Markowitz and Naive Diversification Strategies: The Nigerian Experience

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Abstract
This study investigates the performance of Markowitz and Naive diversification strategies in the Nigeria stock market. Thus, it examines the portfolio construction strategy that will generate superior performance regarding risk reduction and return maximization. These strategies were used to select 28 securities from the 159 equity stocks listed on the Nigerian stock exchange for 6 years using monthly data from January 2011 to December 2016 which is equivalent to 72 periods. Using the Welch's t-test to test the mean performance of Markowitz and Naïve diversification strategy, the null hypothesis was accepted. Thus, the study found out that there is no significant difference between the mean returns of Markowitz and Naïve diversification strategy using stocks quoted on the Nigerian stock market. The implication of this result is that the two techniques are capable of minimizing risk thereby maximizing expected return. However, the study recommended the adoption of these strategies since they are applicable to the Nigeria stock market.

Keywords: *Markowitz diversification; Naive diversification; Risk; Return; Optimal portfolio*

1.0 Introduction

One of the major reasons for investing in securities is to earn a return that will compensate for the forgone consumption. Thus, we invest to earn a return in the future. Investment decision is very difficult to make because of the repugnant nature of man towards risk. There are several factors that tend to impede our investment decisions. For instance, in an emerging capital market like that of Nigeria, factors such as inadequate managerial skills, time, ignorance of diversification strategy etc, have limited investors to prefer low risks investment which ends up yielding minimal returns. This would have been different if investors or potential investors are aware that combination of securities could enhance the return on investment thereby minimizing the associated risk. Thus, instead of investing in single security, investors would benefit more if assets were combined to form portfolios. The act of combining these securities into a portfolio is what we refer to as diversification.

Diversification is the act of selecting and combining securities into a portfolio for the purpose of maximizing returns and minimizing risk. It is akin to "not putting all your eggs in one basket". An investor can diversify using either the Markowitz diversification strategy or the Naive diversification strategy. Markowitz diversification involves the combining of assets that are less than perfectly positively correlated in order to reduce risk without sacrificing any of the portfolio returns. This is a sophisticated method of diversification because it considers risk, return and covariance of the selected assets. The Markowitz technique is a mean-variance strategy, thus, the benefits of portfolio diversification depends on the correlation between returns on securities. On the other hand, the naive strategy whereby equal weights are assigned

to all (N) assets is called 1/n rule. It is a naive strategy in the sense that it involves combining of assets into a portfolio without an analysis of the risk, returns and covariance between assets. Instead, equal weights are assigned to the security components of the portfolio. That is equal amount are invested in these securities.

The expectation of return for a given level of risk is what determined investors choice of investment. This risk could be divided into systematic and unsystematic risk. Systematic risk affects the entire market while unsystematic risk is firm or industry specific. Unsystematic risk can be eliminated through diversification using Markowitz or the naive technique.
Proponents of portfolio theory generally refer to the 1/N rule as naïve diversification or Talmud, where N is the number of assets in the portfolio. They note that this technique may be suboptimal because it does not consider the covariance and thus may inadvertently lead an investor to increase the risk of their portfolio beyond their tolerable limit. Reckoning with the fact that Markowitz diversification strategy is a sophisticated strategy, one expects it to outperform the 1/n rule which is a naïve strategy if subjected to empirical analysis.
Most of the studies conducted on portfolio diversification were done in developed or emerging capital markets in Europe, America and Asia. There is hardly any study conducted using the Nigerian data to verify its applicability on the Nigeria stock market except for Nwakanma and Gbanador (2014). Hence, this creates the need to examine few stocks quoted on the Nigerian Stock Exchange to verify if the result will be consistent with theory or results from other capital markets.

The major aim of this study is to empirically compare the performance of the Markowitz and Naive diversification strategies in the Nigeria stock market. Thus, the study will ascertain the portfolio construction strategy that generates superior performance regarding risk reduction and return maximization. It will also examine if diversification is capable of enhancing the performance of portfolio of assets constructed using securities from the Nigeria stock market.

2.0 Literature Review

Reckoning with Markowitz (1952), the relevant characteristics of a security for portfolio formulation are the security's return, risk and covariance with other securities. He argued that investors prefer returns and hate risks. Thus, he suggested that the assets to be included in a portfolio should most preferably have returns which covary negatively with each other. Since such assets are usually difficult to find, the next preferred option are assets with low positive covariance or correlation coefficients of returns.

