest can be regarded as real rates.

The Gibson paradox, long observed by economists and named by John Maynard Keynes (1936), is a positive relationship between the interest rate and the price level. Hannsgen (2006) in his paper explains the relationship by means of interest-rate, cost-push inflation. In the model, spending is driven in part by changes in the rate of interest, and the central bank sets the interest rate using a policy rule based on the levels of output and inflation. The model reveals that the cost-push effect of inflation, long known as Gibson's paradox, intensifies destabilizing forces and can be involved in the generation of cycles.

Halicioglu (2004) tested the existence of Gibson paradox using the traditional and modern time series technique in the case of developing country, Turkey. Even though the results from the traditional Gibson paradox regression suggested a positive relationship between interest rates and the price levels in Turkey data, subsequently it was proven to be spurious. On analyzing the time series property of the variables and the results from the Johanson cointegration procedure, the results reveal that there is no support for Gibson paradox in turkey.

In the same vein, Barsky & Summers (1985) provided a new explanation for Gibson's Paradox —the observation that the price level and the nominal interest rate are positively correlated over long periods of economic history. They explained this phenomenon in terms of the fundamental workings of a gold standard. Under a gold standard, the price level is the reciprocal of the real price of gold. Because gold is a durable asset, its relative price is systematically affected by fluctuations in the real productivity of capital, which also determines real interest rates. Their resolution of the Gibson Paradox seems more satisfactory than previous hypotheses. It explains why the paradox applied to real as well as nominal rates of return, its coincidence with the gold standard period, and the co-movement of interest rates, prices, and the stock of monetary gold during the gold standard period. Empirical evidence using contemporary data on gold prices and real interest rates supported their theory.

Cogley, Sargent & Surico (2011) estimating vector autoregressions with drifting parameters and stochastic volatility, show that the statistical association between inflation and nominal interest rates declined in the U.S. in the late 1980s and that Gibson's paradox reappeared after 1995.They estimated th new Keynesian DSGE model for two subsamples (the Great Inflation and the period after 1995) to identify structural changes that contributed to its reappearance. Counterfactual experiments point to two features: a more anti-inflationary monetary policy rule and a decline in the extent of price indexation to past inflation. They found out that Changes in these features account for the return of the Gibson paradox.

Sertis & Zestos (1999) use developments in the theory of nonstationary regressors to investigate the empirical relationship previously taken to support the Gibson paradox using quarterly data over the period of 1957:1-1994:4 on nominal interest rates – prices for eight European countries of Belgium, Denmark, England, France, Ireland Italy and the Netherland employing the methodology suggested by Kydland and Prescott. They results suggest that the (relevant) cyclical nominal interest rates-price level contemporaneous correlations are week. This casts doubt in the validity of the Gibson paradox phenomenon. Evidence based on the integration property of the data equally reveal that standard Gibson paradox regressions are spurious.

Furthermore, Milne & Torous (1984) examine the Canadian evidence on the existence of the Gibson Paradox. The results demonstrate a positive and statistically significant correlation between the long-term interest rate and the price level over the time period 1870-1981 at frequencies corresponding to the Gibson Paradox. They used Cross-spectral techniques in the analysis, and an attempt was made to eliminate foreign influences from the Canadian data by computing deviations from interest rate parity theory and purchasing power parity theory. In explaining the Gibson Paradox in the Canadian data, the results indicate that long-term movements in the price level are due to interest-responsive long-term movements in the stock of high-powered money and long-term movements in the interest-sensitive money multiplier.

Abdulla (2013) aims to provide an analysis and explanation of the curious empirical relationships that exist between the price of gold, the interest rate and commodity prices, operating under the English 19th century fractional reserve gold standard and the modern American fractional reserve *fiat* paper standard, known as the Gibson Paradox. The paper argues that the value and purchasing power of the British pound and American dollar are managed in relation to their rate of exchange with gold and the real rate of interest, such that, changes in the

general level of prices are the effect and not the cause.

