THE RANDOM WALK THEORY: AN EMPIRICAL TEST IN THE NIGERIAN CAPITAL MARKET

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ABSTRACT

The movement of stock prices has been found to be random in some capital markets across the world and in others non-random. Analysis of all-price-index (API) data of shares of listed firms on the Nigerian Stock Exchange from January 2000 to December 2012 using the Augmented Dickey-Fuller (ADF) test shows that share price movements on the Nigerian Stock Exchange do not follow the random walk pattern described by Fama (1965), and thus the random walk hypothesis is not supported by findings in the Nigerian capital market. Results also indicate the existence of market inefficiencies in the Nigerian capital market necessitating the inflow of cheap and free information about security fundamentals into the market for share pricing by the forces of demand and supply.

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Keywords: Random walk theory, Random walk hypothesis, Market efficiency, Stock price movement, Security fundamentals, Intrinsic values.

JEL Classification: G12, G14, G17.

Contribution/ Originality

This study contributes to the existing on the random walk theory as research results shows that share prices in the Nigerian capital market do not follow the random pattern as described by Fama (1965).

1. INTRODUCTION

The Nigerian capital market is a regulated one in which prices of securities are not determined solely by the interactions between the forces of demand and supply. Security prices determined by market forces are restricted by an imposed price band by the Nigerian Stock Exchange which prevents security prices from moving beyond 5% above and 5% below the at the beginning of a trading day. The existence of manipulations in the market (Nwidobie, 2013), insider trading and

slow pace of provision of security and market information to the market (Osaze, 2007), and the dependence of security price determination on security and market information on previous periods resulted in the description of the Nigerian capital market as efficient in the weak-form efficient (Adelegan, 2003).

Gordon (1959) postulated that stock values are determined by dividends paid in the immediate preceding period, the growth rate of the dividend and the equity capitalization rate. Change in any of these variables results in a change in the price of that stock. Subsequent stock values vary as values of these determinants vary. Fama (1965) contended that future price path of stocks are not determinate as they move as numbers that are random, not following any definite path. This movement to him is feasible as the stocks "fully reflect" available information, implying that successive price changes (successive one-period returns) are independent. This proposition of Fama (1965) has been tested in different capital markets across the globe with varying results. Ali and Mustafa (2001) in their test of this hypothesis in the Pakistani capital market using the correlation coefficient of successive returns, averages, logarithms and regression analysis on daily price data of listed equities concluded that information collectively had an effect on stock prices which can be both negative and positive.

Examining Chinese A-shares and B-shares market using parametric and non-parametric variance ratio on daily data of 370 shares from 1996-2005, Fifielda and Jetty (2008) concluded that random price movements exists. Findings by Hasanov and Omay (2007) showed evidences of randomness of stock values on the Romanian Stock Exchange. Chung and Hrazdil (2010) concluded from their study of stock price movements on the New York Stock Exchange that random movement of stock price exist on the exchange. Kapetanios *et al.* (2003) observed from their cross-country study that Chinese, Polish and Russian stock values are stationary. Studies Bariviera (2011) in the Thai stock market and Lin *et al.* (2011) in the Shanghai Stock market showed evidences of randomness in stock prices in these markets. Is there any evidence of randomness of stock prices in the Nigerian capital market?

1.1. Objective of Study

The objective of this study is to determine if there exists randomness in share price movements in the Nigerian capital market as has been determined in other capital markets the world over.

1.2. Research Hypothesis

The following hypothesis will be tested to determine the randomness of share prices on the Nigerian Stock Exchange:

H_o: share price movements on the Nigerian Stock Exchange do not follow the random walk pattern described by Fama (1965) i.e. $\delta=0$

H_1: share price movements on the Nigerian Stock Exchange follow the random walk pattern described by Fama (1965) i.e. $\delta\neq0$

1.3. Scope of Study

This study covers share prices of listed firms on the Nigerian Stock Exchange at the end of daily trading from January 2000 to December 2012.

2. THEORETICAL FRAMEWORK AND REVIEW OF LITERATURE

2.1. Theoretical Framework

The argument by Fama (1965) of unpredictable movements in future values of stock prices underlies the random walk hypothesis. Campbell *et al.* (1997) observed the existence of three successively more restrictive sub-hypotheses with sequentially stronger tests for random walk exists. To Worthington and Higgs (2003), the least restrictive of these is that in a market that complies with the random walk theory, it is not possible to use information on past prices to predict future prices. Thus returns in such market are serially uncorrelated; corresponding to a random walk hypothesis with dependent but uncorrelated increments. Further increments they argued, may be independent but identically distributed or independent and identically distributed.

The fundamental analysis approach to security valuation posits that at any point in time, an individual security has an intrinsic value which depends in turn on such fundamental factors as quality of management, state of the firm's industry and returns, rate of return on equity and the general economic outlook. Changes in the values of these variables result in changes in share values which change follow any definite pattern (an outcome of random walk behaviour). The existence of these unpredictable future values of shares caused by changes in values of its fundamentals, to Fama (1965), evidences the existence of efficiency in that stock market; concluding that the actual price of any security in that market at any point in time is always a good estimate of its intrinsic value, or the actual values of the securities wandering randomly about their intrinsic values.

