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An Empirical Analysis Of The Effect Of Stock Diversification on Portfolio Risk Optimization: Evidence From The Nepalese Share Market

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Abstract

Diversification refers to investments made in a variety of sectors. It is designed to make the portfolio more efficient and optimize return while minimizing risk. Diversification is an investment approach that allocates funds across various assets, thereby reducing risk and enhancing portfolio returns. By diversifying the variety of assets in a portfolio, it is possible to achieve a rational trade-off for investment gain and practical risk reduction. This study aims to empirically examine the impact of selected stock diversification on portfolio risk and return in the Nepalese share market using diversification as a key parameter to identify an optimal portfolio. The study provides a better strategy for fund managers, individual investors, and Mutual funds investment companies, etc. Markowitz's Diversification model is applied to evaluate portfolio effectiveness using available historical data from the Nepal Stock Exchange website. Data assessment indicates that a diversified portfolio, comprising different sectors, yields a higher return than a single-sector portfolio. Specifically, Portfolio 2, which is diversified in stocks, yields a better return than Portfolio 1. Based on these observations, we can conclude that stock market diversification serves as a risk-reducing cushion, supporting the maximization of returns over a specified period. These findings suggest that stock diversification serves as a hedge for investors in downturns.

***Keywords*: Diversification, Portfolio, Stocks, Markowitz Diversification, Risk**

INTRODUCTION

A corporation can diversify by entering a new product market in addition to the core business (Hsu, Chen, & Cheng, 2013). The active involvement of corporate management in diversification initiatives has been confirmed by numerous researchers. Diversification raises debt capacity, reduces bankruptcy risk, and improves asset placement and productivity by bringing in new goods and markets (Higgins & Schall, 2016). Transferring funds from a cash surplus unit to a deficit unit is possible for a diverse business without incurring transaction fees or taxes. Diversified businesses minimize operating cash flow variability and pool unsystematic risk to gain comparative advantages in hiring, since important personnel may feel more secure in their positions (Nyaingiri & Ogollah, 2015). People frequently use investment portfolios to manage their financial resources. An investment portfolio is a selection of assets such as stocks, bonds and other securities. Diversifying the portfolio is crucial to reducing the high risk associated with investing in a single asset. In order to lower the risk associated with a single investment,

diversification is the process of distributing investment funds among several distinct businesses or investment kinds.

Under conditions of long-term development planning, a diversified business firm that evolves as one planned LOT has to continuously evaluate and compare the advantages accruing from these four options, before ultimately selecting one LOT and then another. The decisions on diversification are a little special though, and constitute a crucial component of the general pattern of growth. More than other growth alternatives, they require that the company step outside its usual behaviors and routines and experiment with new channels and possibilities. Ansoff (1957).

Two seemingly incompatible investment mindsets are reflected in the rule: First, avoid putting all of your eggs in one basket. and second, be sure to get the best of everything altogether. In practice, this principle implies that investors should diversify their funds across securities expected to yield the highest returns. The logic follows the law of large numbers: as portfolio size increases, the realized yield tends to approximate the expected yield. Thus, even though individual securities may deviate from expectations, the portfolio as a whole converges toward predicted performance, making diversification a rational strategy. To situate this in theoretical development, diversification provided the anchor point for modern portfolio theory. Early attempts, such as the "rule of media" for the dispersion of expected returns, highlighted that portfolios maximizing average returns were particularly advantageous. However, Markowitz (1952) demonstrated that correlations among securities limit the benefits of diversification; not all risk can be eliminated through portfolio construction. This recognition established the foundation for more rigorous theoretical models. John Lintner, Jan Mossin, Jack Treynor, and William Sharpe created the Capital Asset Pricing Model (CAPM), which built on Markowitz's work. The CAPM links expected return to systematic risk, extending the diversification principle into a general equilibrium framework. According to the model's theoretical assumptions, investors should seek a certain return for holding a security, contingent on the security's risk in relation to the market portfolio. According to Elbannan (2014), the CAPM offers a method for reliably determining equilibrium rates of return across assets since rational investors in competitive markets aim to maximize expected return.

