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Analysis of Weak-Form Efficiency on the Nigerian Stock Market: Further Evidence from GARCH Model

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Abstract: This study investigated whether the Nigerian stock market (from the period 1984 to 2006) follows a random walk. To carry out the investigation, the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) was employed. The result shows that the Nigerian stock market follows a random walk and is therefore weak form efficient. However, the years 1987, the period of financial deregulation, 1988 when some public companies were privatized, 1995 the period of internationalization of the Nigerian capital market and the years 2000-2006 recorded persistent volatility clustering suggesting weak form inefficiency in the market for these years. Nevertheless, the parameter estimates of their conditional mean equations (except in 1995) were insignificant. Besides these years, other years were conspicuously and significantly found to exhibit weak form efficiency. Thus, the Nigerian stock market is weak form efficient and as such no investor can usurp any privileged information to bit the market and make abnormal profit.

Key words: Stock market, weak-form efficiency, random walk hypothesis, GARCH model

INTRODUCTION

The Nigerian stock market came into existence in September 15th 1960 with the establishment of Lagos Stock Exchange which became operational in June 5, 1961. In December 5, 1977, following the recommendation of the government financial system review committee of 1976, the Lagos Stock Exchange was renamed and reconstituted into the Nigerian Stock Exchange. The exchange has since then been the hub of the Nigerian capital market and has been operating through stock brokers or dealers who intermediate loanable funds between lenders and borrowers (Nemedia, 1982).

The Nigerian stock exchange which started with only 19 securities traded on its floors in 1961 now has over 277 securities made up of government stocks, industrial loans, bonds and equities (including SSM). The SSM is the acronym for the second tiers securities market which was established in 1985. With it, the stock exchange relaxed the cost and listing requirement for the small and medium firms in order to assist small and medium sized indigenous companies to have access to the resources of the capital market. The exchange maintains an all-share index formulation since January 1984. Only common stock (ordinary) shares are included in the computation of the index.

Deregulation of the Nigerian economy and hence the financial system in 1986 coupled with the privatization of the public sector enterprises in 1988 necessitated a lot of changes in the capital market. In view of this development, the Lagos Stock Exchange has since June 2, 1987 linked up with the Reuters electronic contributor system for online global dissemination of stock information like trading statistics, all share index, company investment

ratios and company news. In 1996, the exchange launched its internet system (CAPNET) as one of the infrastructure supports for meeting the challenges of internationalization and achieving an enhanced service delivery. Since 1987, there has been a decline in the share of government stock in the stock exchange. The growth of government stock started decreasing while industrial equities and bonds as well as second tier securities market continued to increase yearly (The Nigerian Stock Exchange, 2004).

The internationalization of the market in 1995 accentuated the interest of the private sector investment in the stock market. Conspicuously, as government stock traded in millions during 1995 to the recent day, industrial equities accelerated to billions (The Nigerian Stock Exchange, 2007).

Over the years, the total market capitalization has been increasing. From N20.10 m in 1970, it increased consistently to N4464.20 m in 1980 from where it increased further to N16348.40 m in 1990, N466058.70 m in 2000 and in 2006, the figure rose to N5.12 trillion. In spite of the progressive increase in the total market capitalization, its share of the gross domestic product has been very small. The proportion of market capitalization to Gross Domestic Product fluctuated between about 6.1% in 1970 to 18.20% in 2006. There was however a continued decline in its share of GDP from 1977 to 1999 and this decline could be associated with the widespread distress in the banking system within this period. In 1978 alone, a total of 26 banks including listed ones were put to liquidation (Okpara, 2006).

