International Review of Business Research Papers
Vol. 5 No. 5 September 2009 Pp. 96-109

An Empirical Investigation of The Fisher Effect in Nigeria: A Co-Integration and Error Correction Approach

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The paper examines the existence of fisher effect for Nigeria, by regressing interest rates on inflation rate during the period 1970-2007. The co-integration and error correction regression results indicate that increases in inflation rate lead to increase in nominal interest rates by less than one point, thus confirming the existence of a long run partial fisher effect in Nigeria. The author recommends that the monetary authorities should employ strategies that will prevent inflation from rising if nominal interest rates are to be kept at low levels. In addition, government should give more subsidies, and increase its investment in infrastructure (power, transports, etc.,) in order to promote and raise production. These measures among other things would go a long way in curbing inflation rate and interest rates.

Keywords: fisher effect, inflation, interest rates, co-integration, error-correction.

I. Introduction

The existence of fisher hypothesis has continued to generate series of debate among economists. Fisher (1930) asserted that a percentage increase in the expected rate of inflation would lead to a percentage increase in the nominal interest rates. But Jens Weidmann (1997) opined that full fisher effect applies only to economies without taxes. However, Tobin (1965) argued that real interest rate decreases with inflation, while Darby (1975) believed that interest rate changes by more than one for a unit change in inflation rate, due to the tax effect on interest income. On his part, Mishkin (1984) emphasized that due to the negative correlation between interest rates and inflation, full fisher effect may not hold. Besides, Dutt and Ghosh (1995), Evans (1998), Junttila (2001), and Tillmann (2004) did not believe that the fisher hypothesis holds because they could not confirm any relationship between interest rates and inflation.

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Interest rate refers to the price a borrower pays for temporary usage of capital. It also implies the returns a lender expects by postponing and parting with his/her liquidity. The interest rate is a double-hedge sword in that if it is high, holders of surplus funds will part with some since they expect high returns in the future. On the other hand, higher interest rates discourage borrowing. In a state of equilibrium, interest rate equates demand (investment) and supply (saving) in the capital market (Duetsche Bundesbank, 2001).

Real interest rate is an important determinant of saving and investment behaviour of households and businesses, and therefore crucial in the growth and development of an economy (Duetsche Bundesbank, 2001). Both households and firms are mainly concerned with the real returns (interest) on their assets holding. Even though they know the nominal return (interest) on their assets holding, they are not certain about the direction of inflation in the current period (Hakan and Kamuran, 1999). Given their expectations about the future real interest rates, they decide which assets to hold. If the uncertainty surrounding expected inflation is very high, they will expect the return on their investment to be higher.

Inflation refers to persistent increase in general prices. The rate of inflation has far-reaching implications for the performance of the economy. For instance, higher rates of inflation will reduce aggregate demand, production, unemployment, trade deficits, and balance of payment to mention just few. On the other hand, a low and moderate inflation will encourage economic activity, particularly production. This in turn will raise gross domestic product (GDP), reduce unemployment, and eases the balance of payment problems.

Available statistics reveal that both interest rate (captured by the lending rate) and inflation rate have trended together. For instance, inflation rate rose from 13.8 percent in 1970 to 21.2 percent and 39.6 percent in 1976 and 1984, respectively. The increase in inflation rate continued, as it jumped to 44.5 percent in 1992 before reaching 57.2 percent in 1993. However, inflation rate fell to 6.9 percent and 5.4 percent in 2000 and 2007, respectively. In the same vein, interest rate increased from 8 percent in 1970 to 10 percent in 1976 and further to 13 percent in 1984. Interest rate continued to rise, moving to 31.2 percent and 36.09 percent in 1992 and 1993, respectively. However, interest rate declined to 21.55 percent in 2000 and to 5.4 percent in 2007. The high rates of interest and inflation have adverse effects on investment demand. The decline in investment expenditure in turn leads to low levels of production and employment, and decline in the wellbeing of the peoples.

