Volume 20 Issue 42
Originally issued as C5



Global Journal of Management and Business Research: C Finance
Volume 20 Issue 5 Version 1.0 Year 2020
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4588 & Print ISSN: 0975-5853

An Empirical Test of the Relationship between Exchange Rate, Interest Rate and Inflation in Five African Countries from 1980 to 2012

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GJMBR-C Classification: JEL Code: F31



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An Empirical Test of the Relationship between Exchange Rate, Interest Rate and Inflation in Five African Countries from 1980 to 2012

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Abstract- **The study examines the empirical relationship between exchange rate, interest rate and inflation in the context of Sub - Sahara African countries using panel data over 1980-2012 periods. The estimated values of the pooled, fixed and random effects models reveal identical results that interest rate and inflation maintain a monotonous relationship with the exchange rate, though the relationship is insignificant for interest rote only in the random effect model based on 1% level of significance. However; the result of the Hausman Test shows that the random effect model is not appropriate rather, the fixed-effect model is preferred. Based, on the Johansen Fisher panel co integration approach, a long-run relationship is established among the specified variables. Finally, it was discovered that the interest rate is weakly exogenously determined in the selected-countries throughout the freely and managed floating exchange rate systems.**

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I. Introduction

The volatility of nature for prices is a major source of concern in all countries since the 1970s. The issue of a more serious nature in sub-Saharan African countries where inflation in foreign countries known as "imported inflation" is seen to be driving "domestic inflation", making policies to control inflation ineffective. Continuous devaluation of currency and inflation in the 1980s seems to suggest a correlation between the two variables. Kenya experienced a persistent increase in inflation from 1980 - 2012, the exchange rate depreciated in 2012 compared to 2011 and 2010, interest appreciated slightly in 2012 and 2011 compared to 2010. Inflation consistently increased in Nigeria, from 1980- 1991 creeping inflation, 1992 - 1994 walking inflation, 1995 - 1939 running inflation, 2000 - 2012 hyperinflation, the exchange rate depreciated if 2012 compared to 2011 likewise Interest rate. Botswana, the exchange rate depreciated slightly in 2012. Inflation 1980-1984 running inflation, 1985 - 2000 galloping inflation or hyperinflation i.e. inflation In Botswana persistently increased at a faster rate into hyperinflation which causes a continuous fall in the purchasing power of the Botswana National Currency - Pula. Egypt, the exchange rate appreciated slightly, inflation continued firmly from walking to hyperinflation and remained stubbornly, the interest rate increased at a creeping rate (IMF, country report 2012). Malawi, exchange rate continued to appreciate, inflation degenerates into hyperinflation (IMF database, 2012), interest rate increase at a creeping rate World Bank Database, 2012).

The connection between exchange rate, interest rate and inflation has long been a key focus *of* international economies--most standard theoretical models *of* exchange rates predict that exchange rate is determined by economic fundamentals, one of which is the interest rate differentia! between home and abroad.

The modern exchange rate theories view exchange rate as a purely financial phenomenon, Friedman hypothesis stipulates that inflation is always and everywhere a monetary phenomenon and can be produced only by a more rapid increase in the quantity of money than output. The Neo-classical and their followers at the University of Chicago, inflation is fundamentally a monetary phenomenon. A high rate of inflation causes severe fluctuations in exchange rates. The Keynesian liquidity preference theory emphasis that rate of interest is purely a monetary phenomenon. When prices rise, the same unit of a currency can buy less. Central Banks use the interest rate to control the money supply and consequently, the inflation rate.

The relationship between exchange rate, Interest rate, and inflation has been ranging or perhaps inclusive issues for professionals /researchers since the advent of macroeconomic theory. A good number of authors have empirically and some cases theoretically examined these interrelationships over time and across Nations, but no conclusion has been reached on the effects of inflation on the exchange rate and interest rate. Therefore, diversity of the nature and duration of effects on this subject matter has attracted a lot of interest in the literature.

