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# Is CAPM a Good Predictor of Stock Return In The Nigerian Petroleum Marketing Stocks?

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**Abstract**
This research is on testing the predictive power of Capital Asset Pricing Model (CAPM) as enunciated by Sharpe (1964) in the determination of the required rates of return of Nigerian petroleum marketing sector stocks that coincides with the actual rates of return. As it were, there is no clear cut understanding on the belief with particular reference to Nigerian petroleum marketing sector stocks. In the light of the above assertion, the objective of this study is to find out the required rate of return of Nigerian petroleum marketing sector stocks from 2000-2012 and compare them with the actual rates of return in the corresponding periods to indentify the valuation status of the stocks. Being an empirical study, analytical research design was adopted. The data used were secondary data, which were collected from the financial statements of the firms, The Nigerian Stock Exchange publications, and Central banks of Nigeria publications. The findings show that the Capital Asset Pricing Model (CAPM) as enunciated by Sharpe (1964) did not give any appropriate forecast of the returns from the petroleum marketing sector stocks throughout the thirteen-year period of study. The CAPM made twenty-seven under-valuations and seventy-four overvaluations to make a total of one hundred and one misappropriations in the thirteen years period of study in the petroleum marketing sector. Therefore, the Capital Asset Pricing Model (CAPM) is not a good predictor of stock return in the petroleum marketing sector of the Nigerian Stock Exchange.

**Keywords:** historical equity market risk premium, historical equity beta, required rate of return to equity, actual market return, actual stock return.

## 1. Introduction

In finance, there is widespread agreement that the Capital Asset Pricing Model (CAPM) is a good predictor of share price movements in stock markets. While the above assertion had been empirically validated in several stock markets in developed economies, there have been few such studies in the stock markets of developing economies like Nigeria. Such studies have now become imperative given the recent developments that have seen the Nigerian stock market capitalization increasing from N276, 111,743,197.30 on January 2, 1998 to N10, 180,292,984,225.00 on December 31, 2007 and N8, 974,448,519,042.53 on December 31, 2012 without a relative increase in the volume of stocks being traded. The fluctuations in stock prices at times do not make economic sense given the economic reality of the companies. Sometimes stock prices went ahead of what the underlying business would earn, just as sometimes they fell below. There seems to be no clear-cut method of fixing share prices in the Nigerian stock exchange. The model that guides this cycle is quite hazy and there is need to unravel the mystery surrounding the issue of share price movement. To this effect, the major objective of this study is to examine the relevance of CAPM in the Nigerian context. For this study, particular reference was placed on the petroleum marketing sector. In achieving this, the specific objective is to apply the Capital Asset Pricing Model (CAPM) to the Nigerian petroleum marketing sector data and from the results infer whether petroleum marketing sector stocks returns were correctly estimated, under or over estimated as at the time of the forecast. In addressing this objective, the study seeks to answer the question: From the perspective of the Capital Asset Pricing Model (CAPM), are the subject-firms stocks returns correctly valued, undervalued, or overvalued by the CAPM? To hazard a guess, from the perspective of the Capital Asset Pricing Model (CAPM), the subject-firms stocks returns were not correctly valued.

Companies quoted on the Nigerian stock market are segregated into many sectors but the area of interest to the researcher is the petroleum marketing sector. The decision to research only on petroleum marketing sector stocks is informed by the fact that petroleum marketing sector is among the major vibrant sectors in Nigerian Stock Exchange. Therefore, the findings and conclusions to be derived from this work were as related to the petroleum marketing sector stocks in Nigeria. The study covers the period of thirteen years (2000-2012), comprising 156 months. This period was selected to cover both the pre and post consolidation era in the banking sector in Nigeria. The study covers only petroleum marketing sector stocks in the secondary arm of the Nigerian stock market. In line with the objective of the study, data from the Nigerian stock exchange was collected and utilized to validate the existence of a relationship between petroleum marketing sector stock returns movement and the models under study in an emerging market setting. In doing this, daily official price lists of the exchange and the annual reports of the firms were collected over the period, January 2000 to December 2012. Only firms listed on the exchange between years 2000 to 2012 were selected for this study. This period was selected for our study because it was a relatively stable period in Nigeria as it was fairly free from major political factors that could upturn the capital market so adversely.

The relevance of the study can be capture in the work of Damodaran (2006) who concludes that valuation is at the heart of what we do in finance, to those who need to identify and buy stocks that trade at less than their true value so that they can make profit when the prices converge on true value. It is also necessary when there is need to investigate whether market prices deviate from true value. One major limitation of this study is the unavailability of complete data for 2013. The inclusion of the 2013 years data would have made the work the most recent study.

**2. Review of Related Literature**

The CAPM was developed by Sharpe (1964) in an attempt to simplify the individual portfolio theory as it relates to investment in securities. It states that the return on any asset or portfolio is related to the riskless rate of return and the expected return on the market in a linear fashion. It shows the relationship between expected return of a security and its unavoidable systematic risk thus, $\mathbf{R = R_f + \beta(R_m - R_f)}$, where R = Expected rate of return on a security or a portfolio, $R_f$ = Risk-free rate of return, $R_m$ = Expected market rate of return, $\boldsymbol{\beta}$ = Systemic risk of the security (the beta) relative to that of the market.

