Traditional Index Investing and Low Volatility Investing Strategies:

Evidence from Nigeria Stock Market

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Abstract:
The main objective of this study is to investigate the power of the Modern Portfolio Theory (MPT), Markowitz portfolio optimization, to achieve better risk/return characteristics than investing in an index portfolio. Combining a strong portfolio that beats the market in the long-run would be the ultimate goal. The essence is to determine how each of these strategies compare with one another in terms of generating superior performance based on maximizing returns and minimizing risks. More so, it examines the applicability of diversification to the Nigeria Stock Exchange regarding risk reduction and returns maximization. This involved data on daily closing prices of five (5) assets (companies) drawn from different sectors of the Nigerian Stock Exchange. Due to the constantly shifting market conditions, the portfolio is rebalanced every four months, and only a relatively short period of market history can be used.

Keywords: Markowitz portfolio optimization, efficient portfolio, Nigeria Stock Exchange, risk, return, General Market Index (GMI).

1. Introduction

In the wake of the global financial crises, low volatility investing has gained an increased following as investors seek ways to achieve more attractive risk/return characteristics, and better capital protection in difficult environments; and mostly, the goal of any investor is to invest in securities that offer returns superior to the benchmark at an acceptable risk [6].

Portfolio optimization is a challenging problem in economic analysis and risk management, which dates back to the seminal work of Markowitz [1]. The main assumption is that the return of any financial asset is described by a random variable, who's expected mean and variance are assumed to be reliably estimated from historical data. The expected mean and variance or standard deviation are interpreted as the reward and, respectively, the risk of the investment. The portfolio optimization problem can be formulated as follows: given a set of financial assets, characterized by their expected mean and their covariance, find the optimal weight of each asset, such that the overall portfolio provides the smallest risk for a given overall return [1-5]. Therefore, the problem reduces to finding the "efficient frontier," which is the set of all achievable portfolios that offer the highest rate of return for a given level of risk. Using the quadratic optimization mathematical framework, it can be shown that for each level of risk, there is precisely one achievable portfolio offering the highest rate of return?

Investment in stocks and the associated expected return from such investment is usually fraught with risk. We invest to earn a return by channeling money or other resources in the expectation of reaping future benefits. The concern of most investors is how to maximize returns while minimizing risk. This is not unconnected with the natural tendency for man to loathe risk. In order to achieve this, Markowitz, in his path-breaking study, initiated the idea of portfolio diversification as a strategy for dealing with the concerns of investors about risk and returns. The difficulty with Markowitz diversification is the level of sophistication and tedious computations involved in selecting assets for inclusion in portfolios. This is because 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 [7].

Given the sophistication of the Markowitz diversification strategy, it would be expected that it should outperform the so-called naïve strategy (traditional index investing). The problem, therefore, that the study investigated is; if

Markowitz is superior to the Naïve strategy using the general market index (GMI) as a proxy. The major objective of this study is to investigate the performance of the GMI and Markowitz diversification strategies in the Nigerian stock market. In order to achieve this objective, the study will attempt to determine which of the two strategies will perform better in the Nigerian stock market and also explain whether diversification is capable of reducing risk and enhancing the return of a portfolio of securities in the Nigerian stock market.

2. Literature Review

The process of spreading an investment across assets through the vehicle of constructing a portfolio is called diversification. According to Chance et al. (2011), diversification is one of the most important lessons from capital market theory. Although endless theoretical and empirical debates have occurred over whether beta and other factors drive asset returns, there is little disagreement that diversification is a worthwhile activity.

According to Chandra (2005), investment decisions are influenced by various motives. Some people invest in a business to acquire control and enjoy the prestige associated with it. Some people invest in displaying their wealth. Most investors, however, are largely guided by the pecuniary motives of earning a return on their investment. For earning returns, investors have to bear some risk invariably.

According to Bodie et al. (2004), when we control the systematic risk of the portfolio by manipulating the average beta of the component securities, the number of securities is of no consequence. But in the case of nonsystematic risk, the number of securities involved is more important than the firms – specific variance of the securities. Sufficient diversification can virtually eliminate firm-specific risk. Understanding this distinction is essential to understanding the role of diversification in portfolio construction.

