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RESEARCH ARTICLE

RETURN AND VOLATILITY SPILLOVERS AMONG STOCK AND FOREIGN EXCHANGE MARKETS: EMPIRICAL EVIDENCE FROM SELECTED AFRICAN MARKETS

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ABSTRACT

The study examines the relationships between equity and foreign exchange markets with a focus on return and volatility spillovers in Egypt, Kenya, Nigeria, South Africa and Tunisia. To aid analysis, a bivariate VAR-GARCH BEKK model is employed in the study. The main findings suggest a higher dependence of own return in the stock markets and a uni-directional return spillover from the currencies to the equity markets except for South Africa which has a weaker interrelation among the two markets. Furthermore, results was able to prove a higher level of segmentation among the stock and foreign exchange markets in transmitting volatility spillovers, hence indicating a low integration among them. Investors who are likely to diversify into these growing African markets are likely to reap results of this diversification by trading strategically in the equity and currencies markets.

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INTRODUCTION

Globalization coupled with capital account liberalization recently, in many emerging and frontier markets have led to free flow of information, investment opportunities and openness as compared to decades ago. As a result of this, there is now free flow of capital investments, predominantly from developed markets to countries in Asia, Africa, Eastern Europe and Southern America. Emerging economies as at end of 2012 accounted for 38% of global GDP, which is predicted to rise to 63% by the year 2050, while their stock markets are expected to expand rapidly alongside the expected development (Standard Chartered Bank, 2013). According to a United Nations Development Programme (UNDP) (2013) report, portfolio investment flows to Africa, as compared to decades before have also increased significantly around over 200 billion US Dollars with over 43% of these investments in stock portfolio originating from the United States of America.

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Furthermore, an International Monetary Fund (IMF) wealth report of 2012 suggests that, Africa which currently has no representation in the top 10 economies of the world will have Nigeria and Egypt by 2050, which shows a balance of shift in global economic power and Africa's rise. Volatility can be explained as a natural occurrence which happens to be with financial markets and mostly caused as a result of irrational nature of participants through trading of financial securities. This collective behavior of the market participants may lead to fluctuations in prices of financial securities, hence, causing a phenomenon known as volatility. How volatile a stock or a currency becomes is relatively due to the price and volume movements and demand respectively, which in any case is a strong indicator of how risky the variable (stock/currency) can be. According to Andersen (1996) information flow to a particular market is related directly to the volatility in stock returns, hence, can be related to any other financial variable. This goes on to prove that, volatility clustering exists in higher tendency in developed markets where prices of stocks and currencies change rapidly during the trading day as a result of information flow, which reflects in prices at a higher pace compared to developing markets. On the other hand, Xue and

Gencay (2012) also believe that volatility clustering is at times caused by multiple trading frequencies and the availability of thin trading (which lead to serial correlation in returns), which may be the case in most emerging and frontier markets, specifically in Africa and some parts of Asia. For the purpose of this study, it is important to note that, the stock market and the exchange rate markets in every country are two important variables which come together to serve a purpose by contributing to financial development, and makes diversification ideas a reality, thus, investors are affected by the dynamics and behaviors of these two markets in every country. Therefore, having adequate knowledge of how these two financial variables which aid in foreign and local investments to a larger extent help in reducing losses, thereby making proper hedges against the risks and movements that exist between them and make the required returns from such portfolio investments (Morales, 2008). Many African stock markets are noted to be illiquid and also characterized by thin trading while on the other hand; exchange rates have over the years performed poorly against the major currencies. For example, the Ghana cedi becoming the worst performing currency in the world during the year 2014 by falling 40% against the United States Dollar alone (Financial Times, Bloomberg, 2014). It is therefore important to note that, as foreign investors go into emerging African markets, there is the tendency to brace up with risks associated with equity and currencies in terms of volatility. By knowing this, foreign investors, multinational corporations etc. would be able to hedge against fluctuations in both markets.