The model recognizes only the systemic risk because it submits that only risk which cannot be diversified away, i.e. systemic risk, is worthy of being rewarded with a risk premium for financial valuation purposes. The remaining risk, i.e. unsystemic or diversifiable risk may be reduced to zero by portfolio diversification and so it is not worthy of a risk premium. The line that reflects the combination of systemic risk and return available on alternative investments at a given time is called the security market line (SML). Any security that lies on the SML is being correctly priced. If there is temporary disequilibrium in the market and the return on some assets becomes higher than that given by the SML, then the security is underpriced. Under this market condition, if the market mechanism is working ideally, as investors demand more of such securities as super-good investment, the prices will continue to rise until that higher level of return reaches the SML value. Conversely if as a result of the market disequilibrium the level of return is lower than that given by the SML, then the security is overpriced. Under this market condition, if the market mechanism is working ideally, as investors sell-off more of such securities as super-bad investment, the prices will continue to fall until the level of return rises to that given by the SML value. Therefore, investors should select investments that are consistent with their risk preferences. While some investors consider only low risk investments, others welcome high risk investments. However, investors should sell overpriced securities, buy underpriced securities, and hold onto correctly priced securities. The key to this decision is that when actual return –CAPM required return = +ve alpha, the security is underpriced, when actual return –CAPM required return = zero alpha, the security is correctly priced, when actual return –CAPM required return gives positive value, the security is overpriced. The CAPM provides a framework for valuation of securities.

In the Capital Asset Pricing Model (CAPM), market risk of a risky asset or stock is measured by beta (β) which when multiplied by the Equity Market Risk Premium yields the total risk premium for a risky asset. That is, total equity risk premium for a risky asset (Rp) is equals to its beta multiplied by the equity risk premium (ERP) for the entire equity stock market portfolio (i.e. Rp = β(Rm – Rf). Hence, from our definition of expected return, that for a risky asset at any point in time is represented by Re = Rf + β(Rm – Rf). That is, ERP for the entire equity market is Rm – Rf while that of a specific equity stock is βi(Rm – Rf). Therefore, expected return on any risky investment = Risk-free Rate +Beta of the risky asset (ERP).

On the determinants of ERP are the risk aversions of investors, economic risk, information uncertainty, liquidity, and catastrophic risk. High risk aversion investors beget higher ERP. That is, the more the risk aversion the higher the ERP. As the risk aversion declines, ERP will fall. Investors risk aversion depends on age (Bakshi and Chen, 1994) and preferences for future or current consumption (Damodaran, 2011). The older the investors the more risk averse and the higher the ERP. The younger the investors the less risk averse and the lower the ERP. Investors' preference for current consumption over future consumption increases ERP. Conversely, Investors' preference for future consumption over current consumption decreases ERP. That is, ERP increases as savings rate decreases and decreases as savings rate increases.

On the impact of economic risk on ERP, the economy with predictable inflation, interest rates and economic growth should have lower ERP than one that is volatile in these variables. Lettau, Ludwigson and Wachter (2007) link the changing ERP in US to shifting volatility in the real economic variables which include employment, consumption and GDP growth. Individuals will choose a lower and more stable level of wealth and consumption that they can sustain over the long term over a higher level of wealth and consumption that varies widely from period to period. Constantinides (1990) notes that individuals become used to maintaining past consumption levels and that even small changes in consumption can cause big changes in marginal utility. Hence the stock returns are correlated with consumption, decreasing in periods when people have fewer goods to consume and the additional risk explains the higher observed ERP. Using dividend yield as proxy for risk premium they establish the close relationship between the volatility in GDP growth rate and the Dividend yield over a very long time period (1885-2005). Though studies that looked at the relationship between the level of inflation and ERP find little or no correlation, Brandt and Wang (2003), Modigliani and Cohn (1979) present evidence that ERP tend to increase if inflation is higher than anticipated or expected and decrease when it is lower than expected. Campbell and Voulteenaho (2004) related changes in dividend yield to changes in the inflation rate over time and find strong support for the findings of Brandt and Wang (2003), Modigliani and Cohn (1979). In the words of Damodaran (2011:9), reconciling the findings, it seems reasonable to conclude that it is not so much the level of inflation that determines ERP but uncertainty about that level.

On information uncertainty, the higher the confidence reposed on the level of volatility in earnings and cash flows reported by individual firms in the economy the lower the ERP and vice versa. More precise information should lead to lower ERP while more complex information should lead to higher ERP. Information here relates to future earnings and cash flows. Yee (2006) says that earnings quality depicts the level of volatility of future earnings and that ERP should increase (decrease) as earnings quality decreases (increases). Investors demand large ERP to compensate them for the added uncertainty if earnings volatility is high.

In considering additional risk created by illiquidity of in equity market, investors need to demand large discounts on estimated value as they need to pay transaction costs in liquidating their equity positions. This means they would pay less for equities today which warrant demand for a large ERP. Therefore, a situation where it is envisaged that there will be high transaction costs as a result of illiquidity, when investors want to liquidate their equity positions demand high ERP. Gibson and Mougeot (2002) conclude from study of US stock returns (1973-1997) that liquidity accounts for a significant component of the overall ERP, and that its effect varies over time. Baekart, Harvey and Lundblad (2006) show evidence that the differences in equity returns (and risk premiums) across emerging markets can be partially explained by differences in liquidity across the markets.

Catastrophic risk is caused by events that occur infrequently but can cause dramatic drops in wealth. For example, the great depression from 1929-1930 in US, collapse of Japanese equities in the 1980s. When there is possibility of catastrophic risk occurring the higher the ERP. Rietz (1988), Barro (2006), Gabaix (2009), Barro, Nakamura, Steinsson and Ursua (2009) studied the possibility of catastrophic events on ERP and find that the average length of a disaster is six years and that half of the short run impact is reversed in the long term. On the appropriateness or compatibility of ERP observed in practice with what obtains in theory, it all depends on the level of risk aversion coefficient assumed in the analysis.

