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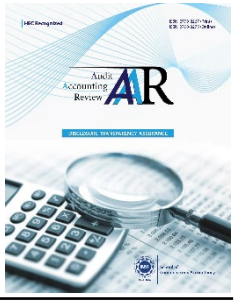

Title:	**A Low-Risk vs. Market-Based Portfolio in Equity Market: Evidence from Global Financial Crisis and Global Pandemic Crisis in Pakistan**
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A Low-Risk vs. Market-Based Portfolio in Equity Market: Evidence from Global Financial Crisis and Global Pandemic Crisis in Pakistan

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Abstract

The study tests the characteristics of a low-risk-based portfolio compared with a broader market-capitalization weighted portfolio (benchmark portfolio) in Pakistan Stock Exchange (PSX). This study considers all listed stocks at PSX as an investment universe. Low-risk stocks were assessed by measuring the idiosyncratic risk. Extensive back-tests were performed to compare the financial performance for 2005-2022. Results show that the market-capitalization-based portfolio outperforms the low-risk-based portfolio in terms of annualized returns. However, the latter significantly reduces the risk and leads to superior risk-adjusted performance. The low-risk portfolio indicates resilience to market turmoil and reduces the downside risk of the market portfolio. The risk-return relationship appears to be stronger in the case of idiosyncrasies. The effect of the GFC-2008 and the GPC-2020 are also investigated; the results indicate that a low-risk-based portfolio carries higher returns while the market capitalization portfolio carries relatively higher risk. Both individuals and institutional investors can enhance the risk-adjusted performance of their portfolios by adopting a low-risk-based strategy.

***Keywords*:** low-risk portfolio, market-based portfolio, performance evaluation, Pakistan Stock Exchange (PSX)

JEL Codes: G11 Portfolio Choice & Investment Decision

Introduction

The finance theory assumes a positive link between risk and return. It means that the higher the risk, the higher the return, which infers that bearing a higher risk will be rewarded with a higher return. This illustrious risk return trade-off remained the focus of theoretical and empirical research in financial markets for the last several decades (Lintner, 1965; Markowitz,

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1965; Sharpe, 1964). To measure the risk factor, Harry Markowitz, the founder of the "Modern Portfolio Theory," in his article Markowitz (1952), developed his pioneering portfolio model known as "Markowitz Portfolio Selection." He derived the expected rate of return and risk for a portfolio of assets. Markowitz (1952) measured risk as volatility in stock prices. He assessed volatility with the help of standard deviation and concluded that while making investment decisions, investors maximize expected returns for a given amount of portfolio risk, which leads to the positively sloped and concave efficient frontier.

Capital Market Theory and Asset Pricing Theory are two famous theories for evaluating risky assets. CMT builds on portfolio theory to develop models for pricing risky assets, including the CAPM introduced by Sharpe (1964), Lintner (1965), and Mossin (1966), which posits a positive linear relationship between risk and return. However, in the 1970s, CAPM was criticized by researchers like Black et al. (1972), Fama and French (1993), and Banz (1981), who identified anomalies indicating that factors such as firm size, book-to-market ratio, price-to-earnings ratio, and past performance also affect stock returns. Over the years, many anomalies have suggested that CAPM fails to explain differences in returns adequately. Empirical studies have shown that low-beta stocks may outperform predictions of the CAPM under borrowing constraints, while high-beta stocks may underperform. Additionally, the relationship between beta stocks and returns appears flatter than the model implies. These limitations have led to numerous papers proposing extensions to the model by including additional risk factors and critiquing its assumptions.

The CAPM was developed by Sharpe (1964) and expanded by Lintner (1965), while Black et al. (1972) posited a positive linear relationship between beta (systematic risk) and expected stock returns. While diversification is the main essence of CAPM, which aims to minimize idiosyncratic risk and maximize returns, empirical evidence shows that portfolios often remain poorly diversified. This leads to the notion that unsystematic risk, combined with beta stocks, positively correlates with expected returns. Studies have found a strong linkage between average returns and value at risk, consistent across different investment periods and loss probabilities (Chen et al., 2014; Yang & Ma, 2021). The CAPM was criticized when researchers, such as Black et al. (1972) and Fama and French (1993), reported anomalies, saying that firms' characteristics such as

firm size, price-to-earnings ratio, book-to-market value, and prior return performance are also key factors in explaining the cross-section returns. A firm's low price-to-earnings ratio (P/E) yields higher returns than a high P/E ratio. According to Fama and French (1992) and Bradrania et al. (2023), anomalies indicate that beta is not the only factor that describes the returns. The existence of many anomalies questions the explanatory power of CAPM and suggests that it fails to explain the cross-section of stock returns fully. Several studies, such as Black et al. (1972) and Fama and French (1992), have empirically shown that the relationship between beta and returns in the CAPM is flatter than the model suggests. These findings suggest that beta alone does not fully explain stock returns, and studies indicate that the relationship between beta and returns is less steep than CAPM initially suggested.

