

DECOUPLING SYSTEMIC RISK INTO ENDOPATHIC AND EXOPATHIC COMPETING RISKS THROUGH AUTOREGRESSIVE CONDITIONAL ACCELERATED FRÉCHET MODEL

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Abstract: Identifying systemic risk patterns in geopolitical, economic, financial, environmental, transportation, epidemiological systems and their impacts is the key to risk management. This paper proposes a new nonlinear time series model: autoregressive conditional accelerated Fréchet (AcAF) model and introduces two new endopathic and exopathic competing risk indices for better learning risk patterns, decoupling systemic risk, and making better risk management. The paper establishes the probabilistic properties of stationarity and ergodicity of the AcAF model. Statistical inference is developed through conditional maximum likelihood estimation. The consistency and asymptotic normality of the estimators are derived. Simulation demonstrates the efficiency of the proposed estimators and the AcAF model's flexibility in modeling heterogeneous data. Empirical studies on the stock returns in S&P 500 and the cryptocurrency trading show the superior performance of the proposed model in terms of the identified risk patterns, endopathic and exopathic competing risks, being informative with greater interpretability, enhancing the understanding of the systemic risks of a market and their causes, and making better risk management possible.

Key words and phrases: Business statistics, extreme value analysis, nonlinear time series, risk management, time-varying tail risk.

1. Introduction

Systemic risk refers to the risk of collapse of an entire complex system due to the actions taken by the individual component entities or agents that comprise the system. Systemic risk may occur in almost every area, for example, financial crisis, flooding, forest fire, earthquake, market crash, economic crisis, global disease pandemic (like COVID-19), among many others (Zhang, 2021a,b). Typically, a system contains a number of risk sources, and once one comes first to collapse, the whole system is affected immediately, i.e., the risk sources are competing. When a disaster event (systemic risk) occurs, it may not be known

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