In most cases, previous works in relation to volatility and spillovers among equity and currency markets can be seen to be mostly done on developed markets or on Asia (such studies include, Aloui, C. (2007), Choi, Fang & Fu (2009), Granger, Huang & Yang (2000), Yang & Doong (2004), Kanas, A. (2002)). For this reason, we can say that African markets are the least researched and have limited amount of studies as a whole. Whereas the African markets are also characterized as frontier or emerging, it is important to do more to provide enough evidence. On the issue of relationships between the stock and exchange rate markets, there are also a few studies, whereas they are done mostly on the developed markets as already mentioned. Most of these results, as in (Phylaktis & Ravazzolo (2000), Ajayi & Mangone (1996) and Huzaimi & Liew (2004)) come with mixed results as well, such as significant relationships and also at times unrelated results (see for example Nieh& Lee (2001)). It is therefore important to have a look at some African countries to know whether or not the results would be similar to those already studied on the developed countries. On the other hand, related studies such as, Bonga-Bonga (2013), Kumar (2013) and Mishra, Swain &Malhorta (2007) are just the few ones that have specifically written about the South Africa, India and Brazil, which are typical emerging countries from the BRICS group. In the light of this, the study focusing on the selected African countries in a justification to contribute to the already existing work on both the developed and some emerging economies.

In this study, we employ a bivariate VAR-GARCH BEKK model in the analysis after preliminarily data screening has been fulfilled. Results of the study reveal a high level of segmentation, depicting a uni-directional relationship among the stock and foreign exchange markets. Most often, it was evident that the spillovers between these two markets were mainly from the foreign exchange to the stock market of the respective countries. Other parts of the paper are arranged as follows: presentation of data, descriptive statistics and model used for the study is explained in the next section. Presentation of the results follows and ends with summary of conclusions and discussions.

Model of the study

In modeling financial time series data, it is well known that most econometric models are unable to capture the required features due to the fact that they have characteristics exhibiting large values and usually not normally distributed and the variance of the errors not been constant thus known to be heteroscedastic. The ARCH model pioneered by Engle (1982) is mostly preferred in studies related to volatility clustering. The model assumes that large shocks in data series tend be followed by another large shocks within a period of time. With reference to Engle (1982), the ARCH model assumes conditional variance and also depends on certain key elements of information set in an autoregressive manner. Since the introduction of the ARCH model,modeling of volatility in financial time series has grown over the years, leading to different extensions to the original model. It is important to note that, multivariate GARCH (MGARCH) models aid in forecasting and estimating correlations and covariances that exist among the set of variables used into the study. MGARCH models specifically help in the estimation and forecasting of covariances and correlations and are time-varying in nature (Brooks, 2008). For the purpose of this study, the principal focus is on modeling the co-movements, risks between markets, shock transmission and correlation and among stock and foreign exchange markets, therefore imperative to consider the MGARCH models.

The general multivariate GARCH model was first specified by Bollerslev, Engle and Wooldridge (1988) in the form as:

$$y_t = \mu_t + \epsilon_t, \qquad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

$$\epsilon_t|\phi_{t-1} \sim N(0, H_t),$$

Where $\mu_t$represents the N x 1 vector of conditional expectation of y_t at period t, ϵ_t represents the N x 1 vector of shocks at time t.ϕ_{t-1}presents all available information at time t_{-1}.

The bivariate VAR-GARCH-BEKK model has in recent times been used in studies to identify how financial market variables are related to each other. In the context of African markets, it was realized that this model has not yet been implemented yet, thus the need to employ this into this study. The VAR-GARCH-BEKK model as specified will be used to analyze co-movements in the conditional variance and covariance of the series used in the study.

By estimating the mean equation, the first order Vector Autoregressive (VAR (1)) is used to help arrive at the conditional mean returns of all the variables that are been paired. The model is therefore written as follows:

$$y_{1t} = \beta_{10} + \beta_{11} y_{1t-1} + \alpha_{11} y_{2t-1} + u_{1t} \quad \ldots\ldots\ldots\ldots\ldots(2)$$

$$y_{2t} = \beta_{20} + \beta_{21} y_{2t-1} + \alpha_{21} y_{1t-1} + u_{2t}$$

The vector $u_t$which is the error term captures innovations that may be available in each of the markets. However, the spillovers (own and cross markets) of the variables are captured by the estimates of the β coefficient which represents the vector autoregressive parameters.