Ross et al. (2008) are of the view that the process of spreading an investment across assets (and thereby forming portfolio) is called diversification. They went further to say that the principle of diversification tells us that spreading an investment across many assets will eliminate some of the risks.

As it could be observed, an investor can reduce portfolio risk simply by holding instruments that are not perfectly correlated. Thus, the investor can reduce their exposure to the individual asset by holding a diversified portfolio of assets. Zulkifli et al. (2008) assert that 15 stocks are enough to diversify away a satisfying amount of diversifiable risk. A sample for constructing portfolios is constructing equally weighted portfolios. 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.

Until the 1970s, bank savings account as a risk-free asset combined with a stock portfolio would be a great investment, and the strategy that financial management advisors would recommend. The difference from now and then is the access to a wider variety of asset classes and more available information. From the information perspective, it is also easier to combine these different assets into complex portfolio strategies. One has to understand that each asset must be judged on its contribution when it comes to risk and return, but the combination of a couple of stocks can provide a different risk and return for the portfolio overall. (Bodie, Kane & Marcus, 2004).

There are several authors, for example, Markowitz, (1991), Elton and Gruber (1997) that discussed the main issues that an individual faces when investing, one issue is how to allocate the resources among alternative assets. All financial institutions have the same problem, the added difficulty, and the complication needed to include the characteristics of the liabilities in the analysis explicitly. The structure of these problems is different, but we can still classify these to the portfolio theory.

There have been a lot of previous studies within the field of portfolio theory. One article, written by Cowles (1933), examined the outcome from passive versus actively managed portfolios. The result of this research was that the managed portfolio underperformed the passive benchmark. Cowles examined return but did not take into consideration risk, but the Modern Portfolio Theory (MPT) states that risk, as well as a return, must be considered according to Elton and Gruber (1997). This makes the use of risk as an important factor when constructing a portfolio. Markowitz (1959) argues that risk can be minimized but not eliminated, and this without changing a

portfolios' return. Since the risk is such an important concept, it has to be defined, and according to Investopedia.com (2006), one interpretation is: *"The chance that an investment's actual return will be different than expected. This includes the possibility of losing some or all of the original investment. It is usually measured by calculating the standard deviation of the historical returns or average returns of a specific investment"[9].*

MPT is the philosophical opposite of traditional asset picking. It is the creation of economists, who try to understand the market as a whole, rather than looking for what that makes each investment opportunity unique. The asset allocation problem is one of the fundamental concerns of financial theory, according to Cohen and Natoli (2003). Asset allocation and risk are vital components in the MPT. Investments are described statistically, in terms of their expected long-term return rate and their expected short-term volatility. The volatility is equated with "risk," measuring how much worse than average an investment's bad years are likely to be. The goal is to identify the acceptable level of risk tolerance and then find a portfolio with the maximum expected return for that level of risk (Elton & Gruber, 1997). If the investor were to create the perfect investment, attributes to include would be high return coupled with no risk. The reality is, as Elton and Gruber (1997) states, this kind of investment is almost impossible to find. Not amazingly, individuals spend a lot of time developing methods and theories that come close to the "perfect investment." But none is as popular, or as powerful, as the MPT. It is important that industry professionals understand how to use that available theory to design portfolios that best align with a client's wishes and risk tolerances. It is also important that financial advisors understand what drives portfolio risk and return and how these forces can be manipulated for the maximum benefit. The MPT provides a solid theoretical foundation for building portfolios that are robust and closely aligned with investors' stated risk and return preferences.

MPT holds that diversification of assets may increase returns at given risk levels or at least provide the same results at a reduced risk level. Applications of the theory use volatility of returns implied by market price fluctuations as the composite of risks. It is most certainly the dominant theory in portfolio strategies. It is a theory on how risk-averse investors can construct portfolios in order to optimize market risk for expected returns, emphasizing that risk is an inherent part of higher reward.

The concept for investors when combining a less-risky portfolio is diversification, according to Bodie et al. (2004). The adage "don't put all your eggs in the same basket" is easy to say but more difficult to actually perform in reality. The importance of diversification is of great value, and as proof of this, Harry Markowitz won the Nobel prize in economics for his research within this field (Markowitz, 1991). Markowitz diversification strategy explains the sophisticated method of diversification, which considers both the risk and return of the portfolio simultaneously. This portfolio risk depends on the correlation between the two securities. Hence, the extent of the benefit of portfolio diversification is a function of the correlation between returns on securities.

