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An Investigation of Nigerian Insurance Stock Options Prices

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Abstract: Modelling the stochastic behaviour of stock prices have been an exciting challenge for applied statisticians and mathematical economists. Statistical models have commonly been used in the analysis and forecasting of time series data. Usually, the best model is selected to forecast future outcomes based on a selection criterion. This study investigates the longitudinal pattern of Nigerian insurance stock option prices. The present study considers the Expert Model Mining System (EMMS), which incorporates a set of competing methods such as Exponential Smoothing (ES), Auto Regressive Integrated Moving Average (ARIMA) and seasonal ARIMA models. The selection process uses the Bayesian Information Criterion (BIC). However, the Mean Square Error (MSE) and the Coefficient of Determination (R^2) statistics are also being included in probing the adequacy of the selected model. Empirical analysis results show that most stock option prices portrayed exponential smoothing growth behaviour. In fact, all the simulated models are quite good with a minimal coefficient of determination of 97%. Moreover, despite the direct capital and premium incomes triggered by the free market consolidation exercises and the growth portrayed by the stock prices, the insurance industry is still very much undercapitalize with market capitalization of only 5% of Nigerian Stock Exchange (NSE). Finally, the situation is quite alarming, when comparing Nigerian insurance density and market penetration to others major African countries.

Key words: Nigerian Insurance stock prices, time series analysis, EMMS, ES, ARIMA models, BIC, forecasting

INTRODUCTION

Forecasting stock option prices is an important and challenging financial problem that has received a lot of attention since the great depression of 1929. It is widely agreed that although, daily and monthly financial asset prices returns are approximately unpredictable, return volatility is highly predictable, a phenomenon with important implications for financial economics and risk management (Andersen *et al*., 2001). Statistical models have been extensively used for time series data analysis and forecasting. In an effort to account for different stylized facts, several types of models have been developed. We have amongst others, the Autoregressive Moving Averages (ARMA) models, Autoregressive Integrated Moving Average (ARIMA) models, Autoregressive Conditional Heteroscedasticity (ARCH) models, Exponential Smoothing (ES) models, Stochastic Volatility (SV) models and Artificial Neural Network (ANN) models.

Researchers have extensively studied the stock prices return dynamics of the United States (US) and European markets using these models in great detail. In this case, it is well known that asset returns have fatter tails to be successively fitted by a normal distribution (Andersen and Bollerslev, 1997; Bollerslev and Domowitz, 1993; Turner and Weigei, 1992). Emerging stock and bond markets have experienced significant growth in the past several years and a lot of interest has been tailored towards investigating the behaviour of these markets (Chahai and Wang, 1998; Aggarwal *et al*., 1999). Moreover, the US and other developed nations companies, mutual funds and pension funds have also been increasing their exposure to these markets in today's globalise economy.

Most of the previous studies focused on the long term b ehaviour of the stock markets (Turner and Weigei, 1992; Chan *et al*., 2002) and these analyses are rarely extended to emerging economy like Nigeria, whose stock markets are less developed. In Nigeria for instance, stock data spanning decades are unavailable because the exchange only came into existence after independence in 1960. More than that however, many of the companies listed on the exchange do not send returns to the exchange as required (Ibiwoye and Adeleke, 2008). The situation is more dramatic in the insurance industry because of the secretive nature and lack of openness in pretext by individual companies of protecting themselves against their competitors. This study models the behaviour of Nigerian insurance daily stock prices from

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2001-2008 using Expert Model Mining System (EMMS). The EMMS procedure usually provides the best simulated model amongst a set of competing forecasting methods. The choice of this study period is partially motivated the somewhat free market economy and recent stable civil democratic rule, which has engineered some land mark policy reforms in the financial sector of Nigeria economy.

Review of Nigerian insurance industry: Development planning in Nigeria, which started in the 1960s after independence experienced difficulties due to poor performance of most key sectors of the economy. However, since the return to democratic rule in 1999, several strategies and frameworks of economic development have been engineered.