Furthermore, the bivariate GARCH (1, 1) BEKK is defined as follows:

$$H_t = C_0 C_0' + A_{11} \varepsilon_{t-1} \varepsilon_{t-1}' A_{11}' + G_{11} H_{t-1} G_{11}' \quad \ldots\ldots\ldots\ldots(3)$$

Where C_0represents the upper triangular matrix which is at the same time a constant of the equation.$A_{11}$and G_{11}also measures the ARCH (own shocks) and GARCH effects are the unrestricted (n x n) parameters respectively. It must be emphasized that both contribute to capturing the degree of innovation (i to market j) in the market and conditional volatility availability between the markets respectively.

Data and descriptive statistics

In the study, data for a period of 12 years starting 1st October 2002 to 31 October 2014 is used by generating 3154 daily observations for both stock and the foreign exchange data from all the countries used in the study. Daily price data was gathered from DataStream on the variables; Egypt stock exchange (EGX 30), the Egyptian Pound, Nairobi Stock Exchange (NSE 20), Kenyan Shilling, the Nigeria All Share Index, Nigerian Naira, Johannesburg Stock Exchange (JSE All Share Index), the South African Rand, Tunisian Stock Index (TUNINDEX) and the Tunisian Dinar. Furthermore, the daily price data were converted into simple percentage returns using the formula;

$$Ret = ((P_t - P_{t-1})/P_{t-1}) * 100.$$

Taking into account the fifth assumption of the classical linear regression model, there is a prediction which assumes that the disturbances of the data must be normally distributed, thus, the need to look into the skewness and kurtosis behaviors of the data. Statistically, a normally distributed data is known to be not skewed and also must have a kurtosis of 3. From the table below, it can be seen that all the variables from the respective countries exhibit excess kurtosis which means they have fat tails, while there is the existence of skewness in some of the series. It can also be seen that all the series exhibit a distribution of leptokurtic (kurtosis greater than 3) in them which is an indication that more of the variance is due to infrequent deviations. It must be emphasized that the direction (positive or negative) of a skewed data explains the direction in which returns may be expected from the series. When there is negative skewness, a market is known to have a downtrend and when it is positive, there is an uptrend. The Egyptian Pound, Johannesburg all share index, the South African Rand, Kenyan shilling, Nairobi stock exchange, Nigerian all share Index and the Nigerian Naira are all skewed to the right or are positive which is an indication of positive shocks coming from the respective countries. The positivity of the skewness also explains that investors in these markets are likely to expect positive returns compared to their counterparts with negative skewness. It must be emphasized that, the non-normality of the distribution of the data calls for a non-linear model as a suitable one for analyzing the study, hence, the use of the Bivariate VAR-GARCH-BEKK model. In most cases, when it comes to volatility related studies the standard deviation is often used as a measure of how risky the asset under consideration may be. From the percentage returns, the Johannesburg all share index came up with the highest standard deviation of 179.58% which means it is the most volatile among all the series. It is closely followed by the Egyptian stock exchange (EGX30) with 172.85%. The higher volatility may be as already mentioned political turmoil that rocked the country in 2011, rendering it unstable for some time in the last few years. Also, the NSE20 the South African Rand and Nigeria All share index followed with medium volatility of 117.05%, 107.05% and 103.95% respectively, with the remaining series reporting the lowest standard deviations less than 100% where the Egyptian pound is the less risky with 18.13%.