The random walk hypothesis states that the current market prices reflect all information contained in the record of past stock prices. This definition portrays that there is no regularities of patterns in security prices that repeat themselves over time as to predict future stock prices from past prices. Consequently, investors cannot usurp any privileged information as to beat the market and make abnormal profit. The first to point out that security prices and prices of other speculative commodities follow a random walk was Bachelier (1900). His study was not recognized until Working (1934) confirmed the same result. Since then, the weak form hypothesis has been tested in hundreds of studies. Fama (1965, 1991), Jennergren and Korsvold (1975), Rom (1997), Hadi (2006) and Raja *et al.* (2009) lend support to the random walk assertion while Magnus (2008) in his recent study obtained a contradictory result. Few studies have been done on the efficiency of the Nigerian stock market. Samuels and Yacout (1981) were the first to conduct a test on the efficiency of the Nigerian stock market. Their result using weekly data for a sample of 21 quoted companies over the period 1978 to 1979 concluded that the Nigerian stock market exhibit a random walk (Olowe, 1999).

Ayadi (1984), Olowe (1999), Kukah *et al.* (2007) and Mmeregini (2009) using Nigeria data as well and different parametric or non parametric tests joined others in developed world and Samuels and Yacourt for Nigeria to support the random walk assertion. Ayadi (1984) and Olowe (1999) also found that the Nigerian stock market exhibits a random walk hypothesis while Kukah *et al.* (2007) in their parametric test arrived at the same result of random walk. But their result of non parametric test contradicts the random walk hypothesis.

MATERIALS AND METHODS

The autoregressive conditional heteroscedasticity (ARCH) introduced by Engle (1982) and the generalized ARCH (GARCH) models introduced by Bollerslev (1986) will be employed to investigate the weak form efficiency condition of the Nigerian stock market. The appeal of the GARCH (1, 1) model is that it allows for a time variant conditional variance and nonlinearities in generating mechanism. Also, it captures both volatility clustering and unconditional return distribution with heavy tails (Mala and Reddy, 2007).

The GARCH model is based on the assumption that forecasts of time varying variance depend on the lagged variance of the asset. The estimation of the model involves the estimation of two distinct specifications one for the conditional mean and the other for the conditional variance. The basic GARCH (1, 1) model can be expressed as:

$$r_t = \mu + \phi r_{t-1} + \epsilon_t \quad (1)$$

$$\epsilon_t / \phi_{t-1} \sim N(0, h_t)$$

$$h_t = k + \alpha \epsilon_{t-1}^2 + \beta h_{t-1} \quad (2)$$

where, $K > 0$, $\alpha \geq 0$, $\beta = 0$. $\alpha + \beta$ is a measure of persistence of volatility clustering. The closer the value is to 1, the high the persistence of volatility clustering. If $\alpha + \beta < 1$, the GARCH is weakly stationary. Equation 1 is the conditional mean equation with r_{t-1} as a vector of exogenous variable and an error term ϵ_t in the equation. While Eq. 2 is the conditional variance the h_t equation with K as the mean constant, ϵ_{t-1}^2 is the news about volatility from the previous period (the ARCH term) measured as the lag of the squared residual from the mean equation and h_{t-1} the conditional variance is the last period forecast variance (the Arch term) and must be non negative.

In the evaluation of efficiency market hypothesis, if the parameter of the exogenous variable ϕ in the mean equation for GARCH model is insignificantly different from zero, that is $\phi = 0$, we accept weak form EMH otherwise, we reject the hypothesis that the market is weak form efficient. Also, the closeness of the sum of α and β to 1 indicates a high persistence in volatility clustering which implies inefficiency in the market.

The logarithm of relative prices (P_t, P_{t-1}) multiplied by 100, that is $(\ln P_t - \ln P_{t-1}) 100$ is used to calculate continuous compounded monthly stock returns.

RESULTS AND DISCUSSION

The monthly returns of the quoted companies were analyzed using our GARCH (1, 1) model. The result of our analysis shows that the Nigerian stock market is weak form efficient. This result agrees with the findings of Samuels and Yacout (1981), who used serial correlation method on weekly share prices in Nigeria, Ayadi (1984), who used nonparametric test on weekly price changes, Olowe (1999) employing sample autocorrelations on monthly stock prices and that of nonparametric test of Kukah *et al.* (2007). The results are shown in Table 1 with reported values in parenthesis as the standard error values.