Author(s) & Year	Core Idea / Contribution	Focus Area	Implication for Portfolio Diversification
Markowitz (1952, 1959)	Pioneered Modern Portfolio Theory; introduced mean-variance optimization	Portfolio construction; risk-return tradeoff	Foundation of diversification; investors should hold mean-variance efficient portfolios
Alexandre Adam (2008)	Portfolio returns are easier to grasp than wealth-based measures in asset management	Risk measurement framework	Supports using return-based evaluation for practical portfolio management

Olaf Korn (2006)	Evaluated performance, strengths, and weaknesses of Markowitz's approach in equities	Application to equity portfolios	Highlights both applicability and limitations of diversification
George G. Polak (2010)	Emphasized balancing high returns with risk under uncontrollable states of nature	Decision-making under uncertainty	Stresses tradeoff: return maximization vs. risk management
Gupta (2009)	Diversification specifically impacts the risk component of the portfolio	Risk reduction through diversification	Reinforces diversification as primary risk management tool
B. Rosenow (2002)	Portfolio optimization is complex since system parameters (e.g., correlations) are only estimates	Parameter uncertainty in optimization	Diversification is limited by estimation errors in correlations
Surya (2014)	Investors/portfolio managers aim for an optimum portfolio	Practical investment management	Highlights real-world desire for optimal portfolios
Andrew F. Siegel (2007)	Mean-variance efficient portfolios are central to investment analysis, pricing, and corporate finance	Broader application in finance	Demonstrates diversification's relevance beyond investing
Louis K. C. Chan (1999)	Reinforced the roots of modern investment theory in Markowitz's efficient portfolio concept	Historical foundations of portfolio theory	Connects modern diversification strategies to original t

The main issue that portfolio theory attempts to solve is the ubiquitous issue of risk in investing. Diversification, which entails taking steps to protect investors from unfavorable outcomes by utilizing the varied contributions of many inputs to overall performance, can frequently reduce or even eliminate risk (Leong, 2016). To help with asset management, analytical techniques for portfolio optimization have been developed extensively. These techniques are especially useful for spreading risk by diversifying investments over a variety of assets (Shinzato, 2017). Increased individual investor participation in online financial trading due to the development of internet technology has resulted in quicker and more noticeable changes in stock prices (Kakinoki, 2014). Because of their unique mean-variance efficiency and independence from expected returns as a criterion, minimum-variance portfolios are nonetheless thought to be durable even though they frequently have a concentration problem. Giving each asset in the portfolio a same weight

is a straightforward but efficient substitute (Maillard, 2010). Specifically, mean-variance efficient portfolios aim to maximize returns for a specific degree of risk, where risk is typically quantified by the standard deviation or volatility of returns (Lee, 2011).

LITERATURE REVIEW

Harry Markowitz's Modern Portfolio Theory, a Reservoir of Investment Decision making in his "Dimensions of Investment", published in 1952 at Purdue University under the aegis of the William Moore (18 78-1954) Memorial Foundation for Economic Education and stunned students of that generation who were happiest just to accept things as they were, marks an epoch in investment theory and practice. His discovery was rich in ideas and inspiration, anticipating large parts of the later development. He developed a portfolio problem, applying mean-variance model to select a collection of investment subject matters. He observed that there was portfolio risk for investors and this has the important and fundamental implication that the risk of a stock is to be judged by both the variances and covariances. Additionally, he stated that a portfolio with fully negatively correlated assets is ideal. He noted that the majority of assets in circulation have a perfect positive correlation (Markowitz,1952). They also described how Black Letterman allocations can be used to allocate an asset to portfolios with the least risk and investigated how assignment of an asset by assets to the portfolio reduced risk. To develop an ideal portfolio, they were more focused on categorizing tangible assets. However, there are challenges when mentioning securities like stocks, debentures, mutual funds, and bonds that are traded on stock exchanges but have no physical presence. The owning of a variety of equities in a portfolio is referred to as stock diversification.

In this chapter the authors introduce the concepts surrounding diversity as a source of value when constructing a portfolio and the ongoing pursuit in creating market cap free portfolios. They introduce a measure to measure how diversified a portfolio is, which they term as the diversification ratio. This metric is then used to construct the Most-Diversified Portfolio, or a risk-efficient portfolio. We examine the resulting portfolios' theoretical characteristics and contrast them with those of other well-known estimators, including the market-cap weights portfolio, the equal weight portfolio, and the lowest variance portfolio. The empirical evidence confirms that risk-efficient portfolios dominate in many respects these well-established strategies. The conclusion is that actively traded portfolios with opportunities to maximize diversification stand a strong chance of outperforming the popular passive scheme of tracking an index in the long run. The clear and bold message, says (Coignard, 2008) is that investors and their trustees can no longer ignore the benefits of maximizing diversity. Extending this work beyond value and momentum investing, which focuses on strategies that are independent of the market cap, the authors consider variety as factor in portfolio construction. They introduce a metric of portfolio diversification referred to as the diversity ratio. A risk-efficient portfolio, the Most-Diversified Portfolio, is then generated with such metric. We analyze the theoretical characteristics of constructed portfolios and compare with other well-known strategies like minimum variance, equally weighted and market-cap weighted portfolios.

