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PORTFOLIO CONSTRUCTION WITH POSTMODERN PORTFOLIO THEORY FRAMEWORK*

Postmodern Portföy Teorisi Çerçevesinde Portföy Oluşturma

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Keywords:
Postmodern Portfolio Theory, Downside Risk, Portfolio Optimization, Participation Index

JEL Codes:
C61, G11, G17

Abstract

This study includes alternative portfolio construction approaches consistent with the Modern Portfolio Theory (MPT) and Postmodern Portfolio Theory (PMPT). We propose a weighting strategy based on Sharpe and Sortino optimization, and unlike MPT, we create PMPT portfolios using downside metrics, such as downside risk, downside beta, and downside capital asset pricing model (D-CAPM). Portfolios consist of stocks in the Borsa Istanbul Participation 30 Index (XK030), with the stocks in the portfolio having been revised according to screening periods. In addition, we created an equally weighted portfolio and used XK030 as a benchmark for comparative analysis. The sample period covers 527 trading days between May 6, 2022, and June 28, 2024. The results show that the Sharpe portfolio consistently follows the benchmark index throughout the observation period. Sortino outperforms both the benchmark and conventional market index in some specific periods when the market has an upward trend, especially. This study provides evidence that the MPT and PMPT approaches and measures can be used in asset allocation and portfolio management. Investors can manage their assets and balance portfolio weights by implementing the models in different market conditions.

Anahtar Kelimeler:
Postmodern Portföy Teorisi, Aşağı Yönlü Risk, Portföy Optimizasyonu, Katılım Endeksi

JEL Kodları:
C61, G11, G17

Öz

Bu çalışmada Borsa İstanbul Katılım 30 endeksinde yer alan pay senetleriyle Sharpe ve Sortino oranlarının maksimizasyonuna dayalı alternatif ağırlık belirleme stratejileri kullanılmış, modern portföy teorisi ve postmodern portföy teorisiyle uyumlu portföyler oluşturulmuştur. Sharpe portföyü için geleneksel risk ölçütleri, Sortino için aşağı yönlü metrikler kullanılarak ağırlıklar hesaplanmış ve elde edilen ağırlıklarla 6 Mayıs 2022 – 28 Haziran 2024 tarihleri arasındaki dört endeks izleme döneminde 527 işlem günü için portföy getiri serileri oluşturulmuştur. Ayrıca eşit ağırlıklı portföyler ve Katılım 30 endeksi karşılaştırma ölçütü olarak kullanılmıştır. Analiz sonuçları Sharpe getiri serisinin endeksi yakından izlediğini, Sortino portföyünün ise piyasanın yükseliş trendine girdiği spesifik periyotlarda hem karşılaştırma endeksinin hem de geleneksel piyasa endeksinin üstünde performans sergilediğini göstermektedir. Bu çalışma MPT ve PMPT yaklaşımlarının ve ölçütlerinin varlık tahsisi ve portföy yönetiminde uygulanabilirliğine ilişkin kanıtlar sunmaktadır. Ayrıca çalışma yatırımcıların farklı piyasa koşullarında ilgili modelleri kullanarak varlıklarını yönetebileceğini ve portföylerini dengeleyebileceğini göstermektedir.

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1. Introduction

It is important for investors to manage the uncertainty arising from market conditions. A common strategy is to minimize risk through diversification. Optimal allocation through diversification differs according to market conditions, investors’ risk preferences, and the risk-return trade-off. The fundamental approach in MPT, an efficient portfolio, has the highest reward for a given level of risk or the lowest risk for a given reward (Wilmott, 2001). Markowitz’s mean-variance model is the core of MPT, and variance is a fundamental measure of risk in this model (Markowitz, 1970). Today, we use standard deviation as a risk measure in financial markets. On the other hand, portfolio risk depends on the correlation between the assets comprising the portfolio. Beta, the coefficient of systematic risk, is accepted by investors as the sensitivity of a financial asset to market returns. Beta is included as a risk measure in the CAPM formula developed by William Sharpe and his contemporaries (Petzel, 2022). The market premium for tolerating an asset’s volatility relative to a benchmark, which is the return on a risk-free investment, is measured using the CAPM (Chen, 2016).

Even though the standard deviation is a powerful volatility measure, it does not reflect asymmetric risk (See PMPT Framework heading). Nevertheless, indicators and risk measures of MPT, such as the Sharpe ratio, are still useful for portfolio management. In contrast, empirical studies show that downside risk measures are feasible for investors to capture negative conditions. Estrada (2002, 2007) provides empirical evidence that downside risk metrics and D-CAPM enable more accurate asset pricing. Moreover, according to Estrada, the findings on downside risk measures are consistent with investors’ loss aversion in behavioral finance literature. In this respect, PMPT overcomes the limitations of MPT that do not reflect investors’ perceptions. As a matter of fact, it is significant for investors to understand how sensitive the portfolio is to downside risk. Investors neglect upside risk because the risk measure is associated with potential earnings.

