A Stochastic Analysis of Some Selected Companies for Capital Market Price Investments

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Abstract

The stock market performance and operation has been widely recognized as a significantly viable investment field in financial markets. Therefore this paper studied stochastic analysis of Markov chain in the closing stock price data of three selected companies (2017-2021) via Nigeria Stock Exchange. The stock prices were transformed into 3-steps transition probability matrix solution for each year. The criteria of obtaining future stock price changes of the year were considered. The analytical solution of stochastic analysis showed that NASCO Nigeria, PLC has the best probability of price increasing in the near future: 19%, which is a tool for proper decision making in terms of investments. In the assessment of future price changes of these three companies OANDO Nigeria, PLC has the highest price of 75% which shows it is profit making organization and are hopeful for future investment plans both short or long term respectively. Finally, percentage increase in the parameters shows percentage decrease in various future price changes over the stipulated trading days.

Keywords: *Stochastic Analysis, Stock prices, investments, companies and transition probability matrix*

Introduction

Stock is one of essential elements of every investor over an investment and is the capital upturned by a company or corporation through the issue and payment of shares. It is a security that signifies the ownership of a section of a business. In units, stocks are known as shares. The stock market is made up of buyers and sellers of stocks, which epitomizes ownership claims on companies. It talks about to a number of exchanges and other venues in which shares of publicly held companies are bought and sold. The legal platform upon which the financial activities are done is referred to as stock exchange. They are done through institutionalized formal exchanges

or through over-the-counter podiums bound by a set of distinct procedures. The stock market is one of the most vital machineries of a free-market economy. It is in the midst of the best options to various companies for expansion or set up a new business venture. Investments can be done in stock, bond, mutual funds etc. An increase in price of stocks in the stock market indicates an increase in investment. These amounts up to economic growth of the domicile nation having that stock market. The account of development of foreign capital market has proven that the stock not only has provided substantial long-term interests of investors in the past, but also will make available a good investment plan in the future to the best interest of traders etc.

However, the above concepts needs mathematical model such as Markov chain which can realistically predict the future assessment of stock price movement. It is essential to study stochastic analysis of Markov chain related problems, well formulated and accurate analytical studies in order to obtain good results; therefore, the analytical solution is adopted based on the specific feature of the problem, even though stock quantities characteristics may depend on additional physical quantities in terms of modeling,

Though, a lots scholar has written extensively on the modeling stock price using Markov chain and results obtained in various ways. For instance,[1] applied stochastic analysis of Markov chain in the closing stock price formation of three selected companies The criteria of obtaining future stock price changes of the year were obtained in time varying investments. [2]studied the behavior of a on the Nigerian stock exchange market. They used the Markov chain approach with a threshold to determine long-term and short-term profits, and then compared the results with the expected return of Capital Asset Pricing Model. The results showed that regardless of the state, the mean profit of the stock and the expected profit of the Capital Asset Pricing Model will be realized in the long run. Also, depending on the state, the average return will be realized after a maximum of two days. This indicates that for a distribution channel, the form i.e long-form or short-form channel returns will still be made [3] applied the Markov process for predicting of stock market performance. The study proved Markov process to be relevant when stock market prices are analyzed for future predictions. The findings from the study shows that Bharat petroleum, Reliance and Hindustan Petroleum have high probability of increase in its value while Indian Oil Corporation (IOC) and Oil India exhibits higher chance of being stable with no significant increase or decrease.

More so, [11] examined stock market prices due to its fluctuations and influences in financial lives and economic health of a country. Their findings showed that stock price is a random work and no investor can alter the fairness and unfairness of a stock price as defined by expectation. [15] studied Markov process of stock market performance. In their result oil, India exhibits a higher chance of being stable with no significant increase or decrease. [12] Considered Markov chain model on share price movement. Result showed GT Bank shares change hands more than the FB Bank. [8] Studied the Markov chain model on forecasting of stocks prices in Nigeria. In their result Markov chain model was determined based on probability transition matrix. [7] Explored the stochastic analyses of Markov chain in finite states. Their work replicated the use of 3-states transition probability matrix which enables them to proffer precise condition of obtaining expected mean rate of return of each stock. ,[16] considered stochastic analysis of share prices. Results showed precise condition of determining expected mean return time for stock price; improving investment decision based on highest transition probabilities. In the same

manner, [8] studied the behavior of stock market using Markov chain. The study reveals that regardless of bank's current share price steady state probabilities of share price remain the same all through the iteration. [11] Studied long run prospects of security prices in Nigeria where the data were collected from the randomly selected banks from the banking sector of Nigeria. The analysis suggested that the price level of Nigerian bank were likely to remain relatively stable in the long run irrespective of the current situations.[17] examined the long run behavior of the closing price of shares of eight Nigerian banks using Markov chain model. They computed limiting distribution transition probability matrix of the of share price and found that despite of the current situation in the market there is hope for Nigerian bank stocks. It was concluded that the results derive from the study will be useful to investors.