The most important and well acclaimed amongst others is the recapitalisation of Banking and Insurance sectors. This was pioneered to serve as a vehicle for providing adequate services to stimulate national economic growth.

Insurance is understood by most people to be critical to a well-functioning economy as it provides payment in the event of unexpected losses. Insurance introduces security into personal and corporate business situation. It also serves as a basis of credit as no financial institution would lend money for purchase of capital goods.

Insurance industry plays a central role in Nigeria through risk bearing and other financial investment services, employment of labour, payment of tax and providing vehicle for investors. While the life insurance companies provide cover against risk of life and pensions Funds Administration services, the non-life business on the other hand provides protection against the risk of loss or damage to property.

The sources of revenue of an insurance company include premiums for covers granted, income from the investment of shareholders and surplus funds, commission from ceding insurance business to other insurance and reinsurance companies claims recovery in respect of compensation it receives from reinsuring part of her risks.

The Nigerian insurance sector represents the backbone of the Nation's risk management and financing system, ensuring financial security, being one of the most important financial intermediaries and providing a long term capital for human and infrastructural projects. Moreover, insurance mitigates the impacts of risks and directly correlated to economic growth as industries and entrepreneurs' exposures; otherwise their risk taking abilities can be hampered. Thus, a strong and competitive insurance industry is a compelling imperative for Nigeria's economic growth and development (Babalola, 2008). The insurance is continuously undergoing serious reforms and transformation to make it competitive and live to its customers' expectation and play adequately its risk management role in the Nation's economy. The history of the insurance industry in Nigeria, especially post independence has showcased among others, a continuous demand for adequate capitalization.

`In recent times, we can easily recast the recapitalisation exercises of 1997 and 2003 in the insurance industry. In 1997, life insurance companies were mandated by law to recapitalize to the tune of ₦20 million, while general business insurance companies were to recapitalize with ₦20 million. However, general insurance business companies that underwrote special risks were required to recapitalize with ₦70 million. On the other hand, composite insurance companies had the recapitalisation prescription of ₦90 million, while reinsurance companies were expected to recapitalize with ₦150 million. This was successfully implemented.

As a result of the signing into law of the 2003 Act, a new capital base was initiated for the insurance and reinsurance companies. Under this law, life insurance companies were required to recapitalize with ₦150 million, general business insurance companies ₦200 million, composite insurance and reinsurance companies, ₦350 million each. This was the recapitalisation regime for insurance and reinsurance companies until September 2005, when the Federal Government lifted insurance capital base to the tune of billion of Naira following a successful experience in the Banking Industry. Life insurance, general insurance business and reinsurance companies were mandated to recapitalize to the levels of ₦2 billion, ₦3 billion and ₦10 billion, respectively (Chukwulazie, 2008).

Besides the capital market and private placements, insurance companies are also pooling their resources to form bigger insurance companies. Though, there is no deliberate policy to reduce the number of insurance companies operating in Nigeria, which was about one hundred and four at that time has been reduced to about 23 of them, which are currently being quoted in Nigerian Stock Exchange (NSE). Moreover, Nigerian investors' attitude and perception of insurance stocks are dramatically changing positively. In fact, discerning investors have since identified insurance stocks as the next investment destination since most of the insurance stocks are guaranteeing impressive returns. Hence, there is currently a high level of investors interest for insurance stocks in the market and subsequently a high level of their trading volume.

MATERIALS AND METHODS

The data of this study are mainly from daily stock prices of insurance companies traded on the floor of the Nigerian Stock Exchange (NSE). The longitudinal data cover almost eight years starting from 2nd of January 2001 to 10th of September 2008 and coincidently the period corresponds to Nigeria's recent stable market economy and civil democratic governance. Although, about twenty six insurance companies are listed on the floor of NSE, some of them did not survive the consolidation exercise. We only consider the ten insurance companies, whose daily listed stock prices are available for the 8 years period under study. Details on these companies can be found in Nigerian Insurance Digest (2007).

