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MODELING THE EFFECTS OF BITCOIN, GOLD, INFLATION, AND USD/TL EXCHANGE RATE ON BIST 100 MOVEMENTS

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Huseyin Cetin
Bursa Technical University, Department of International Trade and Logistics, Bursa, Turkiye.
huseyin.cetin@btu.edu.tr , ORCID:0000-0001-7296-0447

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ABSTRACT

Purpose- From 2021 to 2025, economic pressures such as high inflation rates and exchange rates affected the Turkish financial markets. In this context, this paper examines the impact of Bitcoin, gold prices, the Consumer Price Index (CPI) of Turkey, and the USD/TL exchange rate on the volatility and returns of the BIST 100 from February 2021 to March 2025.

Findings- This study indicates that macroeconomic variables have a greater influence than Bitcoin and gold prices on BIST 100 movements. In this study, E-GARCH, Markov regime-switching, and Bayesian impulse response were implemented. E-GARCH results indicate that Bitcoin prices and gold prices have an insignificant effect on BIST 100 index volatility, while inflation and the USD/TL exchange rate have significant positive effects. The findings from Markov regime-switching indicate that in the first regime (high-volatility regime), USD/TL exchange rate positively affects BIST 100 stock index returns. In addition, in the second regime (low volatility regime), Bitcoin prices have a significant negative effect on BIST 100 returns, while inflation, gold prices and USD/TL exchange rates have significant positive effects. According to Bayesian impulse response analysis, positive shocks to Bitcoin prices, inflation, and USD/TL exchange rates generate positive responses in BIST 100 index performance, while positive shocks to gold prices generate a negative response in BIST 100 index performance.

Conclusion- On the whole, the results indicate that although Bitcoin and gold prices have differential effects on BIST 100 returns depending on market conditions, the primary determinants of BIST 100 returns are the inflation rate and USD/TL exchange rate. This study contributes to the literature by jointly examining digital and traditional assets within a regime-dependent and volatility-based framework for a high-inflation emerging market.

Keywords: Bitcoin, gold, BIST 100, inflation, USD/TL exchange rate
JEL Codes: C22, C58, F30

1. INTRODUCTION

Macroeconomic variables such as inflation rates and exchange rates are very prominent in emerging economies such as Turkey, while digital assets are increasingly becoming a very important aspect of modern financial markets. Beyond inflation rates and exchange rate variables, assets such as gold and Bitcoin are becoming more significant concerning how the stock market operates, particularly when the economy is in a downtrend.

For the Turkish market, the existence of mixed findings on the effect of gold spot prices, the value of the USD/TL exchange rate, inflation levels, and Bitcoin price on the returns of the BIST 100 index brings particular significance. While various studies suggested the existence of a negative influence on stock market performance posed by increasing inflation rates along with the deterioration of the value of the Turkish lira, other studies revealed the inconsistency on the extent of exchange rate variability in influencing the stock market performance. Moreover, regime-dependent and nonlinear interactions affecting Turkey’s stock market performance motivate the use of regime-switching and nonlinear causality frameworks (Bildirici et al., 2022).

The Turkish economy provides a good case for the study, since there is a high level of inflation, fluctuating exchange rate, and a growing interest in the movement of the cryptocurrency markets. This study jointly models Bitcoin, gold, inflation, the USD/TL exchange rate using E-GARCH, Markov regime-switching, and Bayesian impulse response analysis. Accordingly, this study analyzes both the returns and volatility of the BIST 100 index over the period from February 2021 to March 2025.

This study is among the first to jointly examine digital and traditional assets under regime-dependent dynamics for a high-inflation emerging market. The rest of this paper is organized as follows: the second section presents the literature review and conceptual framework, followed by the data and methodology. The empirical results are then discussed, and the final section concludes the paper.

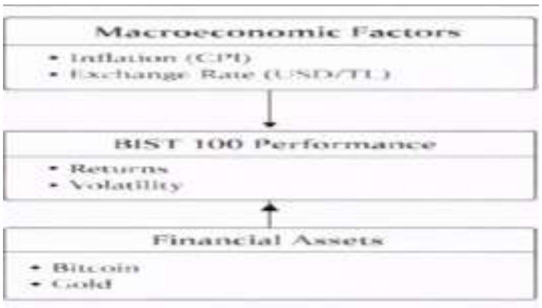
2. LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

On the basis of the existing literature, the following conceptual framework is proposed to examine how the performance of the BIST 100 index is affected by both macroeconomic variables and financial assets. The literature indicates that Bitcoin performance is more inclined toward short-run and speculative dynamics rather than long-run linkages with stock markets. Although Unvan (2021) reports a significant bidirectional relationship between Bitcoin and the BIST 100 index, Dirican and Canoz (2017) find no long-run association between these variables, while Kumar et al. (2023) show that Bitcoin does not exert persistent effects on the Indian stock market. These results are broadly consistent with the Speculative Asset (Bubble) Theory, suggesting that Bitcoin prices are driven by speculative characteristics.

