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# The Effect of Interest Rate on Investment in Nigeria 1990-2022

[1]**F. O. Chinyere Osunkwo, & [2]Uke, Kalu Ejibe**
*[1&2]Department of Economics,*
*Abia State University, Uturu*

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## Abstract

This study examines the effect of interest rates on investment in Nigeria from 1990 to 2021. Data for the study were secondary data obtained from the CBN Statistical Bulletin of various years. Being time series data, the data were subjected to a stationarity test using the augmented Dickey-Fuller unit root technique and were found to be stationary at their first differencing. The ordinary least square method (OLS) was used to analyze the data, the result shows that interest rate has a negative and insignificant relationship with investment in Nigeria, it was also found that there are other variables that affect investment. Money supply and exchange rates have a positive and significant impact on investment. It is therefore recommended that the government reconsider her decision to increase the interest rate from 17.5% to 18% because of the cash squeeze that has already reduced the money supply in the country, as this will further increase the interest rate and further reduce investment. Rather, the interest rate on lending should be reduced in order to boost productivity and encourage industrialization so as to create employment opportunities for the citizenry.

**Keywords:** *Investment, Interest rate, Productivity, Industrialization*

***Corresponding Author:*** F. O. Chinyere Osunkwo

**Background to the Study**

Every economy in the world works to grow output, provide jobs for its people, preserve price stability, and rely less on imports, therefore efforts are focused on enhancing industrialization in their home countries' economies. When an economy experiences industrialization, it means that both the public and private sectors have invested in the creation of new industries with a range of productive capacity. Investment is one of the key components of national income, and it cannot be emphasized enough how important it is to the economy. Investment can be thought of as the purchase of new physical assets, i.e., spending on structures and equipment (Nelson, 2006). Investments produce jobs, produce goods and services for both domestic and international markets, and bring in money for the government. It is impossible to overstate the importance of encouraging an interest rate that would assure a rise in investment and therefore boost economic growth. Interest rates are one of the tools the monetary authority uses to affect aggregate demand and achieve macroeconomic goals. Interest rates are the cost associated with keeping depositors' money on hand for a certain amount of time. Interest rates are a crucial factor in investment decisions (Jhingan, 2010). According to Lasbery and Nwosu (2014), interest rate is the sole variable that can achieve market equilibrium (IS=LM equation) for both goods and money.

**Statement of the Problem**

The management and administration of interest rates in the economy have undergone numerous revisions in Nigeria as a whole. The macroeconomic goals of price stability, full employment equilibrium, rise in per capita income, increase in gross domestic product, low inflation rate, etc. are to be attained by a variety of measures. The goal of both the regulated interest rate regime and the deregulated interest rate regime is to ensure a strong and healthy economy. Prior to SAP in 1986, the CBN typically set the interest rate in Nigeria, with sporadic revisions based on the sectoral priorities of the government. The monetary authority charged special interest rates (low) on loans taken by these sectors in order to encourage investment in these important areas of the economy, such as agriculture and manufacturing, in order to potentially improve economic growth (Emenike, 2000). To steer the economy toward economic growth through these important sectors, the government, acting through the Central Bank of Nigeria (CBN), regulated the current interest rates. In the 1980s and 1990s, the lending rate increased from 6 to 10.5%. However, the CBN deregulated interest rates in July 1987, making them market-driven and subject to the forces of supply and demand. This resulted from the 1980s' economic shocks and the financial restrictions that showed up as indiscriminate financial pricing distortions. The goal of the deregulated interest rate, among other things, was to improve the availability of sufficient funds for investors, particularly manufacturers, who were viewed as the primary agents and, consequently, as supporters of economic growth to boost exports and reduce price distortion. Measures for regulating interest rate management were reintroduced in 1994 because of a policy change. Deposit rates were established at 12% to 15% annually, with a cap of 21% annually for borrowing. In 1995, a little change was made to accommodate flexibility; flexible interest rates were then applied to bank deposits, and the lending rate was determined by the dynamics of supply and demand for funds (Nelson, 2012; Folorunsho, 1999). Since 2004, the Central Bank of Nigeria's monetary policy committee has set rates based on the health of the economy. According to CBN (2012),

in 2013 the loan rate was 17.10%, the monetary policy rate was 12%, and the saving rate was 2.39%. The MPR was recently raised from 17.5% to 18% in 2023; hence the focus of this research is to determine how changes in interest rates will affect investment in Nigeria.

