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Volatility Transfer from Developed Countries to Emerging Markets: Evidence from Nigeria

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Abstract
In this paper, we examine the existence of volatility transfer from stock exchanges of 5 major developed economies of USA (NYSE), Canada (S&PTSX), France (CAC) Germany (DAX) and UK (FTSE) to the Nigerian Stock Exchange (NSE). To ascertain the relationship between these five bourses and the NSE, we employ the Ordinary Least Square Estimation (OLSE) technique. Moreover, we use the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model to determine the existence or otherwise of volatility transfer from these five advanced bourses to the NSE. The results of this study confirm the existence of volatility transfer from the NYSE, S&PTSX, CAC, DAX and FTSE to the NSE from January 1st January 2006 to 15th March 2010. Following from this, it behooves on policy makers in Nigeria to pay particular attention to events in these bourses and in these economies and proactively take prompt actions when necessary.
Keywords: Global Financial Crisis, Bourses, Contagion, GARCH, Meltdown, OLSE, Volatility Spillover, Volatility Transfer.

I. Introduction

The global financial crisis of 2007-2009 is believed to be worse in coverage and in intensity than the great depression of the 1930s. The literature has identified both remote and immediate causes of the problem (Reinhart & Rogoff; 2008). Its immediate cause has been traced to the subprime loan crisis in the USA, which spread with the aid of securitization and globalization to Europe, Canada, and lastly Africa. It is estimated that the global stock markets lost about $26,400 billion (almost 100 times the initial subprime loss) between July 2007 and November 2008. Also, the crisis accounted for an estimated loss of about $4,700 billion dollars in world output (or about 20 times the initial subprime loss) by November 2008 (Blanchard, 2009).

The crisis also affected Nigeria adversely. The huge capital outflows from the country (partly in response to the financial stress in advanced countries) and the enormous decline in capital inflows to the country (as a result of collapse of commodity prices, and fall in remittances, portfolio and direct investments, as well as aid etc) put a lot of strains on the Nigerian capital market. The latter's crash was monumental, with serious implications for the Nigerian economy. For instance, the Nigerian all share index that stood at 23,844 at December 2004 rose to 65,075.02 at the close of business on the last day of February 2008, a growth of about 172.91 per cent. This gain was however reversed as the global meltdown hit the Nigerian financial system with the Nigerian Stock Exchange (NSE) all share index falling below its December 2004 level to stand at 21,652 at the end of January 2009. This crash in the Nigerian stock market has serious implications for the banking subsector as the latter contributes roughly about 65 percent of the market capitalization of all listed equities on the NSE. Moreover, the exposures of the banking sector to the capital market (through granting of margin loans) as well as the oil and gas sector further put a lot of stress on banks in Nigeria.

There are four main channels identified in the literature through which economic and financial crisis was transmitted from the developed economies to the developing ones. These are the trade channel, capital market channel, foreign aid channel and remittances (Balakrishnan, Danninger, Elekdag, & Tytell, 2009; Roe, 2009; Odi 2009). Although many extant studies have examined the transmission of financial crisis and financial stress to developing countries, there is a dearth of empirical investigation into the effect of the crisis on the Nigerian capital market. This study seeks to fill the lacuna by specifically ascertaining the existence of volatility transfer from the developed countries to the Nigerian stock market during the period of the crisis.

The paper is in five sections. Following this introductory section, the second section reviews the extant literature on the subject matter. In the third section, we present the methodology while the fourth section discusses the results of the exercise in section three. The fifth summarizes the findings and draws some conclusions, while making recommendations to help policy makers.

2. Literature Review

The recent global financial crisis has its root in the modest growth and profit experienced by the U.S financial institutions in the 1990s. During this period, their erstwhile stringent lending policies were relaxed, thereby

allowing previously high-risk borrowers a greater access to loans (particularly housing loans). As more of these high-risk borrowers borrowed often at initially low interest rates but with stiff penalties for defaults, they became attractive for packaging and repackaging into exotic products for sale to other investors. Most investors bought and hedged on these financial instruments unaware of the risks inherent in them (Greenlaw, Hatzius, Kashyap & Shin, 2008; Blanchard, 2009; Brunnermeier, 2009).