Stocks with low volatility have outperformed high-volatility stocks during the last several decades. At the same time, the low-risk anomaly has gained remarkable interest. The low-risk anomaly in equity markets refers to the experiential phenomenon in which assets with low risk, regarded as having lower volatility, tend to provide higher risk-adjusted returns related to high-risk assets. This phenomenon contradicts the traditional financial theory (CAPM). One of the key features: Investing in lower volatility (beta) is that investors can achieve better returns without taking on the expected level of risk. CAPM suggests a positive linear relationship between beta and expected returns. The low-risk anomaly challenges this assumption, showing that low-beta stocks often yield higher returns than predicted. This phenomenon has been observed across several market conditions, i.e., crises, in which investors seek safety and stability. The low-risk anomaly has led to the popularity of low-volatility investment strategies, where portfolios favor low-risk stocks, aiming to achieve better returns with lower risk. The anomaly has been documented in several stock markets globally, indicating its robustness across different economic environments. Low-volatility investing provides high returns at lower risk as compared to traditional market-cap-weighted indexing. The anomaly persists across time and countries, as Ang et al. (2009) explains how low-volatility investing may lead to high returns. Since the market factor is reduced, volatility is lower, whereas returns are high because of Sharpe's ratio factors like beating beta (BAB), value, and duration; for example, Frazzini and Pedersen (2014). The persistence of low-risk anomaly has been perceived in international bonds, stocks, currencies, and credit derivatives (Frazzini &

Pedersen, 2014; Traut, 2023). Blitz and Groot (2014) provide empirical evidence from commodities markets, while Cao and Han (2013) focus on options markets. Frazzini and Pedersen's (2014) article tries to illuminate this anomaly with leverage constraints.

To conclude the discussion, it is stated that a low-risk anomaly exists, as confirmed by many studies conducted in different geographical locations (USA and other emerging and developed markets) with different periods using various methodological choices. Most of the previous studies, e.g., Black et al. (1972), Blitz and Van Vliet (2007), Boudt et al. (2019), Chow et al. (2014), Fama and French (1992), Haugen and Heins (1975), Raza and Ashraf (2019), and Traut (2023) focus on developed countries, where equity markets are relatively stable. However, fewer studies have been conducted in the context of emerging markets; for example, (Baker & Haugen, 2012; Blitz et al., 2013; Joshipura & Joshipura, 2019). A review of the literature reveals a few reasons for conducting this study. First of all, this study acts as a pioneer in the field by focusing specifically on PSX. Furthermore, PSX shows tremendous growth, and the index has reached 70000 points in 2024. This indicates that the PSX exhibited relatively high volatility in this period. This study aims to address significant gaps in the literature on low-risk anomalies and investigate this phenomenon within the context of the PSX. This study offers insights into how distinct characteristics, such as high volatility, specific governance challenges, and unique investor behavior, influence the performance of low-risk investment strategies. By focusing on these aspects, the research seeks to contribute eloquently to understanding the low-risk anomaly, thereby enhancing our grasp of how emerging markets operate under different risk-return dynamics. This research is timely and essential for investors and policymakers navigating the complexities of equity markets in emerging economies.

The equity markets in developed economies are relatively stable compared to less developed economies. Bekaert et al. (2006) argue that the market integration process increases in capital flows after implementing economic and financial liberalization policies, and the cost of capital in emerging markets leads to different risk and return characteristics. There is a substantial difference in market microstructure and the level of corporate governance between developing and developed markets (Raza et al., 2023; Said et al., 2021; 2024). This leads emerging markets to experience higher volatility. The governance structures in Pakistan differ from those in

developed markets, and examining how these issues, including regulatory frameworks and corporate governance, influence market efficiency can provide valuable insights (Zia-ur-Rehman, 2023). Investor behavior in emerging markets often deviates from traditional finance theories due to cultural influences, risk perception and behavioral biases. Analyzing these behaviors further clarifies the low-risk anomaly (Almansour, 2023). Comparative analyses highlight unique factors influencing the low-risk anomaly, enriching the literature on market characteristics. Examining the relationships between macroeconomic factors and PSX performance can shed light on how external influences shape market behavior. Finally, longitudinal studies on PSX are needed to track changes over time and their effects on the low-risk anomaly, which is crucial for understanding evolving investment strategies. Due to a lack of research on emerging markets, a deeper examination of PSX is essential. A significant amount of volatility affects investor sentiment and decision-making, and its unique growth trajectory reflects broader economic and social dynamics. In order to avoid mispricing and unpredictable returns, it is essential to understand how this volatility contributes to the low-risk anomaly.

The current study is primarily different from studies on emerging equity markets (Joshipura & Joshipura, 2019). They constructed equally weighted decile portfolios to separate volatility from other effects by ranking stocks based on their three-year standard deviation of monthly returns and applying the Fama-French three-factor model and the Carhart (1997) four-factor model. Blitz et al. (2013) constructed equally-weighted quintile portfolios by ranking stocks based on the past three-year volatility using the standard deviation of monthly returns and applying single and multifactor models. This study (Alighanbari et al., 2016; Bishwal, 2022; Raza & Ashraf, 2019) and follows a heuristic approach by taking annualized returns and calculating a past two-year volatility by standard deviation. A low-risk-based strategy improves both the selection and weighting methods of a portfolio. In this approach, the portfolio is constructed following a series of steps. First, the risk of all stocks is estimated. Literature shows two main approaches to estimating the risk of each stock, i.e., volatility and systematic risk. Volatility is estimated with the help of the standard deviation. In the second method, beta is a proxy for systematic risk. In the second step, all stocks are ranked based on relative risk. In the third step, a specific number of stocks with the lowest risk are selected. The number of stocks to be selected in a portfolio is arbitrary and it depends on the choice of the

portfolio manager. However, as a standard practice, 100 less risky stock(s) are selected by a world-renowned index, e.g., the S&P 500 low volatility index. In the last step, weights are assigned to the finally selected stocks based on their inverse volatility, or beta, i.e., stocks with lower risk receive higher weights within the portfolio. Lastly, this study also investigates the impact of GFC and GPC. This study set the following objectives to achieve:

- To compare the relative riskiness of a low-risk-based portfolio with a benchmark portfolio (market-capitalization-based portfolio).
- To compare the performance of a low-risk-based investment strategy with a market-capitalization-based investment strategy.

Sections 2 and 3 offer literature review and the study's methodologies. Sections 4 and 5 provide results and a conclusion.