Finally, due to the instability of stock price movements; which can be linked as stochastic formation. For that reason, the method of Markov chain was used to study the closing stock prices of Transco, Nasco and Oando Nigeria PLC for the period of 2017-2021. The stock price data replicated 3-states transition probability matrix solution for each company and the last three months of each year were used as column vector to determine the future stock price changes. From the analytical solution of stochastic analysis the mean rate of returns, stock standard deviation and variance and other price changes were considered. This paper extends the [1] by assessing the price movement of these three companies, stating their future stock price changes and varying of some parameter values in term of percentage increase.

This paper is arranged: Section 2.1 presents mathematical framework, the problem formulation is seen in Subsection 2.1.1, Analysis and Results are seen in Section 3.1 while Discussion of Results are presented in Subsection 3.1.1 and the paper is concluded in Section 4.1.
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2.1 Mathematical Framework

Definition1: Stochastic process can be seen as a statistical event that evolves time in accordance to probabilistic laws. Mathematically, a stochastic process may be defined as a collection of random variables which are ordered in time and defines at a set of time points which may be continuous or discrete.

Definition 2: A stochastic process X is said to be a Markov chain if Markov property is satisfied :

$$P\left(X_{n+1}=j/X_0,\mathrm{X}_1,\cdots,X_n\right)=P\left(X_{n+1}=j/X_n\right) \tag{0.1}$$

For all $n\geq 0$ and $i,j\in S\left(\text{state space}\right)$.

It is sufficient to know that the Markov property given(1.1) is equivalent to easy of the following for each $j\in S$.

$$P\left(X_{n+1}=j/X_{n1},X_{n2},\cdots,X_{nk}\right)=P\left(X_{n+1}=j/X_{nk}\right) \tag{0.2}$$

$\left(\text{for any } n_1<n_2<,\cdots,n_k\leq n\right)$

Assuming $X_n = i$ implies that the chain is in the *ith* state at the *nth* step.it can also be said that the chain' having the value i' or ' being in state i'. The idea behind the chain is described by its transition probabilities:

$$P\left(X_{n+1} = j / X_n = i\right) \tag{0.3}$$

They are dependent on i, j and n.

Definition 2: The chain X is said to be homogeneous if the following are stated below

$$P\left(X_{n+1} = j / X_n = i\right) = P\left(X_1 = j / X_0 = i\right) \tag{0.4}$$

For all n, i, j.

The transition matrix $\mathrm{P} = \left(P_{ij}\right)$ is $n \times n$ matrix of transition probabilities.

$$P_{ij} = P\left(X_{n+1} = j / X_n = i\right) \tag{0.5}$$

Hence, the transition probabilities with homogenous Markov chain are always stationary at a point.

Theorem 1: Suppose P is a stochastic matrix which implies the following:

i) P has non-negative entries or $\mathrm{P}_{ij} \geq 0$

(ii) $\sum_j P_{ij} = \sum_j P\left(X_{n+1} = j / X_n = i\right) = \sum_j P\left(X_1 = j / X_0 = i\right)$

which is stationarity or point of convergence.

Proof:(i) each associated entry in P is a transition probability P_{ij} and being probability $P_{ij} \geq 0$.

(ii) $\sum_j P_{ij} = \sum_j P\left(X_{n+1} = j / X_n = i\right) = \sum_j P\left(X_1 = j / X_0 = i\right)$

Which is stationarity.

$P\left(X_i \in S / X_0 = i\right) = 1.$

Theorem 2 :(Chapman-Kolmogorov Equations).