Propositions about long run neutrality are at the heart of most macroeconomic models. Yet, since the 1970's when Lucas and Sargent presented powerful critiques of traditional neutrality tests, empirical researchers have made little progress on testing these propositions. King & Watson (1997) show that in spite of the Lucas-Sargent critique, long run neutrality can be tested without specifying a complete model of economic activity which is possible when the variables are integrated. In this case, permanent shifts in the historical data can be uncovered using VAR methods, and neutrality can be tested when there is a priori knowledge of one of the structural impact multipliers or one of the structural long run multipliers. In most circumstances such a priori knowledge is available. King& Watson use this framework to test four long run neutrality propositions: (i) the neutrality of money, (ii) the super neutrality of money. (iii) a vertical long run Phillips curve, and (iv) the Fisher effect. In each application, their a priori knowledge consists of a range of plausible values for the relevant impact and long run multipliers. Their results indicate that the U.S. postwar data are consistent with the neutrality of money and a vertical long run Phillips curve. They equally found evidence against the super neutrality of money and the long run Fisher relation. They opined that the sign of the estimated effect of money growth on output depends on the particular identifying assumption used. For a wide range of plausible identifying restrictions the results further indicate that nominal interest rates are found to move less than one-for-one with inflation in the long run.

Sulku, (2011) examine the long run neutrality of money, LMN, in the Turkish economy applying Fisher and Seater (1993) ARIMA framework, considering different monetary aggregates, M1, M2, M2Y and M3, during the period of 1987:Q1-2006:Q3. The results indicate that LMN holds in Turkey and the results are robust under all alternative monetary aggregates.

3. Data and Methodology

3.1 Data

This study explored quarterly data on Nigeria for the period1970Q1-2012Q4 due to the absence of published nominal interest rates (R) at this frequency, before 1970. Money Deposit Bank (MDB) lending rates, sourced from IFS- Online 2013 were used as proxy for the nominal interest rates. The justification for this choice stem from the fact that these are the rates to which investments respond. Nigerian consumer price index (P) of 2005=100, as sourced from the same IFS-Online 2013 was used as proxy for the price levels.

3.2 Model Specification

Evidence of discrepancies trailing Fisher's hypothesis is the scenario which Keynes (1930) referred to as "Gibson Paradox", which suggests that over a long time horizon, interest rates are highly correlated with the aggregate level of commodity prices, rather than rate of price changes (inflation), a view contra to Fisher effect. Abstracting from the method of Halicioglu (2004), we express Gibson regression as follows:

$$lP_t = a + bR_t + \mu_t \quad (1)$$

where: p is the price level, l is the logarithm, t indicates the time trend, a is the constant, b represents the parameter estimate, R is the nominal interest rate and μ, the stochastic error term.

Nominal interest rates are not taken to logarithm for the fact that they are expressed in percentages.

To provide for more informed policy decisions, this study digresses further to investigate the direction of influence via testing for granger causality between nominal interest rates and the price level. In the light of the above, we intend to investigate the nature of the causal relationship between interest rates dynamics and inflation rates in Nigeria for the periods 1970 – 2012, using bi-variate (ADL) representations founded on cointegration analysis and the error correction modeling (ECM) strategy. This enables the study to evaluate the nature of causality between nominal interest rates and the price level in both long and short-run frameworks. To achieve these fits, we implement simple ADL models with p and q lags suggested by Koop (2005), using multiple equation models as specified below:

$$Xt = \alpha + \gamma_1 X_{t-1} + \ldots + \gamma_p X_{t-p} + \beta_1 Y_{t-1} \ldots \beta_q Y_{t-q} + e_{1t} \quad (2)$$

$$Yt = \alpha + \beta_2 Y_{t-1} + \ldots + \beta_q Y_{t-q} + \gamma_2 X_{t-1} \ldots \gamma_p X_{t-p} + e_{2t} \quad (3)$$

The above VAR models provide us the platform for gauging the direction of causality between nominal interest rates and the price level in the short run. This multiple modeling approach has become very necessary since in many cases, it is not obvious which way causality could run. In the same vein, Sargent (1971) explained that it is inadequate to hypothesize a one-way influence running from inflation to interest rates or vice versa in explaining Gibson Paradox, but instead within the context of bi-variate models, it is necessary to view interest rate and inflation as being mutually determined, hence should exhibit bi-directional relationship.

The decision rules to guide the interpretation of the results of testing the null hypothesis that $\beta_1 = \ldots = \beta_q = 0$ and $\gamma_2 = \ldots = \gamma_p = 0$ are as follows:

(i)Using the 5% significance level for equation 3, if all or any of the P-values for the coefficients $\beta_1, \ldots, \beta_q$ were less than 0.05, we reject the null hypothesis of no causality and conclude that inflation (X) granger cause interest rates (Y). (ii)Using the same level of significance for equation 4, if all or any of the P-values for the coefficients $\gamma_2, \ldots, \gamma_p$ is less than 0.05, we reject the null hypothesis of no causality and conclude that interest rates (Y)

granger cause inflation (X). (iii) If none of the P-vaues is less than 0.05, then we conclude that Granger causality is absent.

