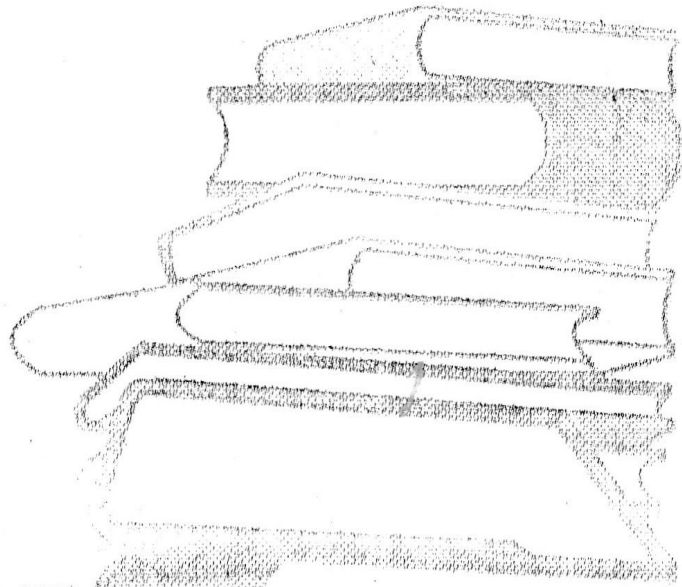


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**PORTFOLIO SELECTION MODELS IN THE
NIGERIAN CAPITAL MARKET:
Lessons for the Emerging Markets**

by

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ABSTRACT

Investors are always conscious of their investment decision as they continually target rewarding investments. Portfolio selection plays an important role in meeting this target. Traditionally, the Sharpe's Capital Asset Pricing Model and Markowitz Portfolio Model have dominated the scene of portfolio selection, their drawbacks notwithstanding. This paper capitalized on the strengths of these models and developed an empirical model that establishes a minimum rate of return of any security, which determines the 'entrance' or 'exit' of a security in the portfolio upon which a rewarding (efficient) portfolio is formed and resource efficiently and proportionately allocated to the selected securities. Apart from risk averse investors dominating the market, inconsistency in the risk-return rule was evident. Therefore a more comprehensive or composite approach of both quantitative and qualitative approaches is recommended, among others.

1. INTRODUCTION

Investment is one of the means of accommodating the vagaries and uncertainties of life. Hence it is said

to be the profitable postponement of immediate consumption. In other words, investment ensures better living in the future. However, this is only attainable if and only if proper identification, analysis and selection of alternative investment opportunities are carried out. It is not the case of rule of thumb but a conscientious effort to select the best among alternative options.

Essentially, investment may be in intangible (financial) or tangible (real) assets. In either asset, the analytical approach to the choice of the most profitable asset differs. Even within investment in financial asset, which forms part of this paper, the analytical approach differs. Basically, two ways are outstanding in approaching investment decision in financial assets. These are

- i) Analyzing and selecting individual securities
- ii) Analyzing and selecting components of securities (Portfolios).

The choice of any of the two approaches depends on the perception, knowledge and income of the analyst/ investor, among other things. But the point to note is that in either approach, investments are selected based on acceptable criteria. Thus, both guarantees focus for the investor on the best yielding securities to invest. This notwithstanding, the best second approach, portfolio analysis and selection, is preferred for the purposes of this paper.

Portfolio analysis prepares good ground for portfolio selection, as it tries to determine the expected return and risk associated with individual securities that make up the portfolio. Thus, portfolio selection commences when proper analysis has been concluded. Portfolio analysis helps in identifying active portfolios from which the most preferred portfolios are selected.

Effort is made in this paper to adopt an empirical approach by using stocks quoted in the Nigerian Stock Exchange to demonstrate the portfolio selection theory. It must be noted and very importantly too that portfolio selection starts with analysis of individual securities using appropriate return risk models.

2.0 Theoretical Framework

Portfolio selection is second to the last stage in investment decision in financial assets. It is based on the Markowitz Portfolio Model which is

built on the following assumptions (Sarkis, 1983)

1. Investors focus on the expected rate of return and on the variance of a security.
2. Investors prefer more returns and less risk.
3. Investors wish to hold efficient portfolios: Those yielding maximum expected return for a given level of risk or minimum risk for a given level of expected return.
4. Investors agree on the probability distribution of rates of return on securities.