$P_{ij(m+n)} = \sum_{r=i}^{n} P_{ir(m)} P_{rj(n)}$ Since $\mathrm{P}_{m+n} = \mathrm{P}_m \mathrm{P}_n$ and so on $\mathrm{P}_n = \mathrm{P}^n$ the *nth* power of P .

$$P_{ij(m+n)} = P\left(X_{m+n} = j / X_0 = i\right)$$

Proof: $$\sum_r P\left(X_{m+n} = j, X_m = r / X_0 = i\right)$$

$$\sum_r P\left(X_{m+n} = j / X_m = i / X_0 = i\right) P\left(X_m = r / X_0 = i\right)$$

Using the following in probability rule:

$P\left(A \cap B / C\right) = P\left(A / B \cap C\right) P\left(B / C\right)$ and setting $A = \left\{X_{m+n} = j\right\}, \mathrm{B} = \left\{X_m = r\right\}, \text{and } \mathrm{C} = \left\{X_0 = i\right\}$

Using Markov property yields

$$P_{ij(m+n)} = \sum_r P\left(X_{m+n} = j / \mathrm{X}_m = r\right) P\left(X_m = r / \mathrm{X}_0 = i\right)$$

$$\sum_r P_{rj(n)} P_{ir(\mathrm{m})}$$

$$\sum_r P_{1r(\mathrm{m})} P_{r1(\mathrm{n})}$$

Hence $\mathrm{P}_{m+n} = \mathrm{P}_m \mathrm{P}_n$ and so $\mathrm{P}_n = \mathrm{P}^n$, the power *of* P.

2.1.1 Problem Formulation

let $S_i(\mathrm{t})\ \left(i = 1, 2, ..., N, t = 1, 2, ..., n\right)$ be the of daily closing stock prices in naira of three selected companies : Transc, Nasco and Oando $i-th$ asset at time t be defined as three state Markov processes in finite states. Let $N \times n$ data matrix associated with $S_i(t)$ *be* X_{it} . We consider N closing prices over n months, time horizon. For each X_{it} we use the last three closing stock prices of each year (0ct.-Dec.) as column vector which measures the change in stock prices at time t ,where $t = 0, 1, 2, \cdots, N$ and t is measured in weekly intervals, $t \in$. Therefore, the vector is defined such that

$$\theta_{0it} = \begin{pmatrix} \theta_{i01} \\ \theta_{0i2} \\ \theta_{0i2} \\ \vdots \\ \theta_{0in} \end{pmatrix} \tag{0.6}$$

To obtain an estimates of the transition probability as follows

$$P_{ij} = P\left(X_t = j / X_{t-1} = i\right), \ for \ j = 0, 1, 2, 3, \cdots, N$$

$$P_{ij} = \begin{cases} P \text{ if } j = 1 + j \\ q = 1 - P \text{ if } j = i - j \\ 0 \text{ otherwise} \end{cases}$$

where $k+1$ is the number of states.

$$\left.\begin{array}{l} n_{ij} = \sum_{i=1}^{n} P_{ij} \text{ for i j=0,2,3} \\ \dfrac{n_{ij}}{n_i} \text{ for } i\ j = 0,1,\cdots k \end{array}\right\} \tag{0.7}$$

However, for $k = 3$ is an estimate of the transition matrix.

$$\hat{P}ij(\text{Transco})_{2017-2021} = \begin{pmatrix} \hat{P}_{00} & \hat{P}_{01} & \hat{P}_{03} \\ \hat{P}_{10} & \hat{P}_{11} & \hat{P}_{12} \\ \hat{P}_{20} & \hat{P}_{21} & \hat{P}_{22} \end{pmatrix} \tag{0.8}$$

$$\hat{P}ij(\text{Nasco})_{2017-2021} = \begin{pmatrix} \hat{P}_{00} & \hat{P}_{01} & \hat{P}_{03} \\ \hat{P}_{10} & \hat{P}_{11} & \hat{P}_{12} \\ \hat{P}_{20} & \hat{P}_{21} & \hat{P}_{22} \end{pmatrix} \tag{0.9}$$

$$\hat{P}ij(\text{Oando})_{2017-2021} = \begin{pmatrix} \hat{P}_{00} & \hat{P}_{01} & \hat{P}_{03} \\ \hat{P}_{10} & \hat{P}_{11} & \hat{P}_{12} \\ \hat{P}_{20} & \hat{P}_{21} & \hat{P}_{22} \end{pmatrix} \tag{0.10}$$

