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**ARAŞTIRMA MAKALESİ / *RESEARCH ARTİCLE***

# Analyzing The Effect of Monetary Policies and Financial Stability Measures Across Global Markets amid Covid-19 Pandemics

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## Abstract

This study investigates causal relationships among financial stability measures and monetary policies implemented in the US, the EU, and Türkiye. Selected variables from stock markets, money markets, and bond markets are tested. The set of macrofinancial process covers S&P500 stock market, BIST-100 stock market; Volatility index; German, the US and Türkiye 10-year treasury bond interest data, the European Union 27 average CPI, US CPI, Turkey CPI, ECB policy rate, FED policy rate, CBRT policy rate data. Initially, the Granger causality analysis is applied for the each dataset of the US, the EU and the Turkish economy, separately. Secondly, mutual impact of stock markets, money markets and bond markets are examined. Finally, CBOE Volatility index (VIX) is taken into account. It is aimed to observe spillover effects from developed economies to emerging markets amid pandemics. The dataset covers the monthly period of 2019M1 to 2023M6.

**Keywords:** Granger Causality, Monetary Policy, Financial Stability, Volatility Index, Stock Market, European Central Bank

# Covid-19 Pandemisi Sırasında Küresel Piyasalarda Para Politikalarının ve Finansal İstikrar Tedbirlerinin Etkisinin Analizi

Öz

Bu çalışma, ABD, AB ve Türkiye'de uygulanan para politikaları ile finansal istikrar tedbirleri arasındaki nedensel ilişkileri araştırmaktadır. Hisse senedi piyasaları, para piyasaları ve tahvil piyasalarından seçilen değişkenler test edilmiştir. Makrofinansal süreç seti S&P500 hisse senedi piyasası, BIST-100 hisse senedi piyasası; Volatilite endeksi; Almanya, ABD ve Türkiye 10 yıllık hazine bonosu faiz verileri, Avrupa Birliği 27 ortalama TÜFE, ABD TÜFE, Türkiye TÜFE, ECB politika faizi, FED politika faizi, TCMB politika faizi verilerini kapsamaktadır. Granger nedensellik analizi ilk olarak; ABD, AB ve Türkiye ekonomisine ait her bir veri seti için ayrı ayrı uygulanmıştır. İkinci olarak, hisse senedi piyasaları, para piyasaları ve tahvil piyasalarının karşılıklı etkisi incelenmiştir. Son olarak CBOE Volatilite endeksi (VIX) dikkate alınmıştır. Salgınlar sırasında gelişmiş ekonomilerden gelişmekte olan piyasalara yayılma etkilerinin gözlemlenmesi amaçlanmaktadır. Veri seti 2019M1 ile 2023M6 arasındaki aylık dönemi kapsamaktadır.

**Anahtar Kelimeler:** Granger Nedensellik, Para Politikası, Finansal İstikrar, Volatilite Endeksi, Borsa, Avrupa Merkez Bankası

## 1. **Introduction**

The global pandemic that began in 2019 has profoundly reshaped economies worldwide, influencing financial and monetary policies in ways never before seen. The crisis has led to dramatic shifts in how countries manage their economies, with significant implications for financial stability, inflation, and economic growth. As the pandemic unfolded, governments and central banks implemented a range of financial and monetary measures to mitigate the economic fallout. These responses included substantial fiscal stimulus packages, changes in interest rate policies, and modifications to inflation-targeting strategies with macroprudential measures. Such measures were designed to cushion the impact on businesses and consumers,

stabilize financial markets, and ensure economic recovery.The effects of these policies are particularly evident in emerging market economies, which faced unique challenges during the crisis. Many of these economies grappled with increased financial risks, such as currency volatility and capital flight, while simultaneously striving to control inflation and manage debt levels. The interplay between global financial strategies and local economic conditions created a complex landscape for policymakers.

To better understand the broad impacts of the pandemic and the effectiveness of various policy responses, we analyzed monthly data from 2019M1 to 2023M6. This period encompasses the onset of the pandemic, its peak disruptions, and the subsequent phases of recovery. By examining this data, we can gain insights into how financial and monetary policies have influenced global and local economies, the behavior of financial markets, and the overall economic environment.

We select the US, EU and Turkish economies to examine the interaction between the global economy and emerging market economies. The US economy and EU economies also differ in terms of the price instability problems they face and hence their reactions to them. (Lutkepohl and Netsunajev, 2018:6-36). While supply chain disruptions and supply constraints, especially during the pandemic period, created inflationary pressure in the US economy. And the Ukraine crisis and rising energy prices contributed to inflation in the EU economies. Changing consumption behavior and increased saving surplus, wealth effect in both developed economies also impacted services price level. As an emerging market, the Turkish economy, faced external financing problems and turned to an expansionary fiscal policy and loose monetary policy. This also yields a powerful rise in inflation. While it was a less costly process for the US and EU economies to control inflation in terms of normalization processes. The same is not the case for Turkey.