This study is important because empirical studies on the existence of fisher effect in developing countries remain scanty. Besides, the high rates of interest and inflation have continued to be source of worry for both government and policy

makers. The paper is structured as follows. Following the introduction, section two consists of literature review and theoretical framework. Section three is for methodology and model estimation, while section four is the discussion of results. Section five consists of recommendations and conclusion.

2. Literature review and theoretical framework

This section reviews relevant literature on fisher hypothesis (that is, interest rates-inflation relationship). For instance, Hakan Berument and Kamuran Malatyali (1999) analyzed the interest behaviour within the fisher hypothesis framework for Turkey. The authors discovered that interest rates increase with expected inflation. After, controlling for risk factor, they found that real interest rates declines with higher inflation. The work of Fahmy and Kandil (2003) does not support the short-run fisher effect because expected inflation has negligible impact on short-term interest rates. However, the correlation between inflation and nominal interest rates is very strong in the long run. Rolando Peláez (1995) performed a co-integration analysis for quarterly inflation rate and expectation rate of inflation extracted from the three-month treasury bill rate. The results showed that the variables (interest rates and inflation) are co-integrated. Bharat Kolluri and Subrahmanyam Ganti (1982) employed several techniques for the United States for the period 1953–1978. The authors discovered a strong association between nominal interest rates and the expected rate of inflation except during the period 1953 to 1960.

Lee Coppock and Marc Poitras (2000) examined the fisher hypothesis in Brazil and Peru. The results did not support the evidence of full fisher effect. After controlling for risk, the authors found that interest rates did not fully adjust to changes in inflation. Taufiq Choudhry et al (1991) reported a stronger fisher effect in the early 1980s. Mitchell-Innes et al (2008) examined whether the fisher effect holds during the period of inflation targeting in South Africa (2000-2005). The results showed that in the short-run fisher hypothesis did not hold during the inflation targeting period. The authors blamed the South African Reserve Bank's (SARB) for controlling short-term interest rates. But, in the long run a partial fisher effect exists. Mishkin and Simon (1995) investigated whether the fisher effect holds for Australia. The authors' results illustrate that whereas in the long run the fisher effect exist, the same cannot be said for the short-run. They submitted that, short-run changes in interest rates reflect changes in monetary policy, while long run movement in interest rates is attributable to inflationary expectations.

Chen and Shrestha (1998) examined short- and long-run fisher relationship for US, UK, Canada and Japan, using monthly data on Euro-currency interest rates and inflation rates. The authors confirmed a long-run fisher effect for all the countries. However, short-run fisher effect exists only for UK and Japan. Kasimir Kaliva (2007) findings support the existence of full fisher effect, because nominal interest rates and expected inflation move one-for-one both in the short

run and the long run. Richard Froyen and Lawrence Davidson (1978) confirmed a partial existence of fisher hypothesis, because the reaction of nominal interest rates to an increase in the expected inflation rate is not one-on-one, for the period they studied. Perez and Siegler (2003) employed both univariate and multivariate techniques to estimate the expected price level changes for the U.S. during the pre-World War I period. They concluded that expected inflation has a significant positive influence on nominal interest rates. Moreover, they confirmed the fisher effect in the short-run. Paul Johnson (2005) reported that both inflation and interest rates are co-integrated, even though fuller fisher effect does not exist.

