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# Efficiency of Well-Diversified Portfolios: Evidence from Data Envelopment Analysis

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**Abstract**

In this work, we evaluate eight exchange traded funds (ETFs) and their benchmark index (the KOSPI 200 Index), based on the Sharpe ratio and the Treynor ratio and find that the performance of these well-diversified portfolios are quite poor relative to individual stocks. Investors' preference to avoid the well-diversified portfolios would be related to this poor performance. However, we empirically show that ETFs and the KOSPI 200 Index are the most efficient investment instruments with respect to the new performance measure designed on the basis of the data envelopment analysis (DEA) methodology. Examining the panel data over the period between 2003 and 2014 indicates that well-diversified portfolios improve the efficiency by adjusting the input variables ($\sigma$ and $\beta$). Furthermore, they do so more effectively as they mature.

**Keywords** Diversification, Performance measure, Efficiency, DEA, ETF



## 1 Introduction

Based on a mean–variance framework, modern portfolio theory indicates that investors should hold well-diversified portfolios, but in reality many investors tend to hold portfolios with fewer securities than are necessary to eliminate the diversifiable risk. Kelly [17] documented that the median U.S. stockholder holds only a single publicly traded stock by examining household data from the 1983 Survey of Consumer Finances. Goetzmann and Kumar [14] found that the majority of their sample