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A quantitative characterization of sector-wise performance interdependencies in stock market using changepoint and performance-induced distant clustering

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The Colombo Stock Exchange (CSE) is the Sri Lankan marketplace for companies to trade their stocks to the public. There are 19 sectors in the CSE before the Global Industry Classification Standard (GICS) classification. The stock market has become a significant icon in most of the country's economy. Due to the enhancement of the data science discipline, quantitative research on the stock market has gained popularity among scholars in the recent past. Most of the studies were conducted to predict the value of a stock and its volatility. However, this study explored potential performance dependencies among the 19 industrial sectors registered at the CSE. In known literature, this scope has not been addressed quantitatively. The sectorial All Share Price Index (ASPI) is used to characterize the sector interdependencies, as the volatility of ASPI implies the sector performance at a given time or a short period. Because diverse sector movements can offset each other, leading to a stable index, while extreme sector-specific events or trends can result in increased index volatility. The ASPI indices published by CSE from 2005 to 2019 were considered in the analysis. The persistency of ASPI volatility in a compact interval indicates the consistency of the performance in each sector. Thus, the comparison of volatility changes and their changing time, i.e., changepoint analysis, describes the changes in the sectorial performances. Consequently, the interdependencies among the sector-wise performances can be recognized by the emerging patterns of the changepoints, i.e., the clustered behaviour of the changepoints. Through this approach, the investigation seeks to identify significant transitions or shifts in the behaviour of each sector. Non-parametric methods were employed in the identification of the changepoints of the ASPI series. The standard clustering approaches could not be utilized in grouping the changepoints as the clustering metrics defined by the variation of performances are interconnected. Thus, a new clustering approach was developed using a cluster performance-induced distant measure defined based on a reference industrial sector. This analysis resulted in interdependency among the industrial sectors. Further, variation patterns among the changepoints were identified using interval scaling, and dependent industrial sectors were identified with the help of the performance-induced distant clustering approach. For example, the Bank Finance & Insurance, Telecommunication, and Trading sectors exhibited strong interdependencies. Also, the Construction & Engineering, Oil palms, and Hotel & Travels sectors exhibited strong interdependencies. So far, in qualitative relations, these interdependencies were merely recognized by the gut feelings of financial analysts. Nevertheless, this study provides a clear quantitative characterization of performance dependencies, and thus, the findings are crucial for determining investment strategies and minimizing risk in stock exchanges.

Keywords: Change-point, Clustering, Colombo stock exchange, Industrial sectors, Time series analysis