On his part, Lee (2007) employed the Johansen's technique to test the fisher hypothesis for Singapore for the period 1976-2006. The author discovered a long term fisher effect, and a positive relation was found to exist between inflation rate and interest rates. However, there was no evidence of a full fisher effect. Following the work of Lee (2007), Fama and Gibson (1982), Huizing and Mishkin (1986), and Kandel et al (1996) discovered a partial fisher effect as interest rates react to inflation rate on less than one-for-one basis. Akio Kuroda (1983) found that expected rate of inflation has a significant impact on nominal interest rates, but the fisher effect was found not to be full. Besides, the fisher effect is more in the long run than in the short run. Whereas, Mitchell-Innes (2006) discovered a long run fisher effect, there was no evidence in the short run for South Africa. Westerlund (2008) used panel co-integration to test the fisher hypothesis among OECD countries. The author confirmed the existence of fisher effect. Andreas Beyer et al (2009) investigated the fisher hypothesis for a group of 15 countries, and found a long term relationship between inflation and interest rates. Laurian (1998) using an error-correction model found evidence of fisher effect for the United Kingdom, but the fisher effect exist only in the long run. Atkins and Coe (2002) discovered a long run fisher effect for Canada and the United States. Ekaterini Panpoulou (2005) attempted to test the existence of fisher effect among 14 OECD countries, and observed a full fisher effect as interest rates move one-to-one with inflation rate. Jens Weidmann (1997) re-examined the long run relationship between nominal interest rates and inflation for Germany. The results illustrate that interest rates do not fully adjust to changes in inflation, thus rejecting full fisher effect.

On the contrary, Darby (1975) indicated that interest rates change by more than one for a unit change in inflation rate due to the tax effect on interest income. The findings by Hawtrey (1997), and Crowder and Hoffman (1996) lend support to the fisher's hypothesis. Dutt and Ghosh (1995) found no evidence of fisher effect in Canada. But Tllmann (2004) found evidence of fisher effect. Evans (1998) and Junttila (2001) failed to support the claim that interest rates and inflation are associated.

Theoretical framework

The theoretical framework of this study has its basis on the fisher hypothesis. The theory states that expected inflation is the main determinants of nominal interest rates. It is argued that both households and firms are mainly concerned with the real return on their asset holdings. Even though they are certain about the nominal return on their investment, they are not certain about the movement of inflation (Hakan Berument and Kamuran Malatyali, 1999). Given this uncertainty, they choose which asset to hold taken into consideration various real interest rates in the market. Thus, if there is high expectation of the movement of inflation, economic agents would expect high returns (on interest rates) on their assets. However, Tobin (1965) argued that real interest rate decreases with inflation.

3. Methodology and model estimation

The study employed co-integration and error correction technique to analyze the fisher effect in Nigeria. In the fisher hypothesis, a change in inflation is expected to influence nominal interest rates in one-on-one basis. That is, if inflation rises by 1 percentage nominal interest rates would increase by 1 percentage. Thus, the relationship between interest rate (INTR) and inflation (IFN) is expressed as:

$INTR = f(IFN, U_t)$…… (1)

Even though the objective of this study is to examine the effect of inflation on interest rates, there are other variables that can affect interest rates. The variables include money supply and overall fiscal deficits. Thus, I would include money supply (MOS) and overall fiscal deficits in the interest rate function. The new model is specified as:

$INTR = f(IFN_t, LnMOS_t, FISBA_t, U_t)$…….. (2)

The nominal value of the variables is used, except money supply that is measured in natural logarithm form. The variables are time series, and are obtained from the Central Bank of Nigeria statistical bulletin (various issues).

Before estimation of the interest rate model, I would perform stationarity (unit root) test and causality test. The stationarity test is carried out to ensure that the econometric results generated will be meaningful. The augmented dicker-fuller (ADF) statistic is used to examine the stationarity of the variables.

Table 1: Results of stationarity (unit root) test

Variables	ADF-statistic	Critical values	Order of integration
INTR	-6.897088 (0.0000)	1%= -2.632688 5%= -1.950687 10%= -1.611059	Stationary at first difference
IFN	-5.946757 (0.0000)	1%= -2.632688 5%= -1.950687 10%= -1.611059	Stationary at first difference
LnMOS	-2.047676 (0.0404)	5%= -1.950394 10%= -1.611202	Stationary at first difference
FISBA	-6.240103 (0.0000)	1%= -2.630762 5%= -1.950394 10%= -1.611202	Stationary at first difference
ECM	-3.525413 (0.0008)	1%= -2.628961 5%= -1.950117 10%= -1.611339	Stationary at levels

