Unlocking Predictive Power: A Deep Dive into Cryptocurrency Futures with Time-Varying GBM and Mixed-GARCH Models

Wongtawan Uthumrat[1], Napon Hongsakulvasu[2], Anin Rupp[3,*]
[1]Program in Business Administration, CMUBS (Chiang Mai University, Chiang Mai, Thailand)
[2]Chiang Mai University (Faculty of Economics, Chiang Mai University, Chiang Mai, Thailand)
[3]CMUBS (Department of Finance, Chiang Mai University, Chiang Mai, Thailand)

**Corresponding Author Email: anin.rupp@cmu.ac.th*

Abstract

This study investigates the comparative forecasting performance of two financial models in predicting Bitcoin futures prices. The analysis centers on the three nearest expiration contracts listed on the CME exchange. Two competing forecasting frameworks are evaluated: The Geometric Brownian Motion (GBM) model, which assumes random price movements, and the Mixed-GARCH model, which accounts for time-varying volatility. Model performance is assessed using the Model Confidence Set (MCS) procedure in conjunction with the Mean Squared Logarithmic Error (MSLE) loss function as the benchmark accuracy criterion. The empirical results consistently demonstrate that Mixed-GARCH models yield superior forecasting accuracy relative to GBM-based models across all Bitcoin futures contracts and forecast horizons. These findings suggest that explicitly modeling volatility dynamics substantially enhances predictive precision in Bitcoin futures markets. Furthermore, this study provides investors and risk managers with a practical framework for speculation and risk management in Bitcoin futures markets.

Keyword: Bitcoin Futures, GARCH, Geometric Brownian Motion