3. Methodology

Reckoning with the orientation, objective and the literature review of this study, we collect data of daily closing prices of five (5) assets from different market sectors(to see the effect of diversification across the different market segments) of the Nigeria Stock Exchange and compare it with the benchmark (GMI). The five assets (companies: 7up bottling company, Ashaka cement plc, Julius Berger Nigeria plc, and Flourmill plc) are among the thirty most capitalized stocks in the market; the data covers the period (2007-2009) that included the turbulent period of the global financial crisis of 2008 to see the effectiveness of Markowitz strategy in minimizing risks and maximizing returns over the benchmark.

As a result of time and resources constraints to take every parameter into consideration when evaluating the performance of the portfolio, the perspective of this paper is the power and performance outcome exclusively in the Nigeria capital market. Further, positive and negative leverage, tax-efficiency, and transaction costs are disregarded in this paper. , the pure result from the portfolio is of interest.

There is no actual amount of money that will be invested in the portfolio. Instead, the performance of the portfolio will be displayed in percentage, to be able to give the investor a clearer and more comprehensive conclusion of the findings.

The market index that is used as the benchmark is the general market performance index of the Nigeria capital market. This index mimics the general market movement in total. The challenge arises from the fact that as market condition slight, the risk and expected return of the various securities change. Due to the constantly shifting market conditions, only a relatively short period of market history, which comprises good and bad market conditions, can be used. Also, the portfolio is rebalanced every four months to see the updated performance of the strategy [9].

The basic sources of data used are secondary data. The data analytical tools employed in this study are the mean, variance, standard deviation, coefficient of variation, optimization engine, the covariance of return.
The rate of return on individual assets is calculated using:

$$r_t = \frac{p_t - p_{t-i}}{p_{t-i}} \quad (1)$$

Where P_t = Price of common share at time t

P_{t-1} = price of the share at time t-1

A portfolio is a collection of n securities. The return on the portfolio Rp is a weighted sum of the returns on the individual securities:

$$Rp = \sum x_i R_i \quad (2)$$

Where x_i is the investment in the security *i.* The daily returns R_i on the security *i* is a random variable. They are assumed to be independent between different days and correlated among the various securities on the same day. The expected daily return a_i of security *I* and the covariance σ_{ij} between two securities are defined as:

$$a_i = ER_i \quad (3)$$

$$\text{And} \quad \sigma_{ij} = E(R_i - a_i)(R_j - a_j) \quad (4)$$

Using these notations, the expected return of the portfolio a_p and the covariance of the daily returns of the portfolio can be expressed as:

$$a_p = \sum x_i a_i = \boldsymbol{X^T a} \quad (5)$$

$$\text{And } \sigma_p^2 = \sum\sum x_i \sigma_{ij} x_j = \boldsymbol{X^T \sum X} \quad (6)$$

Here we used the vector, matrix notation:

$$\boldsymbol{a} = \begin{matrix} a^1 \\ \vdots \\ a^n \end{matrix} \qquad \boldsymbol{X} = \begin{matrix} x^1 \\ \vdots \\ x^n \end{matrix} \qquad \text{And} \quad \sum = \begin{bmatrix} \sigma^{11}, & \cdots & \sigma^{1n} \\ \vdots & \ddots & \vdots \\ \sigma^{n1} & \cdots & \sigma^{nn} \end{bmatrix} \quad (7)$$

The variance or the standard deviation of the portfolio returns is considered the portfolio risk [8]. The objective of the minimum risk, required return portfolio problem is to find portfolio weights
$\boldsymbol{X} = (x_1, x_2 \ldots x_n)^T$ to
Minimize $\boldsymbol{X^T \sum X}$
Subject to $\boldsymbol{X^T a} \geq \boldsymbol{a}_{required}$ (8)
And possible to some more constraints on the weights $\boldsymbol{X} = (x_1, x_2 \ldots x_n)^T$
Typical addition constraints are:

$$\sum_{i=1}^{n} x_i = P \text{ or } \sum_{i=1}^{n} w_i = 1 \quad (9)$$

Where x_i is the amount of money invested in security I, and $w_i = x_i/P$
Meaning that the entire value P (100%) must be invested, or

$$0 \leq x_i \leq zP, \; i = 1,2, \ldots n \quad (10)$$

This means that no short positions are allowed and that not more than the fraction $0 \leq x_i \leq P$ of the entire value can be invested in a single security.