In order to confirm the usability of the data for further analysis in the study, additional tests are made to identify whether or not the data applied in the study contain unit root and is stationery. This is done using the Augmented Dickey Fuller (ADF) test and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) respectively. The ADF is known to have a null hypothesis of the presence of unit root, while the alternative hypothesis is that there is no unit root. In the ADF test, the negative number under t-statistic is looked at and the more negative it is, the stronger the rejection of the null hypothesis. From the results below, all the variables are statistically significant at 1% level indicating that the null hypothesis is rejected. Stationarity of the series is however determined with the aid of the KPSS test. The null hypothesis is that there is stationarity of the data. From the test results, there was insignificance of probability at 1% significance level, which means the null hypothesis is accepted which makes the data valid for further analysis. Furthermore, based on the selected model for the study, there is the need to make further tests to check for the ARCH tests. In doing so, firstly, the Lagrange multiplier test which is made to assess ARCH effects in the series is conducted for autoregressive conditional heteroskedasticity on residuals. The obtained *Obs*R-squared* which are large enough are also accompanied by significant *Prob Chi-square* at 1% significance level. This is an indication that the data has ARCH effects and confirms the model selection for the study. Also, the heteroskedasticity test is carried on the residuals at selected lags (15). The Ljung-Box Q-test which is used here is a way to test for autocorrelation using joint multiple lags. From the table below, the LB_{15}signifies Ljung-Box Q-statistics for residual serial correlation up to the 15th order. The results indicate that there is autocorrelation in the returns for the selected variables and as already confirmed, there is the existence of ARCH effects.

Volatility clustering as shown in figure above explains the tendency at which volatility in markets appear in bunches. Under volatility clustering, it is noted that large returns of either signs (-,+) lead to large and small returns of either signs to follow with small returns at a period of time.

Descriptive Statistics

	EGX30	EGYPOUND	JSEALLSHARE	SARAND	KENSHILLING	NSE20	NIGNAIRA	NIGALLSHARE	TUNINDEX	TUNDINAR
Mean %	9.58	1.42	0.53	5.38	0.72	6.73	3.88	0.99	3.84	0.97
Median%	5.03	0.00	0.00	3.76	-1.35	13.04	0.00	0.00	3.20	0.00
Maximum%	20.61	16.78	5.72	14.74	10.30	13.80	46.40	12.73	3.91	2.73
Minimum%	-16.71	-1.50	-4.51	-11.75	-6.19	-12.06	-32.70	-7.42	-6.20	-3.50
Std. Dev.%	172.85	18.13	179.58	107.00	52.14	117.05	35.49	103.95	68.63	44.67
Skewness	-0.27	35.35	0.46	0.41	0.51	-0.80	6.11	5.72	-0.13	-0.10
Kurtosis	15.02	1685.83	21.96	24.60	7.57	8.75	378.43	175.00	8.67	5.83
Jarque-Bera	19019.78**	3.73E+08**	47377.72**	61396.99**	2884.53**	4349.91**	18542091**	3903929**	4230.87**	1053.10**
Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ADF (T-Stat)	-23.84**	-17.01**	-19.12**	-18.61**	- 18.00**	-18.51**	-19.86**	-19.04**	-17.64*	-17.78**
KPSS (LM Stat)	0.10	0.02	0.20	0.04	0.02	0.10	0.10	0.10	0.22	0.03
ARCH (LM Test)	240.22**	115.49**	830.41**	434.60**	584.72**	454.78**	560.20**	359.10**	540.42**	210.21**
LB_{15}	35.34**	172.50**	35.41**	17.73**	59.84**	24.13**	60.40**	35.51**	22.83**	19.50**
Sum	302.03	44.91	16.64	169.75	22.69	212.15	122.44	31.09	120.98	30.59
Sum Sq. Dev.	9841.60	384.63	857.04	4319.69	3609.87	10168.14	6961.33	799.60	1485.23	629.10
Observations	3154	3154	3154	3154	3154	3154	3154	3154	3154	3154

(***) explains statistically significant at 1%. KPSS (Kwiatkowski–Phillips–Schmidt–Shin) is a test for stationary process.
KPSS Lagrange Multiplier is seen to be not significant and hence the null hypothesis of stationary cannot be rejected.
Standard Deviation and the mean were annualized. ARCH (LM) is the Lagrange multiplier test for ARCH up to lag 15, LB15 is Ljung-Box Q-statistic using 15 lags and ADF is the Augmented Dickey Fuller for unit root test.