According to Ellis (1971), in a pioneering study, Markowitz showed that a portfolio was quite different from the sum of its parts. In particular, a portfolio constructed from two stocks could be superior to either. He argued that portfolio performance should be measured in terms of both rate of return and the variance in the rate of return. Hence, if both stocks are held in a portfolio their year-to-year fluctuation will be less than their separate fluctuation. A portfolio that comprised of these two stocks would have less variance than either stock alone and yet have an equally high long run return.

An asset allocation strategy as simple as the rule to divide the available capital evenly among some (or even all) investment opportunities falls short of the sophistication of modern portfolio theory, which in broad terms states that a portfolio should strike an optimal balance between prospective return of an investment and the possible risks of investing. The optimal decision depends on the risk preferences of the investor (Pflug, Pichler & Wozabal, 2012). However, Jobson and Korkie (1981) is of the view that naïve 1/N diversification can outperform the

Markowitz rule out-of-sample, due to the inability to reliably predict the portfolio's mean and correlation structure; failure of Markowitz's second condition.

As in Chow et al (1999), Markowitz introduced an efficient process for selecting portfolios. His landmark innovation, mean-variance optimization, requires financial analysts to estimate expected returns, standard deviations and correlations. In that, Markowitz show how analysts could use this information to combine assets optimally so that, for a particular level of expected return, the resulting portfolio would offer the lowest possible level of expected risk, usually measured as the standard deviation or variance.

In spite of the fact that the 1/N rule is referred to as a naïve strategy, Demiguel, Garlappi and Uppal (2009), among others show that it can perform remarkably well under certain conditions. Indeed, when the asset returns have equal means and variances and when they are independent, 1/N is the best one with suitable risk aversion adjustment. Chan, Karceski and Lakonishok (1999) in a similar study, posit that it is hard to find an investment policy that consistently outperforms the uniform investment strategy.

However, Abankwa, Clark & Dickson (2013) differ from the suggestions of naïve investment proponents as they assert that Markowitz optimization strategies of all types add significant value under varying market conditions in all but the smallest size portfolio.
Al-Qudah, Al-Khouri and Ahmed (2004) investigated the effects of diversification on the portfolio riskiness in Amman Stock Exchange, and the methodology was based on the Markowitz model (1952). The results revealed the existence of a significant level of risk reduction. However, the t-test stated that the significant reduction benefits of diversification were virtually exhausted when a portfolio contains 10-15 stocks.

Nwakanma and Gbanador (2014) conducted a study to investigate Talmud and Markowitz diversification strategies using stocks listed on the Nigerian Stock Exchange. They examined the applicability of diversification to the Nigerian stock exchange regarding risk reduction and return maximization. The essence was to determine the strategy that will generate superior returns. The study employs quarterly closing prices of 17 assets drawn from the Nigeria stock market for 17 years, which is equivalent to 68 periods. The difference between independent sample means (t–test) was used to test the hypothesis and the result revealed that diversification is capable of diversifying a reasonable amount of risk but statistically, there is no significant difference between the performances of these strategies.

In a study conducted by Gupta and Khoon (2001), diversification benefits are available up to about 27 securities. The size of the well diversified portfolio for the borrowing investor is found to be 30 while that for the lending investor at 50 stocks. Similarly, Al Suqaier and Al Ziyud (2011) in their study implemented Markowitz model in determining the portfolio variance of randomly selected stocks, assuming equally weighted portfolio. The results obtained in this paper emphasized the role of diversification in Amman Stock Exchange (ASE), and advocated that investors can eliminate great part of risk by diversifying among different stock holding. They went further to explain that (15-16) stocks are required to capture most of the benefits associated with diversification. However, substantial benefits occur by diversifying across as few as (10) stocks. This result proved the hypothesis generated and assures the existence of a negative and significant relationship between the number of stocks in the portfolio and the portfolio risk also, the result verify the second hypothesis, which stated that the benefit from diversification increases at a decreasing rate.

Ahuja (2011) conducted a study to investigate if the theory of risk reduction through portfolio diversification is applicable to the Karachi Stock Exchange using mean variance model. He used daily closing prices of 15 randomly selected securities for the period of 2007 to 2009. The researcher concluded that portfolio diversification is applicable to Karachi stock exchange and that 10 securities can bring significant reduction in risk.