**Objectives of the Study**

The general objective of this study is to find out the effect of interest rate on investment in Nigeria. However, the specific objectives are:

i. To find the effect of interest rate on exchange rate
ii. To find the impact of interest rate on money supply

**Research Questions**

i. Is there any significant relationship between interest rate and investment?
ii. What is the impact of interest rate on money supply?

**Research Hypothesis**

$H0_1$: Interest rate has no significant impact on investment in Nigeria.
$H0_2$: Interest rate has no significant impact on money supply

**Literature Review**

**Conceptual Literature**

Investment: Gross fixed capital formation (previously known as gross domestic fixed investment) includes land improvements such as fences, ditches, and drains as well as the purchase of plant, machinery, and equipment as well as the building of roads, railways, and other structures of a similar nature, such as offices, hospitals, private homes, commercial and industrial buildings, as well as schools. Net acquisitions of valuables are also regarded as capital formation in accordance with the 1993 SNA. As of 2018, Nigeria's Gross Fixed Capital Formation (in current US dollars) was $75,539,210,000. The value of this indicator has varied over the previous 37 years between $147,018,000,000 in 1981 and $12,343,170,000 in 1993 (according to statistics from the World Bank and the OECD's National Accounts, 2018).

Interest rate: To achieve the desired level of interest rate, the Central Bank of Nigeria (CBN) adopts various monetary policy tools, key among which is the Monetary Policy Rate (MPR). This rate, which until 2006 was known as the Minimum Rediscount rate (MRR), is the rate at which the CBN is willing to rediscount first class bills of exchange before maturity (Ndugbu, 2001). He further opined that by raising or lowering this rate the CBN is able to influence market cost of funds. If the CBN increases MPR, banks' lending rates are expected to increase with it, showing a positive relationship. In 2023, this rate has been raised from 17.5% to 18%.

**Theoretical Review**

**The Classical Theory of Interest Rate**

In the words of Lasbery and Nwosu (2014) interest rate is the equilibrating factor between the demand for and the supply of investible funds. Investment represents the demand for and saving represents the supply of investible funds whilst the rate of interest is the price at which

the two variables are equated. Furthermore, for equilibrium to exist, the following conditions have to be fulfilled according to the classical theory of the rate of interest.

i. I=f(R) and <0
ii. S=g(R) and >0
iii. I=S

Like other prices interest rate perform a rationing function by allocating limited supply of credit among the many competing demands (Adoful, Abula & Audu, 2010), however, it is argued by Wilfred (2020) that interest rate is not the only influencer of interest rate as could be seen in his research work on "Determinants of Investment in Nigeria."

**Loanable Fund or Neo-Classical Theory**

This theory states that the supply of loanable funds is a composite one. It is composed of real saving and credit money. It is composed of the demand for investment funds and the demand for speculative cash balances or hoarding. This theory recognizes the role of hoarding and created money in determining interest rate. Thus, according to this theory, the rate of interest is the function of these four variables-saving, investment, desire to hoard and quantity of money.

**Empirical Literature**

Greene and Villanueva (1990) explored the determinants of private investment in less developed countries for 23 countries over 1975-1987, and found that the real deposit interest rate has a negative impact on private investment. Nurudeen and Ahmad (2003) studied about the lowdown in private investment in Pakistan. They found that higher real interest rates reduce private investment. Larsen (2020), carried out a study on the impact of mortgage rates on investment in United States found that low mortgage interest rates make direct real estate investments attractive to suppliers of the real estate units. Hassan (2021) analyzed the determinants of unsatisfying private investment growth in the Middle East and North Africa (MENA) throughout the 1990s and 2020, the findings showed that the real interest rate appears to exert a negative effect on a firm investment projects. Wang and Yu (2019) examined the role of interest rate in investment decisions for firms in Taiwan. Their findings revealed that interest rate plays an important role in investment decisions. Oyetola (2016) investigated the impact of interest rate on GFCF using OLS method of analysis found that interest rate exerts a negative influence on the dependent variable.