	EGX30	*EGY POUND*	*JSE ALL SHARE*	*SA RAND*	*NSE 20*	*KEN SHILLING*	*NIG ALL SHARE*	*NIG NAIRA*	*TUNINDEX*	*TUN DINAR*
EGX30	1									
EGY POUND	-0.20	1								
JSEALL SHARE	0.20	-0.05	1							
SA RAND	-0.13	0.04	-0.80	1						
NSE 20	0.10	-0.06	0.11	-0.10	1					
KEN SHILLING	-0.07	0.04	-0.15	0.13	-0.57	1				
NIG.ALL SHARE	0.06	-0.03	0.02	-0.02	0.03	-0.02	1			
NIG NAIRA	0.02	0.02	-0.01	0.03	-0.03	0.03	-0.33	1		
TUNINDEX	0.08	-0.01	0.33	-0.33	0.07	-0.08	0.01	-0.02	1	
TUN DINAR	-0.06	0.05	-0.43	0.46	-0.08	0.11	-0.01	0.05	-0.63	1

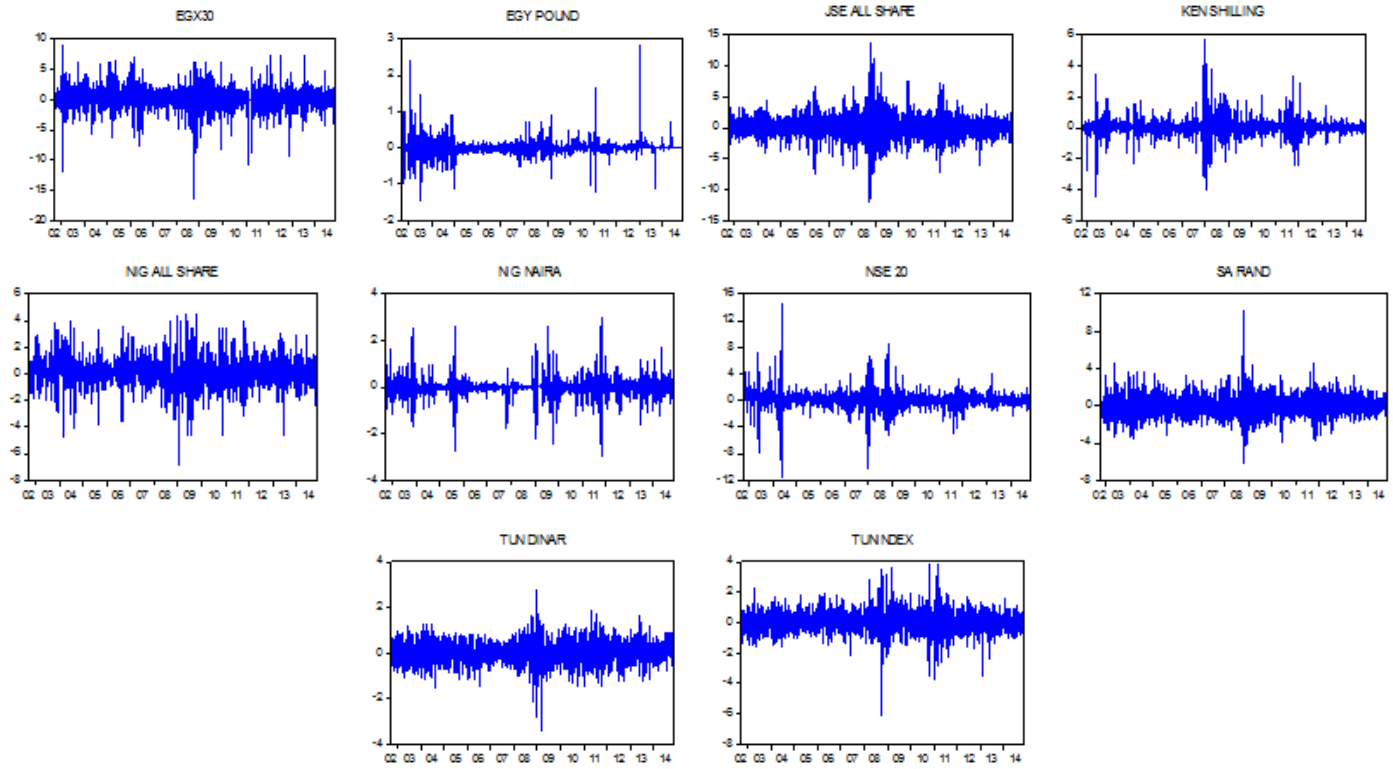
Numbers in bold represent statistically significance at 10% level.