From Damodaran (2011:15), there are three broad approaches used to estimate ERP. One is to survey subsets of investors and Managers to get a sense of their expectations about equity returns in the future. The second is to assess the returns earned in the past on equities relative to riskless investments and use this historical premium as the expected. The third is to attempt to estimate a forward-looking premium based on the market rates or prices on traded assets today and this is termed implied premium. In survey premium the challenge is finding the right subset of investors that best reflects the aggregate market. The Securities Industry Association (SIA) surveyed investors from 1999 to 2004 on the expected return on stocks and yields numbers that can be used to extract ERP. In the 2004 survey of 1500 US investors, the median expected return was 12.8% which yields a risk premium of about 8.3% over the Treasury bond rate at that time. The survey yielded expected return of 10% in 2003, 13% in 2002, 19% in 2001, 33% in 2000, and 30% in 1999 (Damodaran, 2011:16). Merrill Lynch, in its monthly survey of institutional investors globally reports average ERP of 3.5% in February 2007, 4.1% in March 2007 after a market downturn, 3.76% in January 2010, range of 3.85-3.90% for the rest of 2010, and 3.86% in January 2011. Graham and Harvey (2010; 2009) survey of Chief Financial Officers (CFOs) of companies from 2000-2010, report a mean and median ERP of 4.74% and 4.3% in February 2009 and 3% and 2.7% in June 2010 respectively. They observed peak ERP in September 2000 at 4.65%, lowest of 2.47% in September 2006, and an average of 3.38% across all 10 years of survey on about 9000 responses. Welch (2000) survey of 226 financial economists reports an arithmetic mean annual ERP of about 7% for a ten-year time horizon and 6-7% for one to five-year time horizons.

Fernandez (2010a) examined widely used textbooks in corporate finance and valuation and noted that ERP varied widely across the books and that the moving average premium has declined from 8.4% in 1990 to 5.7% in 2008 and 2009. His survey of academics in 2010 Fernandez (2010b) concludes that Professors in the US used an average ERP of 6%, compared to 5.3% being used by European Professors. Fernandez et al (2011a), survey with 5,731 answers on which US Market Risk Premium (MRP) used in 2011 by Professors, analysts and companies, report that Professors used 5.7%, analysts used 5%, companies used 5.6%. Fernandez et al (2011b), survey with 6,014 answers shows the Market Risk Premium (MRP) used in 56 countries in 2011. Studies that have looked at the efficacy of survey premiums indicate that if they have any predictive power, it is in the wrong direction. Fisher and Statman (2000) document the negative relationship between investor sentiment both individual and institutional, and stock returns. That is, investors becoming more optimistic and demanding a larger premium, is more likely to be a precursor to poor rather than good market returns.

According to Damodaran (2011:20), the most widely used approach to estimating ERP is the historical approach, where the actual returns earned on stocks over a long time period is estimated, and compared to the actual returns earned on a default-free (usually government security). The difference on an annual basis between the two returns is computed and represents the historical ERP. This approach is good given that we are almost looking at the same historical data. However, differences may occur between the Historical ERP and actual ERP being used in practice because of three reasons viz, different time periods for estimation, differences in index of measuring Risk-free rates and market return indices, differences in the way in which returns are averaged overtime. For the time period, the longer and more current the time period covered the lower the standard error of estimating ERP and the better the relevance to today's market. On risk-free estimation one can use either short term government securities (Treasury bills) or long term government securities (Treasury bonds). Larger ERP is obtained when using Treasury bills than the Treasury bonds. Some practitioners and academics use Treasury bills rate as the risk-free rate with the alluring logic that there is no price risk in a Treasury bills whereas the price of a Treasury bond can be affected by changes in interest rates over time. This argument makes sense only if we are interested in a single period ERP, say for next year. If our time horizon is longer, say 5 or 10 years, it is Treasury bond that provides the more predictable returns. The third choice is to use Treasury bills rate plus term structure spread to get a normalized long term rate. In estimating market return, using the broadest market-weighted index of stocks with a long history is good. On averaging to project the future ERP, the argument in corporate finance and valuation that using the GM presents a better picture than the AM is strong. This is because returns on stocks are negatively correlated, that is, good years are more likely to be followed by poor years and vice versa, and the AM is more likely to overstate the ERP. This is also why AM yields higher values than the GM. The GM is better for much longer period than a year (Fama and French, 1992).

Fernandez (2007:3) states that the historical equity premium (HEP) is the historical average differential return of the market portfolio over the risk-free debt and this average differential return may be arithmetic or geometric mean. Different stock market indexes are used as the market portfolio and government bonds or bills of different maturities are used as risk-free debt. According to Fernandez (2007:4), Ibbotson Associates (2006) used the income return (the portion of the total return that results from a periodic bond coupon payment) of the government bonds (5.2%) and average return on the S&P 500 (12.3%) to produce HEP of 7.1% for 1926-2005. In the same time period using Treasury bills rate of 3.8% they produced HEP of 8.5% under the arithmetic mean and 6.7% (i.e. 10.4-3.7) under the geometric mean. Ibbotson and Chen (2003) using the New York Stock Exchange (NYSE) database for 1926-2000 on historical equity returns conclude that the expected long term equity premium (relative to the long term government bond yield) is 5.9% arithmetically and 3.97% geometrically. Goetzmann, Ibbotson and Peng (2001) employed a new NYSE database for 1815-1925 to estimate the US equity returns and the HEP since 1792 (without dividend data in pre-1825 and incomplete in 1825-1871) and produced HEP relative to bonds of 3.76% arithmetically and 2.83% geometrically for 1792-1925, 6.57% arithmetically and 4.99% geometrically for 1926-2004. With Treasury bills rate they produced HEP of 8.63% arithmetically and 6.71% geometrically for 1926-2004. Dimson and Marsh (2001) calculated the geometric HEP for 1955-1999 of US, UK, Germany and Japan and obtained 6.2%, 6.2%, 6.3% and 7% respectively.