Relevant studies such as Yıldız and Erzurumlu (2018), Yıldız et al. (2022) emphasize the advantages of PMPT to MPT; nonetheless, this is a remarkable finding from their empirical studies based on forecasts of expected returns. Although many studies utilize downside risk measures across different indices, the existing literature regarding stock selection, asset allocation, and portfolio construction with a downside risk framework for Borsa Istanbul is still developing. The main motivation of this study is to construct portfolios using the PMPT framework, that is, the downside risk framework, and to compare them with MPT portfolios, equally weighted portfolios, and the market index. The secondary motivation of this research is to propose an alternative weighting method for the participation index based on the PMPT approach and tools. Accordingly, we created and compared the Sortino, Sharpe, and EW portfolios for 527 trading days and four periods using the XK030 daily stock returns. There are many empirical studies on Borsa Istanbul (Istanbul Stock Exchange) that focus on conventional indices such as BIST 30 and BIST 100. Acar (2020), Bayat and Yiğiter (2021), and Yıldız’s (2021) research can be given as examples. Therefore, we conducted a study on alternative index that interest to different segments in the Turkish capital market. In the context of this, we created and compared the Sortino, Sharpe, and EW portfolios for 527 trading days and four periods using the XK030 daily stock returns.

The XK030 is a thematic index (the Turkish Islamic Index) and companies’ shares in the index are specified following the screening process. The stocks included in the index are reviewed according to the qualitative and quantitative criteria. In other words, participation indices comprise companies that comply with specific rules. We provide the screening process steps of the Borsa Istanbul Participation Indices in Annexes.

As it is known, the Sharpe ratio is a simple metric that shows the risk-return trade-off and indicates risk in terms of total volatility. The ratio can typically be followed by investors who want to minimize the total risk of the portfolio. The Sortino ratio is a downside risk-oriented metric that is suitable for investors with low-risk tolerance. In this study, we construct portfolios using the Sharpe and Sortino ratio optimization methods, consistent with MPT and PMPT measures. In addition, we create equally weighted portfolios (EW) and include the participation XK030 as a benchmark. In the first section, we introduce the PMPT framework, its measures, and tools. The literature review is followed by an explanation of the data and methods. The final section presents our findings and results.

2. PMPT Framework

The fundamental risk measures of the MPT have certain limitations. One such limitation is the use of the standard deviation as a risk measure based on the symmetricity of the return distribution. Rom and Ferguson (1994, 2001) introduced the PMPT framework under the title "Comes of Age," stating that an MPT's risk measure does not reflect investors' perception of risk. In fact, they emphasize that investors do not accept movements above the target return, known as upside volatility, as risk. Rather, investors consider that risk the possibility of a positive return (Riddles, 2001). Harlow (1991) argues that it is meaningful to use downside risk metrics because they are consistent with investors' risk perceptions. On the other hand, Nawrocki (1999) states that an investor's total wealth affects the tendency of risk aversion. Some researchers argue that downside risk is an appropriate measure of risk, but investors should also track total risk depending on the time horizons (Nawrocki, 1999: 23). As an asymmetric measure of risk, downside volatility is related to the minimum acceptable return or the target return (Figure 1).

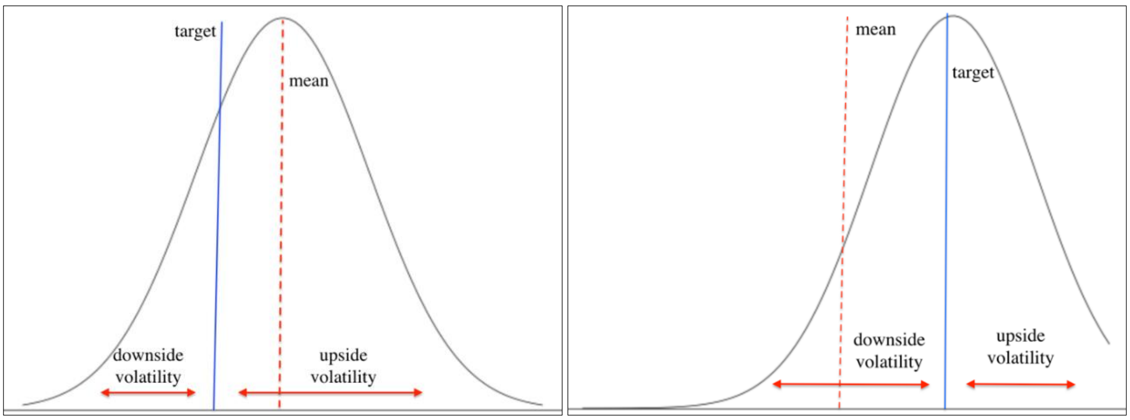


Figure 1. Downside Volatility in Symmetric and Skewed Distribution
Source: Rigamonti, 2020.

Under the symmetric distribution shown in Figure 1 (left side), the risk is reduced by minimizing deviations from the mean. However, return series are generally not symmetrically distributed and risk cannot be measured fairly by minimizing the deviation (right side). In other words, if returns have a skewed distribution or if targets (benchmark) are not equal to the mean, minimizing the total risk is not equivalent to minimizing the downside risk. In this respect, the PMPT's heuristic approach is suited to estimating the downside volatility for investors (Rigamonti, 2020). Downside deviation (σ_d) is a measure of downside volatility and is calculated using Equation 1.

$$\sigma_d = \sqrt{\frac{\sum_{i=1}^{n} \min(0, r_i - r_t))^2}{n-1}} \tag{1}$$

where r_i denotes the return of stock and r_t denotes the target return or minimum acceptable return (MAR). r_i can be computed using Equation 7.