Evidence has shown in the study of Simon and Rajak (1999), even Lahari and He Hatrovashaska (2008) made a striking contribution to the relationship between the exchange rate and interest rate. According to them, a positive relationship exists between the exchange rate and interest rate. But Lahari and Hanatrovaska further affirmed that there was a non-monotonic relationship between changes in the level of the inflation rate and

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changes in the exchange rate. Also, Furma and Stiglitz (1998) examined the effect' of an increase in interest rate, inflation and some non-monetary factors on an exchange rate for developing countries and found that a high-interest rate induced appreciation of nominal exchange rate but this effect was more pronounced in low inflation countries than high inflation countries. But the study of Goldfajin and Baig (1998) reported the absence of strong co integration regarding the relationship between the interest rate and exchange rate.

In recent times. Gel and Ekinci (2006), Herwatz and Reimers (2005), Westerlund (2005), Ling, and Wafa (2010), Sathya, Sharma and Liu's study suggested a positive relationship between the interest rate and inflation. However, Summers (1983) had earlier rejected the Fisherian hypothesis that supports the long-run relationship between the interest rate and inflation. In the equal vein, the study of Hong and Phillips (2005) gave mixed results on the presence of co integration.

The absence of clear-cut empirical relationships between exchange rate and other macroeconomic variables are even more pronounced in Nigeria for example, Aigbonkhan (1991) and Omotor (2008) emphasized that inflation, exchange rate, money supply, government expenditure and real GDP are significantly related while Enoma (2011) concluded that exchange rate depreciation, money supply and real GDP are the prime determinant of inflation in Nigeria. Therefore, the discrepancies in these studies need to be further examined in the context of sub-Sahara African countries of which this study sets out to accomplish.

II. Review of Related Literatur

Literature related to this study will be reviewed under the following subheadings, theoretical underpinning and the empirical basis of the study.

a) Theoretical Underpinning

Purchasing power parity theory (PPP) propounded by David Ricardo in 1821, elaborated and brought back into use by the Swedish economist, Gustav Cassel. The PPP theory provides, the long-run framework for the monetary and asset market or portfolio balance approaches to exchange rate determination. The purchasing power parity theory has an absolute and relative version. The theory says that the equilibrium exchange rate between two currencies is equal to the ratio of the price levels she in two nations.

b) Absolute purchasing power parity theory

Postulate that the equilibrium exchange rate between two currencies is equal to the ratio of the price levels in the two nations. It is misleading because it completely disregards the capital account, the existence of many non-traded goods, and it fans to take transportation cost or other obstruction to the free flow of international trade.

c) Relative purchasing power parity theory

It postulates that the change in the exchange rate over some time should be proportional to the relative change in the price levels in the two nations over the same time.

The modern exchange rate theories are based on the monetary approach and the asset market or portfolio balance of payments that have been developed since the late 1960s. These theories view the exchange rate as a purely financial phenomenon, and they also seek to explain the great short-run volatility of exchange rate and their tendency to overshoot their long-run equilibrium level. These theories are different from the traditional exchange rate theories which are based on trade flows and help explain exchange rate movements only in the long-run.

d) Inflation

It is a highly controversial term which has undergone modification since it was first defined by the neoclassical economists. The neo-classical economists defined inflation as a galloping rise in prices as a result of the excessive increase in the quantity of money. They regard inflation as destroying disease born out of lack of monetary control whose results undermined the rules of business, creating havoc in markets and financial ruin of even the prudent. It fundamentally a monetary phenomenon. But Keynes did not believe like the neo-classical, according to him, there being underemployment in the economy, an increase in money supply leads to an increase in aggregate demand, output and employment. Both Keynesians and monetarist believe that inflation is caused by increased in the aggregate demand (increase in the money supply).

e) Theories of interest Rate

We have:

i. The classical,
ii. The loanable funds,
iii. The Keynesian and
iv. The modern theory of interest rate.

The Keynesian liquidity preference theory determines interest rate by the demand for and supply of money which is a stock theory. Its emphasis that the rate of interest is a purely monetary phenomenon. On the other hand, the loanable fund's theory is a flow theory that determines interest rate by the demand for and supply of loanable funds. Prof. Robertson criticized the loanable fund theory as a "common sense explanation" of the determination of the rate of interest. But this theory is also not free from certain defects.