And the required portfolio excess return should not be less than 0.01%

$\sum_{i=1}^{n} w_i ¢ \geq 0.01\%$

An optimization will often result in a narrow portfolio. This can lead to certain concentration risks and lead to overexposure to risks that the model will have difficulty estimating, such as fraud (i.e., in the case of Enron), natural disaster (catastrophe hitting a firm's headquarters or place of business) and so on. To protect the portfolio against these risks, we use these constraints combined with the covariance matrix as inputs for portfolio optimization procedure with an excel solver in order to force a certain level of diversification [8].

4. Result Analysis

The following tables and graphs give an insight into the various computations done in order to give a robust evaluation of both GMI and Markowitz strategies.

4.1. The Efficient Frontier

The efficient frontier is constructed by holding a constant return while minimizing the standard deviation. In table 1, each return and its corresponding standard deviation are listed. The weight for achieving a maximum sharp ratio is given for each scenario.

Mean return	Standard deviation	7up bottling plc	Ashaka cement plc	Julius Berger Nig. ltd	Fluormil Nigeria plc	Mobil oil plc
0.06%	0.98%	62.15%	24.56%	0.00%	13.29%	0.00%
0.10%	0.98%	63.37%	23.15%	0.00%	13.47%	0.00%
0.50%	0.96%	75.63%	9.08%	0.00%	15.29%	0.00%
0.96%	0.98%	70.51%	0.00%	1.17%	28.33%	0.00%
1.42%	1.07%	49.30%	0.00%	7.16%	43.54%	0.00%
1.88%	1.17%	28.09%	0.00%	13.15%	58.76%	0.00%
2.43%	1.29%	2.74%	0.00%	20.31%	76.95%	0.00%

Table 1 Mean return/standard deviation matrix 2007-01-01

The weightings are solved by testing every possible combination of assets resulting in the given return. The weights generating the lowest standard deviation for the given return is considered an efficient portfolio. Every efficient portfolio is then presented as a data point, resulting in an efficient frontier [9].

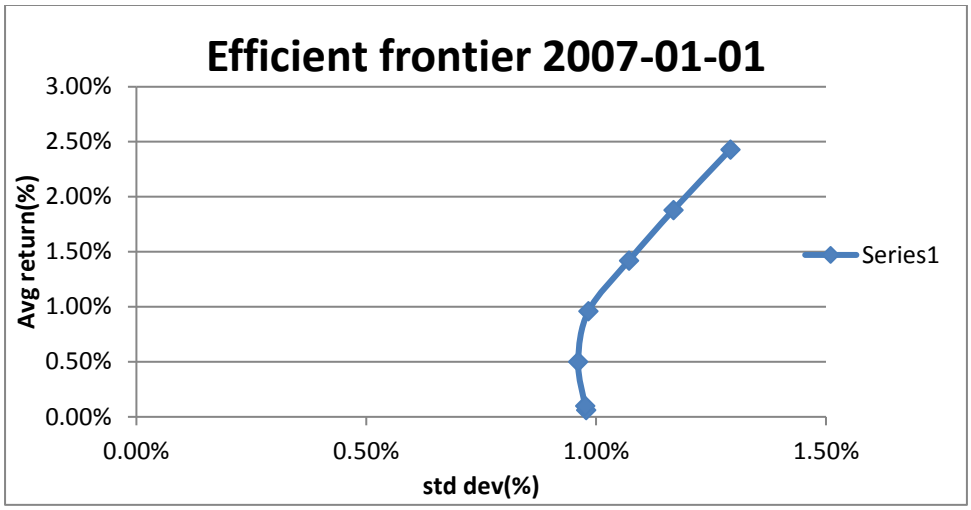

Figure 1 Efficient Frontier 2007-01-01

Using data from the table1, the efficient frontier is plotted in figure 1. By combining the assets through different weightings of the stocks in the optimization engine (excel solver), a portfolio (series) for every point on the efficient frontier can be comprised. As illustrated in the figure above, there is no portfolio situated above the efficient frontier, and all those that lie below are inferior to those situated on the efficient frontier. Each point on the efficient frontier represents a different but efficient portfolio. By investing in an efficient portfolio, the investor achieves the highest possible return for the given risk.