The downside deviation is in the denominator of the Sortino ratio, which is the fundamental performance metric of PMPT. According to Chen (2016), downside deviation is the natural starting point for the pursuit of a single risk measure reflecting both volatility and skewness. As shown in equations 2 and 3, unlike the Sharpe ratio, Sortino focuses on the between the return and MAR (Sortino and Van der Meer, 1991; Sortino and Price, 1994).

$$sharpe = \frac{r_i - r_f}{\sigma} \tag{2}$$

where r_f denotes the risk-free rate and σ denotes standard deviation.

$$sortino = \frac{r_i - r_t}{\sigma_d} \tag{3}$$

where r_t denotes the target return.

PMPT's other risk metric is downside beta, which is a coefficient that measures the sensitivity of stocks to the market when the markets show a downward trend. Downside beta differs from traditional beta calculated as the covariance between stock returns and market returns divided by the variance of market returns. There are different calculation techniques for downside beta. In this study, we used the formula given by Charoenwong and Ng (2013), based on the approach of Bawa and Linderberg (1977).

$$\beta_d = \frac{E[(r_i - r_f)\min(r_m - r_f, 0)]}{E[\min(r_m - r_f, 0)]^2} \tag{4}$$

where r_m denotes market return. The numerator represents the covariance of stock returns and negative returns of the market portfolio. The denominator shows the square of the negative returns of the market portfolios. The use of downside beta in the CAPM formula transforms into a special form called D-CAPM (Equation 5).

$$E(r_i) = r_f + \beta_d(r_m - r_f) \tag{5}$$

where $r_m - r_f$ denotes excess return.

In the PMPT, the volatility skewness ratio indicates the distribution of the return series volatility. This ratio is obtained by dividing the upside variance of the distribution of the return series by the downside variance (Equation 6):

$$s_v = \frac{\frac{1}{n-1}\sum_{i=1}^{n}\max(0, r_i - t)^2}{\frac{1}{n-1}\sum_{i=1}^{n}\min(0, r_i - t)^2} \quad (6)$$

where t denotes target return. If the ratio is equal to 1, it indicates a symmetric distribution, and if $s_v > 1$ positive skewness, $s_v < 1$ negative skewness. We evaluated the ratio for the XK030 using data from 500 trading days. The index was negatively skewed (0.93196), meaning that the downside volatility of the series was higher than the upside volatility.

3. Literature Review

Relevant literature can be classified into two groups. The first group includes empirical research testing the PMPT in different markets. These studies have examined the ability of PMPT tools to explain stock returns. Artavanis et al. (2010) tested the explanatory power of PMPT risk measures (semivariance and downside beta). Researchers estimated cross-sectional linear simple regression and cross-sectional bivariate regression for the two periods and obtained different results in the London Stock Exchange and Euronext Paris. Tahir et al. (2013) empirically tested the CAPM and D-CAPM in the Karachi Stock Exchange by implementing the Fama-MacBeth procedure. El-Masry and El-Mosallamy (2016) examined the explanatory power of CAPM and D-CAPM in conventional and Islamic funds risk-adjusted performance. Rasool et al. (2018) investigated the explanatory power of the downside risk framework in four South Asian markets. On the other hand, Raza (2018) conducted a study on the Pakistan Stock Exchange with totally different results. Yıldız and Erzurumlu (2018) tested the explanatory power of downside risk metrics for stock returns in Borsa Istanbul with local and global single-factor models. Yıldız et al. (2020) conducted a comparative analysis of the CAPM and D-CAPM risk parameters, which better explain stock returns. Table 1 presents the findings of the studies.

Table 1. Summary of Findings (1)

Author(s)	Sample	Findings
Artavanis et al. (2010)	London Stock Exchange, Euronext Paris	Downside risk measures are found to be more effective for stocks. In contrast, there is no difference between downside beta and conventional beta for portfolios.
Tahir et al. (2013)	Karachi Stock Exchange	D-CAPM is a convenient model explaining risk-return trade-off.
El-Masry and El-Mosallamy (2016)	21 mutual funds in Saudi Arabia	D-CAPM is a more applicable measure for emerging markets.
Rasool et al. (2018)	Four South Asian Countries	D-CAPM is better pricing model as compared to standard CAPM for emerging equity markets.
Raza (2018)	Pakistan Stock Exchange	Despite the observation of negatively skewed behavior, the conventional model (CAPM) demonstrates better explanatory power for expected returns compared to D-CAPM.
Yıldız and Erzurumlu (2018)	Borsa Istanbul (Istanbul Stock Exchange)	D-CAPM provides more explanatory power than the CAPM. Downside risk metrics are considerable for emerging markets.
Yıldız et al. (2022)	Developed and Emerging markets	Downside betas are superior to CAPM betas in explaining stock returns.

The results of these studies show applicable PMPT measures for investment and risk management in different markets. The second group includes studies on portfolio selection, asset allocation, and optimization based on downside risk metrics and PMPT tools. Galloppo (2010) presented a resampling method in portfolio management, using Markowitz and PMPT models in three indexes. Geambaşu et al. (2013) emphasized that the PMPT method produces better empirical outcomes complying with the theoretical framework. Todoni (2015) proposed a new method and used the multiplier method and Sortino ratio to calculate risk-adjusted return in emerging markets including Romania, Hungary, the Czech Republic, Bulgaria, and Poland. In another remarkable study, Garcia (2019) introduced a portfolio selection model that allows investors to simultaneously evaluate average stock returns, downside risk, and ESG criteria. Jankova (2019) analyzed the risk-return of two investment portfolios using the MPT and PMPT approaches. Nassar and Ephrem (2020) proposed allocation strategies using the Sortino ratio to balance risk and return in DJIA. Yıldız (2021) utilized the alpha from CAPM and D-CAPM approaches as a criterion for stock selection and reported that the results from through applying on Borsa Istanbul 30 Index. Bayat and Yiğiter (2022) analyzed portfolio performance constructed by MPT and downside measures in the Borsa Istanbul 100 Index. May and Yeing (2022) developed a stock selection strategy based on Sortino. Table 2 presents the findings of the studies.

