Granger Causality between Macroeconomic Variables and Stock Market Prices at Nairobi Securities Exchange, Kenya

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Abstract: **The concept of co integration as have been since the time of Adam Smith and is the central theme in his work, An Inquiry into the Nature and Causes of the Wealth of Nations, as it shows that one of the crucial application of economic theory is to give explanations to the link that exist between different causal relation among economic variables and the most critical question posed is how do economist relate the existence of causal relationship with a given number of observations. To answer this question, it is necessary to understand the concept of causality and its application in economics. This paper tried to find the bidirectional relationship of selected microeconomic variable and stock market prices. Before estimating Granger causality, variables were tested for stationarity using Philip Perron test in which variables were integrated upon first difference. The results showed that stock market prices granger caused exchange rate, inflation granger caused interest rate. There was also significant granger causality between nominal GDP and exchange rate and on the relationship between interest rate and nominal GDP. All these effects were unidirectional effects.**

Key Words: **Granger Causality, Stationarity, NSE, Kenya**

I. INTRODUCTION

Statistical concept of pair wise was put forward by Granger (1981) is based on F-test which tries to explain the effects of changes in one variable has changes in another variable. It is said that there is granger causality between variables X and Y if the past values of X forecast the present values of Y. The term Granger causality does not imply that a change in one variable causes a change in another variables and it simply implies that there is correlation between past values of one variable and the past values of another variable.

There is a lot of cynics in regard to the relationship that exist between exchange rate, interest rate, inflation rate and GDP fluctuation variables and the financial performance of a firm in terms of its profitability and security returns. Some studies indicate significant relationships between the variables whereas some indicate insignificant relationship between the variables. According to Chen et al (2001), multi-factor models have been developed as an explanation for the variation in security returns and the extant literature suggests that a wide range of factors explain security returns. The variations have been attributed to such variables as goods prices, money supply, real activity, exchange rates, interest rates, political risks, oil prices, trade sector, budget deficits, domestic consumption, unemployment rate, imports and regional stock market indices and real wage (Menike, 2006).Empirical results regarding the inflationary effect and official exchange rate depreciation in cross-country studies and individual country studies are also conflicting (Rutasitara, 2004).

While investigating the effects of exchange rate, interest rate and GDP fluctuation variables on stock prices in the emerging Sri Lankan stock market using monthly data for the period from September 1991 to December 2002, Menike (2006) found that most of the companies reported a higher R^2justifying higher explanatory power of exchange rate, interest rate, inflation rate and GDP fluctuation variables in explaining stock prices. This was consistent with other emerging market studies where inflation rate and exchange rate reacted negatively in relation to stock prices. Vaz *et al.*, (2008) examined the effect of publicly announced changes in official interest rates on the stock returns of the major banks in Australia during the period from 1990 to 2005. The results indicated that Australian Bank stock returns were impacted positively by the announcement of increased in official interest rates. Furthermore, banks experienced net-positive abnormal returns when cash rates are increased, which is consistent with the dividend valuation theory that suggests if income effects dominate, then stock returns need not be negatively impacted. Olweny and Omondi (2011) sought to find out the impact of macroeconomic factors on the performance of the stock market. The results showed that Foreign exchange rate, interest rate, and inflation rate, affect stock return volatility.

II. METHODOLOGY

Granger Causality: Assume that the information set F_t has the form $(x_t, z_t, x_{t-1}, z_{t-1}, \dots, x_1, z_1)$ where x_t and z_t are vectors and $z_t$usually will include y_t and z_t may or may not include other variables than y_t. It is said that $x_t$is Granger causal for y_t with respect to F_t if the variance of the optimal linear predictor of y_{t+h} based on F_t has smaller variance than the optimal linear predictor of y_{t+h}based on z_t, z_{t-1} … for any h. In other words, x_t is Granger causal for y_t if x_t helps predict y_t at some stage in the future.

Granger causality is particularly easy to deal with in VAR models. Let the data be described by the model.

$$\begin{bmatrix} y_t \\ z_t \\ x_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \end{bmatrix} + \begin{bmatrix} A'_{11} & A'_{12} & A'_{13} \\ A'_{21} & A'_{22} & A'_{23} \\ A'_{31} & A'_{32} & A'_{33} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \\ x_{t-1} \end{bmatrix} + \cdots + \begin{bmatrix} A^k_{11} & A^k_{12} & A^k_{13} \\ A^k_{21} & A^k_{22} & A^k_{23} \\ A^k_{31} & A^k_{32} & A^k_{33} \end{bmatrix} \begin{bmatrix} y_{t-k} \\ z_{t-k} \\ x_{t-k} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{bmatrix} \ldots\ldots\ldots\ldots\ldots 1$$