According to the classical theory, the rate of interest is determined by the supply of and demand of capital the supply of capital is governed by time preference and the demand for capital by the expected-productivity of capital.

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f) Empirical Literature

In Africa, both monetary and structural factors were considered as the root cause of inflation and exchange rate as carried by Chhibber et al. (1989) macroeconomic effects of devaluation in Zimbabwe a CGE analysis. Madesha Chidoko and Zivanomoyo (2012) looked into the empirical relationship between exchange rate and inflation in Zimbabwe during the period 1980 to 2007. Using the Granger causality test, estimated results reveal that both exchange rate and inflation have a long-run relationship. On the other hand, inflation and exchange rate are found to granger-cause each, other during the period under consideration. Hegerty (2012) carried out a study titled: Does high inflation lead to increased inflation uncertainty? Evidence from nine African countries, using monthly data beginning in January 1976 and end in early 2012.

The study proxies uncertainty for sub-Saharan Africa with exponential GRACH Models, before testing for relationships using Granger causality tests and impulse-response functions, inflation increases are shown to fuel uncertainty in all cases, while the reverse relationship holds for only half of the countries. Imimole and Enema (2011) examined the impact of exchange rate depreciation on inflation in Nigeria for the period 1986 - 2008, using an Auto-Regressive Distributed Lag (ARDL) cointegration procedure. The research found that exchange rate depreciation, money supply and real gross domestic product are the main determinants of inflation in Nigeria and that Naira depreciation is positive, and has a significant long-run effect on inflation in Nigeria. This implies that the exchange rate depreciation can bring about an increase in the inflation rate in Nigeria. However, Sowa and Kwakye (1993) claim that Chibber and Shafik (1992), emphasize monetary factors at the expense of supply factors in Gnana and conclude that the supply constraint (output) was the main force behind inflation. Goswami (2008) conducted a study on the relationship between exchange rate and Interest rate, the result reveals that there is a strong positive relationship between exchange rate and interest rate, confirming the findings of the study carried out by Simon and Razak (1999). Keminsky and Schumulkler (1998) studied the relationship between the interest rate and exchange rate in six Asian Countries, the result concludes that interest rate is not exogenously determined by the exchange rate. Adetiloye, Kehinde Adekunle (2010) study adopted techniques of correlation and find the significance of the relationship between the consumer price index and the exchange rate in Nigeria, using 1986 to 2007 data. They found out that there is a higher positive relationship between the ratio of Imports and the index than exist between the parallel and official rates. Lahlri and Hanatrovaska (2008) investigated the relationship between interest rate end exchange rate. Their findings revealed a strong positive relationship between the exchange rate and interest rate. Kanas (2000) study on Colombia extended the works of Montiel (1989) and Dornbush, Fischer (1990) observed that exchange rates did not play an important role in explaining the variation in inflation in Colombia and that Inflation appeared to be primarily inertial concerning the exchange rate but largely determined by demand shocks.

Ndungu, (1993) estimated a six- variable VAR on money supply, domestic price level, exchange rate index, foreign price index, real output and the rate of interest. In an attempt to explain the inflation movement in Kenya, he observed that the rate of inflation and exchange rate explained each other. Canetti and Greene (1991), using vector auto regression analysis to separate the influence of money supply growth from exchange rate changes on prevailing and predicted rates of inflation in Africa, find that both exchange rate movements and monetary expansion affect consumer price changes in several sub-Sahara African Countries. In particular, the authors find a significant causal impact of exchange rates on prices in Sierra Leone, Tanzania and the Congo. Greene and Canetti (1991) evaluated the relative strength of exchange rate and monetary expansion in propagating inflation in ten African Countries, the results prove that the exchange rate explains the inflationary trend in these countries.

London (1989), examined on money supply and exchange rate, in the inflationary process of twenty-three African Countries. The application of cure monetarist model on supply, expected inflation and real income were significant determinants of inflation for the period between 1974 and 1985. The exchange rate was later Included as one of the explanatory variables in pure monetarist modal and the result shows that exchange rate movement had a remarkable influence on the inflationary process in the 1980s.