A major theme in this literature is that if the owners are risk averse, the owners will work to limit the risk considerations even more than they would give that all of their wealth is tied up (or more narrowly tied up) in the companies that they own. The intuition for this idea is simple. In the aggregate, Any risk-averse investor's expected utility decreases as wealth variability increases. An rise in firm-specific risk will reduce the expected utility of a controlling shareholder who is under-diversified and risk-averse. To the extent that this effect is strong enough, this controlling shareholder will have the incentive to decrease firm risk in order to maximize the utility. If anything, a well-diversified controlling shareholder has been diversified away from risk specific to the firm, and the effectiveness of the device is preserved. Hence, to enhance her expected utility, a block holder who is undiversified will aim to mitigate firm risk (Faccio, 2011). One prominent theme in this literature is that if their wealth is highly concentrated in the units they control, risk-averse owners will seek to have even lower risk than they would if they held diversified portfolios. The intuition for this idea is simple. When an investor is risk averse, her expected utility usually decreases as her wealth fluctuates. In the event that a controlling shareholder has an ego-utility function, her predicted utility will decline as the firm's unique risk increases if she is risk averse and under diversified. When the effect is large enough, the controlling shareholder will choose a decrease in company risk for an increase in utility. But since risk is diversified, we can see that firm-specific risk does not enter the utility of any shareholder with control.

A portfolio's variance quantifies the risk of a single asset or a collection of assets. When the variance values are bigger, there is more volatility. A generalization of the two-asset formula is the variance of more than two assets, for which there is a similar formula for the expected return. If you hold a lot of investments in one portfolio, the increasing value of the portfolio's losing investments normally cancels out the falling value of the assets, reducing your risk. As a result, the total risk is lower than the weighted average of the individual assets in a portfolio (Mangram, 2013). A major topic in this research is that risk-averse business owners will tend to be more conservative if their money is heavily concentrated in the companies they own. Variance measures the relative volatility of the single stock or portfolio with respect to the market. Higher variance values suggest more volatile. Just as the projected return equation is generalized to greater than two assets, so is the variance of more than two assets an extension of the variance for two assets. Holding several assets together in a portfolio lowers risk; typically, declining assets are offset by rising portfolio assets.

METHODOLOGY

The amount that investment returns vary from the mean is expressed as the standard deviation of a portfolio. In simpler terms, it shows investors the extent of the difference in return they might anticipate and what they may receive. In terms of historical context, analysts commonly use this volatility measure to determine the beginning of a potential yearly range of return from a portfolio or a portfolio of stocks.

Portfolio risk is diverse, depending on the portfolio construction, where portfolio risk represents the variability of the risk investment return from the expected return. In order to

understand the variability is necessary for investors to make informed decisions. In this study, portfolio risk is measured using standard deviation, which quantifies the dispersion of returns around the mean.

Before applying formulas for mean, standard deviation, and portfolio variance, the following statistical assumptions are considered: return of individual assets is normally distributed and standard deviation is used as a proxy to measure risk and mean is used for return, where mean and variance of assets returns assumed to remain constant over the analyzed period and Assets weights in portfolio also assume to be constant during the analyze period.

Mean (Average Return):

Mean is used to evaluate average return using the formula,

$$\mu = \frac{1}{N}\sum_{i=1}^{n} x_i$$

μ= Mean

x_i=Individual stock value 1 to n period

N=Number of value

Standard deviation(σ):

Standard deviation uses to measure how risky or volatile the return.