And it is assumed that

$$\Sigma_u = \begin{bmatrix} \Sigma_{11} & \Sigma_{12} & \Sigma_{13} \\ \Sigma_{12} & \Sigma_{22} & \Sigma_{23} \\ \Sigma_{13} & \Sigma_{23} & \Sigma_{33} \end{bmatrix} \ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

This model is a totally general VAR model –only the data vectors have been partitioned in 3 subsectors, the y_t and the x_t vectors between which tests for causality and the z_t vector which is conditioned on. In this model, x_t does not Granger cause y_t with respect to the information set generated by z_t if either $A^i_{13} = 0$ and $A^i_{23} = 0$; $i = 1, \ldots, k$ or $A^i_{13} = 0$ and $A^i_{12} = 0; i = 1 \ldots k$

This is the way Granger causality is tested.

In this study, the Granger model measures stock market prices (SMP), which is the dependent on inflation (INFL), exchange rate (EXR), interest rate (INTR), gross domestic product (GDP), Granger causality will be conducted on the model to determine the directional link between stock market prices and each of the independent variables

The model is functionally represented as;

$$SMP = f(INFL, EXR, INTR, GDP) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

The Granger equations for the model are presented below,

$$SMP_t = \sum_{i=1}^{n} \beta_i INFL_{t-1} + \sum_{j=1}^{n} \alpha_j SMP_{t-j} + \mu_t \ldots\ldots\ldots 4$$

$$INFL_t = \sum_{i=1}^{n} \lambda_i INFL_{t-1} + \sum_{j=1}^{n} \delta_j SMP_{t-j} + \mu_t \ldots\ldots\ldots 5$$

$$SMP_t = \sum_{i=1}^{n} \beta_i EXR_{t-1} + \sum_{j=1}^{n} \alpha_j SMP_{t-j} + \mu_t \ldots\ldots\ldots\ldots 6$$

$$EXR_t = \sum_{i=1}^{n} \lambda_i EXR_{t-1} + \sum_{j=1}^{n} \delta_j SMP_{t-j} + \mu_t \ldots\ldots\ldots\ldots 7$$

$$SMP_t = \sum_{i=1}^{n} \beta_i INTR_{t-1} + \sum_{j=1}^{n} \alpha_j SMP_{t-j} + \mu_t \ldots\ldots\ldots 8$$

$$INR_t = \sum_{i=1}^{n} \lambda_i INTR_{t-1} + \sum_{j=1}^{n} \delta_j SMP_{t-j} + \mu_t \ldots\ldots\ldots\ldots 9$$

$$SMP_t = \sum_{i=1}^{n} \beta_i GDP_{t-1} + \sum_{j=1}^{n} \alpha_j SMP_{t-j} + \mu_t \ldots\ldots\ldots 10$$

$$GDP_t = \sum_{i=1}^{n} \lambda_i GDP_{t-1} + \sum_{j=1}^{n} \delta_j SMP_{t-j} + \mu_t \ldots\ldots 11$$

III. RESULTS AND DISCUSSION

Unit Root Test for Stationarity: The test was developed by Phillips and Perron (1988). It tests the null hypothesis of series contains unit root against alternative that the series are stationary. Gujarati (2004) illustrated that using more than one test will promotes consistency and efficient in confirmation that variable is stationary or not. Therefore, this test was performed to check for this consistency. The results presented in table 1 shows that at levels, stock market prices, exchange rate and GDP variables had unit root (their absolute Z(t) values were less than 5% critical value). However, upon first difference, all the series became stationary or integrated of order one *I (1).* All absolute z(t) statistic values were greater than critical values and the p-values were 0.0000 meaning the null hypotheses were rejected and concluded that variables became stationary after first difference

Table 1: Phillips-Perron Unit Root Test

At Levels						
Variables	**Z(t)**	**Prob>t**	**Critical values**			**Conclusion**
			1%	5%	10%	
SMP	-2.092	0.24477	-3.488	-2.866	-2.576	Presence of unit root
INF	-4.836	0.0000	-3.488	-2.886	-2.576	No unit root (*I(0)*)
EXR	-1.495	0.5362	-3.488	-2.886	-2.576	Presence of unit root
INR	-3.289	0.0154	-3.488	-2.886	-2.576	No unit root (*I(0)*)
GDP	-0.493	0.8935	-3.488	-2.886	-2.576	Presence of unit root
At First Difference						
DSMP	-13.521	0.000	-3.488	-2.886	-2.576	*I(1)*
DINF	-12.354	0.0000	-3.488	-2.886	-2.576	*I(1)*
DEXR	-13.820	0.0000	-3.488	-2.886	-2.576	*I(1)*
DINR	-13.472	0.0000	-3.488	-2.886	-2.576	*I(1)*
DGDP	-11.066	0.0000	-3.488	-2.886	-2.576	*I(1)*