To inquire for the existence of causal link between the variables under review in the long run time horizon, equations 2 and 3 are augmented with their respective error terms lagged one period $\lambda_1 e_{1t-1}$ and $\lambda_2 e_{2t-1}$ respectively. λ_1 and λ_2 indicate the parameter estimates of the error terms. These transform the above VAR to VEC models which are evaluated for flow of long run causality from nominal interest rates to price levels and vice-versa. If equation 2 as augmented with it's error term lagged one period is evaluated and $\beta_1=,\ldots,=\beta_q= \lambda_1 = 0$ indicates no long-run causal link from nominal interest rates to price level and if for equation 3 as adjusted $\gamma_2=,\ldots,=\gamma_p = \lambda_2 = 0$ suggests no significant long run causal association from price levels to nominal interest rates.

3.3 Estimation Procedure

To avoid the problem of spurious regression, it is pertinent that the time series properties of the data sets employed in the estimation of equation (1) is verified. The Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) unit root test techniques are used to investigate the integration level and the possible cointegration among the variables (Dickey and Fuller, 1981; Phillips and Perron, 1988). The ADF test involves estimating the following regression.

$$\Delta X_t = \alpha + \rho_{t+} \beta X_{t-1} + \sum^{i} \lambda X_{t-1+} \varepsilon_t \quad (4)$$

where x is the variable under consideration, Δ is the first difference indicator, t is the time trend and ε is the stochastic error term. A series Xt is said to be integrated of order d denoted by Xt ~I(d) if it becomes stationary after differencing d times and thus X contains d unit roots and a series which is I(0) is said to be stationary (Anwer and Sampath,1997). Phillips and Perron (1988) developed a number of unit root tests that have become popular in the analysis of financial time series. The Phillips-Perron (PP) unit root tests differ from the ADF tests mainly in how they deal with serial correlation and heteroskedasticity in the errors. In particular, where the ADF tests use a parametric auto regression to approximate the ARMA structure of the errors in the test regression, the PP tests ignore any serial correlation in the test regression. The test regression for the PP tests is:

$$\Delta y_t = \beta! \, D_t + \pi y_t - 1 + u_t \quad (5)$$

where u_t is I(0) and may be heteroskedastic. The PP tests correct for any serial correlation and heteroskedasticity in the errors u_t of the test regression by directly modifying the test statistics.

If the variables are integrated of the same order, we apply the Johansen –Juselius (1990, 1992, and 1994) maximum likelihood method test for cointegration to gauge the number of cointegrating vector(s). Finally, if cointegration is identified, vector error correction (VEC) models are specified and evaluated for long term causal link between the employed variables.

4. Empirical Results

4.1 Unit Root Tests

An implicit assumptions that underlie regression analysis involving time series data is that such a data series is stationary (Gujarati, 1995). In this context, testing for stationary or otherwise of the employed data sets becomes of essence in this analysis.

Table2: Unit Root Test Results

		ADF		PP		Conclusion
Variables	Level/First Diff.	Intercept	Trend/Intercept	Intercept	Trend/Intercept	
R	Level	-1.784	-1.944	-1.798	-1.999	1(1)
	First Diff.	-13.122	-13.109	-13.122	-13.109	1(0)
LP	Level	4.I36	2.887	11.705	4.906	1(1)
	First Diff.	-1.229	-3.368	-9.075	-11.316	1(0)

Notes: (i) Unit root tests performed using Eview 6.0
(ii) 95% critical value ADF/PP statistic (with intercept) = -2.878
(iii) 95% critical value ADF/PP statistic (with trend & intercept) =3.437

The results of *ADF* and *PP* in table1 above show that at 95% level of significance, nominal interest rates and price levels variables, both become stationary in their first difference. This suggests that all the employed variables for estimation of the equations are quiet suitable for purposes intended after one period lag.

4.3 Tests for Co-integration

With the manifestation of unit root 1(1) by variables of interest, which is a precondition for the existence of a stable linear steady-state relationship, we employ Johansen and Juselius Trace and maximum eigenvalue tests for co-integrating vectors between the explained and the explanatory variables in equation 1 with a view to determining the number of co-integrating equations (Johansen &Juselius 1990, 1992, &1994). The concept of co-integration was first instigated by Granger (1981) and modified by Engle and Granger (1987), Johansen (1988) and Johansen and Juselius (1990), amongst others. Johansen and Juselius Trace tests procedure are based

on the comparison of H_0 *(r = o)* against the alternative H_1 *(r ≠ o)*, where r indicates the number of co integrating vectors.