With regard to gold, the results indicate mixed evidence. While Tursoy and Faisal (2018) find a negative association between gold prices and Turkish stock market returns, Akkoc and Civcir (2019) argue that gold does not act as a hedge against stock market risk. However, in a different study, Bakan (2025) finds evidence of a positive association between gold prices and BIST 100 returns.

Turning to macroeconomic conditions, the variations of the exchange rate and the level of inflation are significant in explaining the variations of the stock markets. El-Diftar (2023) finds that exchange rate variations have a significant impact on stock market returns in emerging markets, a result consistent with the general implications of the flow-oriented model of Dornbusch and Fischer (1980). Likewise, the impact of a variation in the level of inflation on stock returns is subject to variations over time, consistent with a negative relationship, as explained by Demir (2019), and a positive relationship, as explained by the Fisher Effect (Fisher, 1930), which supports the positive relationship between stock returns and inflation, and has been confirmed for Turkey, as reported in a similar empirical study conducted by Esen et al. (2025). In the conceptual framework, the variation of the BIST 100 stock index is explained by macroeconomic variables and financial assets. Inflation and the exchange rate are anticipated to be the essential macroeconomic variables that determine BIST 100 performance. Figure 1 presents the conceptual framework of the study.

Figure 1: Conceptual Framework of the Research



3. THE DATA AND METHODS

In this section, research data will be given first. After introducing the data, methods will be given respectively.

3.1. Data

The data for Bitcoin and the BIST 100 were obtained from Investing.com, inflation rate information was gathered from the Federal Reserve Bank of St. Louis (FRED), and gold price data were obtained from a gold market database. The choice of such variables relies on the assumption that these variables capture key macroeconomic dynamics associated with stock markets' behavior, especially in economies facing high inflation rates. In the Turkish economy, interest rate variables are more policy-oriented and highly connected with inflation and exchange rate policies; hence, these variables may not add much information independently once inflation and exchange rate variables are considered in the model.

3.2. Methods

In order to analyze the impact of Bitcoin price, gold price, USD/TL exchange rate, and Turkey's inflation rate on BIST 100 stock price movements, the study uses an E-GARCH model, a Markov regime-switching model, and Bayesian impulse response analysis.

3.2.1. E-GARCH Model

Before proceeding to estimate the E-GARCH model, the existence of ARCH effects has been checked and confirmed. The E-GARCH model has been estimated with the distribution of Student's t, and the ARCH effect has been removed after the model estimation. Within the E-GARCH framework, the volatility of BIST 100 has been explained using the shocks, persistence of volatility, and a list of financial and macroeconomic variables. BIST 100 returns have been defined using the logarithmic difference, while the E-GARCH model has been used to evaluate the impact of the variables on the conditional volatility of BIST 100 returns.

BIST 100 returns are defined as follows: $r_t = \ln(BIST100_t / BIST100_{t-1})$ (1)

The E-GARCH(1,1) model is specified as: $\ln(\sigma^2_t)=\omega+\alpha|\varepsilon_{t-1}/\sigma_{t-1}|+\gamma(\varepsilon_{t-1}/\sigma_{t-1})+\beta\ln(\sigma^2_{t-1})+ \delta_1 \Delta BTC_t + \delta_2 \Delta GOLD_t + \delta_3 \Delta(USD/TL)_t + \delta_4 \Delta CPI_t$ (2)

In this specification, α shows the effect of past shocks on current volatility, γ indicates asymmetry effects, and β indicates volatility persistence. Coefficients δ_1 through δ_4 represent direct effects of Bitcoin, gold, exchange rate, and inflation on BIST 100 volatility.

3.2.2. Markov Regime Switching Analysis

For the analysis of the dynamics under different regimes, the two-regime Markov regime-switching model is constructed as follows:

$$\Delta R(BIST100_t) = \mu_{st} + \beta_{1st}\,\Delta BTC_t + \beta_{2st}\,\Delta GOLD_t + \beta_{3st}\,\Delta(USD/TL)_t + \beta_{4st}\,\Delta CPI_t + \varepsilon_{st} \quad (3)$$

The transition probability between regimes is given by:

$$P(s_t = j \mid s_{t-1} = i) = p_{ij} \qquad i, j \quad (4)$$

3.2.3. Bayesian Impulse Response Analysis

Lastly, the Bayesian impulse response analysis is performed using stationary variables to analyze the dynamic impacts of digital and conventional assets' shocks to BIST 100 index responses. In contrast to standard impulse response analysis, Bayesian impulse responses include credible intervals to incorporate parameter variation. A Bayesian Vector Autoregression (BVAR) model is employed to generate Bayesian impulse responses and assess the dynamic effects of Bitcoin, gold, the USD/TL exchange rate, and inflation on BIST 100 index.