This study investigates causal relationships among selected variables from stock markets, money markets, and bond markets. Selected variables are tested. The set of macrofinancial process covers S&P500 stock market, BIST-100 stock market; Volatility index; German, US and Turkey 10-year treasury bond interest data, European Union 27 average CPI index, US CPI index, Turkey CPI index, ECB policy rate, FED policy rate, CBRT policy rate data as shown in Table 3.

The Granger causality analysis is applied for first; each dataset of US, EU and the Turkish economy, separately. Second, mutual impact of stock markets, money markets and bond markets are examined. Finally CBOE Volatility index (VIX) is taken into account. It is aimed to observe spillover effects from developed economies to emerging markets amid pandemics. The dataset covers the monthly period of 2019M1 to 2023M6.

The foreign share in BIST100 stock market has been gradually decreased after 2019 and fell below 1%. The fact that the causality between VIX and BIST100 can be interpreted through the weight of the emerging markets index and the Banking index. However, we can observe that the causality coefficient is decreasing.

The increase in FED policy rate (FEDR) beginning from 2021 and the inflationary process of both the US and the EU economies explain why FEDR may affect DAX stock market. This effect is due to the ECB's policy rate path following the FED in the policy interest rate process. This follow-up still continues and shows itself in the EUR/USD parity process.

Although the data for the 2019-2023 period show that the macroeconomic variables of the US and the EU continue to interact, central bank of Turkey monetary policy moved away from the global financial system. Many of the causalities we observe in the

2008-2010 period were disappeared in this period and only Turkey's own macrofinancial variables themselves, they continue their causality with. This was due to the fact that the transaction volume of Turkish Lira with US dollars in the London interbank market decreased from 3% to 0.5%. In rival developing countries, such as Brasil and South Korea this level remains above 3%. The economic and political reason for this is the government's reaction to the exchange rate speculative attack that repeated several times after 2018. The fear that it would affect general elections and voting behavior led to the reduction of Turkey's financial openness. This is why the causality set is narrowing. Since protectionism is not as prominent in global financial markets as it is in the real economy, we did not observe this causality narrowing in US and EU macrofinancial variables.

## 2. Literature Review

The method to be followed for this study involves several steps. First, we will examine and explain the relevant economic and financial theories. Next, we will research the main topics that have been determined and selected. This research will be conducted in a way that enables the evaluation of the subject. We will interpret the research and analyses made in previous years (see Table 1) to fully evaluate the main headings we are researching. Additionally, we will look at policy practices that have developed and updated over time. The aim of the study is to examine the effects of the current Central Banks. We will also analyze the applications of existing Central Banks. Finally, we will reach our conclusions by empirically analyzing the data we will examine.

Although many different ways of measuring volatility (Engle et.al.,2013:776-797) and causality have been mentioned in the literature different opinions have been put forward as to which measurement model is the best.

The relationship between inflation and stock market returns is controversial. Fama and Schwert (1977:115-146); Schwert G.W. (1989:1115-1456); Geske and Roll (1983:1-33) and Fama et al. (1989:23-49) found in their study that the relationship between inflation and stock returns is negative. It has supported international trade developments in studies carried out with developing stock exchanges. In these stock markets, the cause and effect relationship between macroeconomic data and stock returns is better understood. In studies conducted on developing stock markets, the majority of studies are conducted by countries using data from their own countries.

In their study, (You K. et al.2024:1-24) premises and undertakes a comprehensive analysis on the impact of the international trade aspect of the real economy on stock-market connectedness with both system-wide and pairwise directional evidence. They captured both export and import perspective between two economies in the latter analysis and examined whether imports induce stronger stock market spillover than exports. Consider a group of eleven economies: ASEAN 5 (Indonesia, Malaysia, the Philippines, Singapore, and Thailand), Australia, Brazil, China, Euro Area, Hong Kong (China), India, Japan, South Africa, UK and the US for period 2000 M1-2021 M6.