Literature Review

Risk-Return Trade-off Theories

An important academic literature shows the existence of low-risk based anomaly in the equity markets globally. The existing literature shows that low-risk-based portfolios outperform the market-capitalization-based portfolios over the market cycle on a risk-adjusted as well as on an absolute basis. This puzzling situation is referred to as low-risk in portfolio management theories. This anomaly contradicts traditional finance theories like CAPM, which states that an asset's expected return is directly proportional to its systematic risk (beta). This anomaly has been empirically documented across different markets using different methodological tools. This section aims to contribute to the existing literature by highlighting and linking the modern portfolio theories as background for studying low-risk anomaly. Furthermore, it presents related literature on how low-risk anomalies evolved and identifies different methodological tools of analysis. It also reviews current research on low-risk anomalies in developing markets. Finally, the need for the study to find low-risk anomalies in PSX, an emerging equity, leads to developing a hypothesis that needs to be tested.

Theoretical Background

Modern Portfolio Theory (MPT) highlights a positive link between risk and return, central to theoretical and empirical research. In the 1950s, investors recognized the importance of risk in the risk-return trade-off, although specific measurement techniques were lacking. Quantifying risk

became essential to building effective portfolio models. Markowitz's "Portfolio Selection" model (1952) pioneered this effort by establishing a framework for measuring risk and calculating expected returns. He identified the variance of returns as a meaningful measure of portfolio risk and suggested that risk is integral to achieving higher returns. Risk-averse investors can optimize expected returns based on specific risk levels, leading to a positively sloped and concave efficient frontier. Markowitz's work laid the groundwork for two significant finance theories: "Capital Market Theory (CMT)" and "Asset Pricing Theory (APT)," which focus on the valuation of risky assets.

The CMT expanded the MPT by developing models for pricing risky assets, including the CAPM introduced by Lintner (1965), Mossin (1966), and Sharpe (1964). The CAPM posits a positive relationship between risk (beta) and expected returns, distinguishing between systematic and unsystematic risk, and assumes rational investors in competitive markets. However, it has faced criticism due to empirical evidence revealing anomalies. Black et al. (1972) and Haugen and Heins (1975) identified a low-risk anomaly, suggesting the risk-return relationship might be negative. Banz (1981) challenged the CAPM by demonstrating that small-cap stocks outperformed large-cap stocks on a risk-adjusted basis. The consensus is that the CAPM does not adequately explain stock prices.

Until the 1990s, the CAPM's failure to explain stock prices became visible. Haugen and Baker (1991) highlighted an inverse relationship between risk and return, while Fama and French (1992) found a flat correlation between beta and returns in U.S. markets from 1963 to 1990. They introduced size and book-to-market value as additional factors to explain stock return variations better. In response to CAPM's limitations, Ross developed the APT in the mid-1970s. APT operates on fewer assumptions and does not require a specific market portfolio. It suggests that stock returns are linearly related to multiple macroeconomic risk factors, allowing for market mispricing, that arbitrageur can exploit. However, APT is criticized for not clearly identifying the nature and number of risk factors affecting security returns.

Fama published three key papers (1965a, 1965b, 1970) that eventually developed EMH. In his first paper, Fama (1965a) provided empirical support for the RWH. His second paper (1965b) defended the RWH against critics who used technical and fundamental analyses for stock price

predictions. In his influential 1970 paper, he introduced EMH, asserting that markets are efficient and that investors cannot consistently outperform without insider information. Efficient Market Hypothesis (EMH) suggests that stocks trade at their intrinsic value, and a direct relationship exists between risk and return (Malkiel, 2003). Critics argue that certain market anomalies, which EMH fails to explain (Yalçin, 2010), show that behavioral factors influence stock returns. Studies by Le Roy and Port (1981) highlighted excess market volatility, revealing greater price instability as compared to the assertion of traditional models. Thaler (1999) identified various financial anomalies related to trading volume, volatility, and predictability of stock returns. This study explores the low-risk anomaly in equity markets, which occurs when stock performance deviates from EMH. These unexplained deviations, known as financial market anomalies, can be exploited for superior investment returns, with empirical evidence drawn from the PSX.

Low-Risk-Based Anomaly in Equity Markets

The low-risk anomaly viewpoint directly contrasts the standard financial theory, which assumes a risk-return tradeoff, i.e., the higher the risk, the higher the asset's expected return and vice versa. It is well discussed and evidenced that low-risk assets are inclined to outperform their high-risk counterparts across different asset classes (Traut, 2023). This anomaly was reported at the beginning of the 1970s by Black et al. (1972), challenging the CAPM model. In addition, many studies have recognized that the low-risk factor exists in almost all types of equity markets. The low-risk anomaly exhibited a strong negative association between the expected returns and historical volatility (measured over 1, 3, 6, and 12 months). Blitz et al. (2013) showed that the low-risk anomaly is independent and cannot be explained by value, momentum and size factors/anomalies etc. Haugen and Heins (1975), taking data on US equities for 1926-1971, indicated that equity portfolios with lower variance have achieved higher average returns w.r.t portfolios with higher variance. Haugen and Baker (1991) suggested that it is possible to design low-risk portfolios (with the same or higher average returns) having significantly lower risk than market-capitalization weighted portfolios (i.e., Wilshire 5000) using data of US equities from 1972-1989. Han et al. (2020) utilized the same factor construction approach for A-shares Chinese listed firms and showed that the BAB factor also achieves a significant alpha in this region.