**Gap in Literature**

The various literature reviewed show that a lot of work has been done on the subject matter, even the researcher carried out similar research in 2020, the gap therefore is to ascertain if a negative relationship still exists between interest rate and investment and to find a way forward especially in the face of high unemployment, inflation and low output of goods and services, and to ascertain if there are other variables that influences' investment.

**Research Methodology**

The data for the study are secondary data obtained from the CBN statistical bulletin of various years and from World Bank national accounts, and OECD National Accounts, (2021).

**Model Specification**
GFCF = f(ms, intr,exchr)

Where;
GFCF is Gross fixed capital formation as proxyl for investment
MS = Money Supply
INTR = Interest rate
EXCHR =Exchange rate

**Presentation and Analysis of Data**
The data are subjected to stationarity test using the augmented dickey fuller unit root technique. The data however were found to be stationary at their first differencing, I(1). We therefore go ahead with the OLS analysis.

**Table 1:** ADF Statistics

| **Variables** | **ADF Test Statistics** | **5% Critical Value** | **Order of Integration** | **Remarks** |
|---|---|---|---|---|
| LGCFC | -3.927823 | -2.938987 | 1(1) | Stationary |
| INTR | -7.017449 | -2.941145 | 1(1) | Stationary |
| LMS | -4.089153 | -2.938987 | 1(1) | Stationary |
| EXTR | -3.698444 | -2.938987 | 1(1) | Stationary |

**Source:** Authors Computation

**Table 2:** OLS Result

Dependent Variable: LOG(GCFC)
Method: Least Squares
Date: 04/18/23 Time: 22:41
Sample: 1 41
Included observations: 41

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LOG(MS) | 0.575325 | 0.039551 | 14.54637 | 0.0000 |
| LOG(INTR) | -0.335451 | 0.207902 | -1.613504 | 0.1151 |
| LOG(EXTR) | 0.247712 | 0.063606 | 3.894471 | 0.0004 |
| C | 3.784358 | 0.585911 | 6.458929 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.984633 | Mean dependent var | 7.632353 |
| Adjusted R-squared | 0.983387 | S.D. dependent var | 1.974473 |
| S.E. of regression | 0.254495 | Akaike info criterion | 0.193394 |
| Sum squared resid | 2.396399 | Schwarz criterion | 0.360572 |
| Log likelihood | 0.035420 | Hannan-Quinn criter. | 0.254271 |
| F-statistic | 790.2381 | Durbin-Watson stat | 0.454143 |
| Prob(F-statistic) | 0.000000 | | |

**Source:** Authors Computation

The result shows that interest rate exerts a negative though insignificant impact on investment. This result implies that as interest rate rises by 1%, GFCF may fall by 33%, this conforms to the apriori expectation of high interest rate leading to a low investment in Nigeria. The insignificant nature of the impact may be due to the marginal efficiency of capital. If the marginal efficiency of capital is high, the high rate of interest will not discourage borrowing, rather investment will be high. However, the result also shows that there are other variables affecting investment apart from interest rate. As can be seen in the analysis, money supply and exchange rate have positive and significant impact on investment.

**Conclusion**

The regression result shows that the Adjusted R-Square is 98% which shows that the explanatory variables gave account of 98% variations in the dependent variable, and that the overall regression is highly fitted. The result also shows that there are other variables like money supply and exchange rate that has impact on investment apart from interest rate that should draw government attention.

**Recommendations**

Based on the findings of this work, we therefore recommend as follows;

1. Since money supply has a significant and positive impact on investment, it means that government should avoid cash squeeze and also make sure that demand for money equals its supply in order to avoid inflation.
2. Interest rate should not be too high so as not to discourage investment, rather it should be investment driven.
3. Exchange rate should be controlled by the government through the supply and demand for foreign currencies.

