

Preface

Financial markets can be found in nearly all countries throughout the world. As a result of the integration of a country's local financial system with international financial markets, people's daily lives in such countries, as well as the countries themselves, have become more exposed to cross-border risks, such as financial and economic risks. The financial crisis triggered by the US subprime loan crisis in 2007 eventually led to a global economic crisis that affected simultaneously not only emerging countries but also developed countries all over the world. In order to determine the mechanism of the crisis, a market overview is indispensable, especially when the market is influential on business and economy.

One means to express the overall perspective of a market is to construct an index as a proxy measure. However, unlike an established market, in which the index is officially defined and announced, for a newly developed financial instrument experiencing its rapid market growth, it is not easy to construct an appropriate index due to the lack of information. Moreover, in order to fully reflect the price movements of a financial asset, the index should reflect their distributions. However, these distributions are often heavy-tailed and possibly skewed, and identifying them directly is not easy.

This book develops through the use of nonstationary non-Gaussian multivariate time series analysis a new practical method for constructing an index of prices of a financial asset for which the distributions are skewed and heavy-tailed. In order to facilitate the identification of non-Gaussian distributions, we propose to transform the price observations by the Box-Cox transformation. Then, the long-term trend of the distributions of the optimal Box-Cox transformed observations is estimated by fitting a trend model in which observation noises have a time-varying variance. The parameter of the optimal transformation is determined by the AIC. By applying state-space modeling, the estimation is performed and missing observations are automatically interpolated. Finally, the index is defined by taking the inverse Box-Cox transformation of the optimal long-term trend. The new index becomes impartial, regardless of the price distribution, and is referred to as a distribution-free index.

Economic and financial time series often exhibit a gradually changing long-term fluctuation, i.e., a trend, which may sometimes form a pattern due to an event specific to the attribute of the time series such as fundamental and economic factors. On the other hand, the short-term cyclical fluctuations around the trend can be sensitively influenced by short-term cyclical fluctuations of any other economic and financial time series, regardless of their specific characteristics. In fact, contagious phenomena of short-term fluctuations of financial markets have often been observed worldwide due to the globalization of the financial system. In order to detect such causations, this book proposes the application of the generalized power contribution, which extends the original Akaike's power contribution by decomposing a variance covariance matrix of noises. The frequency-wise effect of multidimensional noise sources on the fluctuation of each variable with feedback loops is thus revealed.

In order to investigate the effectiveness of a distribution-free index, this book applies the construction method of a distribution-free index to financial and economic time series data and analyzes the causations using power contributions. For example, applying this method to the sovereign credit default swap markets, in which the spread distributions are often heavy-tailed and the number of observations varies over time due to immaturity, the worldwide spillover effects of the European debt crisis are detected. Another example shows the clear polarization between advanced and emerging regions by constructing the GDP growth distribution-free indices.

These applications confirm that applying our indexation method to markets with insufficient information, such as fast-growing or immature markets, can be effective. Therefore, wider applicable area of our method can be expected.

Although this book has been made to be as self-contained as possible, the reader may benefit from some of the referenced literature.

This book is intended for anyone who is interested in the practical use of statistical methods in solving real-world problems. We hope that our method will prove useful in analyzing practical problems in finance and economics.

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