While historical ERP approach is backward-looking, the implied ERP approach is forward-looking. The implied ERP can be obtained using the intuition from the rate of return approach. Rate of return = cash flows/purchase cost. We can argue that ERP = rate of return = cash flows/current market price for equity. According to the Gordon (1962) model, the current price per share is the present value of expected dividends discounted at the required rate of return. Using Gordon (1962) model with perpetual sustainable constant stable growth rate in dividends and earnings, Value of equity = expected dividend next period/(required return on equity-expected growth rate) = D1/(k-g) = D(1 + g)/(k-g). From this model the implied required return on equity = [D(1+g)/value of equity]+g. Then subtracting the risk-free rate from the implied required return on equity yields an implied risk premium.

If we use the stable growth discounted dividend model (DDM) as the base model for valuing equities and assume that the growth rate (g) = risk-free rate (Rf), then dividend yield (i.e. dividend/market price) on equities becomes the measure of the ERP. That is, Value of equity = D(1 + g)/(k-g). From this, k-g = D(1+g)/Current market value of equity = Dividend yield = k-Rf = ERP. This view is supported by Rozeff (1984), Fama and French (1988) and Damodaran (2002 and 2011). This model will not hold if companies do not payout dividend and if earnings are expected to grow at extraordinary rates for the short term (Damodaran, 2011:57). Fama and French (2002) using the DDM, estimated the implied equity premium (IEP) for the period 1951-2000 between 2.55% and 4.32%, far below the HEP (7.43%). For the period 1872-1950, they estimated an IEP (4.17%) similar to HEP (4.4%).

Using earnings approach and focusing on earnings instead of dividends, we state the expected growth rate (g) as a function of the payout ratio and return on equity, thus g = [1 – (dividends/earnings)]( return on equity) = [1 – payout ratio]( return on equity). Substituting g back into the stable growth model, we have Value of equity = D(1 + g)/(k-g) = expected earnings next period(payout ratio)/ (required return on equity-expected growth rate) = expected earnings next period(payout ratio)/(required return on equity- [(1 – payout ratio)( return on equity)]. Assume that required return on equity = return on equity, which means no excess return, the equation simplifies to Value of equity = expected earnings next period(payout ratio)/[(required return on equity- required return on equity + (payout ratio)( return on equity)] = expected earnings next period(payout ratio)/[(payout ratio)( return on equity)] = expected earnings next period/return on equity. Hence, return on equity = expected earnings next period/ Value of equity = E(1+g)/MV = Earnings yields = 1/PE ratio. Therefore, required return on equity = expected earnings next period/Current market Value of equity = E(1+g)/MV = Earnings yields = 1/PE ratio and when risk-free rate is subtracted from its value, implied ERP suffices. That is, with earnings approach, implied ERP = Earnings yields on NSE All-Share Index minus risk-free rate = (Aggregate earnings on NSE All-Share Index for each year divide by Current market value of the index) minus risk-free rate.

Brennan (2004) admits that different classes of investors may have different expectations about the prospective returns on equities which imply different assessments of the risk premium. Bostock (2004) says that understanding the equity premium is largely a matter of using clear terms. These statements, I believe, propelled Fernandez (2007) to designated equity premium (also called market risk premium, equity risk premium, market premium, and risk premium) in four different concepts: Historical Equity Premium (HEP); Expected Equity Premium (EEP); Required Equity Premium (REP); Implied Equity Premium (IEP). Fernandez (2007) posits that provided that analysts use the same time frame, the same market index, the same risk-free instrument and the same averaging method (arithmetic or geometric), HEP is equal for all investors. The REP, the EEP and the IEP differ for different investors.

Akintola-Bello (2004:139) used 96 months of security returns from Jan 1992 to December 1999 to estimate the betas for 173 firms quoted on the Nigerian stock exchange. He used growth rates in the NSE All-share index as the proxy for the market rate of return. It is generally accepted that due to some statistical factors, the estimated betas using the regression analysis are not unbiased estimates of the underlying beta of a firm's securities. The underlying beta of a security is likely to be closer to 1 than the sample estimate. To correct for this bias, Merrill Lynch developed an adjustment technique. After using the ordinary least squares to gain a preliminary estimate of beta, using 60 monthly returns, the beta is adjusted as follows: Adjusted Beta = 2/3(Computed Sample Beta) + 1/3(1) = 0.67(Raw beta) + 0.33(1). The formula pushes high betas down toward 1.0 and low betas up toward 1.0. The raw betas computed are adjusted to remove individual securities bias.

Therefore, the conventional approach for estimating betas used by most investment firms, analysts and services is to use historical market data for firms that have been quoted for a long period. One can estimate returns that an investor would have made on their investments in intervals (such as a week, a month) over that period. These returns can then be related to a proxy for the market portfolio to get a beta in the CAPM.

 

Fernandez (2009) computed Historical betas of AT&T, Boeing and Coca-Cola during the two-month period of December 2001 and January 2002 with respect to the S&P 500. Each day, betas are calculated using 5 years of monthly data, that is, on December 18, 2001, the beta is calculated by running a regression of the 60 monthly returns of the company on the 60 monthly returns of the S&P 500. The returns of each month are calculated on the 18th of the month. The monthly return of December 18, 2001 = (total return December 18, 2001/ total return November 18, 2001) – 1.

Pablo and Vicente (2009) using the return of the S&P 500 as market return, computed the correlations of the annual stock returns (1989-2008) of the Dow Jones companies and discovered on average that the composite stock market with a beta that is equal to one does better than calculated betas. They also discovered that the Adjusted betas [ie 0.67(calculated beta) + 0.33) have higher correlation than calculated betas but Adjusted betas have lower correlation than beta that is equal to one. They carried the exercise with four calculated betas every year end versus S&P 500 using, a) monthly data of last 5 years; b) monthly data of last 2 years; c) weekly data of last 5 years; d) daily data of last 5 years; and found similar results with the four betas. Despite this results, Fernandez (2009) reports that 97.3% of the professors that justify the betas use regressions, webs, databases, textbooks or papers, while only 0.9% of the professors justified the beta using exclusively personal judgment (named qualitative betas, common sense betas, intuitive betas, logical magnitude betas and own judgment betas by different professors).