Table 2. Summary of Findings (2)

Author(s)	Sample	Findings
Galloppo (2010)	EUX50, SP100, SPMIB40	Resampling method in PMPT models such as tracking error minimization, mean absolute deviation minimization, and shortfall probability improved portfolio performance.
Geambaşu et al. (2013)	Bucharest Stock Exchange	PMPT increases the investor’s ability to manage risk under different market conditions.
Todoni (2015)	Five emerging markets in Europe	The author used the Sortino ratio, and the multiplier method to analyze the risk-adjusted return performance of the markets, were obtained different results for indices.
Garcia et al. (2019)	Dow Jones Industrial Average (DJIA)	Socially responsible portfolios that were constructed using mean return, downside risk metrics and ESG criteria outperformed the benchmark. The researchers used the Sortino ratio to determine the optimal portfolio.
Jankova (2019)	Prague Stock Exchange	Portfolios constructed with the PMPT provide lower risk and more diversification.
Nassar and Ephrem (2020)	Dow Jones Industrial Average (DJIA)	Asset allocation based on Sortino ratio is highly efficient in different market conditions.
Yıldız (2021)	Borsa Istanbul (Istanbul Stock Exchange)	The results produced by asset pricing models indicate no difference between risk minimization and portfolio diversification.
Bayat and Yiğiter (2022)	Borsa Istanbul (Istanbul Stock Exchange)	Researchers constructed a portfolio using MPT and downside metrics. The findings indicated that the alternative portfolio has a reduced risk compared to the MPT portfolio.
May and Yeing (2022)	Malaysia Stock Market	Sortino portfolios outperformed than Treynor and Jensen’s Alpha portfolios.

These findings show that the PMPT framework can be used to construct portfolios, particularly the Sortino ratio. The results of the studies focusing on emerging markets are very encouraging. Some researchers such as Galloppo (2010) and Nassar and Ephrem (2020) have produced better results in developed markets. In this respect, we believe that this study contributes to relevant literature. Additionally, the application of PMPT to the Borsa Istanbul Participation Index will be important for future comparative studies.

4. Data and Methodology

This study used daily stock return data calculated using closing prices from November 15, 2021, to June 28, 2024. The beginning date is determined by the period when the index was calculated by Borsa Istanbul (The first value date of Participation 30 Index by Borsa Istanbul is 10/01/2021). Closing price data were collected from Refinitiv Eikon Datastream. The daily returns (r_i) were calculated using Equation 7.

$$r_i = \frac{p_t}{p_{t-1}} - 1 \tag{7}$$

where p_t denotes the closing price at time t.

Table 3. Stocks in Participation 30 Index

Stock Numbers	Index Period I (May-September 2022)	Index Period II (October 2022-April 2023)	Index Period III (May -September 2023)	Index Period IV (October 2023-June 2024)
1	AKSA	AKSA	AHGAZ	AKSA
2	AKSEN	AKSEN	AKSA	AKSEN
3	ARDYZ	ALBRK	AKSEN	ALBRK
4	ASELS	ASELS	ALBRK	ASGYO
5	BASGZ	BASGZ	ASELS	ASELS
6	BERA	BERA	ASTOR	BIMAS
7	BIMAS	BIMAS	BERA	CWENE
8	BIOEN	CIMSA	BIMAS	DOAS
9	CCOLA	DOAS	CIMSA	ENJSA
10	DOAS	EGEEN	DOAS	EREGL
11	EGEEN	EREGL	EGEEN	GESAN
12	EREGL	GOZDE	ENJSA	GUBRF
13	GENIL	GUBRF	EREGL	ISMDR
14	GOZDE	ISDMR	GESAN	KLSER
15	GUBRF	JANTS	GUBRF	KRDMD
16	ISDMR	KRDMD	ISDMR	KARSN
17	JANTS	KONTR	KRDMD	KONTR
18	KORDS	KORDS	KONTR	MAVI
19	KRDMD	MAVI	KORDS	ODAS
20	OTKAR	ODAS	ODAS	OYAKC
21	PGSUS	OTKAR	OYAKC	PGSUS
22	PRKAB	OYAKC	PGSUS	PENTA
23	PSGYO	PGSUS	SASA	SASA
24	SASA	SASA	SNGYO	SMRTG
25	THYAO	SNGYO	SMRTG	TKFEN
26	TKFEN	TUPRS	TKFEN	TUKAS
27	TRGYO	THYAO	TUPRS	TUPRS
28	TRILC	TTRAK	THYAO	THYAO
29	TTRAK	VESBE	TTRAK	VESTL
30	VESBE	YYLGD	VESBE	YEOTK

Source: Borsa Istanbul, 2024.