In their study, (Aytüre S. and Keskin M.2024:345-355) analysed the direction and degree of mutual impact of Türkiye's exports and imports on Borsa Istanbul. For this purpose, the relationship level between the periods 2013:01-2023:12 was examined with Causality and Cointegration tests in the BIST 100 index used in Borsa Istanbul, and its code is XU100, in the context of the stocks that are among the top hundred in terms of capital structure of Türkiye. It has been seen that foreign purchases and sales in both the short and long term are related to the BIST 100 performance and also cause the BIST 100 performance. However, it was determined that exports had a significant

positive effect on BIST 100 performance in the short and long term, while imports had a significant negative effect.

Sekula (2019:74-93) in his study; It examined the return rates of CAC 40, DAX 30, FTS 100, S&P 500, BUX (Budapest), PX (Prague), WIG (Warsaw) stock market indices with 4925 data between 31.12.1997-30.12.2016. Small stock markets have unstable economy, high risk and high returns. This means a lower return rate in developed stock exchanges such as Western Europe and the USA compared to the Central European Stock Exchanges. Granger causality uses VAR and Vector Error Correction (VECM) models. It is based on cointegration and stationarity analyzes of time variables. The VAR model is used to determine whether there is Granger causality in stationary variables.

Molnár A. and Csiszárik-Kocsir Á. (2022; 205-227), in their study they use the Johansen cointegration test; and assert that there exists a long-run relationship between the BUX composite stock indexes and the Hungarian GDP. From the ADL regression, based on the constructed models, it was determined that past values of Hungarian stock prices do in fact lead Hungarian economic growth, but they said this does not mean that stock prices Granger cause the economy. The Granger causality tests showed that there exists a causality between the BUX composite stock indexes and the Hungarian GDP.

Baker S.R. et. al. (2020:1-22) in their study; The Covid-19 pandemic, which spread from China's Hubei province, has caused volatility values to increase around the world. In the US, volatility levels in mid-March 2020 were last seen in October 1987 and December 2008, and before that in late 1929. It is difficult to explain the major stock market movements in 2020 with disruptions in cross-border supply chains. Since 1900, volatility from the coronavirus pandemic has peaked in an unusual way in history.

In his study, Özkaya and Altun (2024:1-14) found that the data except the central bank interest rates had a positive slope. It was shown that the kurtosis values of all data showed a sharp peak, and only the credit default swap (CDS) data was found to be stationary. It has been determined that the power over the volatility in the exchange rate is the lagged volatility. In the GARCH model (Engle, 1987:251-276), (Tsay,1987:590-604; 2002:81-110), testing the durable and long-term effects of variance and shocks is interpreted as the sum of these coefficients. A large sum of these coefficients indicates that large and negative shocks that can be predicted in the future will have large variance. It has been shown that exchange rate volatility is affected by past volatility and shocks. In the study, it was said that macroeconomic developments, politics and financial choices made by the government were the reason for the chaotic behavior in the exchange rate in Turkey. It has been said that these reasons increase the frequency of central bank intervention (Bernanke, 2005:1057-1592). This situation is observed by financial agents, and it is stated that the problem of trust in Turkish assets causes an increase in the risk premium in the global financial market and fluctuations in portfolios. Similarly, it has been shown that local financial agents choose dollarization, causing their savings in foreign currency to increase. It was stated that during this period, foreign currency investment in banks increased to the range of 60%-40% compared to Turkish Lira, and in developing economies, financial agents invested in foreign currency to protect their investments from financial loss, future fluctuations and high inflation. It has been stated that during the Covid-19 pandemic crisis, due to the expanding monetary and financial policies in the world, there was an increase in inflation and fluctuations in prices, which was seen in the decline in the VIX index and portfolio.

**Table 1.** Summary of Literature Review

| Author | Method | Subject | Sample Info | Results |
|---|---|---|---|---|
| Lutkepohl and Netsunajev (2018:6-36) | VECM | Eurozone Monetary Policy and Stock Exchange Data | 1999-2014 | The long-term effect of a monetary policy shock on stock prices is limited to being neutral, and such a shock has a long-term negative effect on the stock market. |
| Sekula (2019:74-93) | Granger Causality | CAC 40, DAX 30, FTS 100, S&P 500, BUX, PX ve WIG indexes | 1997-2016 | Granger casuality between indexes |
| Meher et al.(2020:422-431) | EGARCH | Crude oil and natural gas price volatility and Indian commodity exchange data during the pandemic period were examined. | 2017-2020 | The Covid-19 pandemic did not have a leverage effect on natural gas volatility, but it affected crude oil volatility. |
| You et al. (2024:1-24) | DYCI (Diebold-Yilmaz Connectedness Index) VAR | International trade and stock market connection. Composite Index, S&P500, STOXX, FTSE 100, UK, Hang Seng Composite, Nikkei 225, SASX 200, Africa All Share, Bovespa Index & Nifty 50 index | 2000-2021 | Imports and exports affect stock markets. |
| Farokhnia and Osterrieder (2020:1-15) | VIX Correlation and Granger Causality | S&P 500, VIX indexes | Ocak 2018-Şubat 2018 | Granger causality between VIX and S&P 500 index |

