Chapter 6
Beyond Efficiency: Testing DEA-Selected Portfolios with Behavioral Utility and the Sharpe Ratio in BIST 100

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ABSTRACT

The study aims to empirically test the superiority of portfolios composed of stocks located on the DEA efficient frontier and introduces a multidimensional evaluation framework that integrates technical efficiency analysis with investor behavior. The risk-return space, based on *Markowitz's* mean-variance model, is non-parametrically restructured using Data Envelopment Analysis (DEA). Portfolios constructed based on DEA super-efficiency scores are evaluated using a utility function representing investor preferences modeled within a behavioral finance framework (A = 1 and A = 5); performance is also compared via the Sharpe ratio. The analysis, conducted using BIST 100 data for the period 2016-2019, shows that the highest utility and Sharpe ratios are concentrated in portfolios identified by DEA as efficient. These findings suggest that technical efficiency and behavioral investment decisions can align, providing investors with a holistic framework for both rational and behaviorally consistent portfolio selection.

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INTRODUCTION

Portfolio selection plays a central role in investors' financial decision-making, requiring an optimal balance between expected return and risk tolerance. The most widely accepted classical model in this context is the Mean-Variance (MV) model developed by Markowitz (1952). Although theoretically sound, the MV model has several practical limitations, particularly in emerging markets: high sensitivity to the covariance matrix, reliance on parametric assumptions, and the absence of a direct empirical representation of the efficient frontier.

In response to these challenges, Data Envelopment Analysis (DEA), a non-parametric linear programming technique, emerges as a robust alternative for performance evaluation. Unlike Markowitz, who defines absolute efficiency based on mathematical optimization, DEA assesses relative efficiency across comparable decision-making units. In this framework, DEA enables the construction of observable efficient frontiers and allows for the ranking of portfolios through super-efficiency scores.

This study adopts a simplified DEA model with a single input (risk) and a single output (return), deliberately aligning with the minimalist structure of the MV model for consistency and comparability. Using data from continuously traded firms in the Borsa Istanbul between 2016 and 2019, a two-stage analysis is conducted. In the first stage, technical efficiencies are calculated using the input-oriented BCC model, and portfolios are categorized into three groups based on super-efficiency: DEA (high), DEA Medium, and DEA Low. In the second stage, these portfolios are evaluated using both the Sharpe ratio and a utility function reflecting behavioral investor profiles (A=1: risk seeking, A=5: risk averse).

This study is one of the first to demonstrate how DEA can be integrated with behavioral elements in portfolio selection. Building on the investor-specific model of Bailey et al. (2013) and the behavioral portfolio theory of Barberis, Huang, and Santos (2001), the approach incorporates psychological elements such as risk perception, emotional response, and reference dependence. This dual-layered analysis aims to empirically and systematically bridge the gap between rational efficiency and investor behavior.

This study illustrates how the Data Envelopment Analysis (DEA) framework can be applied with behavioral elements in portfolio selection. Building on the investor-specific model of Bailey et al. (2013) and Behavioral Portfolio Theory (Barberis et al., 2001), the approach incorporates psychological elements such as risk perception and reference dependence. The behavioral biases considered (loss aversion and overconfidence) are well-documented in neurofinance literature, which associates them with specific neurological mechanisms. This dual-layered analysis explores the interplay between rational efficiency metrics and investor behavior.