The research sample consists of 52 companies on the XK030. Four periods were included in the study considering the index screening periods (Table 3). The stock weights in the portfolio for each period were calculated based on the previous period. For example, the weights from October 2022 to April 2023 index period were calculated using return data from May 2022 to September 2022. This calculation was based on Sharpe and Sortino's optimization. Then, the daily portfolio returns for the period were calculated using the weights. Following this method, daily portfolio returns were calculated for 527 trading days between May 6, 2022, and June 28, 2024. In short, we constructed the Sharpe and Sortino portfolios. In addition, we include EW portfolios and XK030 returns as a benchmark index for comparison. All computations were conducted using MS Excel and MS Excel Solver functions.

Sharpe and Sortino's portfolios were created using the ratio-maximizing method. In Sharpe ratio (Sortino ratio) optimization, expected returns $E(r_i)$ were calculated based on the CAPM (D-CAPM) formula. Turkey's 2-year bond yield (TR2YT=XX) was used as the risk-free rate (r_f). The target return (r_t) was 1% over the risk-free rate. To simulate index weighting (w_i), constraints were added to models. The objective function and constraints of the model are presented below.

Sharpe ratio objective function as follows:

$$maximize\ \left(\frac{E\left(r_p\right) - r_f}{\sigma}\right) \tag{8}$$

Sortino ratio objective functions as follows:

$$maximize\ \left(\frac{E\left(r_p\right) - r_t}{\sigma_d}\right) \tag{9}$$

where $E(r_p)$ denotes the expected return of the portfolio. It is calculated using Equation 10.

$$E(r_p) = \sum_{i=1}^{n} E(r_i)\, w_i \tag{10}$$

The constraint of optimization as follows:

$$\begin{gathered} subject\ to\ \sum_{i=1}^{n} w_i = 1 \\ 0.001 \leq w_i \leq 0.1, \forall i \end{gathered} \tag{11}$$

Portfolio returns for 527 trading days were calculated using the weights obtained after the Sharpe and Sortino optimization process steps. We update the stock weights in the portfolios for each period. Actual return of the portfolios (r_p) calculated by multiplying the daily realized return of each stock (r_i) by its weight (w_i) in the portfolio (Equation 12).

$$r_p = \sum_{i=1}^{n} r_i w_i \tag{12}$$

We calculate the Normalized Herfindahl Index (NHI) coefficient to measure portfolio concentration. NHI is a normalized form of the HI index. It ranged from 0 to 1. A coefficient close to 0 indicates a fair distribution, whereas a value close to 1 implies high concentration (Equations 13 and 14).

$$HI = \sum_{i=1}^{n} w_i^2 \tag{13}$$

$$NHI = \frac{HI - 1/n}{1 - 1/n} \tag{14}$$

Here, n denotes the number of stocks (Busse et al., 2006).

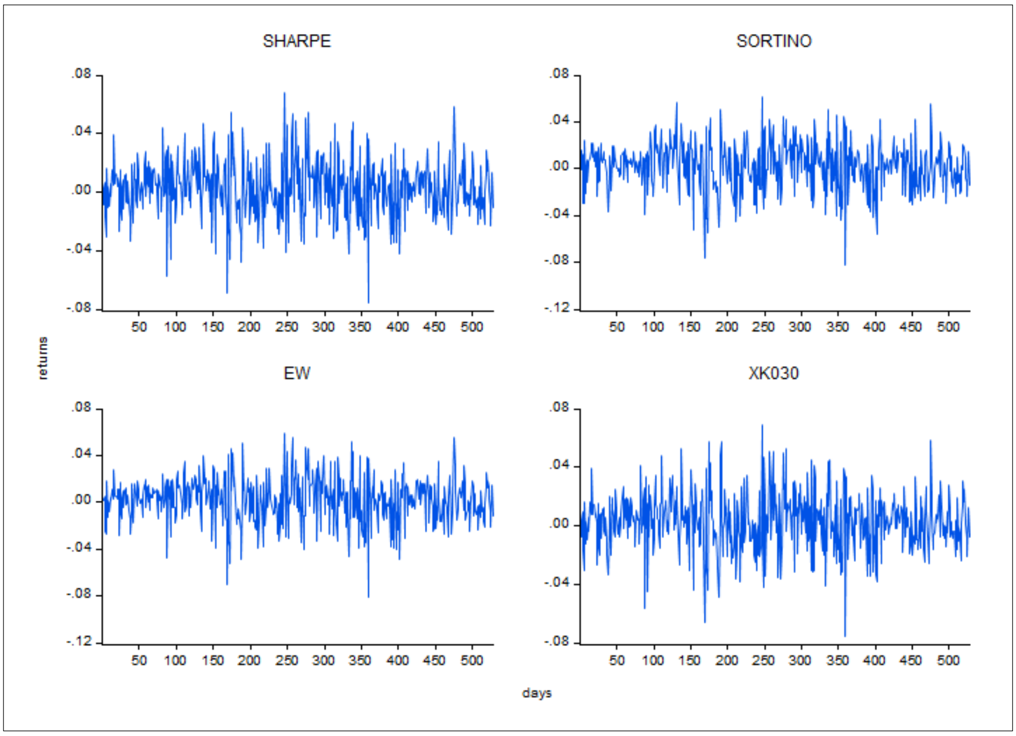
5. Findings and Results

The stock weights and concentration coefficients of the Sharpe and Sortino portfolios are presented in Table 4 according to the outputs of the optimization models solved under the specified objective function and constraints. Daily portfolio returns were computed for 527 days, from May 6, 2022, to June 28, 2024, using weights of four periods. Equally weighted portfolio returns are calculated for the same data range. The XK030 was used as the benchmark. Below, we provide model outputs, graphs, statistics, and estimates.