## 3. Research Methodology

### 3.1 Nature and Sources of Data

Data for this study are of secondary nature. To compute the monthly average market prices for 156 months (2000 – 2012) the daily market prices of each of the subject firms' ordinary shares from 2000-2012 were required. To compute the actual rates of returns of the subject firms, the equity price appreciation or depreciation of the subject firms from 2000-2012 were required. To compute the rates of returns of the market, we need the NSE All-share Index (ASI) from 2000-2012. We also need the Nigerian Treasury Bill rates for each year from 2000-2012 to compute the risk-free rate of return. Therefore, in essence, we need for each subject firm the relevant daily market prices history. The stocks market prices and the NSE ASI were picked from the NSE daily official list for 2000-2012 while the Treasury Bills rates were picked from the CBN Statistical Bulletin 2000-2012.

### 3.2 Population and Sample

The population of this study is all quoted companies in Nigerian Stock market. The sample of study is all the quoted firms in the petroleum marketing sector of the Nigerian Stock Exchange from 2000-2012.

### 3.3 Computation Methodology

Under the CAPM, the expected return as implied by the Capital Asset Pricing Model (CAPM) will be derived and compared with the actual return from each of the firms, to ascertain whether the stock is appropriately valued, undervalued, or overvalued. To accomplish this, it is necessary to derive value for each of the variables in the equation of the CAPM.

#### 3.3.1 Estimating the Expected Rate of Return

To adjust for risk the discount rate for each of the firms will be determined using the capital asset pricing model (CAPM) as in Arnold (2008:765). The message of CAPM is that if we know the risk free rate and the return on the whole market portfolio, the required rate of return on a risky asset will depend upon its beta coefficient, it tells us that the required rate of return on as asset is equal to the risk free rate plus a fraction (or multiple) or the market risk premium where the fraction (or multiple) is represented by the asset's beta coefficient. Thus, $Ki = R_f + \beta i(R_m – R_f)$, where Ki = cost of equity i, which is also the expected required rate of return, $R_f$ = risk free rate, $\beta i$ = each equity risk relative to the market, $R_m$ = market rate of return.

#### 3.3.2 Estimation of Risk Free Rate ($R_f$)

The risk free rate is that which could be earned on some zero-risk asset. Assets that have strictly zero risk are, in practice hard to find, but usually a three-month Federal Government of Nigeria (FGN) Treasury bill for short term and long term FGN bonds were used to represent risk free rate of interest. This is because the interest payable on any of the two is fixed, government is unlikely to default, and if the bill or bond is held to redemption, its maturity value is also certain. In this study the average rate of all the FGN Treasury bills issued for each year serves as a good proxy for risk free rate for each year under consideration.

### 3.3.3 Estimation of Beta Coefficient (β)

Beta coefficient measures the sensitivity of each of the stock's returns to movements in the market's return. It enables us to state what premium should be paid on each of the firms' equity shares by comparing each of them with that of the whole market portfolio. The conventional approach for estimating betas as used by Value Line Investment Services, Merrill Lynch(a U.S. investment firm), and the London Business School Risk Management Service, is to relate historical returns on an investment to a proxy for the market portfolio returns, using the ordinary least square techniques, to get a beta. This is usually represented by the equation of a straight line: Y = a + bx, where 'a' is the intercept of a straight line or 'alpha' coefficient, and 'b' is the slope or 'beta' coefficient. Also, according to Fischer and Jordan (1995:89), the beta coefficient is computed for each equity using $\beta i = n\sum xy - \sum x\sum y/n\sum x^2 - (\sum x)^2 = n\sum RmRi - \sum Rm\sum Ri/ n\sum Rm^2 - (\sum Rm)^2$ and $a = \acute{y} - \beta\chi$. In this study, we used 156 months of each security's returns from January 2000 to December 2012 to estimate betas for the stocks quoted on the Nigerian Stock Exchange. The proxy for the market portfolio is therefore the NSE index, which encompass the total market value of quoted stocks. It is generally accepted that due to some statistical factors such as error in capturing the data and early approximations, the estimated betas using the regression analysis are not unbiased estimates of the underlying beta of a security. To correct for this bias, one can adopt the technique developed by Merrill Lynch and also adopted by Akintola-Bello (2004:141). That is, after using the ordinary least squares to gain a preliminary estimate of beta, using 96 monthly returns, he then adjusted the beta using the model, Adjusted beta = Raw beta (0.67) + 0.33. However, since the data used in this study are historical data, the actual figures were picked from the relevant sources. This makes use of adjusted beta in computing rate of return required irrelevant.

### 3.3.4 Estimation Market Return (Rm)

The NSE All-Share-Index is used as a proxy for market rate of return. The NSE ASI was established on January 02, 1984 as a base date and set at 100 as a base value to which all subsequent values of the index can be related. It is a real time index because it is recalculated at the end of every trading day and captures the population of all listed shares.

### 3.3.5 Estimation of Actual Rates of Return

Usually the rates of return on each share were obtained by computing the relative values of prices between a holding period (monthly) plus the yearly dividend yields. According to Akintola-Bello (2004:70), the return on a security is computed as $(D_t + P_t - P_{t-1})/P_{t-1}$, where $D_t$ = dividend paid in period t, $P_t$= closing price in period t, $P_{t-1}$ = Closing price in period t-1. The 12 monthly returns for each share were chain linked to obtain the annual return for each stock. Chain link simply means finding the geometric mean (GM) of the 12 monthly returns. According to Watsham and Parramore (2007:54) the geometric mean is the most appropriate measure of means when an average rate of change over a number of time periods is being calculated. It is a single measure of periodic growth rate which if repeated n times will transform the opening value into the terminal value. However, in this study, the actual rates of return on each share for each year were obtained by the GM of computed relative percentage increases in the values of prices for a 12-month holding period. To measure the annual growth rate over n years, the appropriate model for geometric mean is as follows: $GM = (1+g_1)(1+g_2)(1+g_3)\text{---}(1+gn)^{1/n} - 1$, where g is the periodic growth rates expressed as decimal. The decision rules in gauging how CAPM best suits the Nigerian stocks are as follows. If CAPM computed return is equal to the actual return, the stock is normally valued by CAPM; if CAPM computed return is less than the actual return, the stock is undervalued by CAPM; If CAPM computed return is greater than the actual return, the stock is overvalued by CAPM.