The results of the unit root indicate that interest rates, inflation, money supply and fiscal deficits are stationary at first difference, while the error correction variable is stationary are levels. Having performed the unit root test, we moved further to estimate the interest rate function. The result of the estimation is presented in the table below:

Table 2: Regression results
Dependent Variable: INTR
Method: Least Squares
Date: 05/15/09 Time: 12:26
Sample(adjusted): 1971 2007
Included observations: 37 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.401936	3.849875	-0.364151	0.7181
IFN(-1)	0.125549	0.044193	2.840908	0.0078
LNMOS	1.346529	0.390020	3.452463	0.0016
FISBA	-2.45E-05	1.13E-05	-2.156958	0.0386
ECM(-1)	0.607966	0.148537	4.093037	0.0003
R-squared	0.723198	Mean dependent var		17.60081
Adjusted R-squared	0.688598	S.D. dependent var		7.376433
S.E. of regression	4.116301	Akaike info criterion		5.792875
Sum squared resid	542.2058	Schwarz criterion		6.010567
Log likelihood	-102.1682	F-statistic		20.90155
Durbin-Watson stat	2.128106	Prob(F-statistic)		0.000000

4. Discussion of results

The econometric results show that the explanatory variables account for 72.3 percentage changes in nominal interest rates. The estimation also reveals that the explanatory variables are jointly significant and capable of explaining the changes in the interest rates. Moreover, the Durbin Watson statistic indicates the absence of serial correlation. The results show that lagged inflation (the variable of interest) is significant and positively related to interest rates. A 1 percentage increase in lagged inflation leads to 0.13 percentage increase in interest rates. This finding lends support to the existence of partial fisher effect in Nigeria, because both interest rates and inflation rate do not move with one-for-one. It

also consistent with the findings by Fama and Gibson (1982), Huizing and Mishkin (1986), Kandel et al (1996), and Lee (2007) that interest rates and inflation do not move with one-for-one. The estimation also reveals that money supply has a significant positive impact on interest rates. A 1 percentage increase in money supply raises interest rates by 1.35 percentage increase in interest rates. Furthermore, it is shown that fiscal deficit has a significant negative influence on interest rates. A 1 percentage increase in fiscal deficits causes the interest rates to fall by 0.000025 percentage. Lastly, the adjustment parameter is shown to be significant and positively signed, and the variables have been found to be co-integrated since the regression residual does not have a unit root even at levels.

5. Recommendation and Conclusion

The paper examines the fisher effect in Nigeria, by employing co-integration and error correction techniques. In line with previous studies, we discovered that a long run partial fisher effect exists for Nigeria. The author recommends that the monetary authorities should employ policies that would check inflation from rising. This can be achieved by encouraging and supporting the production sector of the economy through subsidies, improvement in infrastructure (like power, transport and telecommunications) and so on.

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Appendix 1: Macroeconomic indicators

Years	Interest rate (%)	Inflation rate (%)	Money supply (Nm)	Fiscal deficits/surplus (Nm)
1970	8	13.8	950	-455.1
1971	10	16	1,005.30	171.6
1972	10	3.2	1,616.30	-58.8
1973	10	5.4	1,414	166.1
1974	10	13.4	2,156.20	1,796.40
1975	9	33.9	3,622.40	-427.9
1976	10	21.2	5,278.90	-1,090.80
1977	6	15.4	7,056.70	-781.4
1978	11	16.6	7,699.50	-2,821.90
1979	11	11.8	9,857.70	1,461.70
1980	9.5	9.9	14,397.40	-1,975.20
1981	10	20.9	15,548.10	-3,902.10
1982	11.75	7.7	16,894.10	-6,104.10
1983	11.5	23.2	19,368.90	-3,364.50
1984	13	39.6	21,560.50	-2,660.40
1985	11.75	5.5	23,818.60	-3,039.70
1986	12	5.4	24,215.40	-8,254.30
1987	19.2	10.2	32,092.80	-5,889.70
1988	17.6	38.3	42,780.30	-12,160.90
1989	24.6	40.9	46,222.90	-15,134.70
1990	27.7	7.5	64,902.70	-22,116.10
1991	20.8	13	86,150	-35,755.20
1992	31.2	44.5	129,085.40	-39,532.50
1993	36.09	57.2	198,519.10	-107,735.30
1994	21	57	266,994.90	-70,270.60
1995	20.79	72.8	318,763.50	1,000.00
1996	20.86	29.3	370,333.50	32,049.40
1997	23.32	8.5	429,731.30	-5,000.00
1998	21.34	10	525,637.80	-133,389.30
1999	27.19	6.6	699,733.70	-285,104.70
2000	21.55	6.9	1,036,079.50	-103,777.30
2001	21.34	18.9	1,315,869.10	-221,048.90
2002	30.19	12.9	1,599,494.60	-301,401.60
2003	22.88	14	1,985,191.80	-202,724.70
2004	20.82	15	2,263,587.88	-172,601.30
2005	19.49	17.9	2,814,846.10	-161,406.30
2006	18.41	8.2	4,027,901.70	-101,397.50
2007	18.36	5.4	5,809,826.50	117.20