In addition to Nigerian insurance's market penetration, density and Gross Premium Incomes (GPI). In this study, the insurance densities and market penetrations of four other major African countries for comparative data analysis are also considered.

Statistical models have been widely used for time series data analysis and forecasting in empirical finance and other related fields. The Expert Model Mining System (EMMS) used in this study, selects the best model amongst a set of competing class of methods namely: Exponential Smoothing family, Autoregressive Integrated Moving Average (ARIMA) models and seasonal ARIMA methods.

Exponential smoothing techniques: The robustness and accuracy of exponential smoothing forecasting has led to its widespread use in applications. Pegels (1969) has classified exponential smoothing methods into nine different methods. Each method is classified as being suitable for series with constant level, additive trend or multiplicative trend and with either no seasonality, additive seasonality or multiplicative seasonality. In addition Hyndman *et al.* (2002) have extended this taxonomy to include damped additive trend with either seasonality, additive seasonality or multiplicative seasonality (Taylor, 2003).

Autoregressive Integrated Moving Average (ARIMA) models: The ARIMA modelling approach proposed by Box and Jenkins (1976) has been proven to be very effective in modelling and forecasting financial stocks and assets and many other applications. ARIMA (p, d, q) are in theory and practice, the most general class of models for forecasting a time series data, which can be stationarized by transformations such as differencing and logging of the series y_t. The nonseasonal ARIMA model as classified as an ARIMA (p, d, q) model where, p is the number of autoregressive terms, d is the number of nonseasonal differences and q is the number of lagged forecast errors in the prediction equation.

A stationary time series ΔY that has been differenced d times has stochastic component

$$\Delta Y_i \sim \text{Normal}(\mu_i, \sigma^2)$$

where, μ_i and σ^2 are the mean and variance of normal distribution, respectively. The systematic component is modelled as:

$$\mu_i = \alpha_1 \Delta Y_{i-1} + ... + \alpha_p \Delta Y_{i-p} + \theta_1 \varepsilon_{i-1} + ... + \theta_q \varepsilon_{i-q} \quad (1)$$

where, ΔY the lag-p observations from the stationary time series with associated parameter vector α and ε_i the lagged errors of order q, with associated parameter vector. The expected value is the mean of simulations from the stochastic component,

$$E(Y_i) = \mu_i = \alpha_1 \Delta Y_{i-1} + ... + \alpha_p \Delta Y_{i-p} + \theta_1 \varepsilon_{i-1} + ... + \theta_q \varepsilon_{i-q} \quad (2)$$

Seasonal RIMA models: In the case of Seasonal ARIMA modeling, the differencing, autoregressive and moving average operators are the product of seasonal and nonseasonal polynomials: it has the same elements as the ARIMA procedure and adds elements for specifying the seasonal autoregressive order (P), seasonal differencing order (D) and seasonal moving average order (Q). Also, the system incorporates the number of periods per season (s). The seasonal ARIMA models are denoted as seasonal ARIMA (p, d, q) (P, D, Q)s.

Model performance evaluation: Several model selection criteria have been proposed based on different considerations. The most prominently used techniques are the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) (Schwarz, 1978), which is also the selection choice method in this study.