The Bayesian VAR model takes the form as:

$$\Delta R(BIST100_t)=c_1+\sum\beta_{11,i}\,\Delta R(BIST100_{t-i})+\sum\beta_{12,i}\,\Delta BTC_{t-i}+\sum\beta_{13,i}\,\Delta GOLD_{t-i}+\sum\beta_{14,i}\,(\Delta USD/TL)_{t-i}+\sum\beta_{15,i}\,\Delta CPI_{t-i}+u_{1,t} \quad (5)$$

On the basis of the results of the unit root tests, all the models are estimated using stationary variables with optimal lag order. The effects of Bitcoin, gold, the value of the USD/TL exchange rate, and inflation on the movements of the BIST 100 index are explored using the E-GARCH model, Markov regime-switching methods, and Bayesian impulse response analysis.

4. FINDINGS AND DISCUSSION

In this section, findings of given methods and discussion of the research results will be given.

4.1. E-GARCH Findings

Table 1 reports the E-GARCH model estimation results. CPI and the USD/TL exchange rate have statistically significant and positive effects on the BIST 100 volatility, while Bitcoin and gold are insignificant.

Table 1: E-GARCH Model Estimation Results (Dependent Variable: BIST 100)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
BITCOIN	2.07E-07	8.17E-07	0.253605	0.7998
GOLD	-4.77E-05	8.80E-05	-0.542525	0.5875
CPI	0.003789	0.001518	2.495879	0.0126
USD/TL	0.035248	0.010276	3.430093	0.0006
AR(1)	-0.268774	0.100697	-2.669132	0.0076
MA(2)	0.271355	0.104037	2.608245	0.0091

As presented in Table 2, the ARCH test of heteroskedasticity for the E-GARCH model with the Student's t-distribution has not revealed any remaining heteroskedasticity.

Table 2: ARCH Heteroskedasticity Test Results

Test Statistic	Value	Probability
F-statistic	0.298895	0.5873

4.2. Markov Regime-Switching Regression Findings

Markov regime-switching results show regime-dependent effects. Based on the conditional variance estimates (Log(SIGMA)), Regime 1 is characterized as the high-volatility (turbulent) regime, whereas Regime 2 represents the low-volatility (calmer) regime. In the first (turbulent) regime (Table 3), only the USD/TL exchange rate positively and significantly affects the BIST 100 returns.

Table 3: Markov Regime-Switching Regression Regime 1 (High-Volatility BIST 100 Return Regime) Results

Variable	Coefficient	Std. Error	z-Statistic	Prob.
BITCOIN	7.53E-07	1.93E-06	0.3890	0.6973
CPI	0.000740	0.002871	0.2577	0.7967

GOLD	-0.000135	0.000203	-0.6641	0.5066
USD/TL	0.037858	0.018251	2.0743	0.0381
Log(SIGMA)	-2.462728	0.125728	-19.5877	0.0000

In the second (calmer) regime (Table 4), the significant negative factor is Bitcoin, the significant positive factors are the USD/TL exchange rate, gold prices, and inflation.

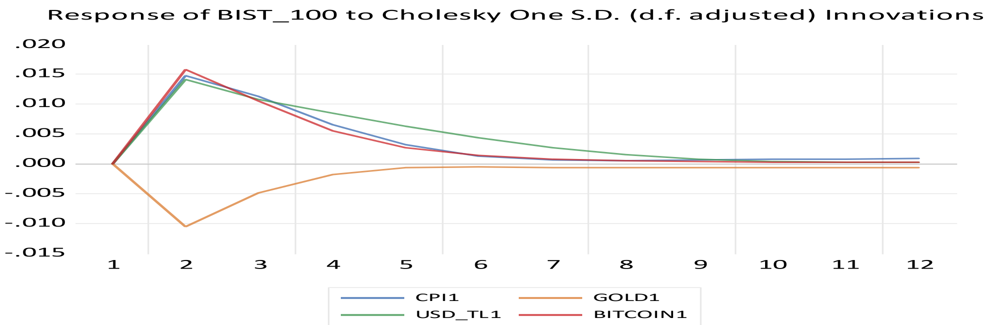
Table 4: Markov Regime-Switching Regression Regime 2 (Low-Volatility BIST 100 Return Regime) Results