Tsui, Low and Kwok (1983) employed monthly data of 40 common stocks listed on the stock exchange of Singapore (SES) for the period of June 1973 to December 1981 to analyze the systematic risk. They found that 40 randomly selected securities in a portfolio give a well-diversified portfolio. Meanwhile, Zulkifli, Basarudin, Norzaidi and Siong, (2008), assert that 15 stocks are enough to diversify away a satisfied amount of diversifiable risk.
Kisika, Mbitha and Kitur (2015), conducted a study aimed at determining the optimal portfolio size for investors on the Nairobi securities Exchange in Kenya. Secondary data consisting of monthly security returns between January 2009 and December 2013 were used. The study adopted the mean-variance optimization model. They found out that portfolio risk reduced as the number of securities in the portfolio increased but beyond the optimal portfolio size the risk started rising again. The optimal portfolio size in NSE was found to lie between 18 and 22 securities.

3.0 Methodology

This study empirically compares the performance of the Markowitz and Naive diversification strategies in the Nigerian stock market. Thus, the study involves the construction of portfolio, using both Markowitz and Naive diversification strategy.
All the one hundred and fifty nine (159) stocks listed on the Nigerian stock exchange that were actively trading from 2011 to 2016 forms the population of this study. In selecting the stocks for the Markowitz portfolios, we calculated the return and risk of all the one hundred and fifty nine (159) stocks quoted on the Nigerian stock exchange after which we computed their coefficient of variations. We later rank the coefficient of variations from which the best twenty eight (28) stocks were selected. Reckoning with the 1/N rule formed portfolio, twenty eight (28) assets were selected randomly using the simple random sampling technique from the equity securities quoted on the Nigerian stock exchange.

As it could be observed, no researcher can be certain of the representative of a study population except the entire population is tested. However, the researcher was able to establish that the sample is a good representative of the population as regards this study. This is because the postulations of some commentaries such as Ahuja (2011), Al-Qudah et al (2004), Zulkifli et al (2008) and Al Suqaier and Al Ziyud (2011) were considered.
The data used for this study were secondary data. That is the monthly closed prices of securities quoted on the Nigerian stock exchange beginning from January 2011 to December 2016. It covers a period of five (6) years or sixty (72) periods.
The data analytical tools employed in this study are the mean, variance, standard deviation, coefficient of variation and covariance of return. The difference between mean as approximated by the student's t-distribution was used to determine and evaluate the hypothesis. The formula for the rate of return on individual assets is given as:

$$r_t = \frac{P_t - P_{t-1}}{P_{t-1}} \quad \ldots\ldots (1)$$

Where: P_t = Price of common share at a time t
P_{t-1} = Price of the share at time t-1

Another common measure of return to shareholders is the mean rate of return, which is otherwise known as the average rate of return. It is the arithmetic mean return within a specified time period and it is expressed as;

$$\overline{r_t} = \frac{\sum_{i-1}^{n} \mathrm{E}(r_t)}{\mathrm{N}} \quad \ldots\ldots (2)$$

Where $\overline{r_t}$ = Average rate of return

$E(r_t)$ = Expected return
N = the number of returns

The portfolio expected return is given as the summation of all expected rate of return of the individual assets multiplied by their weight. That is;

$$\mathrm{E(r_p)} = \mathrm{W_A r_A} + \mathrm{W_B r_B} + \cdots + \mathrm{W_N r_N} \quad \ldots\ldots (3)$$

Where E(rp) = Expected return on portfolio
W_N = Weight of nth asset
r_N = Return on nth asset
Using the 1/N or equal weight, the formula becomes;

$$\mathrm{E(r_p)} = \left(\tfrac{1}{\mathrm{N}}\right)_{\mathrm{A}} \mathrm{r_A} + 1/\mathrm{N_B r_B} + \cdots + \left(\tfrac{1}{\mathrm{N}}\right)_{\mathrm{N}} \mathrm{r_N} \quad \ldots\ldots (4)$$

Where 1/N = equal weight

The variance and standard deviation are commonly used to measure risk. The variance measures the degree by which the actual returns deviate from the expected returns while the standard deviation measures the dispersion of actual return from the expected return.
These can be expressed as;

$$Var = \sigma^2 = \sum_{t-1}^{n} (\mathrm{E}(r_t) - \overline{r_t})^2 \quad \ldots\ldots (5)$$

The standard deviation is the square root of the variable.

$$\sigma = \sqrt{\sum_{t-1}^{n} (\mathrm{E}(r_t) - \overline{r_t})^2} \quad \ldots\ldots (6)$$