Source: Central Bank of Nigeria (various issues)

Appendix 2: Variables used for regression exercise

YEAR	INTR (%)	IFN (%)	LnMOS	FISBA (Nm)	ECM
1970	8	13.8	6.856461985	-455.1	-1.025925
1971	10	16	6.913041283	171.6	0.601029
1972	10	3.2	7.387894865	-58.8	1.679341
1973	10	5.4	7.254177846	166.1	1.574709
1974	10	13.4	7.676102692	1,796.40	-0.11374
1975	9	33.9	8.194892069	-427.9	-4.77451
1976	10	21.2	8.571473022	-1,090.80	-2.57697
1977	6	15.4	8.861732799	-781.4	-6.18804
1978	11	16.6	8.948910671	-2,821.90	-1.53205
1979	11	11.8	9.196008155	1,461.70	-1.12186
1980	9.5	9.9	9.574802914	-1,975.20	-2.99569
1981	10	20.9	9.651693724	-3,902.10	-4.18333
1982	11.75	7.7	9.734719728	-6,104.10	-0.77472
1983	11.5	23.2	9.871423966	-3,364.50	-3.31098
1984	13	39.6	9.978618216	-2,660.40	-4.22885
1985	11.75	5.5	10.07822207	-3,039.70	-0.89647
1986	12	5.4	10.09474407	-8,254.30	-0.78411
1987	19.2	10.2	10.37638698	-5,889.70	5.395038
1988	17.6	38.3	10.663833	-12,160.90	-0.68215
1989	24.6	40.9	10.74123063	-15,134.70	5.770853
1990	27.7	7.5	11.0806445	-22,116.10	12.8441
1991	20.8	13	11.36384524	-35,755.20	4.432814
1992	31.2	44.5	11.76822948	-39,532.50	9.773233
1993	36.09	57.2	12.1986406	-107,735.30	10.60369
1994	21	57	12.49498484	-70,270.60	-3.97669
1995	20.79	72.8	12.67220473	1,000.00	-4.89992
1996	20.86	29.3	12.82215923	32,049.40	1.752396
1997	23.32	8.5	12.97091541	-5,000.00	5.97953
1998	21.34	10	13.17236766	-133,389.30	0.360562
1999	27.19	6.6	13.45845511	-285,104.70	2.558809
2000	21.55	6.9	13.85095444	-103,777.30	0.732379
2001	21.34	18.9	14.09000792	-221,048.90	-4.35869
2002	30.19	12.9	14.28519826	-301,401.60	3.07676
2003	22.88	14	14.50122609	-202,724.70	-2.29162
2004	20.82	15	14.63246167	-172,601.30	-3.94662
2005	19.49	17.9	14.85041815	-161,406.30	-5.72472
2006	18.41	8.2	15.20875613	-101,397.50	-4.51531
2007	18.36	5.4	15.57506127	117.20	-2.23229