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{n}(x_i - \mu)^2}$$

Where,

σ=standard devation

μ=Mean

x_i=Individual stock value 1 to n period

N=Number of value

The variance of a two-asset portfolio was given by

Where σP is the portfolio standard deviation, wA is the weight of asset A in the portfolio, wB is the weight of asset B in the portfolio, σA is the standard deviation of asset A, σB is the standard deviation of asset B, and ρAB is the correlation between asset A and asset B, σP = √ (wA2 * σA2 + wB2 * σB2) (1)

Portfolio variance is the sum over all of these products of the asset weight squared times the variance of each asset. This is then adjusted by the 'covariance' term - this is effectively a measure of how much the two assets close in on each other.

The general form of portfolio variance is:

Portfolio variance = w12σ12 + w22σ22 + 2w1w2Cov1, 2 (2)

Where:

- w1 = the portfolio weight of the first asset
- w2 = the portfolio weight of the second asset
- σ1= the standard deviation of the first asset
- σ2 = the standard deviation of the second asset
- Cov1,2 = the covariance of the two assets, which can thus be expressed as p(1,2)σ1σ2, where p(1,2) is the correlation coefficient between the two assets.

A key metric in portfolio management, correlation indicates the direction and intensity of a relationship between two assets. The correlation coefficient, which ranges from -1.0 (perfect negative correlation) to +1.0 (perfect positive correlation), is how we measure it.

The correlation formula is:

$$\rho_{xy} = \frac{Cov(r_x, r_y)}{\sigma_x \sigma_y}$$

- ρxy = Correlation between two variables
- Cov(rx, ry) = Covariance of return X and Covariance of return of Y
- σx = Standard deviation of X
- σy = Standard deviation of Y

Harry Markowitz created Modern Portfolio Theory (MPT) in the 1950s, arguing that there is an ideal asset combination that provides the maximum possible investment returns for a given level of risk. MPT emphasizes the value of diversity, asset allocation, and frequent rebalancing. It also includes risk-free instruments like T-bonds and T-bills, which by themselves change the efficient frontier and reduce portfolio risk.

To assess the advantages of diversification, the correlation coefficients of the assets are computed based on their daily returns over a time window. This provides a measure of how much of the reduction in risk is due to diversification.

Where the diversification benefit of a portfolio is defined by:

Diversification Benefit= σP−∑(wiσi)

Where:

- σP = portfolio standard deviation
- wiσi= weighted average of the individual stock standard deviation

The sample data used in this study is policyholder's dividends yielding of listed companies in Nepal Stock Exchange Limited (NEPSE) for a decade (fiscal year 2069/70 to 2078/79). The database was derived from official sources of NEPSE and includes companies from various sectors.

RESULTS AND FINDINGS

In this study, the performance of a stock portfolio was examined over a ten-year period, and the outcomes of sector-diversified and non-sector-diversified portfolios were contrasted. According to this analysis, portfolios were not diversified. The least risky portfolios were those that included stocks from the Commercial bank, Non-Life Insurance, Investment, and

Development bank.

The two portfolios included in this study are Portfolio 1, which combines the stocks of commercial banks listed on the NEPSE, and Portfolio 2, which combines diverse stocks from commercial banks, non-life insurance companies, investment firms, and development banks. These portfolios are used to analyze the risk of each individual portfolio and determine which portfolio minimizes portfolio risk for investors. Four scrips listed on the Nepal Stock Exchange Ltd. are included in each portfolio. Only 25% of each portfolio's weight is contributed by individual equities. Table 1 below shows the outcomes of the risk assessment of the portfolios.

Table 2: Portfolios, Risk, and Weightage

	Risk	**Proportion of Stocks**			
Portfolio 1	9.6660	NABIL	HBL	GBIME	EBL
		25%	25%	25%	25%
Portfolio 2	6.6026	MBL	LGIL	CIT	JBBL
		25%	25%	25%	25%

Where:

- NABIL=Nabil Bank Ltd.
- HBL= Himalayan Bank Ltd.
- GBIME= Global IME Bank Ltd.
- EBL=Everest Bank Ltd.
- MBL= Machhapuchre Bank Ltd.
- LGIL= Lumbini General Insurance Ltd.
- CIT= Citizen Investment Trust
- JBBL= Jyoti Bikash Bank Ltd.

The risk values for Portfolios 1 and 2 are 9.6660 and 6.6026, respectively, and are shown in Table 1. The riskiness of Portfolio 1 is higher than that of Portfolio 2. The reduction in risk from Portfolio 1 to Portfolio 2 amounts to approximately 31.7%, indicating a statistically significant decrease in portfolio risk. This finding highlights that portfolios diversified across sectors yield lower risk levels, whereas portfolios concentrated in undiversified sectors carry substantially higher risk exposure. Accordingly, the results support the conclusion that sectoral diversification provides measurable risk-reduction benefits.

