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Choosing the Optimal Model for Predicting Asset Returns: A Comparison of ARIMA-GARCH and MIDAS Models

*Saeed Sadrzadeh Moghadam *, Kambiz Hojabr Kiani **Kambiz Peykarjou***, Alireza Moradi*****

** Ph.D. Candidate, Department of Economic, Faculty of Management and Economics, Islamic Azad University, Science and Research Branch, Tehran, Iran.*
Email: saeed.sadrzadeh@srbiau.ac.ir
ORCID : 0000-0001-9930-0385.

*** Corresponding Author, Prof. Department of Economic, Faculty of Management and Economics, Islamic Azad University, Science and Research Branch, Tehran, Iran.*
Email: khkiani@yahoo.com
: 0000-0002-0191-2138

**** Assistant Prof, Department of Economic, Faculty of Management and Economic, Science and Research Branch, Islamic Azad University, Tehran, Iran.*
Email: k.peykarjou@srbiau.ac.ir
:0000-0002-7468-6549

***** Assistant Prof, Department of Economic, Faculty of Humanities, Kermanshah Branch, Islamic Azad University, Kermanshah, Iran.*
Email: alirezaradin@yahoo.com
ORCID: 0000-0001-9655-8612

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EXTENDED ABSTRACT

INTRODUCTION

In this study, in order to examine and compare two modeling approaches in econometrics in terms of prediction accuracy, the time series of Bitcoin prices with high-frequency data (5-minute daily Data) has been selected for the period from 2015 to 2023. Bitcoin, as the most popular and well-known digital currency, has become an important asset for many investors in financial markets and even ordinary people in recent years. Therefore, extensive studies are being conducted to discover the price structure and variations of this asset over time. The modeling approach using Mixed-data sampling (MIDAS) has been proposed as a new approach in modeling in recent years and, given the significant limitations in econometric modeling, it is being studied more than ever. Prediction approaches are divided into two groups: quantitative and qualitative approaches. In the field of econometrics, there are causal and non-causal regression patterns, which include their autoregression models with conditional heteroskedasticity and autoregressive integrated moving average from causal methods in the domain of economic variable prediction (Brockwell et al., 2002). These models also faced limitations, especially when dealing with data with different time frequencies.

Researchers aiming to model time series variables with different time frequencies need to first synchronize all variables and then incorporate them into the model. There are two approaches for this: harmonizing variable frequencies towards higher time frequencies or harmonizing towards lower time frequencies. The first method is called temporal aggregation, and the second method is called temporal disaggregation (Bayat & Nofouresti, 1394). In most cases, the application of these methods results in reduced model efficiency and loss of useful information. The mixed data sampling approach, developed by Ghysels (2004), is an innovative and novel approach in modeling economic variables. In this study, traditional approaches are tested against the introduced novel approach for prediction using information from a time series. The main question posed is whether traditional econometric methods provide better models in terms of lower error and higher accuracy compared to novel approaches or not?

METHODOLOGY

This study compares the prediction accuracy of ARIMA-GARCH and modeling using the mixed data frequency approach with different time frequencies (MIDAS). To examine the validity of the two mentioned approaches, daily 5-minute intraday time series data of Bitcoin returns were collected and an ARIMA model was implemented for Bitcoin returns (both daily and weekly). To select the orders of p and q in the ARIMA model, a set of models with different p and q orders is estimated while considering visual inspection of autocorrelation and partial autocorrelation functions. Information criteria are then calculated for that set of models. The best ARIMA model in this section is the one with the lowest Akaike information criterion (AIC) value. In the next step, considering the base GARCH (1,1) model, each of the daily and weekly Bitcoin return time series is estimated in three modes: sGARCH, eGARCH, and gjrGARCH. Additionally, in each of the estimated models, five distribution modes are considered: normal distribution, Cholesky normal distribution, Student's t-distribution, Cholesky Student's t-distribution, and generalized error distribution. In total, 15 models are estimated for each time series at this stage. In order to prepare the data for comparing the prediction accuracy of different models, the daily data (3024 data points) and weekly data (432 weekly data points) have been divided into two sections. Daily returns from the beginning of 2015 until the end of 2022 (2528 data points) were used for model estimation, and from the beginning of 2023 until 08/05/2023 (496 data points) were used for prediction. Additionally, for weekly returns, the data up to the end of 2022 (413 weekly

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data points) were used in the estimated model, and the data from 2023 were excluded to assess prediction accuracy. Using the novel approach of modeling mixed data with different time frequencies, the daily and weekly Bitcoin return time series are examined and modeled. For this purpose, the daily and weekly return data, constructed from intraday (5-minute) returns, are utilized. Considering that cryptocurrency markets operate 7 days a week, the modeling in this section involves aligning the higher-frequency data (5-minute intraday returns) as explanatory variables with the lower-frequency data (daily returns) as dependent variables. Additionally, a correspondence of m=7 is defined to link the daily data (as explanatory variables) with the weekly data (as dependent variables). The commonly used weighting functions in the MIDAS framework include Almon, exponential Almon, and beta functions. All three weighting functions are separately incorporated into the model, and the results are used for predicting daily and weekly return time series. The estimations are performed using the midas_r software package, developed by Ghysels and colleagues, which automatically selects optimal initial values and breakpoint counts. Given that the ultimate goal of this study is to assess the predictive power of the model, the best model with the lowest Akaike information criterion (AIC) value at each stage is automatically chosen by the software.