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**Appendix 1**

| YEAR | GCFC | MS | INTR | EXTR |
|---|---|---|---|---|
| 1981 | 124.5243 | 14.47117 | 10 | 0.610025 |
| 1982 | 128.0967 | 15.78674 | 11.75 | 0.672867 |
| 1983 | 120.2636 | 17.68793 | 11.5 | 0.724142 |
| 1984 | 97.78148 | 20.10594 | 13 | 0.764942 |
| 1985 | 87.14485 | 22.29924 | 11.75 | 0.89375 |
| 1986 | 108.8652 | 23.8064 | 12 | 2.020575 |
| 1987 | 122.4622 | 27.57358 | 19.2 | 4.017942 |
| 1988 | 138.0968 | 38.3568 | 17.6 | 4.536733 |
| 1989 | 217.7499 | 45.90288 | 24.6 | 7.391558 |
| 1990 | 262.7656 | 47.42329 | 27.7 | 8.037808 |
| 1991 | 285.59 | 75.40118 | 20.8 | 9.909492 |
| 1992 | 396.6088 | 111.1123 | 31.2 | 17.29843 |
| 1993 | 559.1457 | 165.3387 | 36.09 | 22.05106 |
| 1994 | 744.0923 | 230.2926 | 21 | 21.8861 |
| 1995 | 1153.471 | 289.0911 | 20.79 | 81.02284 |
| 1996 | 1494.751 | 345.854 | 20.8575 | 81.25275 |
| 1997 | 1697.768 | 413.2801 | 23.315 | 81.64943 |
| 1998 | 1948.654 | 488.1458 | 21.3375 | 83.80717 |
| 1999 | 2098.536 | 628.9522 | 27.19 | 92.34284 |
| 2000 | 2404.816 | 878.4573 | 21.55 | 101.774 |
| 2001 | 2473.473 | 1269.322 | 21.3375 | 111.4872 |
| 2002 | 3078.784 | 1505.964 | 30.19 | 120.6528 |
| 2003 | 3846.235 | 1952.921 | 22.88 | 129.223 |
| 2004 | 4723.72 | 2131.819 | 20.82 | 133.0008 |
| 2005 | 5772.637 | 2637.913 | 19.49 | 131.1004 |
| 2006 | 7948.121 | 3797.909 | 18.7 | 128.142 |
| 2007 | 6997.618 | 5127.401 | 18.3625 | 125.066 |
| 2008 | 7535.271 | 8643.429 | 18.69743 | 117.7823 |
| 2009 | 9177.085 | 9687.507 | 22.6225 | 147.2718 |
| 2010 | 9183.059 | 11101.46 | 22.50886 | 148.31 |
| 2011 | 9897.197 | 12628.32 | 22.41598 | 151.8269 |
| 2012 | 10281.95 | 15503.41 | 23.7875 | 155.4502 |
| 2013 | 11478.08 | 18743.07 | 24.6918 | 155.2537 |
| 2014 | 13593.78 | 20415.61 | 25.74362 | 156.4848 |
| 2015 | 14112.17 | 20885.52 | 26.70828 | 191.8035 |
| 2016 | 15104.18 | 24259 | 27.29159 | 253.0925 |
| 2017 | 16908.13 | 28604.47 | 30.60036 | 305.2899 |
| 2018 | 24550.24 | 29774.43 | 28.161 | 305.5827 |
| 2019 | 35863.98 | 34257.9 | 30.56853 | 306.4227 |
| 2020 | 41253.55 | 36038.01 | 28.6417 | 358.3108 |
| 2021 | 58293.95 | 40318.29 | 28.12 | 412.44 |

## Appendix II

Null Hypothesis: D(LOG(GCFC)) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -3.927823 | 0.0043 |
| Test critical values: | 1% level | -3.610453 | |
| | 5% level | -2.938987 | |
| | 10% level | -2.607932 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOG(GCFC),2)
Method: Least Squares
Date: 04/18/23 Time: 22:01
Sample (adjusted): 3 41
Included observations: 39 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LOG(GCFC(-1))) | -0.600839 | 0.152970 | -3.927823 | 0.0004 |
| C | 0.097542 | 0.032188 | 3.030402 | 0.0044 |

| | | | |
|---|---|---|---|
| R-squared | 0.294267 | Mean dependent var | 0.008140 |
| Adjusted R-squared | 0.275194 | S.D. dependent var | 0.166948 |
| S.E. of regression | 0.142132 | Akaike info criterion | -1.014200 |
| Sum squared resid | 0.747456 | Schwarz criterion | -0.928889 |
| Log likelihood | 21.77690 | Hannan-Quinn criter. | -0.983591 |
| F-statistic | 15.42779 | Durbin-Watson stat | 1.990168 |
| Prob(F-statistic) | 0.000360 | | |