RESULTS AND DISCUSSION

The preliminary results are quite revealing. We observe from Table 1 that the skewness coefficients are all positive and very close for most stocks under investigation. Their magnitudes lie between 1.3 and 2.9 which in fact, reflect the usual right skewed nature of equity stock options prices. This can be seen also from the series plots in Fig. 1. On the other hand, the

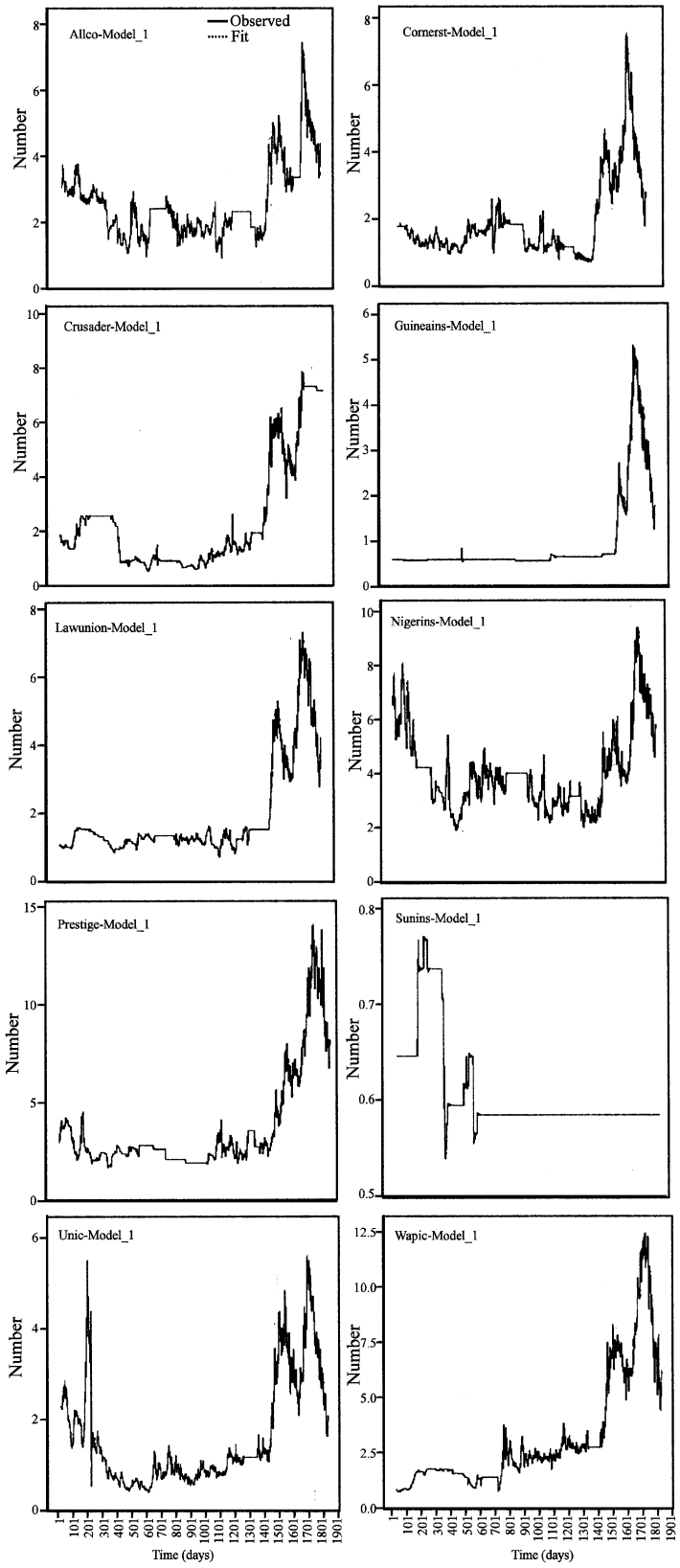

Fig. 1: Series plots of daily stocks prices of the ten insurance companies from 2001-2008

