Chapter 17
Selected Applications of Grey Models in Stock Price Prediction

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ABSTRACT

This chapter examines the possibilities of utilizing the results of Grey Models (GM) in the portfolio selection. Namely, stock price prediction represents one of the most important steps in the portfolio management. Many different models and methods have been developed for this purpose over the decades. The GM models could be utilized for such purpose. However, this approach is still relatively unknown today although research in the Far East has shown that applications of GM approach have good forecasting capabilities. That is why this chapter aims to popularize the GM approach of modeling stock prices and to combine the estimation results with the portfolio performance measurement. The benefits of using GM models within the portfolio management are empirically confirmed using daily data on the stock market index CROBEX from Zagreb Stock Exchange during the period from September 2, 2019, until February 7, 2020. The GM(2,1) model is the best performing one with respect to out of sample forecasts and based on portfolio performance measures important to the investor.

INTRODUCTION

Portfolio management represents a process of managing money (Fabozzi and Pachamanova, 2016), in which several issues and steps need to be defined. These include defining the investor's preferences, goals and limitations; knowing to evaluate financial products and market conditions; constructing the investment portfolio and a trading strategy which will ensure the achievement of the mentioned goals; and finally, evaluation of the performance of such investment strategies (Fabozzi and Markowitz, 2011).

DOI: 10.4018/978-1-7998-5083-0.ch017

It is obvious that knowledge in many different fields is needed so that successful portfolio management can be conducted over time. This is especially true when it comes to quantitative modeling. Many different mathematical and statistical models and methods have been developed over the decades in order to answer specific questions in the area of portfolio management. Since the area of quantitative finance which consists of different models, techniques and approaches has been expanding rapidly, several attempts have been made to classify and categorize them (Granger, 1989; Taylor and Allen, 1992; Ho et al. 2002; Wallis, 2011): econometric approach such as autoregressive integrated moving average, generalized autoregressive conditional heteroskedasticity (AR(I)MA-GARCH), extreme value theory (EVT), non-parametric approaches such as data envelopment analysis (DEA), multiple criteria decision model (MCDM) and other related areas within the operations research (OR), neural networks, etc. All of the approaches have their advantages and shortfalls (for discussion, please see Jo, 2003; Liu et al., 2012; Khuman et al., 2014). The majority of the methodologies are used for forecasting purposes. In order to do so, a mathematical model is needed which is used to try to make accurate predictions (Kayacan et al., 2010).

Since the interest of quantitative modeling within the portfolio management is growing, it is not surprising that the methodological approaches are evolving, combining ideas and concepts from other approaches and that relatively unknown methodologies are emerging in the literature as well. One approach which is relatively unknown compared to some usual econometric approaches of modeling stock price, return and risk is the Grey Systems Theory (GST). This theory has been in development since the 1980s in the Far East (Lin et al., 2005; Liu et al., 2016; Yin, 2013). GST consists of different models and methods which can be used in the area of decision-making under uncertainties, i.e. when the data is "grey". The term "grey" data means that not all information is available for the decision-maker, due to ambiguity, information distortion, etc. This methodology is very appropriate for portfolio management, as many problems arise here due to data uncertainty. Investors often have to make certain decisions without full data available. Although much data and information on the stock markets are available on a daily basis, there is a lot of "grey" data that needs to be modeled adequately. It is not surprising that the research interest in GST applications on stock markets has grown in the last decade. There exist both theoretical and practical papers which deal with GST models and their usefulness on the stock market (Rathnayaka et al., 2016).

Thus, the main objectives of this chapter are to give an overview of the existing research which focuses on forecasting stock prices via the GST approach and to empirically evaluate the usefulness of this approach within the portfolio management. Although the amount of literature on this topic has been growing in the last couple of years (see Delcea, 2015; Camelia, 2015a,b for a bibliometric analysis), there exist several gaps in terms of interpreting the results from the investor's point of view. Namely, in order to determine the usefulness of a model as a tool for stock price prediction, the investor has to define certain criteria. One group of criteria includes the goodness of fit measures which usually compare the forecasts from the model to the real out of sample values of the time series which is being forecasted. However, when the time series has certain economic meaning and interpretation, other aspects have to be taken into consideration. This includes the characteristics of the predicted values. If the time series is the stock price, the investor is interested if the value is going to rise or fall, compared to the current value, as this is important for the value of the portfolio and the whole trading process. This chapter is going to include such aspects of the analysis as well. That is why the contribution of this research is found in a critical overview of the previous related research, as well as in the detailed empirical research which will provide guidance for future (potential) investors on how to fully implement the GST approach within the