Fama and French (1992) found that beta alone does not explain stock returns and added size and book-to-market value factors, significantly improving the CAPM model. Blitz and Van Vliet (2007) showed that low-volatility portfolios globally provided higher risk-adjusted returns than market-capitalization portfolios. Ang et al. (2009) observed a negative correlation between expected returns and historical volatility in 23 developed markets. Haugen and Baker (2008) reported that risky equities yielded the lowest returns from 1963 to 2007 in the US. Baker et al. (2011) confirmed the low-risk anomaly, showing that low-risk equities performed better than high-risk equities from 1968 to 2008. Traut (2023) supports the low-risk anomaly as a valid factor and calls for further research. Li et al. (2014) demonstrated that low-volatility portfolios outperformed high-volatility while Asness et al. (2014) found that low-risk strategies are more effective. Dimson et al. (2017) validated that low-risk stocks in the UK and the US outperformed riskier stocks. Kothe et al. (2021) discovered a 0.77% annual excess return in non-US developed bond markets. Frazzini and Pedersen (2014) revealed lower risk-adjusted returns with higher leverage and significant abnormal returns from "Betting Against Beta" portfolios. Adhami et al. (2023) identified an inverse relationship between risk and return in crowdlending markets. Jensen et al. (2022) confirmed the replicability of the "Low Risk" theme across multiple countries, while Hou et al. (2020) and Pyun (2021) noted limitations in the low-risk anomaly, highlighting the need for further critical analysis.

The low-risk anomaly has been comprehensively studied in the US and other developed markets, while fewer studies are available in emerging and developing markets. Baker and Haugen (2012) discovered that low-volatility outperformed high-volatility equities across all 21 developed and 12 emerging markets from 1990 to 2011. Blitz et al. (2013) also investigated the relationship between risk and return in emerging equity markets and found it flat or negative. The results of their study are contrary to CAPM. Chen (2017) documented a negative relationship between investment and expected returns in the Chinese stock market. Gupta (2018) reported the empirical evidence of low-risk anomaly in the Indian stock market and proved that low-volatility portfolio returns outperformed the returns on high-volatility portfolios. Joshipura and Joshipura (2019) used the data from the Nifty 500 index and find that the portfolios having low volatility outperform the high-volatility stocks. They further proved that the volatility effect is unique irrespective of size, value and momentum factors. Similarly,

Saengchote (2017) provided evidence of low-risk anomaly and showed that abnormal returns with low-beta stocks are robust and significant using data from the Thai stock market for the period 2004-2015. Regardless of the myriad studies noted above, there is a dearth of such research in the context of Pakistan. However, related studies, i.e., Ghufran et al. (2016) and Hussain and Khan (2023), analyze the causes of stock market volatility in Pakistan and find persistent high volatility along with a negative leverage effect. Mubarak et al. (2019) discussed the reasons for fluctuations in stock prices in Pakistan. Hussain and Uppal (1999) predicted that the volatility of PSX is long-term.

The Resilience of Portfolios during Financial Crises

The global financial crisis in 2008 and onward, resulted in a large drawdown in investments in the equity markets starting from USA, Europe, Asia, and emerging economies of the world. As confirmed by Bordo and Landon-Lane (2010) who showed that the global financial crisis of 2008 also resulted into the stock market crashes, engulfing many countries including USA and other countries, within a few months of its start. The investors in USA faced a fall in their portfolios over time. The S&P 500 index declined by more than 50% from its peak in October 2007 to the bottom in March 2009. Similarly, there was a decline of more than 40 % alone in the global equity market represented by MSCI AC World in 2008. However, there are studies which confirm that in comparison to broader market portfolios, the low-risk based portfolios show resistance to financial crisis and result in relatively lower value at risk. Furthermore, they also suffer fewer losses as measured by drawdowns, as observed by Boudt et al. (2019).

Evidence from Emerging Markets

The emerging equity markets are vital for international diversification due to higher economic growth and profit opportunities, as described by Blitz et al. (2013). They reported that the emerging market weight has enlarged in the composition of the MSCI All Countries Index from approximately 1% in 1988 to about 15% in 2013. This increase in weight in MSCI is due to the issuance of new shares, listing of new companies, higher realized returns, financial liberalization and deregulation policy measures. Furthermore, market demand due to the growing population, increased foreign direct investment, and global financial integration of the emerging

markets are also included in the factors responsible for the increase in weight in MSCI (Blitz et al., 2013). The emerging markets have been subject to market turmoil, high volatility, and various financial and economic crises, such as Mexico in 1994, the Asian Financial Crisis in 1997 and Russia in 1998. Most of the other previous studies, for example, Fama and French (1998), Patel and Sarkar (1998), Rouwenhorst (1999), and Van Der Hart et al. (2003) examine stock returns in emerging markets, confirming value, size, and momentum effects. An exception is Rouwenhorst (1999), who showed that beta is unrelated to returns in developing markets using data from 1982 to 1997. A significant gap in the literature can be observed as there is little information available regarding the performance of low-risk-based strategies in equity markets of developing countries.

Methodology

This study constructs a low-risk weighted portfolio and compares its performance with the market-capitalization weighted portfolio. The study considers all the firms on PSX as the reference investment universe, $I = i, \ldots, n$, where each firm listed at PSX is denoted by "i". The selection of each stock "i" at the time "t" is carried out in multiple steps. First, returns are estimated from the adjusted closing prices of each firm and the estimate relative riskiness of each stock "i" at time "t" is calculated. The risk component of each stock "i" can be calculated by following a minimum-variance optimization approach used by Alighanbari et al. (2016) or by using the heuristic approach used by Alighanbari et al. (2016), Boudt et al. (2019), and Raza and Ashraf (2019) etc. The study used the ADF and PP Unit Root test first to check the stationarity in data. The former method of low-risk optimization required complex mathematical estimations such as a variance-covariance matrix (Raza & Ashraf, 2019). The latter has the advantage of simplicity as it calculates risk via standard deviation and then assigns weights to less risky stocks (Raza & Ashraf, 2019).