The model has its weaknesses especially in providing a definite framework for determining the values of individual assets or portfolios. Consequently, Sharpe (1964) developed a testable model called Capital Asset Pricing Model (CAPM). This model is used for determining the prices of financial assets (securities) and is based on a number of assumptions as follows:

1. There are many investors, each with an endowment (wealth) that is small compared to the total endowment of all investors. Investors are price-takers, in that they act as though security prices are unaffected by their own trades.
2. All investors plan for one identical holding period.

3. Investments are limited to a universe of publicly traded financial assets, such as stocks and bonds, and to risk-free borrowing or lending arrangements.
4. Investors pay no taxes on returns and no transaction cost (commission and service charges) on trades in securities.
5. All investors are rational mean-variance optimizers. That is investors are risk-average individuals who maximize the expected ability of their end-of-period wealth.
6. All investors analyses securities in the same way and share the same economic view of world (Bodie et al, 1989)

These models have there inherent drawbacks especially when applying them in real life situation. According to Copeland et al (1988) in Asiogbu et al (1999) "virtually everyone of the assumptions under which the capital asset pricing theory is derived is violated in the real world". These pitfalls notwithstanding, the models have been a sustained and good guiding tool in portfolio analysis and selection in our generation. The models can assist an investor/analyst to assess and select individual portfolio, market portfolio and the most profitable

portfolio (optimum portfolio) within the market portfolio.

Essentially, the inclusion of a stock in the optimal portfolio is always related to its excess return to Beta ratio. According to Elton and Gruber (1987) excess return is the difference between the expected return on the stock and the riskless rate of interest such as the rate on a treasury bill or CBN Certificates. The excess return to Beta ratio measures the additional return on a security (beyond that offered by a riskless asset) per unit of nondiversifiable risk (the risk we cannot avoid). This is mathematically expressed as.

$$(1) \dots\dots\dots R_i - R_f \dots\dots\dots \frac{R_i - R_f}{B_i}$$

- Where R_i = expected return on stock :
- R_f = return on a riskless asset
- B_i = the expected change in the rate of return on stock I associated with a 1% change in the market return.

But expected return on stock i or a portfolio according to CAMP model is determined by three variables: the risk-free return, the market return and the market sensitivity of the asset (Okereke, 1997). This is expressed as.

$$(2) \dots\dots E(R_i) = R_f + B_i [E(R_m) - R_f]$$

Where

R_f = Rate of return on risk free asset (eg TB, CBN Certificate, etc) for the portfolio.

B_i = Beta coefficient of the asset for the portfolio

$E(R_m)$ = Expected return on the market portfolio

$E(R_m) - R_f$ = Excess expected return on the market.

$E(R_i)$ = The expected return on the security i.e. stock.

Beta coefficient (B_i) measures the risk of an asset or portfolio relative to the risk of the market portfolio. It is represented thus

$$(3) B_i = \frac{Cov(R_i, R_m)}{Var(R_m)} \text{ or } \frac{Cov(R_i, R_m)}{\sigma_m^2}$$

The equation 2 above can be used to derive expected return $E(R)$ for the portfolio $E(R_p)$. Thus

$$(4) \dots E(R_p) = R_f + B_m [E(R_m) - R_f]$$

Where B_m = Beta coefficient for the market portfolio, which can be represented as

$$(5) \dots B_m = \frac{Cov(R_m)}{Var(R_m)}$$

From equation 3, covariance of return on stock i and market portfolio in $(cov(R_i, R_m))$ is mathematically represented as

$$(6) \dots Cov(R_i, R_m) = \frac{(R_{it} - \bar{R}_i)(R_{mt} - \bar{R}_m)}{n - 1}$$

Where R_{it} is return on stock i for year t .

\bar{R}_i is the average return on stock i i.e R_{it}/n

R_{mt} = the market return at year t .

\bar{R}_m = average market return i.e R_{mt}/n .