Where σ^2 = Variance
σ = Standard deviation

All other variables are defined as in equations (2) above.
The standardize measure of risk of portfolio is the standard deviation of that portfolio which is given as;

$$\sigma_{\mathrm{p_2}} = \sqrt{\mathrm{W_A^2 \sigma_A^2 + W_B^2 \sigma_B^2 + 2W_A W_B \sigma_A \sigma_B \rho_{AB}}} \quad \ldots\ldots (7)$$

Where $\sigma_{\mathrm{p_2}}$ = Portfolio risk
W_A = Weight
σ_A^2 = Variance of security
ρ_{AB} = The correlation coefficient between the ith and j assets.
Note: the above formula is for a two (2) assets portfolio.
Using the 1/N or equal weight, the formula becomes;

$$\sigma_{\mathrm{p}} = \sqrt{(1/\mathrm{N})_{\mathrm{A}}^2 \sigma_{\mathrm{A}}^2 + (1/\mathrm{N})_{\mathrm{B}}^2 \sigma_{\mathrm{B}}^2 + 2(1/\mathrm{N})_{\mathrm{A}} (1/\mathrm{N})_{\mathrm{B}} \sigma_{\mathrm{A}} \sigma_{\mathrm{B}} \rho_{\mathrm{AB}}} \quad \ldots\ldots (8)$$

Where 1/N =equal weight
All other variables are defined as in equation (6)

3.5.4 Covariance of Return

The covariance between the returns of two securities A and B measures the degree to which the variability of the returns on the two securities tends to move together. It is denoted by;

$$\text{Cov}(r_A, r_B) = (r_A - \bar{r}_A)(r_B - \bar{r}_B) \quad \ldots\ldots(9)$$

Where $\text{Cov}(r_A, r_B)$ = Covariance of asset A and B

$(r_A - \bar{r}_A)$ = Variance of A

$(r_B - \bar{r}_B)$ = Variance of B

3.5.5 Difference between Mean

The sample size is less than 30 each and the sampling distribution of difference between means is approximated by the student's t-distribution. Thus, it is denoted by;

$$t = \frac{\bar{x}_1 + \bar{x}_2}{\sqrt{\frac{Sp^2}{n_1} + \frac{Sp^2}{n_2}}} \quad \ldots\ldots (10)$$

$$Sp^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2} \quad \ldots\ldots (11)$$

where;

$n_1 + n_2 - 2$ = degree of freedom

Sp^2 = the pooled variance

$\bar{x}$ = sample mean

n = number

s = standard deviation

4.0 Data Presentation and analysis

This section reckons with data presentation and analysis. The data used in this study were calculated using Microsoft Office Excel 2007 and Business Spreadsheets Portfolio Optimization Software. The data sets include; Securities and Portfolio risks and returns. However, the statistical tool used in the study was computed using SPSS version 21. The essence of using this software package is because of the volume of data that were used and the number of computation.

The various data are presented as follows:

Table 4.1: Return, risks and Coefficient of variance of the twenty seven (28) assets

Stocks selected using Markowitz strategy	Return	Risk	Coefficient of Variance	Stocks selected using Naïve strategy	Return	Risk	Coefficient of Variance
Sovereign Ins.	0.501	0.0048	104.3750	Sovereign Ins.	0.501	0.0048	104.3750
FTN	0.5023	0.013	38.6385	FTN	0.5023	0.013	38.6385
Skye Shelter	98.9829	2.5945	38.1511	P.S. Mand.	5.4393	0.2815	19.3326
Ellah Lakes	4.07	0.1167	34.8757	Lennards	3.1448	0.1857	16.9348
Nig. Energy	532.9577	15.6485	34.0581	Union Homes	46.7841	3.123	14.9805
Afromedia	0.5047	0.0191	26.4241	Afrinsure	0.5049	0.0421	11.9929
P.S. Mand.	5.4393	0.2815	19.3226	Berger Paint	8.7697	1.0818	8.1066
Lennards	3.1448	0.1857	16.9348	Unipress	4.113	0.6981	6.1335