The heuristic approach then screens the whole investment universe "i" at the time "t" and selects less risky stocks. The low-risk stock numbers in a portfolio or index are random and can fluctuate depending on funds and indices.[†] It is imperative here that the relative risk for every stock can be calculated either through Beta from CAPM, Lee (2011) or with standard

[†] i.e., The S&P 500 Low Volatility Index chooses the 100 stocks with the lowest volatility.

deviation. Some studies favor using downside measures of risk such as value at risk (VaR), drawdowns, or expected shortfall. The selection of the estimation method is also arbitrary. This study estimates the risk by following the methodology of Boudt et al. (2019). It estimates the volatility of stocks based on a rolling window of two years' returns. After screening the investment universe, the second important step is to assign weights to stocks that are included in the low-risk weighted portfolio. The weights of each portfolio component are inversely proportional to its risk characteristics such that stocks with lower risk receive higher weights.

In the first step, 100 stocks with the lowest volatility among all the investment universe "I" were selected. This technique is used by world-leading indices such as the S&P 500 low volatility index. The weights of each stock "i" at the time "t" respectively were implemented as:

$$w_{i,t}^{LR} = \frac{\frac{1}{\sigma_{i,t}} \times L_{i,t}}{\sum_{i=1}^{N} \frac{1}{\sigma_{i,t}} \times L_{i,t}}, \quad (1)$$

where "$\frac{1}{\sigma_{i,t}}$" is the inverse of the volatility for stock "i" at time "t" and $L_{i,t}$ is the dummy representative that the stocks are among the l00 least volatile stocks.

The analysis of this study is based on a large secondary data set covering the period 2005-2022 to construct low-risk and market-capitalization weighted portfolios. For this purpose, this study obtains price data from the PSX-100. To construct a market-capitalization-based portfolio, this study estimates the market capitalization of each firm "i" at time "t."

Data Analysis Techniques

This study compares the financial performance of both portfolios by conducting extensive back-tests ranging from 2005-2022. The period leading up to 2022 is significant for several reasons. First, it spans a complete market cycle, which includes the GFC-2008. This allows for a comprehensive portfolio performance assessment during market stress. Additionally, this timeframe captures the recovery and growth following the crisis and the recent impacts of the COVID-19 pandemic, providing valuable insights into how portfolios respond to both economic downturns and periods of growth. Furthermore, this period includes essential data on Pakistan's stock market, especially after the market reforms and

modernization that occurred in the mid-2000s, making it relevant for analyzing portfolio dynamics in an emerging market context like Pakistan.

First of all, closing historical prices of both portfolios were obtained from investng.com and yahoofinance.com and then annualized returns of both portfolios were reported by calculating returns monthly and then annualizing by using the compounding rule. Rebalancing occurs at the close of each calendar year to maintain the portfolio's alignment with its original asset allocation and risk profile, regardless of market fluctuations. The annualized risk/volatility of both portfolios was further estimated with the help of standard deviation monthly which was then annualized with the square root of the time rule. The semi-deviation and gain-deviation was also reported to analyze the volatility and risk process further. In addition to this, the downside measures of risk, such as Value at Risk (VaR), maximum drawdowns (MD), and expected shortfall (ES) were also reported. The risk-adjusted performance (Sharpe ratio) and the relative measure of performance, commonly known as the coefficient of variation (a measure of relative variability), were also reported. For performance comparison, a paired t-test was also reported. In robustness check, the study also used quantile regression estimates, offering a detailed view of return and loss distributions beyond the mean. It helped analyze how return and risk profiles varied across quantiles, enhancing the understanding of portfolio performance influenced by market factors for both low-risk and market-based portfolios.

Data Analysis

Let’s first see the most commonly used keywords and their frequency distribution. Figure 1 employs a cartographic analysis (WordCloud).

In the realm of research, a "cloud picture" denotes a visual representation that encapsulates intricate data and interconnections within a study. In this method, words are sized in proportion to their occurrence in a text, providing a prompt overview of prevailing themes and trends. To exemplify the most commonly utilized keywords and their frequency distribution, a cartographic analysis (WordCloud) has been employed. This article discusses key market themes such as economics, volatility, portfolio returns, risk, performance, stocks, value, and emerging markets. Economic conditions, such as GDP growth, inflation, and interest rates, significantly influence market performance and portfolio returns. As market volatility

increases, drawdowns and recovery times are often longer. As a result of the stability of the underlying assets, portfolios with different risk profiles exhibit drawdowns and recoveries. Due to political instability, currency fluctuations, and lower liquidity, emerging markets offer high potential returns but with increased risks. Understanding how these factors relate to historical portfolio trends may help investors navigate risk and maximize returns by providing a comprehensive view of how different portfolios respond to market conditions. The outcomes detailed in Figure 5 show all the relevant and important words like Portfolios, Journals, Financial, Economics, and Volatility.

Figure 1

Most Frequently Used Keywords in the Cloud Picture in the field.