Enormous payment defaults emanating from an over-crowded housing market on one hand and a slump in other sectors – such as automobiles on the other hand triggered reduction in lending by banks in their efforts to minimize their exposures. But by this time, the harm had been done leading to the sudden collapse of big and reputable financial institutions – Lehman Brothers and Merrill Lynch in the U.S. and the erosion of overall confidence not only in the Wall Street but also stock markets outside the U.S. A number of financial institutions around the globe were either taken over or merged with others. In some cases, they were declared insolvent or were liquidated. Other industries in the economy – automobiles, retail trade and airlines have not been spared. They have been affected indirectly due to a debilitating credit crunch in almost all economies or directly as a result of low customer patronage. In view of the fact that investors in the affected financial instruments include domestic investors as well as foreign governments, corporations, pension funds and insurance companies, it is not difficult to decipher how the crisis which began in the U.S was able to spread rapidly like a wildfire to the rest of the global economy. Aided by the interlinking of markets worldwide as a result of financial liberalization and globalization what started as a "localized" problem assumed a global dimension both in terms of the sectors and the economies affected, necessitating in most cases an array rescue packages by governments (Nadauld & Sherlund, 2008; Blanchard, 2009).

The literature has indeed used the term "contagion" to define the reaction of financial variables (such as exchange rates, interest rates, and stock market prices) to events in foreign countries (Schmukler, Newfarmer & Kawai, 2001). Movements of one nation's exchange rates, stock prices, and interest rates associated with movements in another nation's exchange rates, stock prices, and interest rates are interpreted as contagion. Contagion thus involves cross-country co-movements of the financial variables and high correlations of these variables across countries. According to Dornbusch, Park, and Claessens (2000), channels of contagion include: those related to fundamental linkages among economies and as well as factors unrelated to fundamentals. Fundamental linkages consist of "real" linkages, usually associated with trade and/or foreign direct investment (FDI), and "financial" linkages, occurring when international investors engage in global diversification of financial portfolios and connect different economies financially. Countries with internationally traded financial assets and with liquid markets tend to be subject to contagion (Kodres & Pritsker, 1998; Calvo 1998). Factors unrelated to fundamentals (herding) include *t*he magnitudes of swings in exchange rates and stock prices across countries appear to be beyond those predicted by any fundamental linkages. Shocks were really transmitted to economies where fundamental linkages are not present or strong. Domestic and international financial markets transmit shocks across countries when the markets become concerned about the future prospects of countries or when markets see a crisis somewhere else. These events affect expectations; investors panic and move away from countries that do not necessarily share fundamental linkages. This type of investor behavior is referred to as "herding."

Dornbusch, Park, and Claessens (2000) review evidences on contagion, namely: correlation of asset prices; conditional probabilities of a currency crisis; changes in volatility; comovements of capital flows and rates of return; and other tests. Their conclusion is that "fundamentals help predict spillovers and that trade links are important factors as well", though "common creditor and other links through financial centers transmit volatility from one country to another..." Their review confirms their conclusion that "comovements are unavoidable and that fundamental factors are important" in determining the susceptibility of an economy to contagion. They conclude with preliminary suggestions for policy, focusing on the importance of disclosure, improved standards, and prudential controls as well as changes in international financial architecture.

The issue of international transmission of shocks through the capital market channels has also been examined in the literature. King and Wadhwani (1990) find evidence of stock market correlations among the United States, the United Kingdom, and Japan, while Lee and Kim (1993) confirm this for twelve major markets. Also, Hamao, Masulis, and Ng (1990) show the transmission of stock market volatility from New York to London and from London to Tokyo. Moreover, Edwards (1998) provide evidence of stock volatility spillovers from Mexico to Argentina and Longin and Solnik (1995) arrive at similar conclusions for seven OECD countries from 1960 to 1990.

3. Methodology

3.1 Model Estimation Techniques

In this study, time series econometric techniques are employed to ascertain the nexus between the Nigerian Stock Exchange (NSE) and the stock exchanges of 5 major developed economies of USA (NYSE), UK (FTSE),

Canada (S&PTSX), France (CAC) and Germany (DAX). Specifically, we apply the Ordinary Least Square Estimation (OLSE) technique to first ascertain the relationship existing between the NSE and the identified countries' exchanges. We thereafter use the Generalized Autoregressive Conditional Heteroskedasticity (GARCH), pioneered by Bollerslev 1986, and Taylor 1986 to determine the existence of volatility transfer or spillover from the bourses of these five industrialized countries to the Nigerian stock exchange during the period under consideration. We employ the daily All-share indices of these six bourses from January 1st January 2006 to 15th March 2010. Each series consists of 970 observations.