Variable	Coefficient	Std. Error	z-Statistic	Prob.
BITCOIN	-2.03E-06	1.07E-07	-19.0068	0.0000
CPI	0.002309	0.000113	20.5021	0.0000
GOLD	0.000209	5.42E-06	38.6294	0.0000
USD/TL	0.057447	0.000634	90.5477	0.0000
Log(SIGMA)	-6.833590	0.479680	-14.2462	0.0000

4.3. Bayesian Impulse Response Analysis Findings

Bayesian impulse response results (Figure 2) reveal dynamic interactions over time. Bitcoin, the USD/TL exchange rate, and Turkey's CPI initially have positive effects on BIST 100 returns, whereas gold has a negative effect. Nevertheless, Bitcoin's impact shrinks over time, while the influence of the USD/TL exchange rate strengthens, and inflation ultimately emerges as the most powerful factor driving shocks to the BIST 100 returns.

Figure 2: Bayesian Impulse Response Analysis Results



4.4. Discussion

Regarding increases in gold prices, the implications of behavioral finance might emerge, as investors may show a tendency to rebalance and may decrease their portfolio weights invested in BIST 100 stocks in a high financial risk environment. Nonetheless, the results of the Markov regime-switching model suggest the possibility of a relationship between increases in gold prices and the reallocation of portfolio investments toward BIST 100 stocks during periods when stock prices are perceived as undervalued. The Bayesian impulse response results indicate a possible profit-taking behavior by investors following increases in Bitcoin prices, which may subsequently be associated with a reallocation of investments toward BIST 100 stocks. This may be interpreted as an indirect support for BIST 100 performance. In addition, the Markov regime-switching results suggest a possible relationship between decreases in Bitcoin prices and the reallocation of portfolio investments from Bitcoin to BIST 100 stocks.

5. CONCLUSION

This study makes a contribution to the existing body of knowledge by simultaneously identifying the relevant interaction effects of Bitcoin prices, gold prices, inflation rates, and the exchange rate of the USD/TL to explore the returns and volatility of the BIST 100 within the same analytical framework incorporating the use of E-GARCH, Markov regime-switching models, and Bayesian impulse response analysis. This study reveals that the effect of Bitcoin and gold on the BIST 100 index varies under different sets of circumstances. The findings of the E-GARCH analysis indicate the significance of the inflation rate and the USD/TL exchange rate as the primary drivers of the volatility of the BIST 100 index, but indicate the insignificance of the roles of Bitcoin and gold as determinants of the volatility of the BIST 100 index. The findings of the Markov regime-switching analysis show that during the highly-volatility regime of the BIST 100 index, the returns of the BIST 100 index are driven by the changes in the exchange rate of the USD/TL while during the less-volatility regime of the BIST 100 index the returns are primarily influenced by the changes in the price of Bitcoin, gold, the inflation rate, and the USD/TL exchange rate. While Dirican and Canoz (2017) and Kumar et al. (2023) focus on the absence of long-run relationships between Bitcoin and BIST 100, the present findings extend this literature by showing that Bitcoin's influence on BIST 100 returns is largely short-lived and regime-dependent, supporting its speculative nature. The strong and persistent effect of inflation on the BIST 100 is broadly consistent with the Fisher effect and Esen et al. (2025)'s findings. The results are consistent with the flow-oriented model and aligned with the evidence reported by El-Diftar (2023). Lastly, the results are partially consistent with the Safe Haven Asset Theory and broadly in line with the mixed evidence reported by Tursoy and Faisal (2018) and Akkoc and Civcir (2019).

It can be concluded from the results that there needs to be proper consideration given to the dynamically varying nature of the market conditions while devising risk management techniques, and for this, institutional investors can use the LSTM models to track the non-linear and varying interlinkages between the gold prices, inflation rates, and the performance of the stock market. In the presence of the nonlinear, regime-dependent, and time-varying relationships revealed in the E-GARCH and Markov regime-switching results, LSTM models could provide a useful addition in modeling complex dynamics not sufficiently represented in traditional econometric models. Stress testing can also help measure the risks associated with the USD/TL exchange rate, and sentiment analysis techniques can track the associated market actions within the Bitcoin market. In terms of policy, the results show that policies should be executed differently depending on the market regime, since the interaction between macroeconomic and financial variables has disparate impacts on market regimes. Authorities could implement regime-contingent policy rules, allowing policy instruments to adjust automatically in response to shifts in market volatility regimes.

This study can be extended to include other financial assets and cryptocurrencies using the models described above and to incorporate data from both developing and developed countries. Higher-frequency data can also be used to examine short-run dynamics in future studies.

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