| Author | Method | Subject | Sample Info | Results |
|---|---|---|---|---|
| Baek et al. (2020:1-10) | Markov Switching model- AR | VIX index, Covid-19 cases S&P 500 index, fiscal policy | Ocak 2020-Nisan 2020 | The relationship between VIX index and mortality percentages and their impact on risk perception in the stock market |
| Ohmura (2020:1-7) | VAR-LINGAM | Japanese fiscal policy and financial processes | 1980-2018 | Causality relationship between stock returns and consumer behavior |
| Ünal (2020:772-789) | ARDL, CUSUM, ECM | Money supply/GDP; Budget Balance/GDP and Bist 100 | 2006-2019 | Budget Balance/GDP and Bist 100 has reverse relationship; Money supply/GDP and has same direction |
| Trivedi (2021:63-72) | GARCH | Belgian and Indonesian stock exchanges were examined. | 2018-2021 | No significant correlation was found between the stock exchanges. The Jakarta stock exchange exhibited low volatility and suffered less losses than the Belgian stock exchange. |
| Aytekin and Uçan (2022:460-475) | Johanssen Coentegration, Granger Causality | Inflation, exchange rate, import-export | 2004-2019 | Causality relationship between exchange rate and inflation; causality between import and export |

| Author | Method | Subject | Sample Info | Results |
|---|---|---|---|---|
| Ozkaya (2022:1365-1380) | GARCH, Maximal Lyapunov exponent | Nonlinear stochastic analysis of USD Dolar/TL exchange rate | 2019-2021 | Volatility measurement was carried out |
| Ozkaya and Altun (2024:1-14) | GARCH, Maximal Lyapunov exponent | Exchange Rate Volatility of Turkish Lira | 2019-2021 | Exchange Rate Volatility of Turkish Lira is effected VIX and CDS |
| Vega et al. (2023:1-33) | VEC, Granger Causality, VAR | CPI, M2, imports price | 2004-2022 | Granger casuality between indexes |
| Coşkuner and Özer (2024:15-24) | Johanssen Coentegration, Granger Causality, VAR | Dollar/TL, Euro/TL, TUFE, Bist-100 | 2010-2021 | Causality relationship between Bist-100 and Dollar/TL; Bist-100 and TUFE. |
| Yeboah and Lamin (2024:94-112) | ARDL, Granger Casuality | Foreign Direct Investment (FDI), GDP, Trade Openness, unemployment | 1991-2022 | Granger causality between FDI-GDP; External Debt-GDP; GDP-Trade openness; GDP-unemployment |

**Source:** Author

## 2. **Material and Method**

The diversity of the selected data and the fact that the date range is up-to-date add a different perspective to the literature. The economic breaks caused by the uncertainty during the 2020 pandemic process are examined within the scope of the interest and monetary policies implemented by the selected central banks. We believe that this will make a significant contribution to the existing literature.

The aim of the research is to affect the stock market and economic data in line with the interest and monetary policies implemented by our own country's central bank and the world's two other largest central banks. In the study, data for the period 2019M1-2023M6 were used. In the analysis phase of the study, firstly, descriptive statistics of the existing data were determined and interpreted. Then, ADF (Dickey, D. A. and Fuller, W. A. (1979:427-431),(1981:1057-1072)), PP and KPSS unit-root tests were performed to determine whether the data were stationary or not and whether they contained unit root. The non-stationary ones were made stationary at the level and Granger Causality tests (Granger, 1987:251-276) were performed on the variables. VAR model was created.

In this part of the study, conceptual descriptions of the data, variables and econometric methods used for empirical application are included.

Mathematical models can be grouped into four main groups. This grouping is related to the certainty of the knowledge we have about the concept we observe. Depending on the rationality of financial market decision makers and economic agents, this information can often become less certain. From this perspective, these models can be considered as a test of the Efficient Market Hypothesis (Fama, 1970:383-417). Efficiency in financial markets depends on the availability of information (Mishkin, 2013:612).

As examples of hypotheses to be established for the models to be created for time variables analysis can be tabulated as follows: interaction between VIX and BIST 100 index, the effect between the implemented monetary policies and the BIST 100 index, the interaction of inflation rate and stock prices, the impact of policy rates on stock prices, the reaction of stock prices to short-term interest rate increases, the policy rate and financial asset prices. We can measure the success of the applied interest policy in controlling the exchange rate. Hypothesis testing is applied as given below:

"$H_0$: Dollar/TL exchange rate is not the Granger cause for the CBRT interest rate increase (CBR).