*I(1) represents the variables that are stationary at first difference

Source: Researchers compilation, 2019

Granger Causality Results

Since from the previous Johansen test and unit root tests results to confirm the presence of cointegration and stationarity respectively. Granger causality proposed by Granger (1981) that before estimating Granger causality, the series should have a stationarity property and the variables in question should have a long term cointegration relationship present. Granger causality test is needed to determine how guide the relationship between them. He proposed that assume we have two variables X and Y. X is said to Granger cause Y if it is useful in forecasting Y implying that X is able to increase the accuracy of the prediction of Y with respect to a forecast, considering only the past values of Y.

From the Granger causality results presented in the table 2, stock market prices Granger causes exchange rate in NSE during the study period with F-statistic of 8.2626 and probability of 0.0004. it implies that stock market prices can used to forecast for future exchanges rates. This may be attributed by the fact that fluctuations in stock prices can cause oscillations in foreign exchange rates and in return causes panic among portfolio managers predisposes them to liquidate holdings in their portfolios. Managers may predispose shares in the portfolio when there is appreciation of the foreign currencies. In this case, managers should increase equity shares when they forecast a depreciation of the foreign currencies. This finding supports a study by Toda Yamamoto (1995) who found a bidirectional relationship between share price and exchange rate. Sifunjo (1999) used Granger causality test and established a unidirectional relationship from exchange rates to share price in Kenya. Thus, in their conclusions, stock market prices Grangers causes exchange rate and vice versa. In contrary to this, Smyth and Nandha (2003), Nieh and Lee (2001) and Bahamani-Oskooee and Sohrabian (1992) found no evidence of significant relationship between stock market prices and exchange rates.

John *et al*., (2018) researched on the association amid prices of different stock that are traded in Tanzania, the Dares Salam Stock Exchange. The study used time series daily data spanning from 2011to 2017. The study utilized the Granger Causality technique with other examinations on the variables and the model itself. From the analysis, the results revealed that there is an association in a short term among the stock prices and exchange rate. Furthermore, Stock Prices Granger Causes exchange rates as demonstrated by Granger Causality and the Impulse test. These judgments are reinforced by the point that instabilities in the Exchange Rates do not affect in the Stock Prices.

The study further confirmed that inflation Granger causes interest rate in Kenya (F-statistic = 5.8682, p-value = 0.0035). This unilateral relationship explains that interest rate is caused by the expected inflation rate. Current interest rates depend on the predicted value of inflation. Central bank normally apply inflation targeting regime uses interest rate as the operational target aimed to achieve the desired inflation rates.

Wasseja *et al.,* (2015) conducted a research on the granger causal affiliation amid macroeconomic determinants and stock prices in Kenya. The study used the secondary data spanning from 1980 to 2012 and used the Vector Autoregressive model. As per Granger causality outcomes, it is proved that movement in the macroeconomic variables had no statistically significant influence on stock prices excluding inflation, exchange and change in stock prices and also seems to be an insignificant factor explaining part of the movement in the macroeconomic variables excluding interest rate.

Mamun *et al.,* (2018) examined the causality linkage amongst stock market development and economic growth in Bangladesh. The Granger causality analysis concludes that the causal relationship is unidirectional than runs from stock market development to the GDP development.

Innocent *et al.,* (2018) investigated the influence of macroeconomic determinants on how the stock market performance in Rwanda. The study used the Engel Granger Cointegration analysis in order to evaluate the long run relationship amongst the variables respectively. The study results found that stock market price granger causes GDP.

Kisaka and Mwasaru analyzed the link among the foreign exchange rate and share prices in Nairobi Stock Exchange. The outcomes of the study established that the 2 variables were cointegrating and that the exchange rate Granger causes the shares.

Nominal GDP Granger causes exchange rates with probability 0.0008. This result elucidates that the gross domestic product (GDP) is a principal indicator used to measure the power health of a county's economy. Worldwide, avoiding overvaluation of currency is one of the most robust imperatives that be obtained from different experience with growth in economy.