Table 1

Augmented Dickey-Fuller (ADF) Unit Root Test for Data Stationarity

Variable	Level	1st Difference	Critical Values (Mackinnon) for Rejection of Hypothesis of a Unit Root			Decision	Order of Integration
			1.00%	5.00%	10.00%		
Low-Risk Portfolio Returns	-1.15	-8.454	-3.596	-4.624	-3.205	Shows Stationarity at first difference	I (1)
Market-Based Portfolio Returns	-1.33	-9.365	-4.654	-2.243	-3.102	Shows Stationarity at first difference	I (1)
GFC (2007-09)	-2.34	-2.245	-3.962	-4.204	-4.950	Non-Stationarity	I (0) & I (1)
GPC (2019-21)	-3.90	-4.062	-6.152	-6.840	-7.524	Non-Stationarity	I (0) & I (1)

Table 2
Phillips-Perron (PP) Unit Root Test

Variable	Level	First Difference	Mackinnon Critical Values for Rejection of Hypothesis of a Unit Root			Decision	Order of Integration
			1%	5%	10%		
Low-Risk Portfolio Returns	1.684	10.845	3.961	3.411	3.127	Non-stationary at level but stationary at first difference	I (1)
Market-Based Portfolio Returns	1.265	9.128	2.906	3.160	4.109	Non-stationary at level but stationary at first difference	I (1)
GFC (2007-09)	-5.674	-3.220	-7.225	-9.419	-7.055	Non-Stationarity at	I (0) & I (1)
GPC (2019-21)	-6.270	-3.902	-8.741	-8.690	-9.600	Non-Stationarity at	I (0) & I (1)

Note. *- GFC stands for Global Financial Crisis and GPC stands for Global Pandemic Crisis

Tables 1 and 2 apply unit root tests to RWH using the low-risk and market-based portfolio returns. As a result, the returns of the Low-Risk and Market-Based Portfolios show non-stationarity at 1% and 5% levels. The tests were also carried out for the GFC and GPC, and the results show non-stationary during both periods. For the purpose of comparative analysis, we report annualized returns and risk in Table 3.

Table 3
Raw Performance

Types of portfolios	Annualized returns (%)	Annualized risk (%)	Skewness	Kurtosis	GFC Returns (%)	GPC Returns (%)	GFC Risk (%)	GPC Risk (%)
Market-capitalization weighted portfolio	8.342	22.150	-1.056	5.483	1.247	2.547	0.396	0.315
Low-risk weighted portfolio	6.553	14.262	-0.336	1.405	1.307	2.744	0.297	0.130

Note. GFC stands for Global Financial Crisis (2008-09), and GPC (2020-21) stands for Global Pandemic Crisis

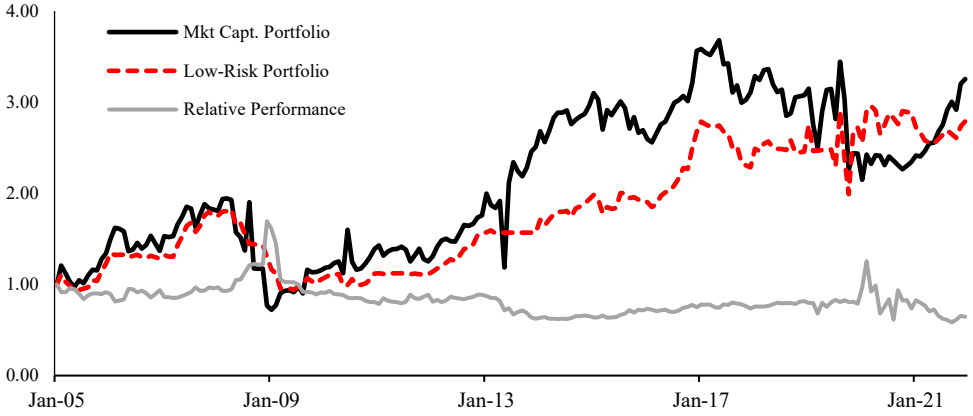
Table 3 indicates that the market-capitalization-based portfolio results in 8.34% annualized returns for the span of 2005-2022. The low-risk-based portfolio results in 6.55% annualized returns in the same period. This means the market-capitalization-based portfolio produces higher returns than the low-risk-based portfolio by 179 basis points. These results are consistent with (Boudt et al., 2019; Chow et al., 2014; and Raza & Ashraf, 2019). Investors do not only care about returns but also consider risk when assessing any investment opportunity. It can be observed that a market-capitalization weighted portfolio results in a relatively high standard deviation compared to a low-risk weighted portfolio. This means that market-capitalization-weighted portfolio returns are more volatile than the low-risk-weighted portfolio. Thus, we conclude that investors who invest in market-capitalization-weighted portfolios bear higher risk than low-risk investors. Upon comparing the portfolio returns during the GFC and the GPC, the tabulated values distinctly indicate higher returns for the low-risk-based portfolio. Furthermore, the standard deviations for both portfolios have been calculated, confirming that the market capitalization portfolio carries relatively higher risk.

Cumulative Performance

To compare the cumulative performance, the returns are on the vertical axis and the period on the horizontal axis.

Figure 2

Cumulative Performance and Relative Performance



The black line indicates the raw performance of market-capitalization-weighted portfolios, while the dotted line shows the low-risk weighted

portfolio performance. The cumulative performance is estimated by investing $1 in both portfolios in 2005, letting the investment mature until 2022. The results are reported in Figure 2.

The results in Figure 2 show an exciting trend. It can be observed that prior to the GFC in 2008, the market-capitalization weighted strategy resulted in superior cumulative financial performance compared to the low-risk weighted strategy. However, in the GFC and the GPC, the market capitalization strategy incurred significant losses. It is the low-risk weighted strategy that shows resistance to the crisis. In the post-crisis periods of GFC and GPC, the low-risk weighted strategy showed an upward trend compared to the market-capitalization-based portfolio. It is also important to mention that in both post-crisis periods, the line that represents the returns of the low-risk weighted portfolio is well above the market-capitalization weighted portfolio, and this is a clear indication of the superior performance.