Table 1: Summary of descriptive statistics of insurance stock prices

Insurance company	No. of days	Min. statistic	Max. statistic	Mean statistic	SD statistic	Skewness statistic	Kurtosis statistic
Aiico	1902	0.99	7.50	2.6394	1.08496	1.423	2.312
Cornerstone	1902	0.89	7.87	2.1350	1.19900	2.083	4.573
Crusader	1902	0.61	8.03	2.5269	2.06910	1.369	0.570
Guinea	1902	0.60	5.30	0.9610	0.92900	2.829	7.248
Law Union	1902	0.73	7.50	1.9710	1.45001	2.018	3.025
Niger	1902	2.00	9.50	4.1300	1.43960	1.251	1.383
Prestige	1902	1.72	14.28	3.7937	2.60882	2.038	3.342
Sun	1902	0.55	0.77	0.6117	0.04727	2.109	3.247
UNIC	1902	0.44	6.30	1.8142	1.31531	1.326	0.821
WAPIC	1902	1.00	22.00	3.6000	2.89700	1.781	2.808

Table 2: Parameters estimates of insurance stock prices

Model	Exponential smoothing model parameters	Estimate	SE	t-value	Sig.
WAPIC					
No transformation	α (Level)	0.699	0.092	7.633	0.000
	γ (Trend)	0.922	0.532	1.734	0.083
	ϕ (Trend damping factor)	0.501	0.098	5.110	0.000
Cornerst					
No transformation	α (Level)	0.784	0.150	5.218	0.000
	γ (Trend)	0.932	1.040	0.896	0.370
	ϕ (Trend damping factor)	0.391	0.168	2.328	0.020
Crusader					
No transformation	α (Level)	0.948	0.212	4.466	0.000
	γ (Trend)	0.495	1.365	0.362	0.717
	ϕ (Trend damping factor)	0.329	0.396	0.831	0.406
Guineains					
No transformation	α (Level)	0.909	0.120	7.599	0.000
	γ (Trend)	1.000	0.669	1.495	0.135
	ϕ (Trend damping factor)	0.439	0.112	3.907	0.000
Lawunion					
No transformation	α (Level)	1.000	0.023	43.599	0.000
Prestige					
No transformation	α (Level)	1.000	0.023	43.600	0.000
UNIC					
No transformation	α (Level)	1.000	0.151	6.612	0.000
	γ (Trend)	0.667	0.813	0.820	0.412
	ϕ (Trend damping factor)	0.390	0.198	1.965	0.050

Company	Fitted model	Parameters	Lag	Estimates	SE	t-value	Sig.
ARIMA model parameters							
Aiico	ARIMA (1,1,1)	AR	1	0.618	0.151	4.097	0.000
	No transform	Difference		1			
		MA	1	0.538	0.162	3.327	0.001
Niger	ARIMA (0, 1, 2)	Difference		1			
	Log transform	MA	1	-0.086	0.023	-3.770	0.000
			2	-0.091	0.023	-3.970	0.000
Sun	ARIMA (0,1, 16)	Difference		1			
		MA	2	-0.128	0.023	-5.677	0.000
			3	-0.090	0.023	-3.994	0.000
			5	-0.135	0.023	-5.931	0.000
			16	-0.065	0.022	-2.902	0.004

coefficients of kurtosis are quite diverse. Five stocks data have kurtosis <3 and the other five having kurtosis >3. In addition, the kurtosis coefficients are laying between 0.57 and 7.25, which can signal a certain degree of volatility for cases with larger tailed. Table 2 displayed the fitted models parameters estimates including their Standard Errors (SE), the student's t-statistics and the level of significance given by the probability p-values. The best simulated models and the models goodness of fit statistics are summarised in Table 2. The Table 3 contains also the Ljung-Box statistics and their significance values, whereas Table 4 provided the out of sample forecast performance statistics. From the results summarised in Table 2, we observe that the first five major companies stock prices exhibited the trend behaviour of the popular damped exponential smoothing model and the next two are simple exponential smoothing. On the other hand, the last four are non regular ARIMA (p, d, q) models. It is important to note that the simulated ARIMA (0, 1, 1) of WAPIC insurance stock prices is equivalent to simple exponential smoothing. The estimated model's alpha (α) and phi (ϕ) parameters are highly significant