Table 2: Pairwise Granger Causality Tests

Pairwise Granger Causality Tests			
Lags: 2			
Null Hypothesis:	Obs.	F-Statistic	Prob.
INF does not Granger Cause SMP	166	1.75722	0.1758
SMP does not Granger Cause INF		2.35591	0.0981
EXR does not Granger Cause SMP	166	1.43523	0.2411
SMP does not Granger Cause EXR		8.26255	0.0004
INT does not Granger Cause SMP	166	1.50732	0.2246
SMP does not Granger Cause INT		0.80027	0.4510
NGDP does not Granger Cause SMP	166	1.82532	0.1645
SMP does not Granger Cause NGDP		1.44075	0.2398
EXR does not Granger Cause INF	166	0.35531	0.7015
INF does not Granger Cause EXR		0.03128	0.9692

INT does not Granger Cause INF	166	1.38651	0.2529
INF does not Granger Cause INT		5.86817	0.0035
NGDP does not Granger Cause INF	166	2.47658	0.0872
INF does not Granger Cause NGDP		2.10911	0.1247
INT does not Granger Cause EXR	166	1.35933	0.2598
EXR does not Granger Cause INT		0.18099	0.8346
NGDP does not Granger Cause EXR	166	7.42785	0.0008
EXR does not Granger Cause NGDP		0.59231	0.5543
NGDP does not Granger Cause INT	166	0.92632	0.3981
INT does not Granger Cause NGDP		4.80236	0.0094

Source: Author, 2019

Interest rates further Granger causes nominal gross domestic product since there was a significant F-statistic 4.8024 (p-value = 0.0094 < 0.05 level of significance). High interest rates in a small open economy leads to high increase in savings that attract foreign inflows that could lead to currency appreciation.

IV. CONCLUSION

Granger causality was also estimated to show causality between macroeconomic variables and stock market prices in Nairobi Securities Exchange. It was established stock market prices Granger causes exchange rate in NSE during the study period. Furthermore, Stock Prices Granger Causes exchange rates as demonstrated by Granger Causality and the Impulse test. The findings showed that that inflation Granger causes interest rate in Kenya and nominal GDP Granger causes exchange rates with probability 0.0008 which showed a unidirectional causality.

REFERENCES

[1]. Bahmagrni-Oskooee, M., & Sohrabian, A. (1992).Stock prices and the effective exchange rate of the dollar.Applied economics, 24(4), 459-464.

[2]. Chen, R., & Choudhary, R. (2001), Inflation and Rates of Performance on Stocks: Evidence from high Inflation Countries, Journal of International Financial Markets, Institutions and Money, .11 .75-96

[3]. Granger CWJ (1981). Some Properties of Time Series Data and Their Use in Econometric Model Specification." Journal of Econometrics, 16, 121 - 130.

[4]. Innocent, G., Shukla, J., & Mulyungi, P. (2018).Effects of macroeconomic variables on stock market performance in Rwanda.Case study of Rwanda Stock Exchange.European Journal of Economic and Financial Research.

[5]. John, F. M., & Kisava, Z. S. (2018). The Relationship between Stock Prices and Exchange Rates: The Focus on Dar Es Salaam Stock Exchange (DSE). Business and Economic Research, 8(1), 1-12.

[6]. Mamun, A., Basher, S., Hoque, N., & Ali, M. H. (2018). Does stock market development affect Economic growth? Econometric evidence from Bangladesh.Management & Accounting Review (MAR), 17(1), 123-144.

[7]. Menike, L. M. C. S. (2006). The effect of macroeconomic variables on stock prices in emerging Sri Lankan stock market.*Sabaragamuwa university journal*, *6*(1), 50-67.

[8]. Nielsen, B. (2001). Weak consistency of criterions for order determination in a general vector autoregression.Department of Economics, University of Oxford.

[9]. Olweny, T., & Omondi, K. (2011).The effect of macro-economic factors on stock return volatility in the Nairobi stock exchange, Kenya.Economics and Finance review, 1(10), 34-48.

[10]. Phillips, P.C.B., Perron, P. (1988). Testing for a unit root in time series regression, Biometrika 75, 335–346.

[11]. Rutasitara, L. (2004). Exchange rate regimes and inflation in Tanzania.

[12]. Sifunjo (1999).The relationship between stock prices and exchange rate (Unpublished MBA dissertation), University of Nairobi, Nairobi.

[13]. Smyth, R., & Nandha, M. (2003). Bivariate causality between exchange rates and stock prices in South Asia.Applied Economics Letters, 10(11), 699-704.

[14]. Toda, H. Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes.Journal of econometrics, 66(1-2), 225-250.

[15]. Vaz, J. J., Ariff, M., & Brooks, R. D. (2008). The effect of interest rate changes on bank stock returns. *Investment Management and Financial Innovations*, *5*(4), 221-236.

[16]. Wasseja, M. M., Njoroge, E., & Mwenda, S. N. (2015). Investigation of the granger causal relationship between macroeconomic variables and stock prices in Kenya.International Journal of Business and Economics Research, 4(3), 98-108.