FINDINGS

The main objective of this study is to examine two approaches in time series modeling for the purpose of determining the optimal model for prediction. The optimal model is selected based on minimizing error and maximizing accuracy. To perform predictions, the collected data range is divided into two parts: training and testing. Both selected models are estimated using the training data. Subsequently, using the estimated model, time series values are predicted for the testing section and compared with the actual values. To ensure consistency in the prediction time range, all data related to the year 2023 are excluded from the sample, and both approaches are estimated for the period from the beginning of 2015 to the end of 2022. Predictions for the ARIMA-GARCH family models are conducted in three modes: sGARCH, eGARCH, and gjrGARCH, each with five distribution types: normal distribution, Cholesky normal distribution, Student’s t-distribution, Cholesky Student’s t-distribution, and generalized error distribution. In the modeling section with different frequency data, predictions are made for

three weighting functions: Almon, exponential Almon, and beta, based on the rolling window approach and recursive pattern. In total, six models are estimated and predicted in this section. The results of this stage indicate that for the daily return time series, the estimated model using the MIDAS framework with the Almon weighting function outperforms the ARIMA-GARCH family models with different distributions and the MIDAS models with beta and exponential Almon weighting functions in terms of prediction accuracy. For the weekly return time series, the MIDAS model with the exponential Almon weighting function and the rolling window prediction approach demonstrates complete superiority. All evaluation metrics for prediction accuracy favor this approach over the other methods introduced in this study

CONCLUSION

In this study, two approaches in time series modeling were examined in terms of prediction accuracy. The traditional econometric approach, which has been used for many years in time series modeling, was compared to a novel approach designed to address a significant issue in economic modeling: the need for consistent time frequencies within a regression model. In this study, all possible scenarios for both approaches were investigated and tested, including various existing models, common error distributions, and weighting functions used in previous studies. Additionally, high-frequency data (5-minute intraday data) were utilized for calculating returns and modeling. In general, the results of this section indicate that the prediction accuracy of MIDAS regression is higher compared to ARIMA-GARCH family models, and selecting an appropriate weighting function can have an impact on improving the prediction accuracy of MIDAS regression. The main complexity in modeling with the MIDAS approach lies in choosing the appropriate number of lags for the high-frequency variable and selecting a suitable weighting function, both of which significantly affect the presentation of more accurate predictions.

Reference

Abasi Nami, H. (2021). Forecasting Crude Oil prices Volatility and Value at Risk: Single and Switching Regime GARCH Models. *Energy Economics review*,17(68), 141-174. SID: https://sid.ir/paper/380078/ [In Persian]

Amiri, H. , Pourjavan, A. and Zahedi, M. (2025). Gold, Currency and Bitcoin as Hedge or Safe Haven for Stocks: Evidence from Tehran Stock Exchange (TSE) using Smooth Transition Regression (STR) Models. *Quarterly Journal of Quantitative Economics (JQE), 21*(4), 220-272. [In Persian]

Andreou, E. Ghysels, E. Kourtellos, A. (2010). Regression Models with Mixed Sampling Frequencies. *Journal of Econometrics*. 158(2), Pages 246-261.

Barakchian, S. M., & Rezaei, M. (2016). Evaluation of Mixed-Frequency Regressions in Forecasting Seasonal Inflation Rate of Iran. *Journal of Economics and Modelling*, 7(25), 25-46. https://ecoj.sbu.ac.ir/article_52259_52c91c7c6bfd6ad4801b43f8e03ddda5.pdf [In Persian]

Bariviera, A.F. (2017). The In-efficiency of Bitcoin Revisited: A Dynamic Approach. *Economics Letters*, 161, 1- 4.

Bayat, M. Noferesti, M. (2015). *Applied Time Series Econometrics: Mixed Frequency Data Sampling Model*. Noor-e-Elm Pub. [In Persian]

Bollerslev, T. (1986). Generalized Autoregressive Conditional Heteroskedasticity. *Journal of Econometrics*, 31(3), 307–327.

Box, G., Jenkins, G. M. (1976). Time Series Analysis: Forecasting and Control. Holden-Day.

Brockwell, P. Davis, R. and Calder, M. (2002). Introduction to Time Series and Forecasting. *Springer*,Vol 2.

Catania, L. Grassi, S. & Ravazzolo, F. (2019). Forecasting Cryptocurrencies Under Model and Parameter Instability. *International Journal of Forecasting*, 35, 485–501.

Celik & Ergin. (2013). Volatility Forecasting Using High Frequency Data: Evidence from Stock Markets. *Economic Modeling*, 36, 176-190.