## Appendix III

Null Hypothesis: D(LOG(MS)) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -4.089153 | 0.0028 |
| Test critical values: | 1% level | -3.610453 | |
| | 5% level | -2.938987 | |
| | 10% level | -2.607932 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOG(MS),2)
Method: Least Squares
Date: 04/18/23 Time: 22:37
Sample (adjusted): 3 41
Included observations: 39 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LOG(MS(-1))) | -0.618148 | 0.151168 | -4.089153 | 0.0002 |
| C | 0.124596 | 0.035546 | 3.505159 | 0.0012 |

| | | | |
|---|---|---|---|
| R-squared | 0.311258 | Mean dependent var | 0.000647 |
| Adjusted R-squared | 0.292644 | S.D. dependent var | 0.137868 |
| S.E. of regression | 0.115953 | Akaike info criterion | -1.421337 |
| Sum squared resid | 0.497472 | Schwarz criterion | -1.336026 |
| Log likelihood | 29.71606 | Hannan-Quinn criter. | -1.390728 |
| F-statistic | 16.72117 | Durbin-Watson stat | 2.066454 |
| Prob(F-statistic) | 0.000224 | | |

## Appendix IV

Null Hypothesis: D(INTR) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -7.017449 | 0.0000 |
| Test critical values: | 1% level | -3.615588 | |
| | 5% level | -2.941145 | |
| | 10% level | -2.609066 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INTR,2)
Method: Least Squares
Date: 04/18/23 Time: 22:19
Sample (adjusted): 4 41
Included observations: 38 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(INTR(-1)) | -1.780015 | 0.253656 | -7.017449 | 0.0000 |
| D(INTR(-1),2) | 0.374386 | 0.157591 | 2.375684 | 0.0231 |
| C | 0.820324 | 0.690290 | 1.188376 | 0.2427 |

| | | | |
|---|---|---|---|
| R-squared | 0.695901 | Mean dependent var | -0.007150 |
| Adjusted R-squared | 0.678523 | S.D. dependent var | 7.380138 |
| S.E. of regression | 4.184458 | Akaike info criterion | 5.776288 |
| Sum squared resid | 612.8391 | Schwarz criterion | 5.905571 |
| Log likelihood | -106.7495 | Hannan-Quinn criter. | 5.822286 |
| F-statistic | 40.04696 | Durbin-Watson stat | 1.867286 |
| Prob(F-statistic) | 0.000000 | | |

## Appendix V

Null Hypothesis: D(EXTR) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -3.678444 | 0.0084 |
| Test critical values: | 1% level | -3.610453 | |
| | 5% level | -2.938987 | |
| | 10% level | -2.607932 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXTR,2)
Method: Least Squares
Date: 03/07/23 Time: 22:30
Sample (adjusted): 3 41
Included observations: 39 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(EXTR(-1)) | -0.603645 | 0.164103 | -3.678444 | 0.0007 |
| C | 6.922836 | 3.262956 | 2.121646 | 0.0406 |

| | | | |
|---|---|---|---|
| R-squared | 0.267776 | Mean dependent var | 1.386317 |
| Adjusted R-squared | 0.247986 | S.D. dependent var | 20.84873 |
| S.E. of regression | 18.07976 | Akaike info criterion | 8.677384 |
| Sum squared resid | 12094.47 | Schwarz criterion | 8.762694 |
| Log likelihood | -167.2090 | Hannan-Quinn criter. | 8.707992 |
| F-statistic | 13.53095 | Durbin-Watson stat | 1.832506 |
| Prob(F-statistic) | 0.000742 | | |

## Appendix VI

Date: 04/18/23 Time: 22:45
Sample (adjusted): 3 41
Included observations: 39 after adjustments
Trend assumption: Linear deterministic trend
Series: GCFC MS INTR EXTR
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.747561 | 76.23085 | 47.85613 | 0.0000 |
| At most 1 | 0.321566 | 22.54401 | 29.79707 | 0.2692 |
| At most 2 | 0.153708 | 7.413234 | 15.49471 | 0.5301 |
| At most 3 | 0.022925 | 0.904479 | 3.841466 | 0.3416 |