With upward sloping, the investment strategy mentioned in the study (low-risk weighted portfolio) outperforms the benchmark strategy and vice versa. It is observed that at the start of 2005, the line was downward sloping minutely, rising again, showing that the MC investment strategy was performing better than the LR investment strategy and vice versa. This trend continues till December 2006. The line rises upward in the GFC (2007-2009) and the GPC (2020-22). In this period, the LR was relatively more successful in absorbing the shocks and almost outperformed the MC investment strategy. In the post-crisis period, the MC portfolio performed superiorly to the LR Portfolio. Though there are a few corrections periods, overall, the LR investment strategy can perform better than its counterpart. This observation of the outperformance of the LR strategy is consistent with the findings of Boudt et al. (2019).

From the above graph, one can say that the maximum drawdowns in both low-risk and market-based portfolios during the global financial crisis (2007-09) declined gradually and flatly, taking more time to recover. However, the end of the graph shows more sudden and huge drawdowns caused by the global pandemic crisis (2019-21) but recovers more quickly.

Risk-Adjusted Performance, Semi Deviation and Gain Deviation

Sharpe ratio provides results in relative terms, which are reported in Table 4. This ratio is 0.37, which means that the investor receives 0.37 units

of returns for each unit of risk. In comparison, the low-risk weighted portfolio results in a 0.45 Sharpe ratio. These results show that in terms of risk-adjusted performance, the low-risk weighted portfolio outperformed the market capitalization portfolio by 80 basis points.

Semi-deviation only shows the extent to which portfolio returns have shown downward moments. The result indicates that the low-risk based investment strategy positively affects the semi deviation of the market-capitalization based investment strategy and it has reduced the semi-deviation from 0.04 to 0.02.

It can be seen that the market-capitalization strategy has a high gain deviation compared to the low-risk strategy's gain deviation. This shows that a market-capitalization portfolio has more winning periods than a low-risk strategy's winning periods. These results are consistent with the previous findings of annualized returns in the study.

Table 4

Risk-Adjusted Performance and Semi Deviation

S.No.	Types of Portfolios	Sharpe Ratio
1	Market capitalization-weighted portfolio	0.37
2	Low-risk weighted portfolio	0.45
		Semi deviation
1	Market capitalization-weighted portfolio	0.04
2	Low-risk weighted portfolio	0.02
		Sharpe Ratio
1	Market capitalization weighted portfolio	0.03
2	Low-risk weighted portfolio	0.02
		Coefficient of variation
1	Market-capitalization weighted portfolio	0.265
2	Low-risk weighted portfolio	2.177

In addition to the standard Sharpe ratio, the COV reported in the last three rows of Table 4 was also estimated. A small COV value indicates little variability, and vice versa. Thus, it is used as the criterion for the consistent performance of both portfolios.

The GFC-2008 pushed many portfolios into significant losses, therefore, in the last decade, fund managers and academia alike stressed the use of additional risk assessment measures as compared to the traditional

measures of risk. The primary purpose of such an analysis is to answer important questions, such as the number of resources a portfolio needs to recover from the worst losses. One may wonder how deeply a fund is affected by market drawdowns as well as the loss a portfolio may incur during a single rebalancing period. The following tests were conducted to answer the above questions.

Value at Risk, Drawdown Analysis and Expected Shortfall

This study estimates the VaR of both portfolios at a 95% confidence interval. Table 5 indicates that the market-capitalization weighted portfolio results in a VaR value of -9.37%. In comparison, the low-risk weighted portfolio results in relatively lower VaR statistics, i.e., -6.98 %. This means the manager must keep about 7% of its assets in reserves to deal with fund redemption. The result concludes that the low-risk weighted portfolio is less exposed to fund redemption risk than the market-capitalization weighted portfolio by a difference of 3%. Table 5 indicates that the portfolio based on market capitalization results in a VaR value of -9.37%.

The drawdown analysis shows when a portfolio needs to recover from the previous losses. Drawdown also shows a temporary decline in a fund's net asset value. This technique has gained popularity and is widely accepted as a practice risk assessment measure. Table 5 indicates that the market-cap portfolio has a historical drawdown of 62.85% for the said period. This indicates the maximum level of fund redemption for the market-cap strategy. Most of the world markets suffered significant losses due to the spillover effects of GFC-2008. PSX is based on market capitalization, therefore, huge losses in 2007-08 were expected if the investors had followed the market-cap strategy.

In comparison to the MC-weighted portfolio, the LR-weighted strategy has a maximum drawdown of 48.50 %. Therefore, one may conclude that the LR-weighted portfolio has experienced fewer losses and a shorter period underwater. However, the drawdowns for the latter are still significantly high and exposed to the spillover effect of the crisis.

One of the possible reasons for lower drawdowns of the lower-risk weighted portfolio is its ability to identify stocks of firms having low volatility. These firms are less risky and result in lower volatility; therefore, they can be used as a possible hedge against a financial crisis. The expected shortfall estimates the worst losses based on a mostly arbitrary benchmark.

This study estimates VaR on a 95% confidence interval, therefore, the expected shortfall will estimate the average outcomes of the worst 5% of cases. Lastly, the GFC and GPC further intensify VaR results in almost all cases with little variations.

Table 5

Value at Risk, Maximum Drawdowns, and Expected Shortfall

S.No.	Types of portfolios	Value at Risk	GFC	GPC
1	Market-capitalization weighted portfolio	-9.3701	-9.8552	-9.5730
2	Low-risk weighted portfolio	-6.9805	-7.3506	-7.0051
Maximum drawdowns				
1	Market-capitalization weighted Portfolio	0.6285	0.5708	0.5823
2	Low-risk weighted portfolio	0.4850	0.4235	0.4133
Historical Expected Shortfall (95%)				
1	Market-capitalization weighted Portfolio	-0.1508	-0.1928	-0.2053
2	Low-risk weighted portfolio	-0.0940	-0.09843	-0.0998

The result shows that a market-capitalization-based portfolio has an expected shortfall of -15.08%, shown in column 3. In comparison, a low-risk weighted portfolio resulted in an average expected shortfall of -9.40% in column 3. A low-risk weighted portfolio has a positive effect on the shortfall, and it reduces the worst losses by almost 6%.