R_{it} , R_i , \bar{R}_m , R_m can be symbolically expressed as follows

$$(7i) \dots R_{it} = \frac{D_t + P_t - P_0}{P_0}$$

Where

R_{it} = the rate of return for stock i at time t

D_t = Dividend yield at time t

P_t = Current market price of stock

P_0 = Beginning market price of stock or previous market price

$$\frac{P_t - P_0}{P_0} = \text{Capital gain}$$

OR

$$(7ii) \dots R_{it} = \frac{Y_t - P_t}{P_t}$$

Where Y_t = Naira value of the stock i.e Net price + Dividend (Income from the stock)

P_t = Current market price of the stock.

$$(7iii) \dots Y_t - P_t$$

$$(8) \dots R_i = \frac{\sum R_{it}}{N}$$

Where N = number of years

The above can be rewritten as:

$$(9) \dots R_{mt} = \frac{R_t - P_{t-1} + D_t}{P_{t-1}} = \frac{P_t - P_{t-1} + D_t}{P_{t-1}}$$

Where P_t = the closing market prices of Nigerian Stock Exchange (NSE) all shares index at the end of year t.

P_{t-1} = the same price relative at the end of year t.

(That is, the market price for the previous year).

D_t/P_{t-1} = the current dividend-to-price ratio for year t-1

D_t = Annualized dividend for securities traded in the stock exchange.

OR

$$(9ii) \dots R_m = \frac{Y_m - P_m}{P_m} = Y_m - 1$$

Where Y_m = Naira value of the market portfolio including dividends

P_m = Current price of market portfolio.

$$(10) \dots R_m = \frac{R_{mt}}{N}$$

Where N = number of years.

Recall equation 3, variance of market return (Var(R_m) or Q^2_m) can be expressed thus.

$$(11) \dots Q^2_m = (R_{mt} - \bar{R}_m)^2 / n$$

or

$$(12) \dots Q^2_m = \text{Var}(y_m)$$

The excess return to beta ratio per market portfolio is expressed as

$$(13) \dots R_m - R_f / B_m$$

The risk associated with a security or market portfolio can be determined by its standard deviation. This is mathematically represented as:

$$(14) \dots \sigma = \sqrt{\sum_{t=1}^n (R_{it} - \bar{R}_{it})^2}$$

$$(15) \dots \text{and variance, } \sigma^2 = \sum_{t=1}^n (R_{it} - \bar{R}_{it})^2$$

where R_{it} = expected return for security i at time t

\bar{R}_{it} = Average expected return

n = number of years.

Standard Deviation (σ_m) for market portfolio is represented mathematically as

$$(16) \dots \sigma_m = \sqrt{\sum (R_{mt} - \bar{R}_m)^2}$$

$$(17) \dots \text{and variance } \sigma^2_m = 1/n \sum (R_{mt} - \bar{R}_m)^2$$

Where R_{mt} = expected market return

\bar{R}_m = Average market return

Covariance of a single security return and market return is respectively represented as

$$(18) \dots \text{Cov}(R_{it}) = \frac{\sigma_{it}}{R_{it}}$$

$$(19) \dots \text{Cov}(R_m) = \frac{\sigma_{im}}{R_m}$$

Where σ , σ_m , R_t and R_m as defined above.

From the above mathematical expressions, we can deduce that a stock is selected among securities in the portfolio if the excess return to Beta ratio of a security is greater than the excess return to Beta ratio of the market portfolio. Thus, a security in a portfolio is selected when

$$(20) \dots \frac{R_i - R_f}{B_i} > \frac{R_m - R_f}{B_m}$$

Where R_f = risk free rate (CBN Certificates is applied). The beta ratio of the market portfolio,

$$\frac{R_m - R_f}{B_m} \text{ becomes}$$

the minimum rate of return for any security to be selected and included in the portfolio. It is the rate that determines the 'entrance' or 'exit' of a security in a portfolio. It is the rate that cuts off any security from being selected among the portfolio of securities. Thus, any security in the portfolio that satisfies equation (20) above is selected and included among Rewarding (Efficient) Portfolio. Otherwise exclude.