Table 4. Stock Weights

Stocks	Period I (Estimation Data Range: 11/16/2021 – 04/29/2022)		Period II (Estimation Data Range: 04/05/2022 – 09/30/2022)		Period III (Estimation Data Range: 11/01/2022 – 04/28/2023)		Period IV (Estimation Data Range: 05/03/2023 – 09/29/2023)	
	Sharpe	Sortino	Sharpe	Sortino	Sharpe	Sortino	Sharpe	Sortino
1	4.44%	10.0%	4.48%	7.06%	0.10%	10.0%	2.13%	0.10%
2	1.50%	10.0%	3.50%	10.0%	3.96%	10.0%	0.77%	0.10%
3	1.07%	6.64%	0.10%	0.10%	1.16%	0.10%	0.10%	10.0%
4	10.0%	0.10%	9.83%	3.23%	1.98%	10.0%	0.10%	10.0%
5	0.81%	0.10%	1.33%	0.10%	5.78%	10.0%	7.63%	0.10%
6	2.13%	10.0%	1.84%	10.0%	0.61%	10.0%	10.0%	10.0%
7	8.58%	0.10%	10.0%	0.10%	1.81%	0.10%	0.26%	0.10%
8	0.84%	0.10%	0.10%	8.40%	9.17%	10.0%	2.35%	0.10%
9	7.02%	4.73%	2.62%	10.0%	4.04%	0.10%	2.56%	2.96%
10	0.10%	10.0%	1.27%	2.39%	2.14%	0.35%	6.22%	0.10%
11	1.35%	10.0%	10.0%	0.10%	0.10%	0.10%	2.87%	0.10%
12	9.90%	0.10%	1.49%	0.10%	0.10%	2.27%	4.48%	9.84%
13	0.52%	10.0%	4.66%	3.30%	10.0%	0.10%	2.39%	0.10%
14	0.10%	7.80%	1.87%	0.10%	0.10%	0.10%	1.00%	9.94%
15	6.75%	0.15%	2.01%	3.92%	4.23%	9.46%	3.38%	0.10%
16	1.18%	10.0%	4.98%	0.10%	2.96%	0.10%	0.49%	0.10%
17	2.03%	0.10%	2.26%	10.0%	2.89%	0.10%	2.81%	10.0%
18	1.32%	7.57%	1.57%	0.10%	2.29%	1.78%	0.32%	0.10%
19	8.38%	1.06%	1.00%	0.10%	3.12%	0.10%	3.05%	0.10%
20	2.34%	0.10%	0.10%	10.0%	4.13%	0.10%	4.75%	3.43%
21	4.88%	0.10%	2.53%	5.16%	3.06%	0.10%	7.06%	4.01%
22	0.10%	0.46%	0.77%	5.50%	5.41%	0.10%	0.47%	9.06%
23	0.10%	0.10%	5.74%	0.10%	9.59%	0.10%	8.14%	0.10%
24	8.53%	0.10%	10.0%	0.10%	0.10%	0.10%	1.61%	2.80%
25	10.0%	0.10%	0.10%	0.10%	0.10%	6.20%	2.29%	0.10%
26	2.89%	0.10%	0.10%	0.15%	1.47%	0.10%	0.33%	0.10%
27	0.20%	0.10%	10.0%	0.32%	8.96%	1.74%	10.0%	3.15%
28	1.72%	0.10%	3.72%	0.10%	9.25%	6.61%	10.0%	10.0%
29	1.11%	0.10%	0.67%	0.10%	1.29%	10.0%	1.46%	0.10%
30	0.10%	0.10%	1.37%	9.18%	0.10%	0.10%	0.97%	3.21%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NHI	0.037	0.057	0.034	0.049	0.031	0.057	0.030	0.053

Graph 1 provides the distribution graphs of the portfolio returns created using the stock weights in Table 4.



Graph 1. Return Distribution of Portfolios

Table 5 provides the descriptive statistics of the portfolio returns. Statistically, it was observed that the series did not follow a normal distribution. The distributions were skewed to the left and asymmetric. The market index had the highest mean value, whereas Sortino had the highest median value.