III. Method of Study and Data

a) Model Specification

The relationships between exchange rate and inflation using pane! data can be modelled based deed and random effect frameworks. The formal presupposes that the constant term varies cross-sectionally but is fixed overtime; the slope estimates are ail fixed both cross-sectionally and over time, interestingly, the later also ascertains the same reports, but the overt difference between the two models are in the context of the random-effect model, the constant terms in respect of each cross-sectional unit rise from a global intercept term and a random variable which in turn measures the random deviation of each cross-sectional unit constant term from the global intercept term. However, before specifying these models, let us look at the mathematical relationship between exchange rate and price changes (i.e. inflation) as specified by the purchasing power parity theory (PPP) of Ricardo (1821).

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$$xcht = \alpha 0 + \alpha 1\,(p - p^*)t + et \quad \ldots\ldots (1)$$

Where:

Xch means the Exchange rate
p means the domestic price index
p* means foreign price index

Therefore, p – p* implies changes in prices which could induce inflation. Analogously, expression (1) can be restated as

$$xcht = \alpha 0 + \alpha 1 Inft + \mu t \quad \ldots\ldots (2)$$

Aigbonkhan (1991) and Ornotor (2008) provided evidence in support of the influence of the exchange rate on the interest rate. Thus, in response to this, the underlying expression (2} can be expanded by including interest rate into it.

$$xcht = b0 + b1Inft + b2Intt + zt \quad \ldots\ldots (3)$$

A visual view reveals that equation (3) is a time series specification, but our interest is on panel data expressions. Hence, equation (3) is transformed into panel specification as follows:

$$xcht = \lambda 0 + \lambda 1Infit + \lambda 2Intit + \varepsilon it \quad \ldots\ldots (4)$$

Equation (4) is referred to as pooled data regression model. To derive the Fixed Effect Model (FEM), we can decompose the random term εit into individual-specific effect and the remainder disturbance term. That is:

$$\varepsilon it = \mu it + vit \quad \ldots\ldots (5)$$

Where:
μit is the remainder disturbance term.
By substituting μit and vit in place of εit in equation (4), the following specification can be derived:

$$xchit = P0 + P1Infit + P2Intit + \mu it + vit \quad \ldots\ldots (6)$$

μt encapsulates all the variables that affect the exchange rate (xch) but remains constant over time.

The Fixed Effect Model (FEM) can be estimated using dummy variables or what is ordinarily called Least Squares Dummy Variables (LSDV) approach.
Thus:

$$xchit = P1Infit + P2Intit + \mu 1Dum1 + \mu 2Dum2 + \mu 3\,Dum3 + \mu 4\,Dum4\,\mu 5Dum5 + vit \quad \ldots\ldots (7)$$

Where:

Dum1 is a dummy variable for Kenya and it takes the value of 1 for all the observations of Kenya in the sample and zero value of otherwise.

Dum2 is a dummy variable for Nigeria and it takes the value of 1 for all the observations of Nigeria in the sample and zero value of otherwise.

Dum3 is a dummy variable for Botswana and it takes the value of 1 for all the observations of Botswana in the sample and zeroes otherwise.

Dum4 is a dummy variable for Egypt and it takes the value of 1 for all the observations of Egypt in the sample and zeroes otherwise.

Dum5 is a dummy variable for Malawi and it takes the value of 1 for all the observations of Malawi and zeroes otherwise.

Bringing in the random effect case into our discussion, we can restate equation (4) to suit this purpose. Thus:

$$xchit = C0 + C1Infit + C2Intit + Wit \quad \ldots\ldots (8)$$

$$\text{Where: } Wit = C1 + vit$$

Thus:

$$xchit = C0 + C1Infit + C2Intit + eit + Vit \quad \ldots\ldots (9)$$

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Where:
eit is the new cross-sectional error term.
Vit is the individual observation error term.