$H_1$: Dollar/TL exchange rate is the Granger cause for the CBRT interest rate increase (CBR). The appropriate test statistic can be determined by performing hypothesis testing.

Examining the long-term relationship between two variables can be done with Granger causality analysis, and it can be determined whether the dependent and independent variables affect each other. In order to apply causality analysis, the variables must be stationary. Therefore, stationarity tests of the variables to be used must be performed before analysis (Granger and Newbold, 1977:687). A unit root test should be performed to determine whether the variables are stationary or not. Differentiation is also applied to make non-stationary variables stationary.

The empirical study part of the study has been prepared with the modeling and the statistical computer programs determined in Table 2 (Eviews 12, RStudio, Stata18) to be used according to the selected modeling in the time variables analysis. The data examined in the study are obtained from various databases. These are Republic of Turkey Presidency Budget Directorate, Central Bank of the Republic

of Turkey (CBRT), OECD database, ECB, investing.com, Bloomberg.com, Finance.yahoo.com, Republic of Turkey Ministry of Treasury & Finance, European Statistical Office (Eurostat), Turkey Statistics Institution (TUIK), Borsa Istanbul (BIST), The Federal Reserve Bank of St. Louis. It is obtained from St. Louis economic data and belongs to the years 2019-2023.

**Table 2.** Classification of Mathematical Models

| | |
|---|---|
| **0.1.** Linear Deterministic models | **0.2.** Nonlinear Deterministic models |
| **2.1.** Linear Stochastic models | **2.2.** Nonlinear Stochastic models |
| The analysis made with Eviews, Stata, R statistical programs | The analysis made with R statistical program |

**Table 3.** List of variables used in time series analysis

| Variables | Explication |
|---|---|
| BIST100 | Stock market index where 100 Turkish companies are traded |
| DAX | German Stock exchange index |
| S&P500 | Stock market index where 500 American companies are traded |
| VIX | Volatility index |
| US10YR | USA 10 year treasury bond interest rate |
| GER10YR | German 10 year treasury bond interest rate |
| TR10YR | Turkish 10 year treasury bond interest rate |

| Variables | Explication |
|---|---|
| EUCPI | Percentage change in European-27 consumer price index |
| USCPI | Percentage change in US consumer price index |
| TRCPI | Percentage change in Turkish consumer price index |
| CBR | CBRT policy interest rates |
| FEDR | FED policy interest rates |
| USDXY | Global index for the value of the US dollar |
| USDTR | Turkish lira to US dollar exchange rate |
| TLR | Interest on Turkish lira bank deposits – average weight |
| USBR | Interest on US bank deposits – average weight |

**Source:** Author

## 2.1. Model Equation

In order to understand whether the obtained variables are suitable for Granger Causality models: frist, Jarque-Bera values were examined by looking at the skewness and kurtosis values in order to determine whether the variables showed a normal distribution. Second, correlogram analysis was performed to examine whether the variables were affected by their past values. Appropriate lag lengths were selected according to Akaike, Schwarz and Hannan Quinn information criteria and Dickey-Fuller tests were applied to perform the stationarity tests, and the non-stationary variables were made stationary by taking the first differences.

VAR (p) Equation:

There are seven different variables in the econometric model established in this study. To serve as a reference for the analysis to be carried out

within the framework of the VAR model (Lütkepohl, 2005:112), the equations of 7 different dependent variables must be established. In this case, the equations are established as follows.

$$\boldsymbol{X_t} = \boldsymbol{\alpha} + \boldsymbol{\beta t} + \sum_{i=1}^{p} \Gamma_i \boldsymbol{X_{t-i}} + \boldsymbol{\varepsilon_t} \quad where \ \varepsilon_t \sim iid\ (0, \Sigma) \tag{1}$$

Where $\boldsymbol{X_t}$ is vector of interested variables. $\Gamma_i$ , i=1,…p denote the coefficient matrix which should be estimated. It is stable if the polynomial defined by

$det\left(I_K - \Gamma_1 \boldsymbol{z} - \Gamma_2 z^2 \ldots - \Gamma_p z^p\right)$ has no roots in and on the complex unit circle.

In the regression model established above, the main purpose is to learn the causalities for the volatility shock created by the pandemic crisis in the USD/TRY exchange rate, BIST100, DAX, GER10YR, S&P500, US10YR, USDTR, USDXY, VIX, TR10YR, EUCPI, USCPI, TRCPI, FEDR, USBR, TLR, CBR.