## 4. Results and Discussions

### 4.1 Results

In this study the expected return of the Nigerian stock market as a whole was approximated by using the return obtained based on the Nigerian Stock Exchange All-Share Price Index (ASI). Presented below in table 1 row 2 are the actual returns of the Nigerian stock market as a whole for the years 2000 to 2012. The risk-free rates for the years 2000 to 2012, as computed from the Federal Government of Nigeria Treasury Bills issued between 2000 and 2012 are displayed in table 1 row 3 and row 4 present the historical equity market risk premia. The last row contains the market risk from 2000 to 2012.

Table 1: Actual Rates of Return of the Market and Risk-free Rates

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Market (Rm) | 37.91 | 38.28 | 7.07 | 51.82 | 17.13 | 4.06 | 31.43 | 53.05 | -58.54 | -36.64 | 17.18 | -20.03 | 30.57 |
| Rf | 12.00 | 12.95 | 18.88 | 15.02 | 14.21 | 7.00 | 8.88 | 6.82 | 8.20 | 3.79 | 3.85 | 9.70 | 13.64 |
| Rm-Rf | 25.91 | 25.33 | -11.81 | 36.80 | 2.92 | -2.94 | 22.55 | 46.23 | -66.74 | -40.43 | 13.33 | -29.73 | 16.93 |
| Market risk | 3.82 | 5.36 | 4.02 | 5.64 | 7.68 | 4.48 | 5.33 | 4.87 | 8.19 | 11.22 | 5.34 | 4.60 | 3.73 |

Source: Compiled from NSE DOL and CBN Statistical Bullettin

 

The CAPM asserts that the expected rate of return on an asset is equal to the risk-free rate plus a risk premium. The risk premium is equal to the equity market risk premium $\{R_m - R_f\}$ multiplied by the asset's beta. The beta (β) is a measure of sensitivity of each individual security to the market and it is for this sensitivity that the holder of a security is rewarded. For individual securities, beta is the appropriate measure of risk. To calculate the beta of an individual security, it is always assumed that the past will be a good surrogate for the future. In other words, a security's past risk characteristics provide some indication of its future prospects. Based on the market model, we used the linear regression method, $\beta = \{n\sum RiRm - \sum Ri\sum Rm\}/\{n\sum R^2m - (\sum Rm)^2\}$, to estimate the value of beta (β)for individual securities. The estimated beta values for the Nigerian quoted firms were obtained as shown in row 2 of tables 2-10. To derive the estimates of the actual return on each security, we plugged in the estimated values of the risk-free rate, $R_f$, the market risk premium, $R_m - R_f$ and the beta (β) into the equation , $Ri = R_f + \beta i(R_m - R_f)$. The resultant expected returns from this process are presented in row 3 as CAPM returns. The actual returns of the stocks using the Capital gain Yield are presented in the tables in row 4 as the actual returns. Table 2-10 row 5 gives the difference between the CAPM return and the actual return while row 6 provide the evaluation status of the stocks under each year from 2000 to 2012. Under the valuation status, O represents overvalued stock by CAPM; U represents undervalued stock by CAPM while N represents appropriately valued stock by CAPM.

Table 2: Actual and CAPM Rates of Return of Afroil

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beta | .08 | -.02 | -.02 | -.89 | 3.51 | 1.53 | .33 | 3.68 | 2.07 | 0 | 0 | 0 | 0 |
| CAPM Return | 14.07 | 12.44 | 19.12 | -17.73 | 24.46 | 2.50 | 16.32 | 176.95 | -129.95 | 3.79 | 3.85 | 9.70 | 13.64 |
| Actual Return | -9.80 | -10.87 | -3.92 | 75.52 | 41.24 | -55.91 | -28.43 | 363.04 | 100.76 | 0 | 0 | 0 | 0 |
| CAPM-Actual | 23.87 | 23.31 | 23.04 | -93.25 | -16.78 | 58.41 | 44.75 | -186.09 | -230.71 | 3.79 | 3.85 | 9.70 | 13.64 |
| Valuation Status | O | O | O | U | U | O | O | U | U | O | O | O | O |

Source: Computed from NSE Daily Official Lists and CBN Statistical Bullettin

Table 3: Actual and CAPM Rates of Return of Beco Petroleum

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beta | - | - | - | - | - | - | - | - | - | - | -.02 | .16 | 0 |
| CAPM Return | - | - | - | - | - | - | - | - | - | - | 3.58 | 4.94 | 13.64 |
| Actual Return | - | - | - | - | - | - | - | - | - | - | -127.12 | -27.44 | 0 |
| CAPM-Actual | - | - | - | - | - | - | - | - | - | - | 130.70 | 32.38 | 13.64 |
| Valuation Status | - | - | - | - | - | - | - | - | - | - | O | O | O |