Table 5. Descriptive Statistics

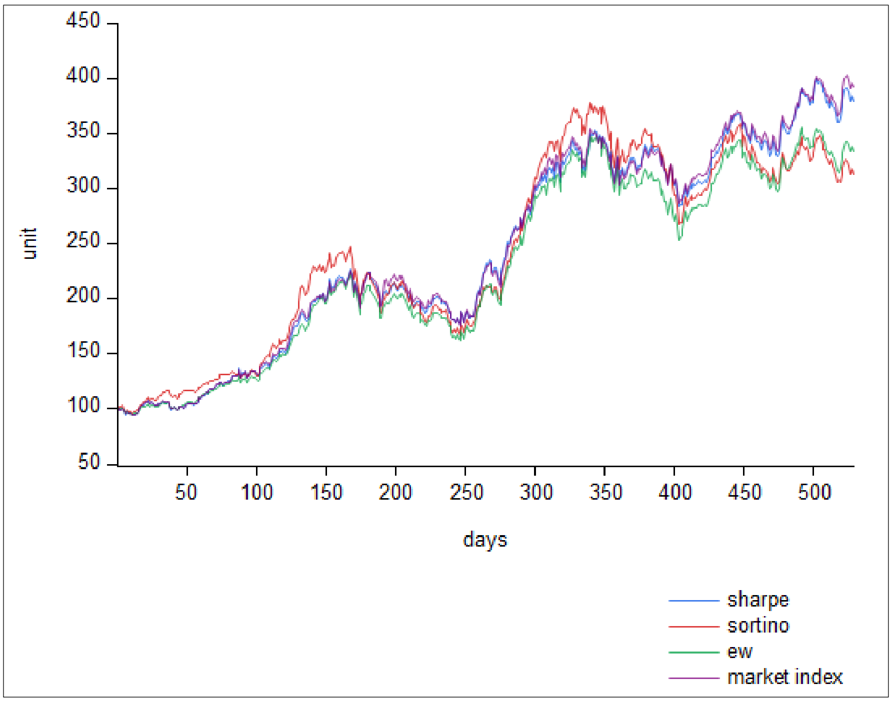
	Sharpe	Sortino	EW	Market Index
Mean	0.002722	0.002370	0.002475	0.002785
Median	0.003615	0.004289	0.003676	0.003570
Max	0.067744	0.061911	0.058943	0.069182
Min	-0.075513	-0.081938	-0.081326	-0.076167
Std. Dev.	0.019379	0.019967	0.019196	0.019545
Skewness	-0.122535	-0.368082	-0.326061	-0.052068
Kurtosis	3.914699	3.844606	3.975223	3.952751
Jarque-Bera	19.69080	27.56419	30.22178	20.17045
Prob.	0.0000	0.0000	0.0000	0.0000
Observation	527	527	527	527

Table 6 presents the correlation coefficients of the portfolios. It can be observed that there is a high correlation between Sharpe and the market index and a relatively lower correlation between Sharpe and Sortino. The Sharpe portfolio returns converge to the benchmark index.

Table 6. Correlation Matrix of Portfolios

	Sharpe	Sortino	EW	Market Index
Sharpe	1.000	0.889	0.959	0.989
Sortino	0.889	1.000	0.945	0.889
EW	0.959	0.945	1.000	0.952
Market Index	0.989	0.889	0.952	1.000

Graph 2 shows the return trends for the four portfolios starting with an investment simulation of 100 units over 527 trading days. Sortino diverged significantly from the benchmark index and others in a positive (upward) direction during some periods. This divergence is particularly evident in the 28-81, 131-172, 301-353, and 358-378 trading day intervals.



Graph 2. Compound Return of Portfolios

According to Graph 2, Sharpe diverges positively (upward) and negatively (downward) from the market index in some periods, and the two portfolios are similar in terms of return performance. In other words, the Sharpe follows the market index by excluding exceptional circumstances. The Sortino moves with the market index for short periods, while markets exhibit a downward trend but then diverge in a negative direction from the market. In the relevant periods, Sortino repeated similar tendencies in different ranges. During the downside market period, Sortino underperformed the market index. On the other hand, the EW portfolio underperforms the other portfolios for 478 trading days. In the examined period, the highest return reached by portfolios were as follows: 399.00 units for the Sharpe on the 501st trading day, 378.09 units for the Sortino on the 338th trading day, 355.00 units for the EW 490th trading day, 401.94 units for the market index 523rd trading day. Table 7 provides the risks, returns, and coefficients of variation (CV) of the portfolios for the 150-day periods.

Table 7. Return, Risk and CV of Portfolios

	Sharpe	Sortino	EW	Market Index
(1-150)				
Return	0.48%	0.57%	0.47%	0.48%
Risk	2.34%	2.46%	2.30%	2.35%
CV	4.87	4.35	4.88	4.93
(151-300)				
Return	0.22%	0.18%	0.22%	0.23%
Risk	2.24%	2.32%	2.24%	2.23%
CV	10.01	13.18	10.03	9.54
(301-450)				
Return	0.11%	0.06%	0.08%	0.11%
Risk	1.98%	2.19%	2.07%	1.97%
CV	18.04	37.95	26.41	18.71
(451-527)				
Return	0.11%	-0.09%	0.04%	0.14%
Risk	3.98%	3.20%	3.56%	3.99%
CV	36.07	-37.23	89.23	27.75

Note: Return and risk values are averages daily.

Sharpe is close to the market index in terms of portfolio performance over the 527-day period. In the first period (1-150), Sortino outperforms the other portfolios. After the second period, Sortino underperformed when the market showed a downward trend. Sharpe portfolio generally shows more stability; nevertheless, there are specific periods in which the Sortino portfolio outperforms both the participation market index (XK030) and the Borsa Istanbul 100 conventional market index (XU100). Additionally, it is seen that the participation market index underperformed Sharpe, Sortino, and EW in some periods. In general, portfolio performance varies according to market conditions. (See Annexes for a comparison of constructed portfolios and market indices.)

6. Conclusion

In this study, we constructed Sharpe and Sortino portfolios using stocks in the XK030. To construct a portfolio, we optimized the Sharpe and Sortino ratios under specified constraints and obtained stock weights. We computed portfolio returns using weights for each period and created a portfolio return series covering 527 trading days. Additionally, we created an EW portfolio and used XK030 as a benchmark for comparative analysis. We further employed XU100 as a conventional market index for a comparison (See Annexes). The results of the study show that the Sharpe portfolio consistently follows the benchmark index. It can be said that the MPT portfolio totally reflects both upward and downward market trends. During the sample period, Sortino outperformed the benchmark index when the market showed an upward trend (See Annexes). According to participation and conventional market trends, it could be concluded that Sortino achieved higher returns in a bullish market regime while underperforming the market index during the correction movements. We argue that investors and analysts could adopt the weighting and portfolio construction method based on PMPT as a strategy to provide excess returns (market outperformance) during a market upturn. On the other hand, they could recognize Sharpe convergence as a strategy to avoid losses during a market downturn. For instance, if we consider the Sharpe and Sortino portfolios as ETFs throughout the examined period, fund managers would achieve higher returns with Sortino ETF in periods of increasing stock prices (See Graph 2 and Annexes). In addition, they can manage various assets, not just stocks, by implementing them in the model and balancing their weights.