Having determined the rewarding (efficient) portfolio, it is important to determine how much of the available resources that must be invested in each security in the portfolio. This is the percentage invested in each security and it is mathematically expressed by Elton and Gruber (1987) as

$$(21) \dots X_i = \frac{Z_i}{\sum_{i=1}^N Z_i}$$

$$(22) \dots \text{where } Z_i = \frac{B_i}{Qei^2} (R_i - R_f - C^*)$$

Where Qei^2 = Variance = σ^2
 C^* = Cut-off rate = $\frac{R_m - R_f}{B_m}$

3. Methodology

The data used in this paper were mainly secondary data. This is because of the nature of the study and in an effort to achieve the objective of the paper. Essentially data were collected from:

- i) Nigerian Stock Exchange Fact Book (1997 and 2000)
- ii) Journals relevant to the study
- iii) CBN annual report.
- iv) Seminar/Research papers on financial markets.
- v) Business Times.

The analysis and selection of securities for this paper is strictly based on securities listed on the Nigerian Stock Exchange. According to NSE (2000) there are 268 securities listed on the Exchange made up of 15 Government Stocks, 58 industrial Loan (Debenture/Preference) Stock and 195 Equity/Ordinary shares of companies as at 1999.

Our portfolio selection is from 195 Equity/Ordinary shares of companies quoted in the Nigerian Stock Exchange (NSE). These companies cut across the various

sectors of the economy. A random sampling of non-profitable technique was adopted. This involved the selection of samples that are convenient and most accessible to the researcher especially in getting relevant information/data. The companies are selected from both first tier securities market and second tier securities market. In all, the researcher randomly selected five (5) public quoted companies as follows:

1. First Bank of Nigeria PLC (FB)
2. Nigeria Breweries PLC (NB)
3. Mobil PLC (M)
4. Lever Brothers Nigeria PLC (LB)
5. Rokana Industries PLC (RI)

These companies are representative of the various sectors of the economy.

The analysis of these securities and subsequent selection is based on theoretical framework of 2.0 above and the mathematical expressions shown in equations 1 to 22. These equations are used in determining excess return to Beta ratio of both individual securities and market portfolio upon which selection is made as well as the percentage of available funds to be invested in each security determined.

4.0 Computation of Securities Decision variables in the Portfolio

The major decision variables are computed as shown below.

4.1 Calculation of expected return and average return of

individual securities. This adopted equations 7(i) and 8 respectively. Determination of standard deviation (σ) variance (σ^2), Covariance (cov) and beta (b_m). These are calculated using equations 9, 16, 17, 19 and 5 respectively

TABLE 1: SUMMARY OF THE RESULTS OF THE CALCULATIONS

Decision Variables	Portfolio				
	FB	NB	M	LB	RI
Return (R_{it})	1995 -3.98	-6668	0.36	0.67	0
	1996 2.64	6667	1.41	-4.57	0
	1997 3.67	266.72	4.46	-2.46	0
	1998 41.0	25.89	14.18	-4.016	0
	1999 0.8945	-3.04	6.398	-7.79	0
Av. Return (R_{it})	3.44	-52.11	5.3	-3.64	0
Variance (σ^2)	34.75	17.7	24.04	7.596	0
Std. Dev. (σ)	5.89	969.25	4.90	2.76	0
Covariance (Cov)	1.71	4218.4	0.914	-0.76	0
Beta (b_i)	0.045	000001	0.18	-0.0998	0

TABLE 2: MARKET VALUES

	R_m	R_m	σ_m^2	$\bar{\sigma}_m$	Cov	b_m
95	1.05					
96	1.81					
97	3.57					
98	-4.53					
99	-8.27					
		-1.2	19.47	4.41	-3.675	-0.189

4.3 Calculating the excess return to beta ratio for individual securities and market portfolio using equations 1 and 13 respectively.

TABLE 3: EXCESS RETURN TO BETA RATIO FOR SECURITIES (SINGLE AND PORTFOLIO)

S/N	Security	$\frac{R_{it}-R_f}{b_i}$	$\frac{R_m-R_f}{b_m}$
1.	First Bank	66.53	
2.	Nigeria Breweries	11,540,000.00	

For instance, Lever Brothers PLC that is the least risky security (2.7%) is allocated 58.62% of the investment while Nigerian Breweries that is most risky (4218.14%) is allocated almost nothing (.0042%). Evidently, these findings imply that the Nigerian Capital Market is dominated by risk averse investors, who are willing to invest (allocate) greater share of their resources to less risky securities. This may be the same result in most emerging markets.