Source: Computed from NSE Daily Official Lists and CBN Statistical Bullettin

Table 4: Actual and CAPM Rates of Return of MRS OIL

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beta | .99 | .73 | .43 | 1.61 | .80 | .74 | .80 | 1.79 | 2.57 | .61 | .59 | -2.07 | .71 |
| CAPM Return | 37.65 | 31.44 | 13.80 | 74.27 | 16.55 | 4.82 | 26.92 | 89.57 | -163.32 | -20.87 | 11.71 | 71.24 | 25.66 |
| Actual Return | 82.38 | 20.63 | -21.12 | 116.92 | .60 | -31.76 | -48.97 | 87.86 | 27.60 | -107.47 | -66.23 | 59.41 | -88.65 |
| CAPM-Actual | -44.73 | 10.81 | 34.92 | -42.65 | 15.95 | 36.58 | 75.89 | 1.71 | -190.92 | 86.60 | 77.94 | 11.83 | 114.31 |
| Valuation Status | U | O | O | U | O | O | O | O | U | O | O | O | O |

Source: Computed from NSE Daily Official Lists and CBN Statistical Bullettin

Table 5: Actual and CAPM Rates of Return of CONOIL

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beta | 2.05 | 2.16 | .49 | 2.64 | 1.09 | 1.05 | -.33 | .10 | 1.42 | .18 | 3.56 | .20 | .99 |
| CAPM Return | 65.12 | 67.66 | 13.09 | 112.17 | 17.39 | 3.91 | 1.44 | 11.44 | -86.57 | -3.49 | 51.30 | 3.75 | 30.40 |
| Actual Return | 31.12 | 11.94 | -60.39 | 208.53 | 21.30 | -26.66 | 42.21 | -65.84 | 16.89 | -107.35 | 171.64 | -5.93 | -176.13 |
| CAPM-Actual | 34 | 55.72 | 73.48 | -96.36 | -3.91 | 30.57 | -40.77 | 77.28 | -103.46 | 103.86 | -120.34 | 9.68 | 206.53 |
| Valuation Status | O | O | O | U | U | O | U | O | U | O | U | O | O |

Source: Computed from NSE Daily Official Lists and CBN Statistical Bullettin

Table 6: Actual and CAPM Rates of Return of Eternal Oil and Gas

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beta | .64 | .46 | -.80 | 4.29 | -1.20 | -.12 | .94 | 4.88 | 1.77 | .29 | 1.19 | 2.07 | -.11 |
| CAPM Return | 28.58 | 24.60 | 28.33 | 172.89 | 10.71 | 7.35 | 30.08 | 232.42 | -109.93 | -7.93 | 19.71 | -52.44 | 11.78 |
| Actual Return | -14.30 | 46.84 | -63.86 | 119.21 | 3.21 | 30.49 | -5.47 | 190.14 | 64.52 | -154.20 | -19.19 | -42.25 | -60.50 |
| CAPM-Actual | 42.88 | -22.24 | 92.19 | 53.68 | 7.50 | -23.14 | 35.55 | 42.28 | -174.45 | 146.27 | 38.90 | -10.19 | 72.28 |
| Valuation Status | O | U | O | O | O | U | O | O | U | O | O | U | O |

Source: Computed from NSE Daily Official Lists and CBN Statistical Bullettin

Table 7: Actual and CAPM Rates of Return of Forte Oil

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beta | 1.14 | 0 | 0.54 | 1.42 | -0.22 | 0.16 | 0.19 | 0.54 | 1.11 | 1.15 | 0.01 | -0.18 | 0.54 |
| CAPM Return | 41.54 | 12.95 | 12.50 | 67.28 | 13.57 | 6.53 | 13.16 | 31.78 | -65.88 | -42.70 | 3.98 | 15.05 | 22.78 |
| Actual Return | 22.93 | 0 | -54.34 | 143.12 | 44.37 | -59.99 | 18.81 | 136.77 | 63.96 | -198.65 | -43.52 | -44.13 | -52.87 |
| CAPM-Actual | 18.61 | 12.95 | 66.84 | -75.84 | -30.80 | 66.52 | -5.65 | -104.99 | -129.84 | 155.95 | 47.50 | 59.18 | 75.65 |
| Valuation Status | 0 | 0 | 0 | U | U | 0 | U | U | U | 0 | 0 | 0 | 0 |

Source: Computed from NSE Daily Official Lists and CBN Statistical Bullettin

Table 8: Actual and CAPM Rates of Return of Mobil Oil

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beta | 0.39 | 0.54 | 0.15 | 1.32 | 0.90 | 0.55 | 0.44 | -0.03 | 0.02 | 0.73 | -0.50 | -0.21 | -0.29 |
| CAPM Return | 22.10 | 26.63 | 17.11 | 63.60 | 16.84 | 5.38 | 18.80 | 5.43 | 6.87 | -25.72 | -2.82 | 15.94 | 8.73 |
| Actual Return | 26.52 | 9.77 | -4.28 | 75.17 | 33.16 | -10.79 | 14.80 | -1.75 | 65.84 | -118.74 | -34.60 | -73.69 | -18.06 |
| CAPM-Actual | -4.42 | 16.86 | 21.39 | -11.57 | -16.32 | 16.17 | 4.00 | 7.18 | -58.97 | 93.02 | 31.79 | 89.63 | 26.79 |
| Valuation Status | U | 0 | 0 | U | U | 0 | 0 | 0 | U | 0 | 0 | 0 | 0 |

Source: Computed from NSE Daily Official Lists and CBN Statistical Bullettin

Table 9: Actual and CAPM Rates of Return of Oando

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beta | 1.81 | 0.33 | -0.25 | 2.35 | 0.47 | 1.10 | 0.76 | 0.58 | 2.44 | 0.63 | 2.14 | 1.51 | 0.35 |
| CAPM Return | 58.90 | 21.31 | 21.83 | 101.50 | 15.58 | 3.77 | 26.02 | 33.63 | -154.65 | -21.68 | 32.38 | -35.19 | 19.57 |
| Actual Return | 44.59 | 66.79 | 0.99 | 43.15 | 33.01 | -13.86 | -32.55 | 49.26 | -40.91 | 24.79 | -35.72 | -99.41 | -60.46 |
| CAPM-Actual | 14.31 | -45.48 | 20.84 | 58.35 | -17.43 | 17.63 | 58.57 | -15.63 | -113.74 | -46.47 | 68.10 | 64.22 | 80.03 |
| Valuation Status | 0 | U | 0 | 0 | U | 0 | 0 | U | U | U | 0 | 0 | 0 |