The assumption here is *e-t* satisfy the ID conditions. Also, dummy variables are not required to capture the heterogeneity in the cross-sectional dimension.

b) Data

Inflation data in respect of the five countries is sourced from the IMF country report 2012. Exchange rates are obtained from the individual countries' Central Banks Statistical Bulletins; while interest rates (lending rate) are collected from World Bank report 2012 for each of the five sub-Sahara African countries.

IV. Data Analysis

a) Results

The presentation and discussion of our findings followed sequentially, first, we present the results of the selected descriptive statistics for each economy and the aggregated economies as follows in Table 4.1.

Table 4.1: Results of the Descriptive Analysis

Currency	**Shilling (Kenya)**	**Naira (Nigeria)**	**Pula (Botswana)**	**Pound (Egypt)**	**Pound (Malawi)**
Mean	1.02	1.03	1.03	1.04	54.78
SD	0.10	0.13	0.13	0.09	66.55
Range	0.80 – 1.19	0.80 - 1.29	0.80 – 1.29	0.91 – 1.34	0.81 (249.11)
JB	0.87 (0.64)	1.10 (0.58)	0.84 (0.66)	29.99 (0.00) **	6.29 (0.04) *

Panel B: Annual Interest Rate for Kenya, Nigeria, Botswana, Egypt and Malawi

Country	**Kenya**	**Nigeria**	**Botswana**	**Egypt**	**Malawi**
Mean	18.65	17.62	13.40	14.68	29.94
SD	6.82	5.45	3.34	2.46	12.30
Range	10.60 – 36.20	8.4 – 31.70	7.70 -24.20	11.00 – 20.30	16.50 – 56.20
JB	8.12 (0.02) *	0.05 (0.98)	5.40 (0.07)	2.71 (0.26)	4.75 (0.09)

Panel C: Annual Inflation for Kenya, Nigeria, Botswana, Egypt and Malawi

Country	**Kenya**	**Nigeria**	**Botswana**	**Egypt**	**Malawi**
Mean	80.17	34.69	92.62	89.37	97.35
SD	69.15	39.61	72.95	70.46	117.46
Range	7.30 (247.26)	0.46 (134.22)	13.36 (247.26)	8.49 (289.65)	143 (369.55)
JB	3.71 (0.16)	6.10 (0.05) *	3.89 (0.14)	6.05 (0.05) *	5.33 (0.07)

Panel D: Annual Exchange Rate, Interest Rate & Inflation for the aggregated Economies

Variable	**Exchange Rate**	**Interest Rate**	**Inflation**
Mean	11.78	18.86	78.84
SD	36.46	9.07	80.38
Range	0.80 (249.11)	7.70 (56.20)	0.46 (369)
JB	2081.78 (0.00) **	269.09 (0.00) **	52.68 (0.00) **

Source: Extracted from E-View Program Window (7)

The results in pane! A reveal the descriptive statistics of values of exchange rate series for 1980 to 2012 period. The mean values for exchange rate throughout the five countries manifest positive values. This means that the exchange rates of these countries have, an increasing tendency. The standard deviation or volatility of the exchange rate appears to be less volatile in all the countries except Malawi where the series

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deviate drastically from its mean value. Also, the spread of the series is widest in Malawi. It is equally shown that exchange rate is only normally distributed in Egypt and Malawi (see the JB Statistics and their correspondent pvs). Panel B shows the descriptive values of the interest rate for the specified countries. The results are analogous to those of panel A except that the series is only normally distributed in Kenya. Panel C centres on inflation and it is discovered that the series is only normally distributed in Nigeria and Egypt but more volatile and unstable in Malawi. Thus, Malawi is prone to inflationary spirals.