6.0 Recommendations

In order to ensure a dependable, medium and long-term consolidation perceptible of the capital market, the following recommendations are proffered.

Investors should adopt appropriate model in selecting their portfolio. The use of rule of thumb is not acceptable. In addition, effort should be made by the investing public and/or analyst to have an on the spot information concerning the activities of the company. This is to confirm what is reported in the paper, upon which decisions were reached. Furthermore, investors or her agents should not only use risk component in an investment in the selection of such security. Others determinants like efficiency in resources utilization, economic cycle, etc should be considered simultaneously. This calls for a more comprehensive or composite approach, which involves both quantitative and qualitative approaches to portfolio selection.

Government should streamline their policies to enhance the stability of the economy. This will ensure enabling business environment upon which prediction, projections and investment decision can be taken with little or no margin of error.

There must be constant check on the components of the portfolio in order to allow 'entrance' and 'exit' of securities in the portfolio. This will assist the investor in adding and dropping securities in the portfolio in order to maximize return while reducing risk.

7.0 Conclusion

Portfolio selection in the Nigerian Capital Market requires some rigorous computations in order to construct an optimum portfolio. Effort has been made in this paper to apply a number of models in determining the security among sample securities to be included in the portfolio. This sample portfolio selection is a guide to investment analyst and/or investors in constructing an optimum portfolio given any number of securities. A vibrant Nigerian capital market and other emerging markets is guaranteed more especially when the recommendations proffered above are considered with all the seriousness it deserves.

3. Mobil	136.30	
4. Lever Brothers	38.20	
5. Rokana	00.00	
Portfolio		7.26
Excess Return to beta ratio for market portfolio		

$$\frac{R_m - R_f}{b_m} = \underline{7.26}$$

A security is included in the portfolio if that security satisfies the following equation.

$$\frac{R_i - R_f}{b_i} > \frac{R_m - R_f}{b_m}$$

From the calculation, securities 1 to 4 i.e First Bank PLC, Nigerian Breweries, Mobil and Lever Brothers should form the rewarding (optimum) portfolio, as they satisfy the equation. Rokana Industries PLC should not be incorporated in the portfolio and therefore eliminated from the model.

It is important to determine how much of the available resources should be invested in each security. They are shown in 4.4 below.

4.4 Calculation of percentage of Investment in each security.

Equations 21 and 22 are applied.

TABLE 4: PROPORTION TO BE INVESTED IN EACH SECURITY

Portfolio	Z_i	Percentage Invested (%) (x_i)
1. First Bank	0.803	11.97
2. Nig. Breweries	0.0000029	.00042
3. Mobil	0.20397	29.41
4. Lever Brothers	0.4065	58.62
ΣZ_i	0.6935	

5.0 Interpretation

It will be observed from the annual returns and average returns that there is a general drop in 1999 in all the securities. The returns and risk associated with the securities is not in line with the risk-return rule, which states that, the higher the risk, the higher the return. For instance, one would expect First Bank PLC that is riskier ($\rho = 5.8\%$) than Mobil PLC to have a higher average return. Instead Mobil that is less risky ($\rho = 4.90\%$) has a higher return of 536%. However, Nigeria Breweries PLC satisfied the risk-return-rule. The inconsistency in the return behaviour may be attributed to the fluctuations in the economic policies and indices. It makes predictions, projections and investment decisions very difficult.

The excess return to beta ratio for the securities selected when compared with the average return of the individual securities established a trend. The ratio increases with increase in average return. But when compared with standard deviation the trend is not consistent. For instance, First Bank PLC has a standard deviation of 5.89% and a ratio of 66.53 and Mobil PLC has a standard deviation of 4.9% and a ratio of 136.3.

From table 4, we observe that the proportion to be invested in each security is governed by the level of risk associated with a security. The lower the risk the higher the percentage allocated to that security.

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