Setting $i\ j = 0,1,2$ for $k = 3$

$$\hat{P}_{ij}(\text{Transco:price changes}) = \begin{pmatrix} B_{11} \\ B_{12} \\ B_{13} \end{pmatrix} \begin{pmatrix} \hat{P}_{00} & \hat{P}_{01} & \hat{P}_{02} \\ \hat{P}_{10} & \hat{P}_{11} & \hat{P}_{12} \\ \hat{P}_{20} & \hat{P}_{21} & \hat{P}_{23} \end{pmatrix} = \begin{pmatrix} \varphi_{11} \\ \varphi_{12} \\ \varphi_{13} \end{pmatrix} \tag{0.11}$$

$$\hat{P}_{ij}(\text{Nasco:price changes}) = \begin{pmatrix} B_{11} \\ B_{12} \\ B_{13} \end{pmatrix} \begin{pmatrix} \hat{P}_{00} & \hat{P}_{01} & \hat{P}_{02} \\ \hat{P}_{10} & \hat{P}_{11} & \hat{P}_{12} \\ \hat{P}_{20} & \hat{P}_{21} & \hat{P}_{23} \end{pmatrix} = \begin{pmatrix} \alpha_{11} \\ \alpha_{12} \\ \alpha_{13} \end{pmatrix} \tag{0.12}$$

$$\hat{P}_{ij}(\text{Oando:price changes}) = \begin{pmatrix} B_{11} \\ B_{12} \\ B_{13} \end{pmatrix} \begin{pmatrix} \hat{P}_{00} & \hat{P}_{01} & \hat{P}_{02} \\ \hat{P}_{10} & \hat{P}_{11} & \hat{P}_{12} \\ \hat{P}_{20} & \hat{P}_{21} & \hat{P}_{23} \end{pmatrix} = \begin{pmatrix} \phi_{11} \\ \phi_{12} \\ \phi_{13} \end{pmatrix} \tag{0.13}$$

Assuming X_t has state space and transition probability matrix of (1.9) becomes

$$\hat{P} = \begin{pmatrix} \beta_1 & \phi & \theta \\ 1-\phi & \beta_2 & 1-\alpha \\ 1-\theta & \alpha & \beta_3 \end{pmatrix} \tag{0.14}$$

Also from where the transition matrices of independent years of Oando Nigeria,PLC is derived. Following the method of [8] The best three prices are chosen in terms of minimum value criterion

$$\left.\begin{aligned} \beta_1 &= \min(\alpha_1, \alpha_2, ..., \alpha_n) \\ \beta_2 &= \min(\phi_1, \phi_2, ..., \phi_n) \\ \beta_3 &= \min(\varphi_1, \varphi_2, ..., \varphi_n) \end{aligned}\right\} \tag{0.15}$$

Thus each minimum value will be used as estimates, in order to determine the value of an economic asset such as stock; consideration should be made to identify some aspect of random variability which is the expected rate of returns and price of the underlying asset, [4]. Hence to determine the expected rate of returns for each stock for the period of trading days the following are defined as

$$\left.\frac{1-\phi}{\beta_1}, \frac{1-\theta}{\beta_2} \text{ and } \frac{1-\alpha}{\beta_3}\right\} \tag{0.16}$$

From (1.9) the behavior of stock market, each is categorized as no-change in price, increasing in price and price decrease in near future. Also the impact of percentage increase and decrease of (1.9) were determined.

3.1 Analysis and Results

To demonstrate the closing stock market price performances Transc,Nasco and Oando investments in finite states using Markov chain model. The daily prices covers from 2017-2021 retrievable from Nigeria Stock Exchange (NSE). From Jan.-Sept. of each year were used to form transition probability matrix while from Oct.-Dec. of each year were used to form a column vectors all for the three companies:

3-Steps transition matrix of Oando Nigeria PLC

$$Oando - P_{ij} = \begin{pmatrix} 0.3776 & 0.2536 & 0.3688 \\ 0.4006 & 0.3071 & 0.2923 \\ 0.2598 & 0.3405 & 0.3997 \end{pmatrix}, O_{12} = \begin{pmatrix} 13.5 \\ 17.97 \\ 15.15 \end{pmatrix}$$

$$Oando_{(STOCK\ PRICE\ CHANGES)} = \begin{pmatrix} 0.3776 & 0.2536 & 0.3688 \\ 0.4006 & 0.3071 & 0.2923 \\ 0.2598 & 0.3405 & 0.3997 \end{pmatrix} \begin{pmatrix} 13.5 \\ 17.97 \\ 15.15 \end{pmatrix} = \begin{pmatrix} 15.2421 \\ 15.3550 \\ 15.6815 \end{pmatrix}$$