A possible explanation for this behavior is that information arrival which leads to changes in asset prices are not evenly spaced but arrive in bunches. The price at which a stock sells at a particular time, for example, reflects or is the result of available information that flows within the market, whether positive or negative and these information in volatility clustering is known to arrive in bunches rather than been evenly spaced. The figure above depicts that the series used in the study show some sort of volatility clustering a point in time during the years under consideration. The returns can be seen to fluctuate around the constant but exhibit volatility clustering, that is, large changes in returns cluster together and small changes in returns also cluster together. This means that the series can be said to exhibit conditional heteroscedasticity. One significant timeline worthy of mention is the 2008 sub-prime crisis. African markets had their own share of the crisis, since they may be one way or another be related to other global indices. It can therefore be seen that all the series exhibit some spikes during this period of time. Also, the Egyptian stock and foreign exchange markets responded with some negative spikes in the stock market during 2011, the year of the revolution which led to the ousting of Hosni Mubarak from office. This may have been as a result of low foreign direct investment in the wake of the political unrest. However due to a low correlation of the Egyptian stock and currency with the other African countries, the effect of the revolution wasn't felt in the other series has also shown in the correlation analysis below. To be able to identify the degree of linear association among the variables, which is a way to prove that there is a linear relationship between them and movements in the variables are to some extent related given by the correlation coefficient.

It can be seen from the table below that the Egyptian Pound seem very much segmented from all the other variables, depicting very low correlation with the other variables in the study, same as the Nigerian Naira. Although some correlations exist among the markets, there seem not to be higher correlation among them, indicating the possibly that these various African markets are independent of each other to a larger extent. One would have predicted a higher correlation between Tunisia and Egypt (both in the MENA region) but the results confirm otherwise.

RESULTS

This section is solely dedicated to presenting the outcome of the study, thereby, focusing on the extent to which the results answers the research questions proposed for the study. In this study, the focus has been to identify the volatility dynamics (linkages) among equity and foreign exchange markets, and to know which market is the source. To be able to do so, the various markets under study in respective countries are paired together, hence generating five (5) pairs. The results below were obtained through employing a bivariate VAR (1) model to arrive at the mean return spillovers while shock transmissions and volatility spillovers depends on GARCH (1, 1)-BEKK estimations. The first four parameters in the table present the matrix β in the mean equation. It captures the linkages between the markets with respect to mean returns. Furthermore, as presented in the tables below, the parameters βii and βjj have different meanings signifying own market returns spillovers while the off diagonal parameters βij and βji represents the returns spillovers when two markets are paired.



Graphical Presentation of series. Source Thomson Reuters DataStream (2014)

Also, the matrices γ and δ as shown in the tables defines the time-varying variance-covariance effect. These matrices capture the volatility dynamics in various markets and between the pair of markets under consideration. The diagonal estimates in matrix γ shows the own ARCH effect within the specific market whereas the diagonal estimates in matrix δ captures the own GARCH effect. However, the various off diagonal estimates show pairwise shock transmissions and volatility spillovers between the stock and foreign exchange market. From the results below, it is can be seen that Egypt, Nigeria, Kenya and Tunisia have high significance among all the pairings while South Africa on the other hand came up with an insignificance results for all the pairings under the parameter βii.