3.2 Model Specification

Towards achieving the objective of this paper, we posit a multivariate model of the following form:

$$NSE = \alpha_0 + \beta_1 FTSE + \beta_2 NYSE + \beta_3 S\&PTSX + \beta_4 CAC + \beta_5 DAX + \varepsilon_i \quad (3.2.1)$$

where:

NSE is the all share index of the Nigerian stock exchange while NYSE index (New York Stock Exchange) represents the stock exchange of USA even as FTSE, S&PTSX, CAC, DAX are the all-share indices of England, Canada, France and Germany respectively. α_0 and β_i are the parameters to be estimated, and ε_i is the error term. We expect "a priori", $\beta_{is} > 0$. Both the OLSE and the GARCH specifications use this basic model (3.2.1) in defining the relationship existing between NSE and the bourses of these five countries.

The conditional variance in the GARCH (1, 1) model is given as:

$$\sigma_t^2 = \omega + \alpha \epsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (3.2.2)$$

Where:

ω = a constant term; ϵ_{t-1}^2 = the ARCH term; and σ_{t-1}^2 = the GARCH term

We can also represent GARCH (q, p) variance as:

$$\sigma_t^2 = \omega + \sum_{j=1}^{q} \beta \sigma_{t-1}^2 + \sum_{i=1}^{p} \alpha \epsilon_{t-1}^2 \quad (3.2.3)$$

4. Research Findings

In line with the objective of this study, we first examine the graphical representation of the time series data. Fig 1 below shows the existence of volatility in each of the series namely: NSE, NYSE, FTSE, S&PTSX, CAC, and DAX. When all the series are combined in figure 2, they also exhibit similar pattern. Both figures are thus suggestive of comovement and possibly volatility transfer during the period under consideration.

To further confirm the relationship existing between the five advanced bourses and the NSE, we present the results of the OLSE in table 1 below. The results indicate that NSE is positively and significantly influenced by NYSE, SPTSX, CAC and DAX at 5 percent significance level during the period under review. It thus implies that the Nigerian bourse responded in similar fashion to the changes that took place in the aforementioned bourses in USA, Canada, France and Germany respectively. On the other hand, the table also shows that the stock exchange of the United Kingdom (FTSE) negatively impacted the NSE during the examined period. This means that changes in the UK had opposite effects on the NSE during the period under consideration.

In addition, the R^2 of 0.821498 in table 1 reveals that about eighty two percent of the variability in the NSE can be attributable to changes that occurred in all the five advanced bourses examined during the period under review. It thus, suggests that the meltdown and volatility experienced in these developed stock exchanges during the recent financial crisis were transferred to the NSE. This conforms to the assertion of Soludo (2009) that the crash of Nigerian capital market could be traced largely to reduction in capital inflows and divestments from advanced economies occasioned by the recent global financial crisis whose origin is widely traced to the subprime mortgage crisis in the United States of America.

Although the OLSE estimation above points to a robust and positive nexus between the five developed bourses identified, evidence of volatility transfer is provided using the GARCH methodology. Results of the GARCH model in table 2 show that the sum of the ARCH and GARCH coefficients (α and β) is close to one, indicative of considerable volatility transfer during the review period. These results thus consistently show evidence of spillover effect from the stock exchanges of USA, Canada, France, Germany and UK to the NSE and lend credence to the results provided earlier by the OLSE technique.

5. Conclusion

We examine in this paper the existence of volatility transfer from stock exchanges of 5 major developed

economies of USA (NYSE), Canada (S&PTSX), France (CAC) Germany (DAX) and UK (FTSE) to the Nigerian Stock Exchange (NSE). The graphical presentations and observations reveal a comovement, as all the stock exchanges under review move in similar fashion. Also, we use the Ordinary Least Square Estimation (OLSE) technique to show that a significant and positive nexus exist between the five advanced bourses and the NSE and that the variability in the latter can be attributed to movements in the former. Using the more appropriate GARCH model, the results of this study confirm that volatility was indeed transferred from the NYSE, S&PTSX, CAC DAX and FTSE to the NSE from January 1st January 2006 to 15th March 2010. On the basis of these evidences, it is therefore imperative that policy makers in Nigeria should pay particular attention to events in these bourses and in these economies and proactively take prompt actions when necessary. This will enable the Nigerian capital market to either avoid unwanted consequences or take advantage of opportunities resulting from activities in these five bourses.