dates	portfolio	GMI
30-04-07	0.92%	6.96%
31-08-07	-1.43%	1.44%
31-12-07	4.03%	3.96%
30-04-08	3.68%	0.82%
31-08-08	-1.09%	-5.19%
31-12-08	-7.46%	-9.64%
30-04-09	-12.86%	-7.50%
31-08-09	6.61%	3.44%
31-12-09	5.18%	-2.98%

Table 2 portfolio and GMI returns

dates	portfolio	GMI
30-04-07	2.72%	5.66%
31-08-07	2.31%	4.17%
31-12-07	4.43%	4.17%
30-04-08	6.01%	7.39%
31-08-08	8.72%	5.51%
31-12-08	5.76%	8.22%
30-04-09	9.43%	19.24%
31-08-09	12.23%	23.23%
31-12-09	7.62%	1.57%

Table 3 Portfolio and GMI risks

Using Tables 2 and 3, we plot the chart illustrating the comparisons of both returns and risks of the portfolio and the GMI. In figure 2, as proved in modern portfolio theory, the GMI outperformed the portfolio returns at the initial stage, while at the long run, most especially during the turbulent period of the global financial crisis of 2008, the portfolio proved more effective in returns maximization. Looking at figure 3, the GMI is clearly nowhere near the Markowitz portfolio in terms of risk minimization.