The results of the five economies are amazingly surprising as reported in panel C. The mean values of the three variables have an increasing tendency since they are positive. The degree of volatility is less in case of interest rate but more in inflation almost approaching 100%. This reveals to us that the region under investigation is on the aggregate riddle with persistent upward changes in prices of goods and services; however, the specified variables are normally distributed over the studied period (1980-2012).

b) Test for Maximum Lag Selection

It is quite arbitrary to use any lag value in empirical work. Given this, we select our optimum lag length using the VAR lag order selection criteria and the results are presented in Table 4.2

Table 4.2: The Result of Lag Selection Criteria

Lag	LogL	LR	PPE	AIC	SC	HQ
0	-216.92740	NA	1333.488	15.70910	15.85104	15.75274
1	-114.40990	175.7443	1.684641	9.029280	9.600225*	9.203824*
2	-108.92890	6.221574	2.224383	9.280834	10.27979	9.586685
3	-94.05795	19.11976*	1.562734*	8.861282*	10.28864	9.297641
4	-85.75400	8.897083	1.874272	8.911000	10.76657	9.478267
5	-76.87057	7.614376	2.398889	8.919326	11.20311	9.617500

*indicates log order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)
PPE: Final prediction error
AIC: Akaike information criterion
SC: Schwartz information criterion
HQ: Hannan-Quinn information criterion

The results above give two conflicting positions. The AIC, LR and FPE select lag 3 while SC and HQ prefer lag 2. However, our study employs SC and HQ selection.

c) Test for Stationarity

Table 4.3: Panel Data Unit Root Test based on ADF-Fisher and ADF-Chio z-Statistics

Series	ADF-Fisher (χ^2)	ADF-Choi (z-stat)	Remarks
Xch (-1)	32.38 (0.00) *	-2.18 (0.01) *	Stationary
Int (-1)	24.02 (0.01) *	-2.87 (0.00) *	Stationary
Inf (-1)	28.81 (0.00) *	-2.19 (0.01) *	Stationary

*Note: The figures in parenthesis are p-values & * implies significant*
Source: Extracted from E-view program window (7).

The probability values for both ADF-Fisher and ADF-Choi statistics h respect of the specified series are ail less than 5% as revealed in Table 4.3. Therefore, the null hypothesis of a unit root in the series of exchange, interest rate and inflation is rejected at first deference. This means that the series is 1(1} complaint anticipating a cointegration test. Here, Johansen Fisher Panel cointegration test under the assumption of intercept no trend is adopted. The test results are reported in Table 4.4

Table 4.4: The Results of Johansen Fisher panel Cointegration Test

Hypothesized No of [(CE(s)]	Fisher Stat (based on trace test)	Fisher Stat (based on Max-Eigen test)
No Cointegration Vector	83.17 (0.00)	65.45 (0.00)

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At most one Cointegration vector	31.22 (0.00)	27.10 (0.00)
At most two integration vectors	19.37 (0.04)	19.37 (0.04)

Note: The figures in parenthesis are the R-values and the significant level is based on 1% (i.e. 0.01}

Source: Extracted from E-view program Window (7)

In the first row, the hypothesis of no cointegration is rejected since the probability values of both Fisher trace and Fisher max Eigen Statistics are less than 1%. The same thing is observed in the hypothesis that the system does not have at most one cointegration vector is rejected. However, In the third row, the hypothesis that there are no at most two cointegration vectors is net rejected at 1% level of significance. Thus, there are at least two cointegrating equations in the system implying that exchange rate, interest rate and inflation are cointegrated in the specified countries.

It is now empirically imperative to evaluate the nature and significance of the relationships between the variables by estimating the pooled, fixed and random effect models which are stated in section three.

Table 4.5: Showing the Nature of the Relationship between Exchange Rate, Interest Rate and Inflation

Pooled Regression Result				**Fixed Effect Regression Result**			**Random Regression Result**		
Variable	**Coeff.**	**t-value**	**p.v**	**Coeff.**	**t-value**	**p.v**	**Coeff.**	**t-value**	**pv**
Constant	-39.00	-7.89	0.00	-39.00	-13.73	0.00	-11.00	-3.32	0.00
Interest	1.64	7.39	0.00	1.65	12.85	0.00	0.48	0.90	0.06
Inflation	0.25	9.93	0.00	0.25	17.27	0.00	0.25	11.16	0.00

Source: Extracted from E-View program window (7)

Table 4.5 shows the results of the pooled, fixed and random regression models. The results seem to be identical across the three models. The signs of the constant term are negative and significant; the sign of the inflation is positive and significant while the interest rate is positive but insignificant only for the random model which effects passes the Hausman test that is uncorrelated with the independent variables.