2.2. Review of Literature

2.2.1. The Random Walk Hypothesis

The Fama (1965) postulation that successive values of a share are independent of each other being random; and caused by changes in stock information is called the random walk hypothesis. In addition, the assumption of identical distribution of successive changes in stock value with his earlier thought gives the random walk model:

$f [r_j, t+1| \phi_t] = f(r_j, t+1)$

Thus the conditional marginal probability distributions of any independent random variable are identical. The density function, f, he argues is the same for all t. Detailing on the argument, Fama (1965) opined that a random walk arises within the stochastic model when the environment is such that the evolution of an investor tastes and the process generating new information combine to produce equilibra in which return distributions repeat themselves through time. This argument seems to suggest that the more random the price of a share, there is greater evidence that available information about the stock in the market has affected investor perception, and buying and selling

attitudes. This indicates that higher levels of randomness of stock prices evidences market efficiency. However, Summers (1986) argues that though evidences in finance studies suggest that efficient market hypothesis cannot be rejected does not mean that available financial assets reflect fundamental valuations. To Summers (1986), the impotency of the available test models in certain types of market in inefficiencies is what the theory what holding on to.

2.2.2. Determinants of Stock Price Randomness

Research results from tests for randomness in share price movement show varied identified determinants of stock price randomness. Using data from stock markets in China, Korea and Taiwan, Lin *et al.* (2011) concluded that stock price limits affect stock price randomness. This finding is supported by the results of Usman (1998) in Nigeria of the existence of price bands which limit the full effect of determinants on stock prices as share prices are prevented from going beyond 5% above or 5% below the current price on any trading day. To Chung and Hrazdil (2010), McMinn (2009) and Tahir (2011), information about a firm's activity affects stock prices. Lim and Kim (2011) argued that greater trade openness of a country and within-country trade openness affect stock price randomness. While arguments abound in finance literature as to the impact of January, Monday and holiday effects on share prices, Vulic (2010) contended that the turn-of-the-month effect exists in the Montenegrin capital market as prices are higher at month end than on other days within the month. Appling the serial correlation, runs and variance ratio tests to index and individual share data for daily, weekly and monthly frequencies, Ma and Barnes (2001) concluded that market indices and daily individual share prices in both the Shanghai and Shenzhen stock market exhibit correlated return patterns; adding that B-shares' prices are more predictable than A-shares.

In their test of the random walk hypothesis for weekly stock returns, Lo and Mackinlay (1988; 1987) compared variance estimators derived from data from 1216 sample observations at different frequencies. Their findings strongly rejected the random walk model for the sample period (1962 to 1985) and for all sub-periods for a variety of aggregate returns indexes and size-sorted portfolios. Countering the proposition of the random walk theory, Keim and Stambaugh (1986) found statistically significant predictions of stock prices using predetermined variables. Fama and French (1987) noted that there exists negative-serially correlated relationship for long-holding period returns; concluding that 25%-40% of longer horizon returns seem predictable from past returns. This is in contradiction to the findings of Lo and Mackinlay (1988) of the existence of a significant positive serial correlation for weekly and monthly holding-period returns.

The test of the random walk model unadjusted in all economies to Oprean (2012) seems defective, contending that tests of this model in emerging economies should take into consideration the level of development of the capital market studied as well as the institutional features of these markets: thin trading, non-linearity of asset prices, financial liberation, liquidity, end-of-the-month and end-of-the-year-effects. The effects of these he argued may seem more pronounced in these economies which may result in the rejection/acceptance of a should-be-accepted or rejected result.

3. RESEARCH METHODOLOGY

3.1. Population for the Study

The population for this study is the entire 204 listed firm on the 26 Nigerian Stock Exchange (NSE) sector categorizations: banking, construction, food, beverages and tobacco, breweries, healthcare, industrial products, aviation, conglomerates, textiles, packaging, printing and packaging, insurance, chemical and paints, petroleum marketing, industrial and domestic products, building materials, computer and office equipment, machinery (marketing), automobile and tyre, managed funds, footwear, agriculture/agro-allied, engineering technology, maritime, hotel and tourism, commercial services, real estates, and mortgage companies.

3.2. Study Samples and Sampling Techniques

The 204 listed firms on the Nigerian Stock Exchange are used for this study as the study data, all-price-index (API), comprise all listed equities on the exchange.

3.3. Sources of Data

Data for this study is secondary data on daily share prices (the all price index) of listed firms on the Nigerian Stock Exchange from 2000-2012. This time series data was obtained from the Statistical Bulletin, 2013.

3.4. Validity and Reliability of Data

Data on stock price (all price index) of listed firms are the actual end-of-period trading values of shares of all 204 listed firms determined on the floor of the Nigerian Stock Exchange and certified by the exchange at the end of the trading period, and are thus valid and reliable.