Nig. Ropes	7.4037	0.4451	16.6338	Ekocorp	4.113	0.6981	5.8917
Union Homes	46.7841	3.123	14.9805	NPF MFB	1.039	0.1972	5.2688
Abbey Mort	1.3296	0.0899	14.7898	NB	132..2945	32.2317	4.1045
Alex	10.069	0.7218	13.9498	Zenith	17.3075	4.088	4.0251
Interlinked	4.4653	0.3371	13.2462	Neimeth	1.0789	0.2872	3.7566
Afrinsure	0.5049	0.0421	11.9929	Dangcem	160.5445	39.8855	3.7175
Royal Exc.	0.5279	0.0522	10.1130	Unilever	40.326	11.1669	3.6112
Studpress	2.4412	0.2666	9.1568	Capital Hotel	4.4096	2.1395	3.5618
Tourist Coy	3.8768	0.4385	8.8410	NCR	11.521	3.7425	3.0784
Prem. Paint	10.2152	1.1792	8.6628	Law Union	0.5755	0.1958	2.9392
Berger Paint	8.7697	1.0818	8.1066	Conoil	33.6432	11.8356	2.8425
Greif Nig.	11.8225	1.5292	7.7312	G. Cappa	12.203	4.9069	2.4869
Courtville	0.5358	0.0739	7.2503	Alumco	5.8712	2.7733	2.1170
Continsure	0.9832	0.1449	6.7854	Deap Cap.	1.2433	0.6474	1.9205
Nig. Aviation	4.5216	0.7372	6.1335	Beta Glass	21.8382	13.0065	1.6790
Niger Ins.	0.526	0.0877	5.9977	Skye Bank	3.633	2.1865	1.6616
Ekocorp	4.113	0.6981	5.8917	Cadbury	31.8821	19.2144	1.6593
UTC	0.5719	0.1006	5.6849	Johnholt	2.7349	2.4499	1.1163
Nig. Enamel	31.7277	5.7252	5.5418	Paint & Co	3.2926	10.8746	.3028
NPF MFB	1.039	0.1972	5.2688	Goldlink	3.8307	13.884	.2759

Source: Author's Computation

An independent sample t-test was conducted to evaluate the hypothesis that "there is no significant difference between the performance of Markowitz diversified portfolio and Naïve diversified portfolio". Using Welch's t-test, the mean of the performance of the Markowitz diversified portfolio (M= 17.8407, SD= 19.8712 was statistically significantly not different (t = 1.488, df = 54, two tailed p=.143) from the performance of Naive diversified (M = 9.8754, SD = 20.1733). Based on the decision rule, since the calculated value of 1.488 is not greater than tabulated value of 1.96, we accept the null hypothesis. By accepting the null hypothesis, it means that there is no significant difference between the performances of Markowitz diversified portfolio and Naive diversified portfolio. The implication of this result is that these two techniques are capable of minimizing risk thereby maximizing expected return.

The group statistics from this analysis gives the impression that Markowitz strategy performs better than the naïve technique. This is evident in the Markowitz mean of 17.8407 against the Naïve technique mean of 9.8754. With this result from the group statistic, Markowitz strategy generates a superior return compared to the naïve diversification technique.

On the other hand, visual inspection of their risk profile also creates the impression that Markowitz with a standard deviation of 19.8712 possesses lesser risk than the Naive strategy with a standard deviation of 20.1733 which is consistent with theory. Reckoning with the results obtained from the portfolios using the Markowitz and Naïve strategies, the returns are 6.35 and 0.59 while the risk are 7.17 and 5.21 respectively which depicts a coefficient of variance of 0.86 for Markowitz and 0.11 for Naive strategy. This also shows that Markowitz performs better than the Naïve technique. Meanwhile, after subjecting the two strategies to statistical test of difference between the independent sample mean, the result reveals no statistical difference between them. The result of this study validate an earlier study conducted by Nwakanma and Gbanador (2014) where it was reported that a statistically significant difference does not exist between the performance of Talmud and Markowitz diversification strategies.

5.0 Conclusion

The study concludes that, there is no significant difference between the performance of Markowitz and naive diversification strategies. Thus, it further shows that both Markowitz and Naïve diversification techniques are capable of maximizing returns on portfolio while at the same time minimizing risk inherent in the portfolios formed using stocks quoted on the Nigerian stock exchange. One striking observation gathered from this study is that despite the high risk associated with individual securities, their overall performance is very poor. The reason for this poor performance could be traceable to the emerging nature of the Nigerian capital market which is characterized by thin trading, illiquidity, low turnover and low capitalization etc. Based on the findings, we also observed that none of these strategies is superior to the other when subjected to statistical analysis. However, the study recommended the adoption of these strategies since they are applicable to the Nigerian stock market. Furthermore, Investors should seek for appropriate information about prospects before making investment decisions.

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