Preface

This book aims to provide a wide-ranging audience of time-series analysis and econometrics with an introduction to an approach to analyzing vector time-series interdependence. In particular, this book is intended as a practical introduction for real-life applications, emphasizing practical analysis of time series using the proposed causal and allied measures, in particular statistical causal analysis of time-series data produced from real life but not necessarily well-controlled experimental intervention. The book does not go in detail on the (asymptotic) theoretical aspects of statistical time-series analysis; rather, it assumes the standard results. The book's emphasis is on a numerical determination of estimated and large-sample theoretical implications for a practical non-large sample.

Chapter 1 provides an introduction and a brief overview of the literature on empirical causal analysis, and positions this book's approach in this body of literature. The chapter compares a variety of conflicting views or interpretations on how statistical associations can be called causal. In particular, controlled random experiments are compared with observational studies in econometrics. The chapter discusses topics such as the relation of causality and exogeneity in the framework of a simultaneous equation; ancillarity and conditioning in relation to exogeneity; and the relation of causality and prediction improvement in empirical analyses.

Chapter 2 first discusses the formal relation of the Granger and Sims concept of causality and then expounds on the measures of one-way effect, reciprocity, and association. The key approach of this book is the elicitation of a one-way effect component of a supposedly causing series. The measures of interdependence are defined overall as well as frequency-wise quantities in the frequency domain, providing three ways of derivation of the frequency-wise measure. One is based on direct canonical factorization of the spectral density matrix, and the other two are based on distributed-lag representation and innovation orthogonalization. Section 2.5 introduces the overall as well as the frequency-wise measures of reciprocity and association.

To address the problem of third-series involvement, Chap. 3 introduces a partial version of the measures of interdependence. The third-effect elimination we suggest is elimination of the one-way effect component of the third series from a pair of

subject-matter series to preserve the inherent feedback structure of the pair. This chapter presents explicit representations of those partial measures and shows how they are numerically evaluated by means of the canonical factorization algorithm by Hosoya and Takimoto (2010). Chapter 3 also shows how the theoretical framework for stationary processes is extended to cointegrated processes.

Using the stationary vector ARMA process, Chap. 4 discusses the statistical estimation of the partial measures of interdependence and testing allied hypotheses. The point is the use of a simulation-based estimation of the covariance matrix of the measure-related statistics and its application to Wald statistics. In Sect. 4.2, we investigate the performance of a small sample of the partial one-way effect measure estimates using Monte Carlo data. To illustrate an analysis of interdependence in the frequency domain, Sect. 4.3 provides an empirical analysis of US interest rates and economic growth data.

Chapter 5 considers the association between structural change in parameters and changes in the causal measure. The chapter proposes an inference method on the association and examines properties of the test statistic by Monte Carlo simulation. Section 5.2 provides a test for measure changes using a sub-sample variance estimation for high-frequency data. Section 5.3 investigates how the proposed test approach works for small sample examples. The two illustrative empirical applications are provided in Sect. 5.4.

Appendix provides technical complements on the concepts of Hilbert space, root modification method, and Whittle likelihood function used in this book.

Regarding the contributors of the chapters, Hosoya wrote Chaps. 1–3; Takimoto and Hosoya wrote Chap. 4, and the computational results were produced by Takimoto; Oya and Kinoshita wrote Chap. 5, and the Appendix was written by Hosoya and Takimoto. Those chapters and the Appendix in the manuscript stage were proofread mainly by Oya. This book is the result of an effective collaboration among the four of us. We have all attended common conferences and meetings, at which some of us made reports on topics related to the contents of this book. We have also held several of our own meetings to discuss the subject matter, computational methods, and the coherence of the content and style of this book.

Sendai, Japan — Yuzo Hosoya
Toyonaka, Japan — Kosuke Oya
Fukuoka, Japan — Taro Takimoto
Kokubunji, Japan — Ryo Kinoshita
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