Table 3: Fitted models summary statistics of various insurance stock prices

		Model fit statistics			Ljung-box	
Insurance company	Model	Stationary R^2	R^2	Normalised BIC	Statistics	Sig.
Cornerstone	Damped trend	0.020	0.994	-4.686	52.050**	0.000
Crusader	Damped trend	0.013	0.998	-4.817	63.926**	0.000
Guinea	Damped trend	0.116	0.998	-6.253	100.01**	0.000
UNIC	Damped trend	0.074	0.994	-4.571	25.032*	0.050
WAPIC	Damped trend	0.033	0.997	-3.552	57.647**	0.000
Law Union	Simple smooth	0.000	0.996	-4.867	52.955**	0.000
Prestige	Simple smooth	0.000	0.995	-3.403	89.133**	0.000
Aiico	ARIMA (1,1,1)	0.010	0.990	-4.434	17.332	0.364
Niger	ARIMA (0,1,2)	0.016	0.988	-3.664	15.103	0.417
Sun	ARIMA (0,1,16)	0.051	0.995	-11.384	23.133	0.059

Table 4: Out-of sample performance of selected estimated models

	Evaluated forecast errors statistics				
Insurance company	Root Mean Square Error (RMSE)	Mean Absolute Error (MAE)	Mean Absolute Percentage Error (MAPE)	Maximum Absolute Error (MaxAE)	R^2
Cornerstone	0.095	0.055	2.441	1.1220	0.994
Crusader	0.089	0.040	1.572	0.9920	0.998
Guinea	0.044	0.014	0.563	0.3540	0.998
UNIC	0.101	0.054	2.870	2.2970	0.994
Law Union	0.088	0.041	1.482	0.5000	0.996
Prestige	0.182	0.083	1.647	2.4580	0.995
Aiico	0.108	0.063	2.467	1.3750	0.990
Niger	0.159	0.103	2.464	1.4490	0.988
Sun	0.003	0.000	0.073	0.0800	0.995
WAPIC	0.168	0.091	2.133	1.6270	0.997

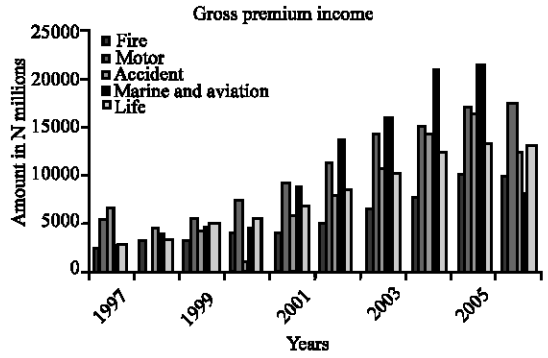

Fig. 2: Nigerian gross premium income across business, insurance digest (2007)

whereas the gamma (γ) trend parameter is not significant for damped exponential smoothing simulated models. The estimated parameters are highly significant for the selected ARIMA models cases. Moreover, from the analysis of results of Table 3, we can state without reservation that the fitted models are very good.

In fact, with normalized Bayesian Information Criterion (BIC) ranging between -3 and -12, each of selected models is the best among a set of competing methods using the EMMS. With coefficients of determination ranging between 97 and 99.9%, the out-of sample performances of the fitted models are very good and quite adequate for forecasting. The Root Mean Square Error (RMSE), the Mean Absolute Error (MAE) and other statistics results displayed in Table 4 suggested the suitability of exponential smoothing in modelling and forecasting the temporal growth pattern of Nigerian insurance stock prices.

In addition, the Long-Jung Q statistics displayed in Table 3 are significant for all the stocks with kurtosis >3. Furthermore, we can observe from the series plots that apart from Sun insurance company, all other stocks prices exhibited a dramatic upward trend after the post 2005 recapitalisation exercise.