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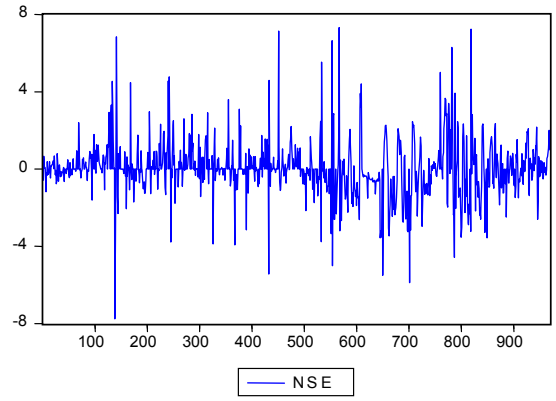
Appendix

Table 1: OLSE Estimates
Dependent Variable: NSE

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FTSE	-61.70251	2.032456	-30.35860	0.0000
NYSE	11.30183	1.126635	10.03149	0.0000
SPTSX	4.478269	0.518166	8.642535	0.0000
CAC	3.102177	1.413616	2.194497	0.0284
DAX	8.763240	0.614490	14.26100	0.0000
R-squared	0.821498	Mean dependent var		37182.74
Adjusted R-squared	0.820758	S.D. dependent var		14065.45
S.E. of regression	5954.890	Akaike info criterion		20.22695
Sum squared resid	3.42E+10	Schwarz criterion		20.25210
Log likelihood	-9805.073	Durbin-Watson stat		0.095969

Table 2: GARCH Estimates
Dependent Variable: NSE
Method: ML - ARCH (Marquardt) - Normal distribution
Included observations: 969
Convergence achieved after 38 iterations
Bollerslev-Wooldrige robust standard errors & covariance
Variance backcast: ON
GARCH = C(7) + C(8)*RESID(-1)^2 + C(9)*GARCH(-1)

	Coefficient	Std. Error	z-Statistic	Prob.
NYSE	-0.012037	0.047894	-0.251330	0.8016
FTSE	0.199867	0.080935	2.469470	0.0135
SPTSX	0.009040	0.060776	0.148747	0.8818
DAX	0.000183	5.68E-05	3.222504	0.0013
CAC	-0.148867	0.064411	-2.311213	0.0208
C	-1.133614	0.328935	-3.446314	0.0006
Variance Equation				
C	0.273359	0.113977	2.398358	0.0165
RESID(-1)^2	0.336405	0.067474	4.985721	0.0000
GARCH(-1)	0.576542	0.085647	6.731578	0.0000
R-squared	0.011148	Mean dependent var		0.011618
Adjusted R-squared	0.002907	S.D. dependent var		1.443102
S.E. of regression	1.441002	Akaike info criterion		3.310499
Sum squared resid	1993.428	Schwarz criterion		3.355789
Log likelihood	-1594.937	F-statistic		1.352807
Durbin-Watson stat	1.442855	Prob(F-statistic)		0.213559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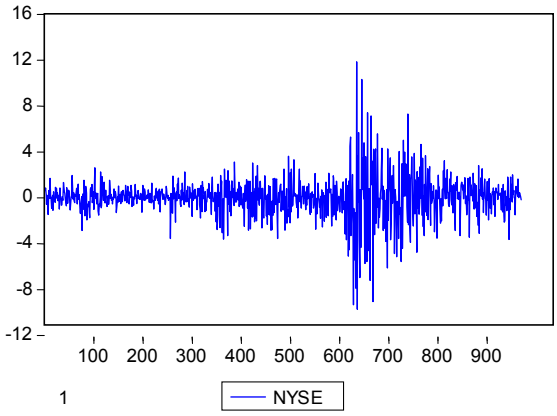
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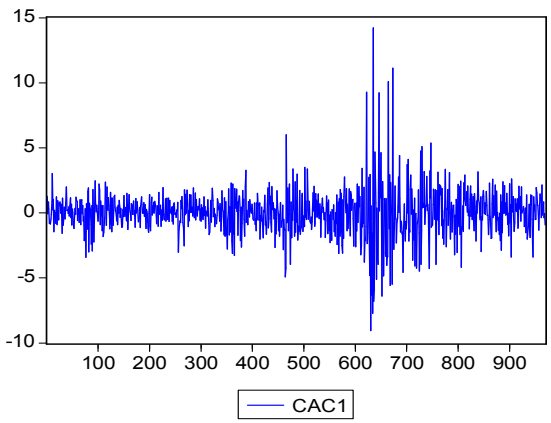
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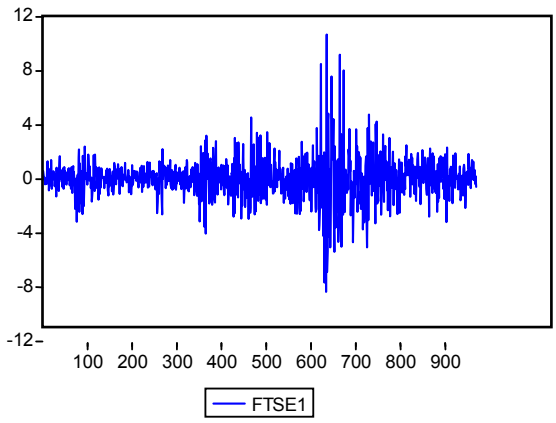
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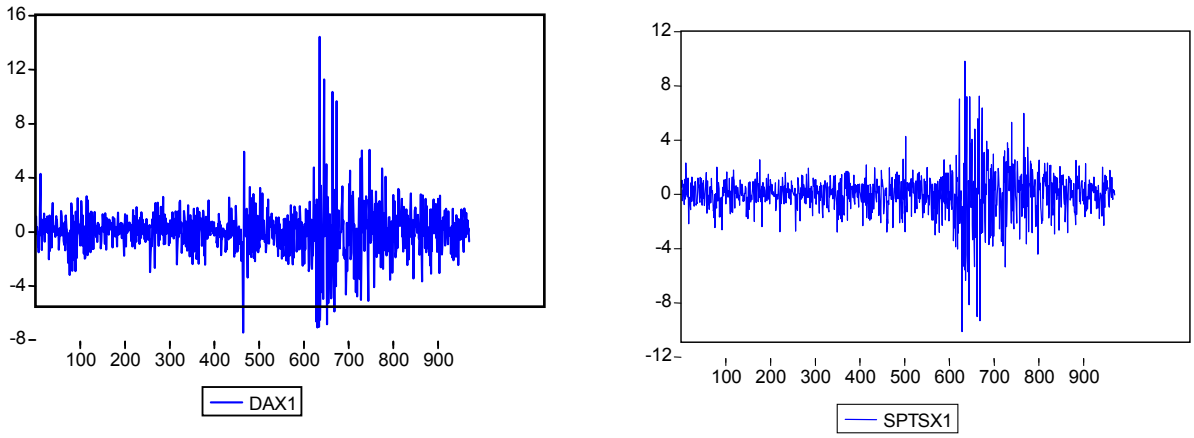

