Effect of portfolio diversification by market factor in the Korean and Japanese stock markets

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We empirically investigate the effect of Markowitz portfolio diversification by market factor in the Korean and Japanese stock market. In order to examine the established research objective, the degree of market factors and the level of portfolio diversification were quantified as follows.

First of all, previous studies found that market factors have stronger influence on the stock market during a market crisis [1-3]. We study the Korean market data including the period of the Asian foreign exchange crisis in December 1997 and the Japanese market data with the period of big recession in January 1990. Two measurements are employed to quantify the level of market effect. The first is the largest eigenvalue created by random matrix theory, RMT, in which the higher value of the largest eigenvalue, the higher influence of market factors. The second measurement is the mean square error, MSE. We construct a correlation matrix removing properties of the largest eigenvalue by the RMT, and then the MSE, the difference between controlled correlation matrix and the original correlation matrix, is utilized, in which the higher value of the MSE, the higher influence of market factors.

Next, the level of portfolio diversification is whether investment weights are well distributed among the all of the stocks within a portfolio. Accordingly, we elicited an efficient portfolio with a minimum risk for a given return based on Markowitz portfolio selection theory [4], and examined how investment weights were distributed among the stocks in the portfolio. Two measurements are also employed to quantify the level of portfolio diversification. The first is a intra-portfolio correlation, IPC ($-1 \leq IPC \leq 1$, decreases in value and converges to -1 as investment becomes more diversified) and the second measurement is concentration

coefficient, CC ($CC \approx N$, increases in value and converges to the N number of stocks as investment becomes more diversified) [5].

The observed results can be summarized as follows. We find that the influence of market factors becomes stronger during market crises in Korean and Japanese stock markets. The largest eigenvalue elicited with the RMT method increased in its value during crises, and the MSE clearly increased also. In addition, we discovered that the level of Markowitz portfolio diversification decreases when the effects of market factors become strong. It was confirmed that IPC increased and CC decreased around the crises in Korean and Japanese stock markets. However, the portfolio constructed by the correlation matrix removing properties of the largest eigenvalue by the RMT, is not influenced by the market factor. These results suggested that the effect of market factors have negative influences on the level of portfolio diversification in the stock market. Moreover, in viewpoint of usefulness of the RMT, we demonstrated that the correlation matrix, from which market factors are removed, can be applied for portfolio diversification.

Keywords
portfolio diversification, market factor, random matrix theory, Markowitz's Portfolio Selection

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