In fact, the Sun Insurance Company did survived the post consolidation period of 2008. This can be used as good empirical evidence in supporting the significance of the impact of recapitalisation and consolidation on the insurance industry. In addition, a critical look at the upward trend displayed in Fig. 2 and 3, we observe a quite appreciable growth in the annual Gross Premium Incomes (GPIs) and the incomes from direct investments of Nigerian insurance industry between 1997 and 2005. Since this period is pre-capitalization stage, it is important to perform further indebt and robust analysis before making any serious concluding remarks.

However, we observe a poor performance of Nigerian insurance industry, when comparing the insurance density and market penetration to four other African countries (South Africa, Egypt and Tunisia) as being shown in Fig. 4 and 5.

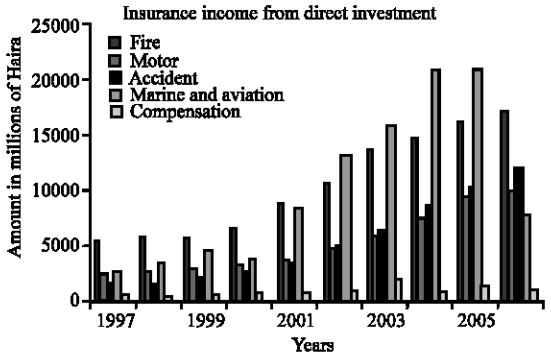

Fig. 3: Insurance income from direct investment (Nigerian Insurance Digest, 2007)

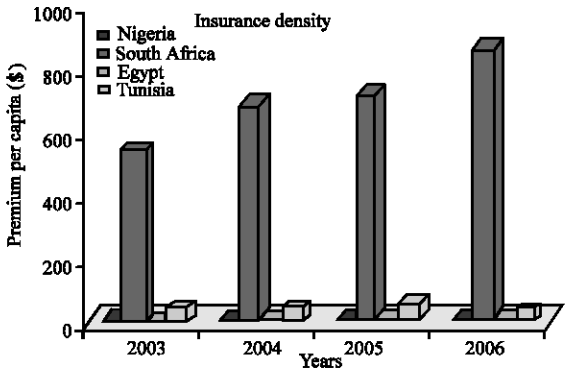

Fig. 4: Insurance density (Omobola, 2008)

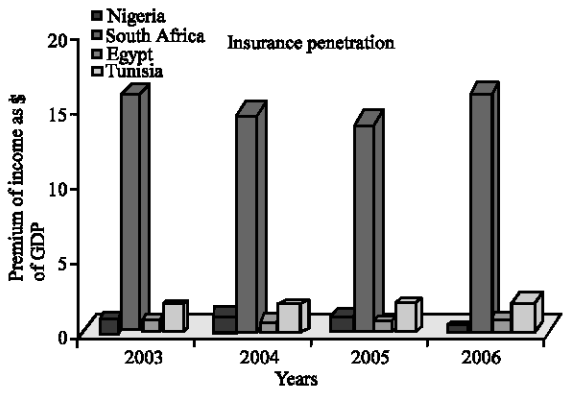

Fig. 5: Insurance market penetration (Omobola, 2008)

CONCLUSION

The EMMS procedure using competing forecasting models including exponential smoothing, non-seasonal and seasonal ARIMA models used to investigate the modelling pattern of insurance stock option prices traded on the floor of Nigerian capital market. The Bayesian Information Criterion (BIC) is used as performance evaluation tool in the model selection process. The empirical analysis findings revealed that most stocks option prices are smoothly exponentially distributed. Additionally, the importance of trend damping is quite useful and informative in investigating equity stock prices by exponential smoothing techniques. The selected simulated models using BIC are quite good and adequate for out-of sampling forecasting. This can be observed from the results of RMSE, MAE and R^2. In fact, the coefficients of determination are between 97 and 99.9%.

Finally, we can state clearly that there is a strong positive longitudinal growth trend both in terms of value of stocks and premium incomes in the insurance industry. However, it also important to point out that Nigerian insurance industry is still lagging behind its competitors domestically and abroad.

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