Figure 1: Graph showing movements in each of the bourses under consideration.

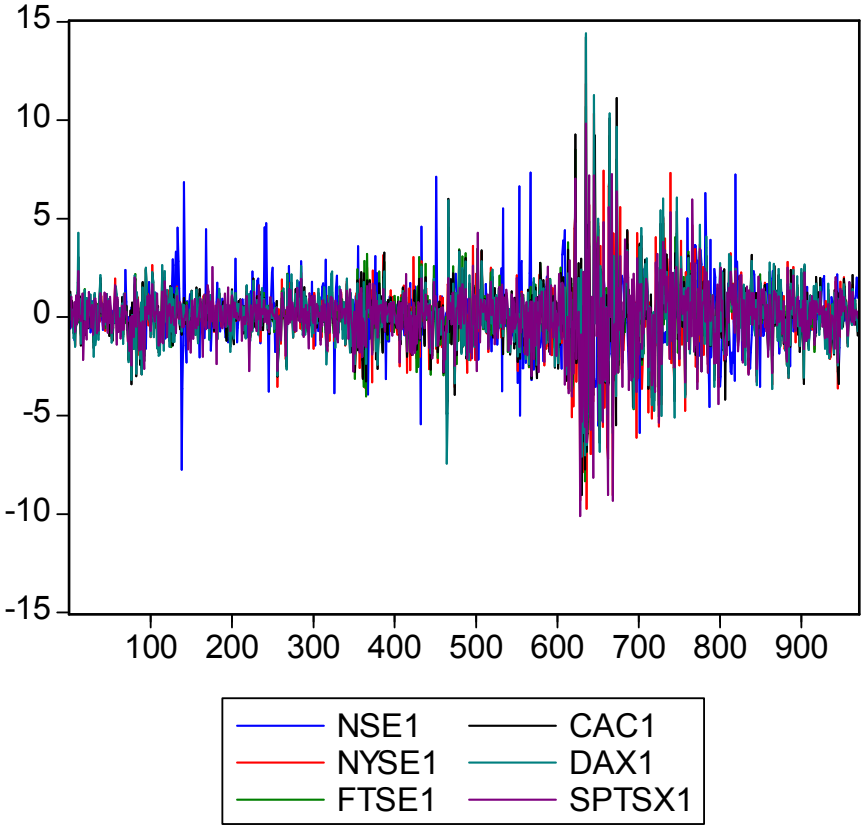

Figure 2: Graph showing movements in all the six bourses combined.

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