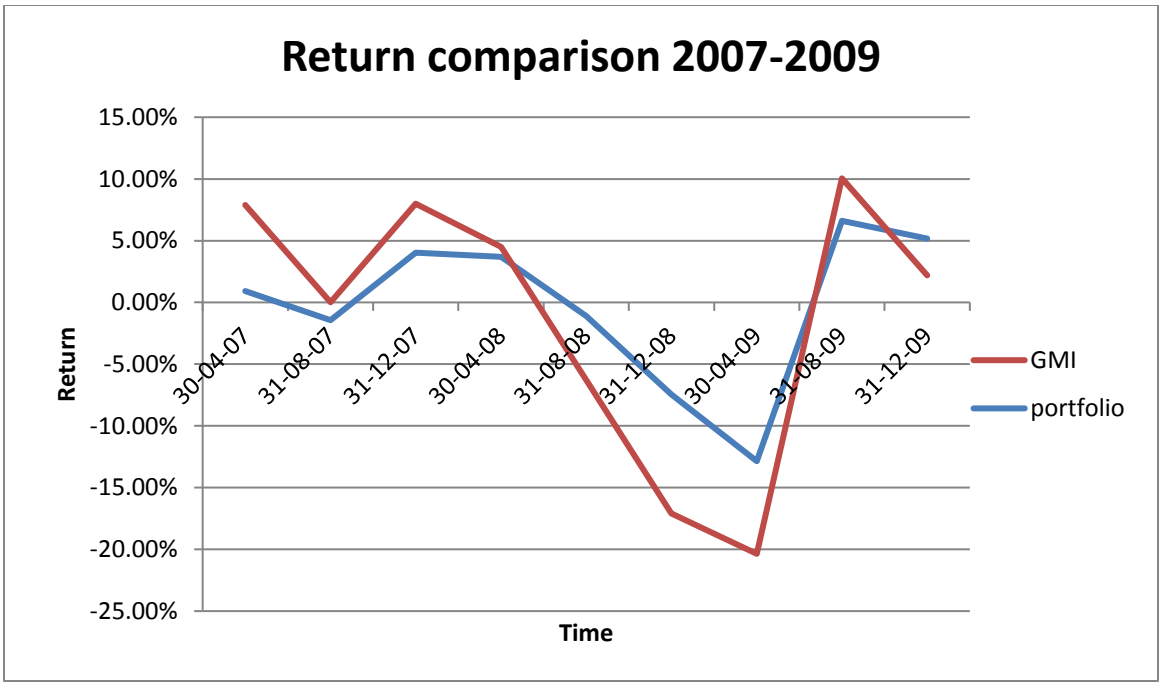

Figure 2 Return Comparison

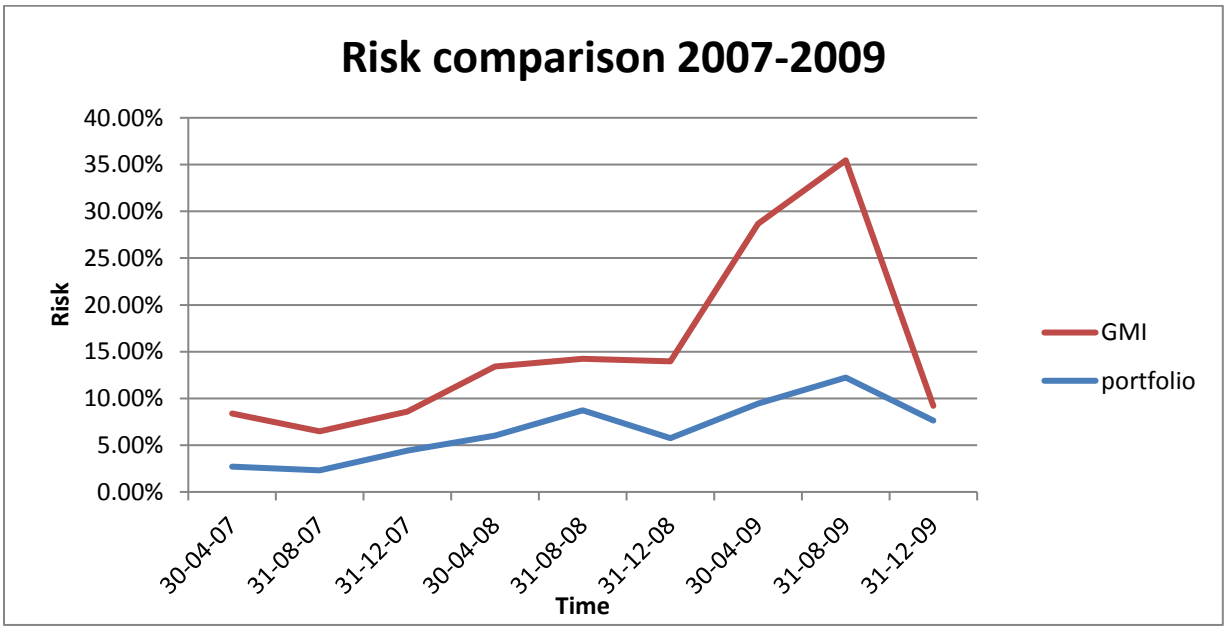

Figure 3 Risk (standard deviation) Comparison

Based on the result obtained, we can confidently say that Markowitz diversification strategy (low volatility strategy) also provides the investor with better risk/return characteristics in the Nigeria Stock Exchange than investing in a passive index, especially in the turbulent period of the global financial crisis of 2008 seen in table 2 and figure 2. As expected at the initial stage, the GMI is ahead of the portfolio with attractive returns, but in the

long run, the portfolio outperformed the index, an indication of the power of portfolio diversification across different sectors of the Nigeria capital market.

On the other hand, as shown in table 3 and figure 3, the GMI is nowhere near the portfolio in terms of risk minimization during the whole period we have chosen.

Conclusively, from our findings, with a careful and outstanding uncorrelated asset allocation in different sectors of the Nigeria Capital Market, low volatility investing would yield more attractive risk/return characteristics than using the naïve strategy traditional index investing.

5. Suggestions for future research

We considered this type of study extremely interesting and were pleased with the outcome. Although we would find it interesting to perform a similar test with several ongoing portfolios compared to different index types to be able to achieve a conclusion statement that is more valid and reliable. Further, each parameter can be analyzed separately but still with the same objective to achieve a greater development than the index, which would be a great complement to our study. The study is exclusively based upon historical data; adding a parameter that includes the investor's preferences would make this type of study even more interesting and would highlight the pros and cons of the human impact.

To construct an optimal risky portfolio that is fully diversified the global perspective should be taken into consideration. It is acknowledged in research (Bodie et Al., 2004) that a globally diversified portfolio will provide the investor with even more valuable diversification opportunities; consequently, it would be interesting to investigate if a portfolio with globally diversified assets would show a different pattern of the result.

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