Chapter 2
Evaluating the Efficiency of Portfolio-Hedging Strategies by Incorporating Third Degree Stochastic Dominance Criteria and Data Envelopment Analysis

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ABSTRACT

The chapter investigates chosen hedging strategies with options as useful risk hedging instruments. Assuming that average investor prefers greater return, is risk-averse, and prefers greater positive skewness, the performance of different hedged and unhedged portfolios is evaluated using stochastic dominance (SD) criteria and data envelopment analysis (DEA). The SD is examined up to the third degree (TSD) using Davidson-Duclos (DD) test. In the DEA, a super efficiency BCC model is used. It is investigated how these two methodologies can be combined and how the TSD criteria can be integrated into DEA in order to simplify the analysis of determining efficient hedging strategies with options.

INTRODUCTION

Portfolio risk management is becoming more important and challenging than ever before. The field of risk management has evolved into a sophisticated and demanding process that requires significant quantitative knowledge and tools, as well as the integration of all new and existing scientific findings. Significant challenges in portfolio management arise when portfolios contain some type of financial derivatives. Derivatives are most commonly used for risk management, but they create an asymmetric return distribution and further complicate portfolio management. The groundbreaking portfolio selection methodology proposed by Markowitz (1952) and Tobin (1958) is based on a comparison of the mean

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and variance of the portfolio returns. As such, it is applicable only in cases where all return distributions are symmetric two-parameter distributions that can be described with the first two moments (such as the normal distribution), or when the investor's utility function is a quadratic function that describes the investor's utility using the first two moments of the distributions considered. Even though it is a great textbook example, this approach has many limitations (see, for example, Fabozzi et. al. (2012)). Portfolio management research should take into account that, in most cases, investors' utility functions are not known, and that portfolio return distributions must be described with more than just the first two moments. In this chapter, portfolio strategies are analyzed in terms of their efficiency. The starting point in this approach is to describe the investors' preferences which define the efficiency of the strategy. If a particular portfolio strategy generates portfolio returns which are never worse than those generated by other strategies for a group of investors with equal preferences, such strategy is considered efficient. All strategies that generate portfolios that are not bettered by any others constitute a set of efficient strategies.

One approach that allows evaluating the efficiency of investment alternatives using multiple criteria is Data Envelopment Analysis (DEA). This mathematical programming method evaluates the relative efficiency of the estimated units based on their inputs and outputs. The basic assumption in DEA is that inputs have to be minimized and outputs have to be maximized. The variables that define an investor's utility can be used as inputs and outputs, and the application of this methodology makes it possible to evaluate the relative efficiency of a set of portfolio strategies.

Another method that allows efficiency analysis is stochastic dominance (SD). It is particularly useful in cases where only certain assumptions about the decision maker's preferences and their utility functions are known. By comparing the return distributions of mutually exclusive portfolio strategies using the SD criteria, it possible to identify those strategies that never have smaller utility than the alternatives for all investors with the same preferences. In this way, the SD can be applied for the comparison of the return distributions generated by portfolio strategies and, if possible, used to identify those strategies that are efficient for all decision makers whose utility functions share the same general characteristics.

Thus, in this chapter, DEA and SD are used as tools for distinguishing efficient from inefficient portfolio strategies. Moreover, an integration of these two approaches is proposed. This integration aims at overcoming the deficiencies of each method and leads to the simplification of the analysis.

Against this background, this chapter uses the SD and DEA for examining the efficiency of equity portfolios with derivatives. The methods are used on a sample of returns generated by hedging strategies with options which are characterized by asymmetric distributions. The reason for analyzing hedging strategies with options is that options are the most efficient tools in the financial arsenal for successfully managing the risk and volatility that characterize today's financial markets (Lehman & McMillan, 2011). Simplified analysis of strategies with options (see for example Aljinović, Marasović & Šego (2011)) always shows strategies as suitable tools for equity portfolio hedging. However, the textbook strategies are not always simple nor always feasible in practice, so options are justifiably considered risky instruments. Therefore, the first objective of the chapter is to demonstrate the alternative approach to the efficiency analysis of portfolio strategies. The second objective is to reach conclusions on the efficiency of portfolio hedging strategies with options by using suitable approaches and more realistic market constraints.

This introduction has given a brief explanation of the research problem, its aims and the methodology. The second section provides an extensive literature overview of similar research. The third section further discusses the methodology, and the empirical findings can be found in the fourth section. This chapter ends with recommendations for future research and the overall conclusion of the research.