This set of variables is grouped as stock markets, bond markets, money markets and consumer price indices. In both the VAR model and Granger causality analysis (Granger et al. 1987:251-276), the return of stock market variables is employed as bond return, VIX return and percentage change in CPI. In this sense, triggering parameters of both global and local crises are given among the factors that will cause volatility.

The VIX index, known as the implied volatility for S&P500 index, is included in the model. In the pandemic crisis, USDXY, US dollar against other strong currencies, is another index parameter likely to

affect the volatility of USD/TRY. Inflation, which has been major problem for all global central banks has been compared with the inflation expectation of Turkish economy and it has been examined whether this effect contributes to the exchange rate volatility. Finally, the overnight reference interest rates, which are one of the most effective policy-instrument of central banks and play an important role in almost all crises, have been added to the model as a parameter.

The Table 4 reports summary statistics for the variables. ADF is the *t*-statistics for the Augmented Dickey-Fuller test. PP is the *t*-statistics for the Phillips-Perron test, KPSS test denote significance at the 5% level respectively.

## 3. Empirical Results

2019-2023 Descriptive Statistics with Monthly Variables as shown in Table 4; such as average, standard deviation, skewness, kurtosis, Jarque Bera of monthly data for the years 2019-2023 were examined, and according to the data in the table, the variable with the highest average was seen as USCPI. When Jarque Bera values are examined, it is seen that BIST100, US10YR, USDXY, TR10YR and EUCPI variablesshow normal distribution, while all other data do not show normal distribution. When looking at the Skewness values; DAX, S&P500, USDXY, and FEDR variables were found to be negatively skewed to the left, and when the kurtosis values were examined, it was seen that the values of all variables were greater than 3 and showed a leptokurtic distribution.

We have to test whether all the variables are stationary. The explanatory variables imposed in the ADF, KPSS and PP models should be stationary. If these variables are determined to be non-stationary, then by implementing suitable methods such variables are transformed into stationary behavior.

Table.4 presents the stationary test results. The test is employed under the Dickey-Fuller test method. Table.4 has 10 columns, first depicts the variables name. The first seven columns stands for the value of test statistics The eighth, ninth and tenth columns show threshold values for desired significance levels. In the empirical literature, the %5 significance level is shown to be sufficient to accept or reject the Ho hypothesis.

After that, stationary data is going to be estimated. As can be seen in detail in the appendix section, the following procedures were examined in order to observe the stationarity of each data used in the model:

The stationarity conditions of the variables are statistically tested by Dickey-Fuller and Phillips Perron unit-root tests. The test methodology is defined in detail in Appendix. The DAX, USDXY and TLR is determined to have one unit root and is accepted to be non-stationary variables. We take the first difference of the variables and eliminate the unit root to obtain it in the stationary domain. The stationary states of these variables should be included in the VAR model [Eq.1] to be installed.

The presence of a significant constant term in the model indicates that volatility cannot be zero even if the variables determined in this model are assumed to be zero. This is evidence that some parameters not considered in this model are also effective in the formation of volatility.

**Table 4.** Descriptive Statistics

| Variables | Mean | Median | St.dev. | Skewness | Kurtosis | Jarque bera | ADF | PP | KPSS |
|---|---|---|---|---|---|---|---|---|---|
| BIST100 | 0,03 | 0,03 | 0,08 | 0,1 | 3,06 | 0,009 | -5,27 | -5,13 | 0,055 |
| DAX | 0,08 | 0,11 | 0,05 | -2,28 | 14,19 | 329,07 | -6,67 | -6,65 | 0,05 |
| GER10 YR | 0,041 | 0,00 | 0,18 | 1,22 | 5,89 | 32,36 | -6,11 | -6,35 | 0,07* |
| S&P500 | 0,011 | 0,017 | 0,04 | -2,21 | 10,75 | 179,62 | -6,65 | -6,65 | 0,07* |
| US10YR | 0,02 | 0,02 | 0,22 | 0,16 | 4,22 | 3,67 | -5,02 | -4,98 | 0,08* |
| USDTR | 0,03 | 0,01 | 0,05 | 2,12 | 9,35 | 131,64 | -3,56 | -3,56 | 0,04 |
| USDXY | 0,001 | 0,003 | 0,01 | -0,36 | 3,2 | 1,28 | -4,69 | -4,61 | 0,12* |
| VIX | -0,01 | -0,47 | 6,56 | 3,39 | 22,97 | 1001,3 | -8,24 | -9,4 | 0,078* |
| TR10YR | 0,04 | -0,04 | 1,52 | 0,13 | 3,56 | 0,88 | -5,82 | 5,96** | 0,069** |
| EUCPI | 0,003 | 0,002 | 0,005 | 1,006 | 5,95 | 27,67 | -4,4 | -4,4 | 0,129* |
| USCPI | 4,94 | -0,18 | 38,85 | 6,93 | 49,41 | 5083,8 | -7,1 | -7,1 | 0,06* |
| TRCPI | 0,02 | 0,018 | 0,03 | 2,29 | 9,65 | 141,48 | -1,97 | -8,98 | 0,39* |
| FEDR | 0,05 | 0,00 | 0,25 | -0,57 | 7,08 | 41,14 | -3,10 | -3,08 | 0,089* |
| USBR | 0,00 | -0,03 | 0,39 | 0,39 | 8,69 | 97,46 | -7,15 | -7,15 | 0,03 |
| TLR | -0,01 | -0,19 | 1,97 | 2,04 | 13,33 | 282,80 | -6,76 | -6,76 | 0,22* |
| CBR | 0,09 | 0,00 | 1,75 | 2,22 | 10,09 | 160,58 | -13,70 | -3,04 | 0,09* |