Many studies in the literature indicate that D-CAPM estimates higher expected returns; hence, the approach may be effective for stock selection and weighting during upward trends. It would be beneficial to concentrate on stocks with high expected returns. This study provides evidence that the PMPT approach to portfolio management is feasible and can be used in combination with MPT tools. Professionals should take positions according to different market conditions using alternative portfolio construction strategies. For instance, a strategy of index-tracking can be utilized for loss aversion during market correction movements. To obtain an excess return, professionals may focus on stocks with higher expected returns, ignoring risk. The findings from our models, including MPT and PMPT approaches align with different market dynamics.

As shown in Table 5, the concentration in the Sortino is higher than that in Sharpe. It is possible to state that Sharpe is better diversified than Sortino. The concentration of stocks in Sortino indicates the overweighting of specific stocks, which can have an impact on the overall performance of the portfolio. We observed that the EW generally underperforms except for the last 47 trading days. In this respect, it can be stated that investors and analysts must consider dynamic portfolio management. PMPT metrics, such as downside risk, downside beta, D-CAPM, and Sortino ratio, can be used for portfolio construction and weighting strategies. Additionally, this study proves that outperforming market returns can be obtained by using alternative portfolio construction strategies. Some findings of this study diverge from the existing literature. For instance, Jankova (2019) found that PMPT provided better diversification and less risk. On the contrary, we obtained more aggressive portfolios when we utilized PMPT methods for estimation. Furthermore, our diversification could not exceed that of MPT. On the other hand, the findings of Yıldız's (2021) research are noteworthy and partially align with our study in terms of the semi-variance approach does not outperform the mean-variance in reducing risk with diversification. Yıldız (2021) found the two approaches do not differ significantly. However, we observed some important differences in portfolio construction. Moreover, our research offers more dynamic outcomes than the study conducted by Bayat and Yiğiter (2022) from the same viewpoint.

This study shows that alternative index simulations are also applicable for portfolio management in addition to market capitalization-based indexation. Naturally, our study has limitations and includes only evidence from a specific period under examination. In future studies, researchers could work on different stock markets or indices. In this way, they could compare the findings and results with those of our study. In terms of portfolio management topics, such as PMPT and behavioral portfolio theory, they are remarkable areas for further research.

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Declaration of Research and Publication Ethics
This study, which does not require ethics committee approval and/or legal/specific permission complies with the research and publication ethics.

Researcher's Contribution Rate Statement
The authors declare that they have contributed equally to the article.

Declaration of Researcher's Conflict of Interest
There are no potential conflicts of interest in this study.

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Annexes

Table 1. Steps of Screening Process

Stocks that are not traded in the BIST Stars Market, BIST Main Market or Sub-Market at the start of the index period are excluded. In other words, the status of the market in which the companies are traded is taken into consideration**.**
Companies are excluded if they are ethically problematic, negatively affect people and other living beings, have a negative impact on their mental and physical health, and are intensive in money trading and interest-bearing transactions. The activities are as follows: Alcoholic beverages (both production and trade) Narcotic substances except for medical purposes (both production and trade) Gambling and gambling-related activities Pigs and their products (both production and trade) Financial transactions with interest Publication contrary to morality and Islamic values Entertainment, hotel management and similar activities that are not in accordance with Islamic values Activities that impose substantial harm on the environment and living beings Biological/genetic activities to change human nature Tobacco products that are harmful to health (production, wholesale trade and distribution)
Shares with certain privileges, such as profit or liquidation rights or usufruct shares, are excluded.
Companies that ignoring Islamic values, supporting acts that violate human rights and humanitarian values, in particular inherent right to life, are excluded. (Companies are also excluded if they are found guilty in these issues.)
Companies are excluded if they are considered directly contrary to the Participation Finance Principles are excluded.
In the screening of financial ratios, companies’ links to sectors rated as completely inappropriate in their interest-bearing assets and liabilities are limited to certain reference values to ensure compliance with the index. Quantitative screening values as are follows: Revenues obtained from non-permissible activities / Total revenues < 5.00% Interest-bearing assets / higher of market value or total assets < 33.00% Interest-bearing debts / higher of market value or total assets < 33.00%

Source: Borsa Istanbul, 2024.

Table 2. Computation Results of Optimization Parameters

Period	**CAPM**	**D-CAPM**	σ	σ_d	r_f	r_t	**Sharpe**	**Sortino**
1	0.34%	0.33%	2.40%	1.54%	0.0805%	0.0813%	0.11	0.16
2	0.27%	0.28%	1.54%	0.85%	0.0683%	0.0690%	0.13	0.25
3	0.12%	0.13%	2.15%	1.34%	0.0377%	0.0396%	0.04	0.07
4	0.63%	0.70%	2.29%	1.07%	0.0580%	0.0586%	0.25	0.60

Graph 1. Comparative Graphs of Portfolios