3-Steps transition matrix of TRANSCO Nigeria PLC

$$TRANSCO - P_{ij} = \begin{pmatrix} 0.3873 & 0.3150 & 0.2978 \\ 0.3673 & 0.2430 & 0.3898 \\ 0.3607 & 0.3927 & 0.2466 \end{pmatrix}, T_{12} = \begin{pmatrix} 5.16 \\ 2.53 \\ 4.3 \end{pmatrix}$$

$$TRANSCO_{(STOCK\ PRICE\ CHANGES)} = \begin{pmatrix} 0.3873 & 0.3150 & 0.2978 \\ 0.3673 & 0.2430 & 0.3898 \\ 0.3607 & 0.3927 & 0.2466 \end{pmatrix} \begin{pmatrix} 5.16 \\ 2.53 \\ 4.3 \end{pmatrix} = \begin{pmatrix} 4.076 \\ 4.1862 \\ 3.9151 \end{pmatrix}$$

3-Steps transition matrix of NASCON Nigeria PLC

$$NASCON - P_{ij} = \begin{pmatrix} 0.3499 & 0.3005 & 0.3496 \\ 0.3311 & 0.3393 & 0.3296 \\ 0.5621 & 0.1859 & 0.2520 \end{pmatrix}, N_{12} = \begin{pmatrix} 21.49 \\ 23.44 \\ 50.4 \end{pmatrix}$$

$$NASCON_{(STOCK\ PRICE\ CHANGES)} = \begin{pmatrix} 0.3499 & 0.3005 & 0.3496 \\ 0.3311 & 0.3393 & 0.3296 \\ 0.5621 & 0.1859 & 0.2520 \end{pmatrix} \begin{pmatrix} 21.49 \\ 23.44 \\ 50.4 \end{pmatrix} = \begin{pmatrix} 32.1823 \\ 31.6804 \\ 27.8484 \end{pmatrix}$$

Table 1: Transition probability matrix of stock market prices of different years

Company	p_{00} β_1	p_{01} ϕ	p_{02} θ	p_{10} $1-\phi$	p_{11} β_2	p_{12} $1-\alpha$	p_{20} $1-\theta$	p_{21} α	p_{23} β_3
OANDO	0.3873	0.3150	0.2978	0.685	0.2430	0.6073	0.7022	0.3927	0.2466
TRANSCO	0.3499	0.3005	0.3496	0.6995	0.3393	0.6021	0.8141	0.6504	0.2520
NASCO	0.3776	0.2536	0.3688	0.7464	0.3071	0.6595	0.6612	0.3405	0.3997

Following the method of[8] gives the following conditions:

$\beta_1 = Min(0.3873, 0.3499, 0.3776) = 0.3499$

$\beta_2 = Min(0.2430, 0.3393, 0.3071) = 0.2430$

$\beta_3 = Min(0.2466, 0.2520, 0.3997) = 0.2466$

Hence we have $\beta_1 = 0.3499$, $\beta_1 = 0.2430$ and $\beta_3 = 0.2466$

Table 2: Transition Probability Matrix of Stock Market Prices :Means, Standard deviations and variances

Companies	$\frac{1-\phi}{\beta_1}$	$\frac{1-\theta}{\beta_2}$	$\frac{1-\alpha}{\beta_3}$	Mean	Std	Var
Transco	1.9577	2.8897	2.4627	2.4367	0.4665	0.2177
Nascon	1.9991	2.6765	3.3013	2.6590	0.6513	0.4242
Oando	2.1332	2.6813	2.4963	2.4963	0.3145	0.0989

Table 3: Future price changes of the three selected companies

	TRANSCO	NASCON	OANDO	HIGHEST
$1-\phi$	0.685	0.6995	0.7464	0.7464
$\beta_1 = 0.1$	6.85	6.995	7.464	7.464
0.2	3.425	3.4975	3.432	3.4975
0.3	2.2833	2.3316	2.488	2.488
0.4	1.7125	1.74875	1.866	1.866
0.5	1.37	1.399	1.4928	1.4928
$1-\alpha$	0.6073	0.8141	0.6595	0.8141
$\beta_2 = 0.1$	6.O73	8.141	6.595	8.141
0.2	3.0365	4.0705	3.2975	4.0705
0.3	2.0243	2.7136	2.1983	2.7136
0.4	1.51825	2.03525	1.64875	2.03525
0.5	1.2146	1.6282	1.319	1.6282
$1-\theta$	0.7022	0.6504	0.6612	O.7022
$\beta_3 = 0.1$	7.022	6.504	6.612	7.022
0.2	3.511	3.252	3.306	3.511
0.3	2.3406	2.168	2.204	2.3406
0.4	1.7555	1.626	1.653	1.7555
0.5	1.4044	1.3008	1.3224	1.4044