Relative Performance

To highlight the performance of low-risk strategy in market turmoil, the relative performance of low-risk strategy for 2005-2022 has been plotted. To obtain the relative performance, the market-cap weighted portfolio is considered as a benchmark portfolio. By assuming that one invests $1 in a low-risk weighted portfolio and $1 in a market-capitalization weighted portfolio, the relative performance is obtained by taking the returns in relative terms. Such a comparison enables the research to investigate the

relative performance in different periods. The results are presented in Figure 4.3.

Before discussing the graph in Figure 4.3, it is important to analyze the slope and direction of the line graph. Simply, if the line graph showing relative performance moves up, it means the low-risk portfolio is outperforming the market-capitalization portfolio.

Inferential Analysis by Applying Paired T-test

To assess whether the differences in the performance of both portfolios significantly contradictory, the inferential statistics have been presented using a Paired t-test; the results are reported in Table 6.

Table 6
Paired t-Test

S.No.	Types of portfolios	Mean	DIM	Pair *t* test	*p* value
1	Market-capitalization weighted portfolio	8.341	1.82	2.451	0.000
2	Low-risk-based weighted portfolio	6.543			

Note. DIM shows difference in mean of both portfolios.

The results in Table 6 show that a market-capitalization portfolio's mean value is higher than a low-risk strategy's mean returns. This implies that the means of both portfolios are equal to 1.8. The results of the "*t*" test and "*p*" value prove that there is a significant difference in the mean returns of both portfolios.

Robustness Check

Table 7
Quantile Regression

S.no.	Types of Portfolios	Quantile	Coefficient	Standard Error	*p*-Value
1.	Low-Risk based Portfolio	10^{th}	0.115	0.023	0.053
		90^{th}	0.165	0.041	0.035
2.	Market-capitalization weighted Portfolio	10^{th}	0.195	0.045	0.031
		90^{th}	0.315	0.063	0.025

Table 8
Wilcoxon Signed-Rank Test

S.No.	Types of portfolios	Mean	Wilcoxon S-RT	*p* value
1	Market-capitalization weighted portfolio	8.351	0.000	0.000
2	Low-risk weighted portfolio	6.550		

Quantile regression estimates conditional quantiles, assesses how return and risk profiles vary across quantiles and examines the impact of market factors on portfolio returns. The 10th percentile indicates the performance of stocks with the lowest returns, generally reflecting weak results in adverse market conditions. In contrast, the 90th percentile highlights stocks with the highest returns, showcasing resilience in volatile equity markets. Low-risk portfolios typically show smaller coefficients, indicating lower sensitivity to market factors, while market-based portfolios exhibit larger coefficients, reflecting greater risk exposure. The study used the Wilcoxon Signed-Rank Test alongside the Paired T-test, yielding consistent results that support the study's conclusions.

Conclusion

Diversification is the main essence of CAPM, and investors hold different stocks within their portfolios to minimize risk and maximize returns. In practice, market anomalies challenge the traditional CAPM and indicate that beta is not the only factor that explains the cross-section of equity returns. One such anomaly is the persistent performance of low-risk stocks in both the long and short run. Low-volatility stocks have outperformed those with high volatility over the last several decades. Low-volatility investing provides high returns at lower risk than traditional market-cap-weighted indexing and is persistent across time and countries. The lower volatility originates from reduced exposure to the market factor, while the high returns come from assessing high Sharpe's ratio factors such as beating against Beta, value, and duration. The performance of low-risk stocks has been tested in different asset classes.

The study initially checked for the normality of the data using different stationary unit root tests, which allow to perform further analyses. The results show that the MC portfolio is better in terms of annualized returns, however, the LR portfolio can reduce the risk of the broader market

portfolio. Due to the lower risk, the LR portfolio results in a higher Sharpe ratio. Furthermore, the LR portfolio also has an advantage in terms of downside risk and exhibits lower drawdowns and VaR. In addition to recovery periods, the study also analyzed decline periods and quick recovery periods for GFC and GPC. To sum up the discussion, it can be inferred that LR Portfolio has fewer chances of fund redemption and requires relatively less amount of assets to recover the losses. Finally, one may confirm that the low-risk-based strategy underperforms the market-capitalization-based strategy in a bearish market(s). At the same time, it can be used as a hedging tool against market downturns in developing economies like Pakistan.

Practical Implications of the Study

The results emphasize how portfolios respond under various economic conditions, offering valuable insights for creating more resilient investment strategies. Investors can better anticipate potential risks and make informed portfolio adjustments by analyzing Value at Risk (VaR) metrics, semi-deviation, drawdown, and recovery dynamics. These findings also guide asset allocation strategies. A diversified approach can help optimize risk-adjusted returns, while regular rebalancing ensures that the portfolio remains aligned with the investor's risk tolerance and financial goals. Portfolio managers must consider rebalancing strategies tailored to their client's investment horizons and risk profiles. This proactive approach can help mitigate significant drawdowns and capitalize on potential opportunities.

Limitations of the Study

- The use of alternative measures, inclusion and comparative study can improve the generalizability of the results.
- The study does not address transaction costs, market liquidity, or practical constraints like minimum trade sizes, which are crucial for implementing low-risk strategies. Future studies would provide a realistic perspective, especially if they are aimed at institutional investors.

Conflict of Interest

The authors of the manuscript have no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

Data Availability Statement

The data associated with this study will be provided by the corresponding author upon request.

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