3.5. Data Analysis Technique

The Augmented Dickey-Fuller (ADF) autoregressive model is used in this study to determine the stationarity (absence of randomness) of share values.

3.6. Model Specification

The Dicken-Fuller model:

$\Delta y_t = \delta y_{t-1} + u_t$

Where Δ is the first difference operator

The unit root model is:

$$\Delta y_t = \mu + \beta y_{t-1} - \sum_{j=1}^{p} \alpha_j \Delta y_{t-j} + \epsilon_t$$

3.7. Model Justification

Similar studies Bariviera (2011), Lin *et al.* (2011), Chung and Hrazdil (2010), Hasanov and Omay (2007); Fifielda and Jetty (2008), Kapetanios *et al.* (2003) and Todea (2002) on the Thai Stock Exchange, Shanghai Stock Exchange, New York Stock Exchange, Shanghai Stock Exchange, Romanian stock market, Shanghai Stock Exchange and Romanian Stock Exchange respectively on randomness of equity prices on the respective stock exchanges used the Augmented Dickey-Fuller model making it appropriate for this study.

3.8. Data Analysis

Augmented Dickey-Fuller (ADF) analysis of 156 observations of monthly all-price-index of equities from January 2000 to December 2012 gives the result on table 1 (in the appendix).

The ADF statistic is -2.32 with the tabulated statistic at 5% level at -3.43. Since the ADF statistic falls in the acceptance region, the null hypothesis is accepted. The Durbin-Watson value of 2.515392 indicates the absence of autocorrelation in the data series.

4. DISCUSSION OF FINDINGS AND CONCLUSIONS

From the research results, we conclude that share price movements on the Nigerian Stock Exchange do not follow the random walk pattern described by Fama (1965) i.e. not random. This result supports the findings of Kapetanios *et al.* (2003) and Lo and Mackinlay (1988; 1987), and also indicate the existence of market inefficiencies in the Nigerian capital market. Findings also suggest that price of equities on the Nigerian Stock Exchange seem to follow a definite path determined by information about the equities and the issuing firms. Thus the price trend of these equities can be determined in advance using values of the securities' fundamentals: previous year dividends value per share, equity capitalization rate and growth rate of dividends. As share prices seem to depend on firm dividend, firms in Nigeria are increasingly retaining earnings to provide for regular payment of dividends future dividends, maintain and direct future price growth and movements (which indicates the some existence of teleguide and manipulation of market values in the Nigerian capital market) which account for and may worsen the absence of random movements in share prices and market efficiency on the Nigerian Stock Exchange. The existence of market inefficiencies in the Nigerian capital market implies the availability of little information about securities in the market, -accessing of market information at a cost, hoarding of information by privileged few and non-imputation of these information in stock market decision which affects investor decisions, trading in the market, local and foreign listings with overall negative effects on capital market development in Nigeria.

5. RECOMMENDATIONS

To ensure free movement of share prices and continuous determination of prices of equities on the Nigerian Stock Exchange based on security fundamentals and the interplay of forces of demand and supply:

(i)   Information security fundamentals should be provided by issuers as at when due for security valuation;

(ii)   Capital market regulators should ensure that information provided in the market are correct;

(iii)   Laws to protect investors and guard against manipulation of information in the Nigerian capital market should be promulgated and enforced; and

(iv)   Market operators culpable for insider trading offences should be punished to ensure availability of information on securities to the market allowing the free interplay of demand and supply to determine security values as current market values of securities on the NSE reflect available security information.

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Appendix

Table-1. Dickey-Fuller test results

Null Hypothesis: SER01 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on SIC, maxlag=13)

			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2.328016	0.0060
Test critical values:	1% level		-4.019561	
	5% level		-3.439658	
	10% level		-3.144229	

*MacKinnon (1994) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SER01)
Method: Least Squares
Date: 06/05/14   Time: 13:37
Sample (adjusted): 2000M05 2012M12
Included observations: 152 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SER01(-1)	-0.035525	0.015260	-2.328016	0.0213
D(SER01(-1))	0.051066	0.078694	0.648919	0.5174
D(SER01(-2))	0.208599	0.077524	2.690782	0.0080
D(SER01(-3))	0.288209	0.079424	3.628750	0.0004
C	667.8745	406.6942	1.642203	0.1027
@TREND(2000M01)	3.443393	4.549056	0.756947	0.4503
R-squared	0.661037	Mean dependent var		145.9605
Adjusted R-squared	0.632306	S.D. dependent var		2273.307
S.E. of regression	2117.588	Akaike info criterion		18.19262
Sum squared resid	6.55E+08	Schwarz criterion		18.31198
Log likelihood	-1376.639	Hannan-Quinn criter.		18.24111
F-statistic	5.604879	Durbin-Watson stat		2.515392
Prob(F-statistic)	0.000094			