Chegeni, A. & Gord, A. (2020). Stock Price Prediction in Tehran Stock Exchange Using Artificial Neural Network Model and ARIMA Model: A Case Study of Two Active Pharmaceutical Companies in Stock Exchange. *Financial Engineering and Securities Management*, 11(44), 350-371. SID : https://sid.ir/paper/396733 [In Persian]

Clements, M. P. and Galvão, A. B. (2008). Macroeconomic Forecasting with Mixed-Frequency Data: Forecasting Output Growth in the United States. *Journal of Business and Economic Statistics*, 26(4): 546-554.

Dashtban, M. Elyaspour, B. & Dashtban, S. (2019). The Effect of Exchange Rate Uncertainty on the Flow of Tourism in Iran: A Stochastic Volatility Model with Leverage Effects and Mixed Frequency Data Sampling (MIDAS) Approach. *Journal of Tourism Planning and*

Development, 8(29), 173-190. SID : https://sid.ir/paper/375069/ [In Persian]

Diebold, F & Mariano, R. (1995). Comparing Predictive Accuracy. *Journal of Business & Economic Statistics*, 13(3), 253-63.

Emre, A. Fendoglu & Saltoglu. (2012). MIDAS Volatility Forecast Performance Under Market Stress: Evidence from Emerging Stock Markets. *Economics Letters*, 117(2), 528-532.

Enders, W. (2008). Applied Econometric Time Series. New York: John Wiley & Sons.

Feng Ma, M.I.M. Wahab, Chao Liang. (2020). Cryptocurrency Volatility Forecasting: A Markov Regime-Switching MIDAS Approach. *Energy*, 212 (2020), 118743.

Ghafari, F. & Farhadi, A. (2015). ARIMA-GARCH and State Space Models' Forecasting Power Case Study: Tehran Exchange Stock Index (TEPIX). *Iranian Journal of Applied Economics*, 5(-), 33-42. SID: https://sid.ir/paper/202056/en [In Persian]

Ghysels, E. Santa-Clara, P. Volkanov, R.(2002b). The MIDAS Touch: Mixed Data Sampling Regression. Discussion Paper UCLA and UNC available at: http://www.unc.edu/eghysels

Ghysels, E. Santa-Clara, P. Volkanov, R.(2004).The MIDAS Touch: Mixed Data Sampling Regression Models. CIRANO Working Papers 2004s-20, CIRANO.

Ghysels, E. Sinko,A. Valkanov, R.(2006). Midas Regressions: Further Results and New Directions. *Econometric Reviews*, 26(1), 53-90.

Glosten, L. Jagannathan, R. & Runkle, D. (1993). On the Relation Between The Expected Value and The Volatility of Nominal Excess Return on stocks. *Journal of Finance*, 48, 1779-1801.

Hua,Yiqing. (2020). Bitcoin price prediction using ARIMA and LST, E3S Web of Conferences 218, 01050.

Klien, L.R. Sojo, E. (1989). Combinations of High and Low Frequency Data in Macroeconomic Model. *Economics in Theory and Practice*. Kluwer Academic Publishers, 3-14.

Moshiri, S. (2001). Forecasting Iranian Inflation Rates Using Structural, Time Series and Artificial Neural Networks Models . *Journal of Economic Research* ,(58), 147-184. SID: https://sid.ir/paper/12112/ [In Persian]

Nelson, D, B. (1991). Conditional Heteroskedasticity in Asset Returns: A New Approach. *The Econometric Society*, 59(2), 347-370.

Noferesti, M. and M. Sezavar. (2021). Predicting the Effects of New Sanctions and Evaluating Fiscal Policies in the Context of a

Macroeconomic Model with Mixed-Frequency Data Sampling for the Iranian Economy Under Sanctions. Journal of Economic Modeling Research 11(44): 85-104.

Pahlevani, M. Roshan, R (2015). The Comparison Among ARIMA and Hybrid ARIMA-GARCH Models in Forecasting the Exchange Rate of Iran. *International Journal of Business and Development Studies*, 7(1),31-50.

Pishbahar, E. BODAGH, S. & Dashti, G. (2019). Forecasting Iran's Agricultural Sector Growth: Using Mixed-frequency Data Sampling (MIDAS) Model. *Journal of Sustainable Growth and Development(the Economic Research)*, 19(3),145-161. SID: https://sid.ir/paper/371137. [In Persian]

Salehifar, M. (2019). Risk and Return Behavior of Bitcoin in Comparison with Gold, Currency, and Stock Markets by Application of GJR-GARCH and TGARCH Models. *Financial Engineering and Securities Management*, 10(40), 152-168. SID: https://sid.ir/paper/197625/ [In Persian]

Silvestrini, A. & Veredas, D. (2008). Temporal Aggregation of Univariate and Multivariate Time Series Models: A survey. *Economic working papers*, 685, Bank of Italy, Economic Research and International Relations Area.

Torki, L. , Esmaeli, N. and Haghparast, M. (2023). Comparison of GARCH Family Models in Estimating Value at Risk and Conditional Value at Risk on the Tehran Stock Exchange. *Quarterly Journal of Quantitative Economics (JQE)*, *19*(4), 43-78. [In Persian]

Wu, S. I. and Lu, R. P. (1993). Combining Artificial Neural Network and Statistics for Stock Market. *Forecasting*, 257-264.