Table 2: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical value	Prob**
None*	0.1316	25.693	15.494	0.0011
At most 1	0.0126	2.128	3.8414	0.1446

Notes: (i) Co-integration tests performed using Eview 6.0
(ii) Trace test indicates 1 Cointegrating equation at the 0.05 level
(iii) * denotes rejection of the hypothesis at the 0.05 level

Table 3: Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical value	Prob**
None*	0.1316	23.564	14.264	0.0013
At most 1	0.0126	2.128	3.8414	0.1446

Notes: (i) Cointegration tests performed using Eview 6.0
(ii) Max-eigenvalue test indicates 1 cointegrating equation at the 0.05 level
(iii) * denotes rejection of the hypothesis at the 0.05 level

Results of Trace and Max-eigenvalue tests for co integration to investigate the extent to which long-run equilibrium relationship exists between price level and nominal interest rates in Nigeria are as shown in tables 2 & 3 above. Starting with the null hypothesis of no cointegration (r = 0) between the price levels (P) and nominal interest rates (R), the results of the tests indicate 1 co-integrating vector (r = 1) each. These suggest that the existence of long run equilibrium relationship between the price levels and nominal interest rates cannot be rejected for Nigeria. In effect, for Nigeria, the Gibson phenomenon, which predicts the tendency for nominal interest rates and the price levels to rise and fall together, is identified in the long run.

Table 4: Estimates of Long-Run Co-integrating Vectors (Linearised)

LP	R
1.000000	2.188981
	(0.89678)

Figure in parentheses indicate standard errors.

From table 4 above it is evident that for Nigeria, there is strong positive relationship existing between nominal interest rates and price levels and nominal interest rates are found to move more than one-for-two with price levels in the long run. The result to this extent fails to expose the direction of flow of such effect. To this effect, we take a step further to investigate the direction of flow of causality between the explained and the explanatory variables.

4.4 Testing for Short and Long-run Granger Causality

4.4.1. Estimating VAR Models for Short-run Granger Causality

Table 5: Vector Autoregressive Estimates (Equ 2)

Regressors	**Parameter Estimate**	**T-Ratio**	**P-Values**
Intercept	-0.243	-0.808	0.419
LP (-1)	1.074	13.894	0.000
LP (-2)	-0.070	-0.906	0.365
R (-1)	**-0.051**	**-0.653**	**0.513**
R (-2)	**0.103**	**1.339**	**0.181**

Notes: R^2 = 0.9992, DW. Statistic = 1.997

For equation 2 (VAR), the Results of the estimation as shown in table 5 above indicate that β_1=,…,=β_q= 0.The values of the parameter estimates (coefficients) of R (-1) and R (-2) are -0.051 (0.513) and 0.103 (0.181) respectively with the figures in brackets indicating their respective P-Values. These results indicate that the value of the coefficient of R (-1) and R (-2) of -0.051 and 0.103 are both not statistically different from zero even at 10% level of significance judging from their respective P-Values. These results suggest non existence of a significant causal link from nominal interest rates to price level in the short run.

Table 6: Vector Autoregressive Estimates (Eq. 3)

Regressors	Parameter Estimates	T-Ratio	P-Values
Intercept	0.559	1.844	0.066
R (-1)	0.058	0.747	0.455
R (-2)	0.967	12.446	0.000
LP (-1)	**-0.060**	**-0.752**	**0.452**
LP (-2)	**-0.000**	**-0.007**	**0.994**

Notes: $R^2 = 0.83$, DW. Statistic = 2.28

For equation 3 (VAR), the Results of the estimation as shown in table 6 indicate that $\gamma_2=,\ldots,=\gamma_p = 0$.The values of the parameter estimates (coefficients) of LP (-1) and LP (-2) are -0.060 (0.452) and -0.000 (0.994) respectively with the figures in brackets indicating their respective P-Values. This suggests the non existence of a significant causal link from price level to nominal interest rates in the short run.

4.4.2. Estimating VEC Model for Long-run Granger Causality

With the identification of a co integrating relation for Nigeria, error correction models (ECM) estimates presents the best option for predicting the dynamic behavior of price level in response to nominal interest rates innovations. In the same vein, the error correction model presents us with the veritable platform for testing for long run granger causality between price levels and nominal interest rates to confirm the existence or otherwise of Gibson phenomenon in Nigeria which is the cardinal objective (focus) of this study. In this direction, we evaluate the VAR (2) models specified in equations 2 & 3 augmenting each with its error correction term (error term lagged one period) e_{t-1}. This transforms each of the VAR to VEC model of two period lags.