Source: Computed from NSE Daily Official Lists and CBN Statistical Bullettin

Table 10: Actual and CAPM Rates of Return of Total

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beta | 1.56 | 0.55 | 0.21 | 1.39 | 0.96 | 0.81 | 0.13 | -0.12 | 0.73 | 0.62 | 0.15 | -0.21 | 0.77 |
| CAPM Return | 52.42 | 26.88 | 16.40 | 66.17 | 17.01 | 4.62 | 11.81 | 1.27 | -40.52 | -21.28 | 5.85 | 15.94 | 26.68 |
| Actual Return | 61.72 | 12.79 | 1.09 | 96.51 | 11.07 | -1.08 | 3.39 | -8.52 | 20.57 | -35.98 | 45.11 | -17.56 | -46.62 |
| CAPM-Actual | -9.30 | 14.09 | 15.31 | -30.34 | 5.94 | 5.70 | 8.42 | 9.79 | -61.09 | 14.70 | -39.26 | 33.50 | 73.30 |
| Valuation Status | U | 0 | 0 | U | 0 | 0 | 0 | 0 | U | 0 | U | 0 | 0 |

Source: Computed from NSE Daily Official Lists and CBN Statistical Bullettin

### 4.2 Discussions

In this study we identify the number and percentage of appropriately valued stocks, the undervalued and over-valued stocks by CAPM. Based on this perception, table 11 below shows the number of stocks under each classification with respect to petroleum marketing sector of the Nigerian Stock Exchange. On the average, 25.23 percent and 74.77 percent of the stocks were undervalued and overvalued respectively in the petroleum marketing sector. In Nigeria, due to public awareness carried out mostly by banks which were compelled to source for funds in the market to shore up their tier 1 capital to N25billion regulatory minimum, activities in the capital market increased from 2004. It got to the peak in 2007 and abruptly ended in the first quarter of 2008. Recessive periods were witnessed in the capital market in Nigeria from end of first quarter of 2008 to first quarter of 2012. In those periods there was more overvaluation in this sector as can be seen from table 11. Therefore it could be claimed that CAPM mostly overvalue stock returns in recessive period.

Table 11: Valuation status of Petroleum marketing stocks

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Total | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 9 | 9 | 9 | 107 | 100 |
| Undervalued | 3 | 2 | 0 | 5 | 5 | 1 | 2 | 3 | 8 | 1 | 2 | 1 | 0 | 27 | 25.23 |
| Normal value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Overvalued | 5 | 6 | 8 | 3 | 3 | 7 | 6 | 5 | 0 | 7 | 7 | 8 | 9 | 74 | 74.77 |

Source: Compiled from tables 2-10 above

### 4.3 Test of the Hypothesis

The objective of the study is to find out whether the subject-firms' actual stock returns were correctly estimated by CAPM in an emerging stock market, Nigeria. To achieve this singular objective of the study, table 11 above was drawn. From the table, there was not, a single correctly valued stock in years 2000-2012. Therefore, the application of the Capital Asset Pricing Model (CAPM) to Nigeria petroleum marketing sector data shows that the stocks returns were either undervalued or overvalued by CAPM. Hence the model did not guide the estimation of equity securities returns in the petroleum marketing sector of the Nigerian Stock Exchange from 2000-2012.

## 5. Conclusions and Recommendations

Based on the findings of the research, a number of conclusions could be made as follows. That Stock prices deviate from their fundamental values as a result of the buy and sell positions of uninformed investors (noise trading) and the informed investors were willing to capitalize on the discrepancy. In effect, stock price changes act as though they were independent random drawings from an infinite pool of possible prices. The only memory stock price has is the 5% margin of price increase or decrease on each day trading. This is in line with the empirical evidence from research by Fama (1965) which posit the independence of future stock price movements from past trends in stock prices.

From table 12 above it is obvious that the Capital Asset Pricing Model (CAPM) as enunciated by Sharpe (1964) did not give any appropriate forecast of the returns from the petroleum marketing sector stocks throughout the thirteen-year period of study. The CAPM made twenty-eight under-valuations and eighty overvaluations to make a total of one hundred and eight misappropriations in the thirteen years period of study in the petroleum marketing sector. That is, one hundred percent failure to deliver accurate forecast of the stock returns. Hence it is obvious that the Capital Asset Pricing Model (CAPM) did not guide share price movement in the Nigeria petroleum marketing sector stocks unarguably for the period 2000 - 2012. Therefore, the Capital Asset Pricing Model (CAPM) as enunciated by Sharpe (1964) is not a good predictor of stock return in the petroleum marketing sector of the Nigerian Stock Exchange.

In order to entrench sanity in the pricing of ordinary shares in the Nigerian Stock Exchange market, we hereby recommend that a model that will recognize to a large extent the movement of stocks prices in tandem with the general market mood be adopted in the Nigerian Stock Exchange market to guide investors' estimation of equity securities returns. In this direction, we suggest compilation of the annual predictive equations for each of the sectors of the exchange by the regulatory authorities. This annual predictive equation could be used to ascertain the appropriate price-earning multiplier, from which the appropriate market price of each stock in each sector could be determined. There appears to be some inadequacies in the Nigerian capital market, especially the absence of market makers. The Nigerian Stock Exchange should go ahead to license a sizeable number of them. Their existence in the exchange market will help to a large extent to make the market prices to respect the fundamentals of the companies concerned. It is hereby suggested that the regulatory authorities in the stock market should maintain zero tolerance stand on the manipulation of share prices by some privileged investors.

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