Var (1) Garch 1,1 Results

EGYPT	Coeff	Std Error	Signif	NIGERIA	Coeff	Std Error	Signif	SA	Coeff	Std Error	Signif
Parameters				Parameters				Parameters			
Bii	0.18	0.02	0.00	*Bii*	0.38	0.02	0.00	*Bii*	0.01	0.02	0.51
Bij	0.42	0.18	0.02	*Bij*	0.54	0.05	0.00	*Bij*	0.01	0.03	0.75
Bji	0.00	0.00	0.01	*Bji*	0.00	0.00	0.94	*Bji*	0.02	0.01	0.22
Bjj	-0.21	0.02	0.00	*Bjj*	-0.09	0.02	0.00	*Bjj*	-0.01	0.01	0.56
ωii	0.30	0.04	0.00	*ωii*	0.23	0.02	0.00	*ωii*	0.18	0.02	0.00
ωij	0.02	0.00	0.00	*ωij*	0.01	0.00	0.00	*ωij*	-0.09	0.01	0.00
ωjj	0.00	0.01	1.00	*ωjj*	0.03	0.00	0.00	*ωjj*	0.05	0.01	0.00
γii	0.25	0.02	0.00	*γii*	0.36	0.02	0.00	*γii*	0.29	0.02	0.00
γij	0.01	0.00	0.00	*γij*	0.01	0.00	0.00	*γij*	-0.03	0.01	0.01
γji	-0.67	0.15	0.00	*γji*	-0.02	0.05	0.71	*γji*	0.03	0.03	0.28
γjj	0.45	0.02	0.00	*γjj*	0.42	0.02	0.00	*γjj*	0.20	0.02	0.00
δ*ii*	0.95	0.01	0.00	δ*ii*	0.90	0.01	0.00	δ*ii*	0.95	0.01	0.00
δ*ij*	-0.01	0.00	0.00	δ*ij*	-0.01	0.00	0.00	δ*ij*	0.01	0.00	0.00
δ*ji*	0.26	0.06	0.00	δ*ji*	-0.04	0.02	0.06	δ*ji*	-0.01	0.01	0.14
δ*jj*	0.91	0.01	0.00	δ*jj*	0.92	0.00	0.00	δ*jj*	0.98	0.00	0.00

Var (1) Garch 1,1 Results

KENYA				TUNISIA			
Parameters	Coeff	Std Error	Signif	Parameters	Coeff	Std Error	Signif
Bii	0.35	0.02	0.00	*Bii*	0.26	0.02	0.00
Bij	0.33	0.04	0.00	*Bij*	0.28	0.03	0.00
Bji	0.00	0.01	0.60	*Bji*	-0.01	0.01	0.29
Bjj	0.00	0.02	0.03	*Bjj*	-0.05	0.02	0.01
ωii	0.11	0.01	0.00	*ωii*	-0.13	0.01	0.00
ωij	-0.02	0.01	0.01	*ωij*	0.00	0.01	0.62
ωjj	0.07	0.00	0.00	*ωjj*	0.02	0.00	0.00
γii	0.32	0.02	0.00	*γii*	0.42	0.02	0.00
γij	0.01	0.00	0.08	*γij*	-0.01	0.01	0.49
γji	0.08	0.03	0.02	*γji*	0.30	0.03	0.00
γjj	0.38	0.02	0.00	*γjj*	0.14	0.01	0.00
δii	0.94	0.01	0.00	*δii*	0.88	0.01	0.00
δij	0.00	0.00	0.13	*δij*	0.00	0.00	0.66
δji	-0.04	0.01	0.00	*δji*	-0.11	0.01	0.00
δjj	0.92	0.01	0.00	*δjj*	0.99	0.00	0.00