Table 2 further illustrates the diversification advantages of the constructed portfolios by demonstrating the degree of risk dispersion achieved.

Table 3: Diversification Benefits

	Diversification Benefits
Portfolio 1	-167.4657
Portfolio 2	-81.6333

The benefits of each portfolio's diversification were displayed in Table 2. The table makes it clear that sector diversification has made a substantial contribution to lowering portfolio risk. Comparing the two portfolios, Portfolio 1 has -167.4657 diversification advantages while Portfolio 2 has -81.6333. One noteworthy aspect is that compared with Portfolio 1's non-diversified stock sector, sector diversification has greatly reduced risk. In light of the above, for any rational investor. In order to lower total risk, it is critical to comprehend the benefits of diversification in each portfolio he has created.

DISCUSSION

Findings

The current study examines the impact of stock diversification on portfolio risk optimization using a sample of stocks across several industries. The analysis reveals that portfolio volatility decreases as the portfolio's total number of equities grows. The findings also highlight the advantages and drawbacks of diversification, indicating that it can considerably lower overall risk.

Interpretation

These findings align with the core principle of Modern Portfolio Theory, which emphasizes diversifying investments across dissimilar assets to reduce risk exposure. The results support the argument that diversification offers meaningful risk-reduction benefits for investors. Consistent with Markowitz's guidance, combining securities with lower correlations enhances portfolio efficiency, ultimately lowering inherent risk while simultaneously improving potential returns.
This study also called into question the effectiveness of diversification. While overall portfolio risk decreases as the quantity of stocks rises, the benefits of diversification decrease beyond a certain threshold. Empirical evidence suggests that most of the benefits of diversification are captured within a portfolio of approximately 20 to 30 stocks, after which the marginal reduction in risk becomes negligible. This indicates decreasing returns to scale with respect to risk reduction. The decision to select stocks for diversification tended toward optimizing portfolio risk. Some stocks were highly correlated, making their inclusion ineffective for risk reduction; by contrast, stocks with low correlations had a significant impact on lowering risk exposure. Therefore, stock selection should carefully consider interrelationships to maximize diversification benefits. While our results offer important insights into the effects of stock diversification on risk of a portfolio, it's crucial to acknowledge the limitations of this study. The analysis was based solely on historical data, and future market conditions may differ. Additionally, risk was measured only through volatility, which may not capture all dimensions of risk. Future research should incorporate alternative risk measures and examine how diversification affects different portfolio types.

In the end, the research elucidated that stock diversification is one of many strategies for portfolio optimization. Unique into this kind of research, investors are offered significant risk benefits. The nearer stocks or elements composing a portfolio can be too unrelated one another, the less risk that portfolio will have; beyond a certain limit of diversification however, it poses

deeply affected. They should select stocks with low correlations; therefore, it is important to have many stock types as possible (i.e. those stocks are from different industries and one is a mammoth holding). These results make a contribution to the body of knowledge in investment portfolio management and point out among other things important implications for investors in their efforts for optimal risk return through diversification strategies.

CONCLUSION

This report also examines how portfolio risk management outcomes are influenced by changes in stock diversity. While theory helps in understanding the nature of various risks, diversification in practice introduces its own considerations. Using the Markowitz Diversification Model, we calculated both stock-level and portfolio-level risks to evaluate whether the holdings in a given portfolio represent excessive exposure. The results showed that Portfolio 2 constructed with greater diversification exhibited lower risk compared to Portfolio 1, aligning with the expectations of rational investors. Portfolio 2's reduced risk stems from its broader sectoral diversification, which lowers overall portfolio volatility. However, investors should carefully evaluate their own tolerance for risk and the specific trade-offs involved before adopting such strategies. This study underscores that to reduce portfolio risk, investors must quantify the benefits of diversification, assemble a well-balanced portfolio, and then assess risks against potential returns. Doing so removes speculation, allowing investors to select portfolios that strike the most effective balance between risk and reward. In conclusion, the key takeaway for investors is clear: diversification remains one of the most practical and effective tools for managing risk without necessarily sacrificing returns. Careful portfolio construction anchored in diversification principles enables investors to move closer to achieving their financial objectives with greater stability.

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