3.1.1 Discussion of Results

It can be seen in Table 1 that the stock quantities were obtained row wise using the method of probability: 1-ϕ, 1-Θ and 1-$\propto$. Column 5,7 and 8 respectively. So, addition of columns: 3 and 5,4 and 8,7 and 9 gives a total probability of 1. This agrees with one of axioms of probability measure which can be used to increase efficiency in term of stock trading.

In Table 2, the predicted the future price of expected returns, means, stock standard deviation and variance of investments are:. **TRANSCO**: 20% chance of reducing its expected rate of returns in future and 29% chance of increasing its expected rate of return,25% chance of no change in expected rate of return with mean rate of 24%, standard deviation of 47% and variance22%.

NASCO: 20% chance of reducing its expected rate of returns in future and 27% chance of increasing its expected rate of return,33% chance of no change in expected rate of return with mean rate of 27%, standard deviation of 65% and variance 42%.

OANDO: 21% chance of reducing its expected rate of returns in future and 27% chance of increasing its expected rate of return, 25% chance of no change in expected rate of return with mean rate of 25%, standard deviation of 31% and variance 9.9%.

However, in order to predict the future price of entire of investments of different transition probability matrix of the companies: we therefore have the following explained row-wise:
TRASCO (2017-2021): Has 39% of reducing its price; 31% chance of increasing its price in the near future; 30% chance of no change in price. Also in the same circumstances 37% chance of reducing its price; 24% chance of increasing its price and 39% chance of no change in price.
Finally 36% chance of reducing its price 39% chance of increasing its price and 25% Chance of no change in price. In all, the overall predicted prices for the above companies gives: 41% chance of reducing its price,42% chance of increasing its price and 39% chance of no change in price.

NASCON (2017-2021): Has 35% of reducing its price; 30% chance of increasing its price in the near future; 35% chance of no change in price. Also in the same circumstances 33% chance of reducing its price; 34% chance of increasing its price and 33% chance of no change in price.
Finally 56% chance of reducing its price 19% chance of increasing its price and 25% Chance of no change in price. In all, the overall predicted prices for the above companies gives: 32% chance of reducing its price,32% chance of increasing its price and 28% chance of no change in price.

OANDO (2017-2021): Has 38% of reducing its price; 25% chance of increasing its price in the near future; 37% chance of no change in price. Also in the same circumstances 40% chance of reducing its price; 31% chance of increasing its price and 29% chance of no change in price.
Finally 26% chance of reducing its price 34% chance of increasing its price and 40% Chance of no change in price. In all, the overall predicted prices for the above companies gives: 15% chance of reducing its price,15% chance of increasing its price and 16% chance of no change in price.

The above assessments of the three companies provides an eye opener of these stochastic analysis that will enhancing their investment decisions, The entire entry stipulates price changes for short and long term business plans.

However, in Table 3, percentage increase in the parameters shows percentage decrease in various future price changes over the stipulated trading period. This situation can be over employment of staff which affects the financial strength of the investments ; the benefits of this assessment is to avert severe depletion of capital investments which may endanger profit making throughout the trading period of the capital investments.

4.1 Conclusion

A submission of Markov chain is a precise tool for modeling stock price formation; since each finite state communicates for proper management decisions. Then the stock market performance and operation has been widely recognized as a significantly viable investment field in financial markets. Consequently this project studied stochastic analysis of Markov chain in the closing stock price data of three selected companies (2017-2021) via Nigeria Stock Exchange. The stock prices were transformed into 3-steps transition probability matrix solution for each year. The criteria of obtaining future stock price changes of the year were considered. The analytical solution of stochastic analysis showed that NASCO Nigeria, PLC has the best probability of price increasing in the near future: 19%, which is a tool for proper decision making in terms of investments. In the assessment of future price changes of these three companies OANDO Nigeria, PLC has the highest price of 75% which shows it is profit making organization and are hopeful for future investment plans both short or long term respectively. Also percentage increase in the parameters shows percentage decrease in various future price changes over the stipulated trading period.