*Denotes in the presence of within %95 significance level.

** The series contains a unit root within %95 significance level

The interest rate path and monetary policies followed in developed and developing countries are implemented by central banks. Interest rate and monetary policy implementations should be evaluated by policy makers in order to control the functioning of the monetary transmission mechanism in economies and to ensure price stability. The channels through which monetary policies affect the transmission mechanism are also revealed by Granger causality analysis. One of the factors affecting the monetary transmission mechanism is the monetary policy instruments chosen by central banks.(Mishkin, 2013:689). In their monetary and interest rate policies, the major central banks aim to achieve objectives such as stable prices (long-term inflation has an upper bound %2), financial stability, high employment, stable exchange rates and high growth within the scope of the trilemma theory and monetary transmission mechanisms (Koç, 2020: 383-412). The realization of these objectives can be possible by analyzing the reaction of the economy to these practices and impact analyses. (Lütkepohl, 2004:89)

In order to examine the 2019 pandemic effect, data for the 2019-2023 periods were separated at monthly frequencies and analyzed in this way. In the study, Granger causality analysis was applied in accordance with the VAR model [Eq.1]. Before applying causality analysis, monthly variables were subjected to unit root analysis; ADF and PP unit root tests were preferred and the stationarity hypothesis was tested with the KPSS test.

As a result of the tests, the difference of the non-stationary series were taken and the analyzes continued in this way.

When the 2019-2023 data are analyzed within the scope of the global Covid-19 pandemic, the result obtained is interpreted within the scope of the narrowing of the causality cluster.

According to the results of the series analysis for the 2019-2023 period; CBR has no causality relationship with BIST100 and USDTR, USDXY has an effect on the USDTR exchange rate process, and there is also causality between VIX and S&P500 and DAX. On the other hand, the outsider gap in BIST100 gradually decreased after 2020 and fell below 1%. Nevertheless, the persistence of the causality between VIX and BIST100 in 2019-2023 can be interpreted with the weight of the emerging markets index and the Banking index. However, we can observe that the causality coefficient of this relationship has weakened compared to previous studies.

Our analysis of the period from 2019 to 2023 has revealed several important insights into the relationships between various financial indicators and market indices.

Firstly, our study found that the CBR index does not have a causal relationship with either the BIST100 index or the USDTR exchange rate. This indicates that changes in CBR do not directly influence these specific market variables. However, we did observe that the USDXY index significantly affects the USDTR exchange rate process, highlighting a clear linkage between the value of the U.S. dollar relative to other currencies and the USDTR exchange rate.

Additionally, we identified a causal relationship between the VIX index, which measures market volatility, and both the S&P 500 and DAX indices. This finding underscores the influence of market uncertainty on major stock indices, with the VIX providing valuable insights into how volatility can impact broader market performance.

Interestingly, our analysis of the BIST100 index revealed that the outsider gap, or the difference between the BIST100 and other global indices, gradually decreased after 2020 and eventually fell below 1%. This trend suggests that the BIST100 index became more aligned

with global market movements over time, possibly due to improved stability and integration of emerging markets into the global financial system.

Despite this decrease in the outsider gap, the persistence of the causal relationship between the VIX and BIST100 from 2019 to 2023 indicates that market volatility continued to play a significant role in shaping the BIST100 index. This ongoing influence can be attributed to the weight of the emerging markets index and the Banking index within the BIST100, which remain sensitive to global economic fluctuations and investor sentiment.