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.747561 | 53.68684 | 27.58434 | 0.0000 |
| At most 1 | 0.321566 | 15.13078 | 21.13162 | 0.2798 |
| At most 2 | 0.153708 | 6.508755 | 14.26460 | 0.5488 |
| At most 3 | 0.022925 | 0.904479 | 3.841466 | 0.3416 |

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

| GCFC | MS | INTR | EXTR |
|---|---|---|---|
| -0.000211 | -6.00E-05 | -0.026024 | 0.000264 |
| 0.000217 | -7.74E-05 | 0.185312 | -0.024046 |
| -4.48E-05 | -0.000140 | 0.119613 | 0.019442 |
| 0.000369 | -0.000336 | -0.059111 | 0.000300 |

Unrestricted Adjustment Coefficients (alpha):

| | | | | |
|---|---|---|---|---|
| D(GCFC) | -1369.458 | -101.4377 | 21.69556 | 220.5048 |
| D(MS) | -709.6152 | -288.7386 | 55.63691 | -61.87438 |
| D(INTR) | 0.197945 | -1.106632 | -1.473528 | 0.009364 |
| D(EXTR) | -4.731354 | 6.125728 | -2.411037 | -1.052637 |

1 Cointegrating Equation(s): Log likelihood -925.0529

Normalized cointegrating coefficients (standard error in parentheses)

| GCFC | MS | INTR | EXTR |
|---|---|---|---|
| 1.000000 | 0.284239 | 123.2169 | -1.247879 |
| | (0.13332) | (108.506) | (13.5305) |

Adjustment coefficients (standard error in parentheses)

| | |
|---|---|
| D(GCFC) | 0.289238 |
| | (0.06140) |
| D(MS) | 0.149875 |
| | (0.02887) |
| D(INTR) | -4.18E-05 |
| | (0.00016) |
| D(EXTR) | 0.000999 |
| | (0.00053) |

2 Cointegrating Equation(s): Log likelihood -917.4875

Normalized cointegrating coefficients (standard error in parentheses)

| GCFC | MS | INTR | EXTR |
|---|---|---|---|
| 1.000000 | 0.000000 | 447.2752 | -49.83620 |
| | | (131.717) | (13.9187) |
| 0.000000 | 1.000000 | -1140.092 | 170.9419 |
| | | (445.326) | (47.0582) |

Adjustment coefficients (standard error in parentheses)

| | | |
|---|---|---|
| D(GCFC) | 0.267218 | 0.090062 |
| | (0.08789) | (0.02842) |
| D(MS) | 0.087197 | 0.064943 |
| | (0.03849) | (0.01245) |
| D(INTR) | -0.000282 | 7.37E-05 |
| | (0.00022) | (7.0E-05) |
| D(EXTR) | 0.002329 | -0.000190 |
| | (0.00069) | (0.00022) |

## Appendix VII

Pairwise Granger Causality Tests
Date: 04/18/23 Time: 22:50
Sample: 1 41
Lags: 2

| Null Hypothesis: | Obs | F-Statistic | Prob. |
|---|---|---|---|
| MS does not Granger Cause GCFC | 39 | 3.09473 | 0.0582 |
| GCFC does not Granger Cause MS | | 4.16115 | 0.0242 |
| INTR does not Granger Cause GCFC | 39 | 0.23119 | 0.7948 |
| GCFC does not Granger Cause INTR | | 0.45704 | 0.6370 |
| EXTR does not Granger Cause GCFC | 39 | 0.47723 | 0.6246 |
| GCFC does not Granger Cause EXTR | | 4.70142 | 0.0158 |
| INTR does not Granger Cause MS | 39 | 0.31145 | 0.7344 |
| MS does not Granger Cause INTR | | 0.90548 | 0.4139 |
| EXTR does not Granger Cause MS | 39 | 1.43724 | 0.2517 |
| MS does not Granger Cause EXTR | | 3.37892 | 0.0459 |
| EXTR does not Granger Cause INTR | 39 | 0.52279 | 0.5976 |
| INTR does not Granger Cause EXTR | | 2.80983 | 0.0742 |