In tables 7 & 8 below, equations 2 and 3 as augmented with inclusion of $e_{1\ (t-1)}$ and $e_{2\ (t-1)}$ respectively are evaluated for flow of long run causality from nominal interest rates to price levels and vice–versa. If equation 2 as adjusted (VECM) is evaluated and $\beta_1=,\ldots,=\beta_q= \lambda_1 = 0$ indicates no long-run causal link from nominal interest rates to price level.

Table 7 VECM Estimation (Eq. 2 Augmented with $e_{1\ (t-1)}$)

Regressor	Parameter Estimate	T-Ratio	P-Values
Intercept	1.515	8.812	0.000
LP (-1)	0.046	0.605	0.545
LP (-2)	-0.101	-1.383	0.167
R (-1)	**-0.281**	**-3.680**	**0.000**
R (-2)	**-0.123**	**-0.667**	**0.096**
$\mathbf{e_{1(t-1)}}$	**0.030**	**9.102**	**0.000**

$R^2 = 0.510$, D.W Statistic 2.057

For equation 2 as adjusted (VECM), the Results of the estimation as shown in table 7 above indicate that $\beta_1=,\ldots,=\beta_q= \lambda_1 \neq 0$. The values of the parameter estimates (coefficients) of R (-1), R (-2) and $e_{1\ (t-1)}$ are -0.281(0.000), -0.123 (0.096) and 0.030 (0.000) respectively with the figures in brackets indicating their respective P-Values. These results indicate that the value of the coefficients R (-1) and $e_{1\ (t-1)}$ of -0.281 and 0.030 respectively are statistically different from zero even at 1% level of significance. This suggests that the null hypothesis that, $\beta_1=,\ldots,=\beta_q= \lambda_1 = 0$ is violated. The results suggest the existence of a significant causal link from nominal interest rates to price levels, in the long run. This effect suggests that nominal interest rate is a veritable tool for the moderation of general price level in Nigeria. This by implication puts forward the fact that supply rather than demand side dominates in determining the level of consumer price index in Nigeria.

Table 8 VECM Estimation (Eq. 3 Augmented with $e_{2(t-1)}$

Regressor	Parameter Estimate	T-Ratio	P-Values
Intercept	-0.018	-0.099	0.920
R (-1)	0.068	0.844	0.399
R (-2)	-0.013	-1.176	0.859
LP (-1)	**-0.006**	**-0.086**	**0.931**
LP(-2)	**0.023**	**0.305**	**0.760**
$e_{2(t-1)}$	**-0.003**	**-1.045**	**0.296**

$R^2 = 0.0111$, D.W Statistic 1.998

For equation 3 as adjusted, (VEC) model, the Results of the estimation as shown in table 8 indicate that $\gamma_2=,\ldots,=\gamma_p = \lambda_2 = 0$. The values of the parameter estimates (coefficients) of LP (-1), LP (-2) and $e_{1\ (t-1)}$ are -0.006 (0.931), 0.023 (0.760) and -0.003 (0.296) respectively with the figures in brackets indicating their respective P-Values. These results indicate that the value of the coefficient of LP (-1), LP (-2) and $e_{1\ (t-1)}$ of -0.006, 0.023 and -0.003 are all not statistically different from zero even at 10% level of significance judging from their respective P-Values. These results suggest non existence of a significant causal link from price levels to nominal interest rates in the long run.

5. Concluding Remark

This paper has investigated the existence of a significant long-run relationship between nominal interest rates and price levels and examines the possible causal link between the variables of interest using quarterly data on Nigeria for the periods of 1970 – 2012. Maximum likelihood method of co-integration, suggested by Johansen (1988, 1991) and Granger causality in an ADL model with p and q lags suggested by Koop (2005) are implemented to determine the number of co-integrating vectors and verify the nature and direction of causality between nominal interest rates and the price levels in Nigeria respectively. The co-integration results show that the null hypothesis of no significant long-run stable relationship between nominal interest rates and the price levels is rejected for Nigeria with the identification of one co-integrating vector. This result fines support for Gibson Paradox in Nigeria which supports the view that nominal interest rates and the price levels trend together over a long period of time and on the positive note too. When the ADL models were estimated to gauge the extent of both long and short run causality between the variables of interest, the results suggest the existence of a very strong causal link from nominal interest rates to price levels, in the long run while no causality was identified in the short run. This portrays nominal interest rate as a veritable tool for the moderation of general price level in Nigeria. This by implication puts forward the fact that supply rather than demand side dominates in determining the level of consumer price index in Nigeria. Therefore policy efforts to drop inflation while keeping the nominal interest rate high may prove ineffective in Nigeria as the two share strong positive relationship.

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