The leading diagonals of our variables show that all variables in the respective countries depend on their past returns. This means that the returns of the equity and foreign exchange markets in Egypt, Kenya, Nigeria and Tunisia are affected by relative shocks in the market while the opposite is true for South Africa. The off-diagonal parameters βij and βji are used to explain how return spillover exists across markets and countries. Looking at the relationship between the EGX 30 and the Egyptian Pound exchange rate, it can be seen that the stock market is influenced by changes in the foreign exchange market by 42%, thus a uni-directional relationship. The Nigerian All share index, on the other hand, receives return spillover of 54% from the foreign exchange market, which is an indication of a high integration among the two markets. Furthermore, all the parameters representing the own shock and volatility spillover are statistically significant. The currency markets coefficients and that of the stock markets can be seen to be influenced by their own past shocks and volatility spillover having an impact on the conditional variance of Egypt, Kenya, Nigeria, South Africa and Tunisia. Shock transmission across markets is represented by the off-diagonal parameters γij and γji which revealed transmissions between the paired variables. The Egyptian Pound can be seen to be very predominant in shock spillover by transmitting 67% of shocks to the EGX 30, however the reciprocal from the stock markets is a little of 1%. The relationship between the Nigerian All share Index and the Naira exchange rate seem to be very weak, thus are not affected so much in terms of shocks. It can be seen that both markets display a bi-directional relationship, hence, with a weak transmission of 2% shock transmission. The Johannesburg stock exchange and the South African Rand, exhibits a bi-directional relationship with both markets exporting shocks to each other. Both markets exhibit this relationship by transporting 3% of shocks to the other. Finally, a uni-directional relationship exists between the stock and foreign exchange markets in Tunisia and Kenya. It can be seen that the Tunisian stock exchange and Nairobi stock exchange all transmit shocks of 30% and 8% each to the currency market. The parameter δ explains the volatility spillover of the study, thus the cross market volatility spillover are explained from the

off-diagonal parameters δij and δji. Volatility spillover between the stock and foreign exchange market in respective countries, the results shows a weak relationship in all countries except for Tunisia. The Tunisian Dinar and the stock market interact resulting in the stock market export spillover of 11% to the foreign exchange market negatively.

DISCUSSIONS AND CONCLUSION

The dynamics of return and volatility transmission between the equity and foreign exchange markets are an important aspect in financial management and choice in investment strategies; hence our study has been able to provide answers to these myths especially in young emerging African markets. The results above contribute to the formed research questions for which the study has been conducted on. Firstly, the study aim to look at the extent to which the equity and foreign exchange markets are linked with a focus of the study based on the question: "*Are there any existence of linkages (return and volatility spillover) between foreign exchange and the stock market of the respective countries? If yes, which market is the source?"*.

Our study found the relationship in returns between the foreign exchange and stock markets in the respective countries studied to be uni-directional and dominated by the foreign exchange market exporting such spillovers to the other side, which was evident in Egypt, Kenya, Nigeria and South Africa. Volatility spillover effects among the two markets came up with volatility persistence to be very limited which shows a relatively low or no integration among the two markets. From our results, only the EGX 30 and the Egyptian Pound came up with a 26% volatility spillover which is seen to be exported to the foreign exchange market from the equity market. In the various countries studied, the result is an indication of a weaker relationship among the two markets studied, depicting a weaker integration, thus each market do not affect the other so much. In terms of external shocks, a conclusion can be made from the fact that, own market volatility spillover in the equity markets are highly significant and this changes in the equity markets proved to be more considerable than any external shocks. In respect to returns spillovers, all the equity markets, with the exception of the Johannesburg stock exchange show a dependence on own past returns.

The equity markets were observed to receive return spillover from the currency markets showing a uni-directional relationship. With reference to these results, one can attribute this to recent liberalizations in financial markets in Africa which has brought about foreign investor participation. However, such investors are *"smart"* and are responsive to risks that may be associated with such young African markets, thus leading to capital outflows during crisis periods, leading to excessive volatility transmissions from the equity to currency markets. By employing the same model as in this study, suggestion for further research can be focused on including other macroeconomic variables such as inflation, unemployment, consumer price index, industrial production etc. to study how they go in hand with the dynamics of spillover of the equity and foreign exchange markets. The study can focus on how these variable changes can affect return and volatility spillover in the equity markets. Also, with similar length of data, a sub sample can be made by studying how recent financial crisis has also affected the volatility dynamics in the major countries studied.

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