Table 4.6: Showing the Results of the Hausman Test

Test Summary	**Chi-Sq. Stat.**	**df**	**p.v**
Cross-Sectional Random	16.619	2	0.0002

Source: Extracted from E-view program Window (7)

The probability value in Table 4.6 is less than 1% which implies that the random effect model is not appropriate and that the fixed model is preferred. Therefore, there are fixed effects in the relationship between exchange rate, interest rate and inflation in the sample of the specified countries.

Indeed, it is plausible to examine the direction of flow of effects between the variables under investigation. To do this, we employ the usual Granger Causality test whose results are presented in Table 4.6.

Table 4.7: Showing the Result of Granger Causality Test

Null Hypothesis	**Obs**	**F-Statistic**	**Prob.**
INT does not Granger Cause XCH	155	0.10247	0.9027
XCH does Granger Cause INT		2.56087	0.0806
INF does not Granger Cause XCH	155	0.14702	0.8634
XCH does not Granger Cause INF		4.37219	0.0143
INF does not Granger Cause INF	155	2.51662	0.0841
INT does not Granger Cause INF		1.30689	0.2737

Source: Extracted from E-view program Window

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Looking at the probability values in the first row of Table 4.7; they are less than 5% for the hypotheses that (1) ınterest rate does not Granger cause exchange rate (2) exchange rate does not Granger cause interest rate.

Therefore, there is zero causality between exchange rate and interest rate. The same results are obtained in the third row in which interest rate and inflation do not Granger cause each other. But the result is quite different in the second row; when the null hypothesis that exchange rate does not Granger cause each other. But the result is quite different in the second row; when the null hypothesis that exchange rate does not Granger cause inflation is rejected at 5% level of significance. Thus, we established that there is long-run undirecting causality between exchange rate and inflation with the direction of flow trickling down from the exchange rate.

Our final empirical analysis in this study is to ferret out whether interest rate and inflation are endogenously/exogenously determined in the selected sub-Sahara African countries. This, however, involves testing for weak and block homogeneity for the series.

Table 4.8: Showing the Result of Weak Exogeneity and Block Exogeneity Tests for interest rate, and inflation variables in the selected Sub-Sahara African countries.

Variable	Weak Exogeneity	Block Exogenety
Interest Rate (-1)	0.14 (1.68)	1.77 (1.39)
Inflation (-1)	0.01 (0.98)	0.84 (3.63)

*Note: The values in parenthesis are the t-values * implies significant @ 5% level.*
Source: Extracted from E-view program Windom (7)

By the rule of thumb, the results on the test of weak exogenetic show that the two variables are not statistically significant. Thus, we can Infer that Interest rate and Inflation are exogenously determined; but in the case of the block exogenetic, inflation is significant. Therefore, it turns out to be endogenous while the interest rate remains exogenous throughout the sampling period 1980-2012 coinciding with the regimes of freely and managed floating exchange rate is specified countries.

V. Conclusion

The study investigates the relationship between the exchange rate, inflation rate and interest rate using pane! da-a for selected sub-Sahara African countries over the period of 1980-2012. It particularly adopts the Johansen Fisher panel cointegration Approach for its long-run analysis and finds that exchange rate, interest rate and inflation are cointegrating together in the long-run horizon. This is in tandem with the findings of Goswami (2005).

Furthermore, the study concludes that there is a strong positive relationship between exchange rate and interest rate thereby confirming the empirical stance of Simon & Razak (1999), and also Lahiri & Hanatrovaska (2008). In line with the study of (Binder, 2000), we conclude that exchange rate maintains a monotonic relationship with prices.

Finally, we find that in the selected sub-Sahara African countries interest rate is weakly exogenously determined contradicting the findings of Keminsky and Schumulkler, (1998) in his study of Indonesia, Korea, Malaysia, Philippine, Thailand and China.

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