Finally, application of fundamental matrix solution to determine future price changes will be an interesting study.

References

[1]Amadi, I.U. and Vivian, M.J.O(2022).A Stochastic Analysis of Stock Price Variation

Assessements in Oando, Nigeria, PLC. *International journal of Mathematical Analysis and Modelling*, 6,issue 2, 216-228.

[2]Adekunle S. A and Eboigbe, S. U.(2017).Markovian Approach to Stock Price Modelling in the Nigerian Oil and Gas Sector, *CBN Journal of Statistics* , 12,No.1,23-24.

[3] Lakshmi ,G. and Jyothi, M. (2020).Application of Markov Process for Prediction of Stock Market Performance, *International Journal of Recent Technology and Engineering* (IJRTE) ISSN: 2277-3878, Vol. 8, No. 6,

[4] Adeosun,M.E., Edeki,S.O. and Ugbebor,O.O(2015).Stochastic Analysis of Stock Market Price Models: A case Study of the Nigerian Stock Exchange(NSE*). WSEAS transactions on Mathematics,14*,353-363.

[5] Agbam, A.S. and Udo, E.O.(2020). Application of Markov Chain model to stochastic forecasting of stocks prices in Nigeria: The case study of Dangote cement. *International journal of applied science and Mathematical theory*, 6,1.

[6] Agwuegbo, S.ON., Adewole, A.P. and Maduegbuna, A.N(2010). A Random walk for stock Market prices. *Journal of Mathematics and Statistics*,6(3),342-346.

[7] Amadi, I. U, Igbudu R and Azor P. A.(2022). Stochastic Analysis of the Impact of Growth-Rates on Stock Market Prices. *Asian journal of Economic, Business and Accounting*.

[8]Amadi, I.U ,Ogbogbo, C.P and Osu, B.O(2022).Stochastic Analysis of Stock Price changes as Markov Chain in Finite States, *Global journal of pure and applied sciences*,28,91-98.

[9]Bairagi A. and CH.Kakaty S.(2015). Analysis of stock market price behavior: A markov chain approach. *International journal of recent scientific research*. Vol .6,issue 10, 7061-7066.

[10]Christain, E.O and Timothy, K.S.(2014). On predicting the long run behavior of Nigerian Bank stock prices: a Markov chain approach. *American journal of applied mathematics and statistics*,2,4,212-215.

[11]Davies, I. Amadi, I.U and Ndu, R.I(2019).Stability Analysis of Stochastic Model for Stock Market Prices. *International journal of Mathematics and Computational Methods ,4*,79-86.

[12] Davou, N.C, Samuel, N.E. and Gokum, T.K.(2013). Markov chain model application on share price movement in stock market. *Computer Engineering and Intelligent systems*,4, 10.

[13]Dmouj,A.(2006).Stock price modeling:Theory and practice.*BIM Paper*.

[14] Eseoghene, J.I.(2011). The Long run propect of stocks in the Nigeria capital Market: a Markovian Analysis. *JORIND* (9)1.

[15] Lakshmi, G.J.M. and Jyothi, M.(2020). Application of Markov process for prediction of stock Market performance. *International journal of recent technology and engineering*, 8, issue 6.

[16]Mettle, F.O, Quaye, E.N.B and Laryea R.A(2014). A Methodology for stochastic Analysis of share prices as Markov chains with finite States.http://www.springerplus.com/content/3/1/057.

[17]Ofomata,A.I.O.,Inyama,S.C.,Umana,R.A . and Omane,A.O(2017).A stochastic Model of the Dynamics of Stock Price for Forecasting. *Journal of Advances in Mathematics and Computer Science.25(6)*,1-24.

[18]Osu, B.O,Okoroafor,A.C. and Olunkwa, C.(2009). Stability Analysis of Stochastic model of Stock market price. *African journal of Mathematics and Computer Science 2(6),98-103*.

[19] Ugbebor,O.O,Onah,S.E. and Ojowo, O.(2001). An Empirical Stochastic Model of Stock Price Changes. *Journal Nigerian Mathematical Society,20*,95-101

[20]Zhang D. and Zhang X. (2009).Study on forecasting the stock market trend based on stochastic analysis method. *International journal of Business and management*. 4(6). 163-170