The conditional mean (μ) parameter is not significantly different from zero in all the models (except for the year 1988). With the exception of 1993-1995, the ϕ parameters in the mean equations of other years are all insignificant for the GARCH model. There is persistent volatility clustering in 1987, 1988 and 1995 owing probably to the financial deregulation in 1987, the privatization of public sectors in 1988 and the internationalization of the Nigerian capital market in 1995. Also all (2000-2006) but 2002 recorded persistent volatility clustering with neither the conditional mean nor the ϕ parameter in the mean equations being significant.

Since, all but one of the conditional mean parameters (μ 's) and most of the (ϕ) parameters in the mean equations are insignificant for the GARCH model, coupled with the fact that about 61% of the period under study indicate non volatility clustering, it becomes obviously evident that the Nigerian stock market follows a random walk process and is therefore weak form efficient.

Table 1: GARCH (1,1) model results of the Nigerian stock market monthly returns for the year 1984-2006

Model	μ	ϕ	$\alpha+\beta$
1984	-0.056055 (1.368738)	-0.68002 (36.03826)	0.45
1985	0.104850* (0.462713)	-0.104689 (14.47494)	0.42s
1986	-0.243247 (2.386498)	-0.142833 (3.669764)	0.49
1987	0.005284 (0.049104)	-0.063068 (0.161057)	0.83
1988	0.022323 (0.006467)	-0.120853 (0.302663)	1.05
1989	0.039223 (2.527981)	-0.407838 (61.61432)	0.53
1990	-0.131194 (0.905635)	-0.056243 (1.602982)	0.44
1991	0.018329 (0.014090)	0.185518 (0.455306)	0.95
1992	0.022720 (0.012115)	0.352520 (0.445491)	0.51
1993	0.007374 (0.012350)	0.939222* (0.247296)	0.53
1994	0.013368 (0.006812)	0.378612* (0.172418)	0.22
1995	-0.011193 (0.021585)	0.950722* (0.290897)	1.00
1996	0.021435 (0.013403)	0.025046 (0.310991)	0.38
1997	-0.068050 (0.329999)	-0.015034 (3.108396)	0.43
1998	0.012090 (0.258804)	-0.040851 (18.00104)	0.47
1999	0.011076 (0.006323)	-0.253663 (0.188481)	0.48
2000	0.021435 (0.024058)	0.197380 (0.502789)	1.90
2001	0.016818 (0.023006)	0.136983 (0.401178)	1.30
2002	-0.000532 (0.022392)	0.127580 (0.321562)	0.43
2003	0.027585 (0.029616)	-0.023756 (0.473767)	1.16
2004	-0.003452 (0.029564)	0.008624 (0.339412)	0.96
2005	0.006837 (0.015981)	0.276390 (0.421513)	0.86
2006	-0.001863 (0.014562)	-0.079484 (0.506490)	0.96

The values in brackets are standard error values. The values with asterisks are significant at 5% critical level

CONCLUSIONS

Understanding the nature of stock market efficiency is important to the investors who seek to find whether the opportunity of making excess return does exist in a given stock market. If a market is efficient, no arbitrage opportunities can be usurped to make excess profits as all the available information has been discounted in current prices. In the light of this, this study investigated the issue of weak-form efficiency on the Nigerian stock market by employing the GARCH (1, 1) model on monthly price index. The result of the study shows that the Nigerian stock market follows a random walk and is therefore weakly efficient. The implication of this is that expectation about overvaluation or undervaluation of stock prices in the market is ruled out. It is therefore a waste of time for investors to keep on studying and charting in search of the undervalued stock in the Nigerian stock market.

However, it is worth noting that the findings revealed that the financial deregulation in 1987, the privatization of the public sectors in 1988 and the internationalization of the Nigerian capital market in 1995 were associated (in each of these years) with persistent volatility clustering in the market suggesting the existence of weak form market inefficiency within these periods. Other years portraying the market as weakly inefficient range from 2000 to 2006 (with the exception of the year 2002). Of all these years, only 1995 has its vector of exogenous variable in the conditional mean equation significant. Thus, the Nigerian capital market is weak form efficient and does not concede the opportunity of making excess returns.

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