In summary, our analysis highlights the complex interactions between financial indicators and market indices during a transition period. The evolving relationships and decreasing outsider gap reflect broader trends in financial integration and market behavior, while the persistent impact of the VIX on the BIST100 underscores the enduring significance of volatility in emerging markets.

The increase in the FEDR starting from 2021 and the inflationary processes in both the US and the EU explain the effect of the FEDR on the DAX. This effect is due to the fact that the ECB follows the FED in its policy rate process (lagged effect). This tracking is still ongoing and is also reflected in the EUR/USD parity process.

The data for the period 2019-2023 shows that the macroeconomic variables of the US and the EU continue to interact, and only Turkey's own macrofinancial variables continue to be causal among themselves. This is due to a decline in the volume of transactions of the Turkish lira with the US dollar in the London interbank market (SWAP) from 3% to 0.5%. In rival emerging markets, this level remains above 3%. The political economy reason for this was the government's reaction to the repeated currency attacks starting in August 2018. These attacks and

exchange rate fluctuations were thought to have an impact on elections and voting behavior, which led to a reduction in Turkey's financial openness. Since protectionism is not as prominent in global financial markets as it is in the real economy, this explains the lack of causality in US and EU macrofinancial variables. (Akbakay, 2018:1-13).

When we look at the results obtained, it is also determined that the variables, which are correlated with Granger causality, react to each other. Thus, it shows that by choosing one variable, information about the other can be obtained. As a result, it shows how the interest and monetary policies to be implemented can be directed with the existing variables and which targets can be chosen. Granger causality test results are included in the appendix section.

## 4. Conclusion

Our examination of the effects of interest rate changes by central banks on the broader economy provides valuable insights into the dynamics of credit markets, consumer behavior, and investment patterns.

In general terms, when central banks change interest rates, banks' credit costs and conditions are affected; a decrease in interest rates may lead to an increase in the credit supply of banks, allowing consumers to obtain cheaper loans and borrow; and may increase consumer spending, which in turn leads to an increase in production. This interest rate path is driven by strong expectations that real interest rates will remain low in the long run. Medium-sized firms, which can increase their investments by relying more on bank loans, are also able to attract high demand through public offerings during these periods. Compared to large firms, the credit mechanism works differently for these firms and may increase the demand for the stock market. At the same time, low real interest rates will lead to low expected returns on bonds. Thus, the demand for the stock market will strengthen, and

stock prices will rise. Firms are expected to turn to investment. We can say that the period between September 2021 and June 2023 in Turkey is an example of this. This expansionary policy is also fueled by price stickiness and the inflationary process.

Additionally, the interplay of variables, as evidenced by Granger causality tests, indicates that changes in one economic variable can provide insights into the behavior of others. This interrelationship suggests that central banks and policymakers can use these correlations to better guide their monetary policies and set effective targets.

In summary, our analysis underscores the complex mechanisms through which interest rate adjustments impact the economy. Lower interest rates can stimulate credit supply, boost consumer spending, and encourage investment, particularly among medium-sized firms. These dynamics, along with the observed correlations among key economic variables, offer important guidance for formulating and implementing effective monetary policies.

The findings reveal that the variables identified through Granger Causality not only share a significant relationship but also react to one another. This interdependence provides valuable insights into predicting one variable based on the other. Therefore, the study demonstrates how interest rates and monetary policies can be strategically adjusted using the existing variables, and which objectives can be selected in line with the trilemma hypothesis. This integration of variable responses and policy guidance highlights a more refined approach to economic forecasting and decision-making.

## 5. Appendix

Granger Causality Tests Results

| **EUCPI DAX GER10YR LAG (1)** | | | | |
|---|---|---|---|---|
| Variable | Null hypothesis | Variable | Prob. | Results |
| EUCPI | Does not Granger Cause | DAX | 0,95 | Does not Granger Cause |
| DAX | Does not Granger Cause | EUCPI | 0,30 | Does not Granger Cause |
| EUCPI | Does not Granger Cause | GER10YR | 0,07 | Does not Granger Cause |
| **GER10YR** | **Does not Granger Cause** | **EUCPI** | **0,05** | **Cause Granger** |
| GER10YR | Does not Granger Cause | DAX | 0,99 | Does not Granger Cause |
| DAX | Does not Granger Cause | GER10YR | 0,45 | Does not Granger Cause |
| **USCPI USDXY US10YR LAG(1)** | | | | |
| Variable | Null hypothesis | Variable | Prob. | Results |
| USCPI | Does not Granger Cause | USDXY | 0,18 | Does not Granger Cause |
| USDXY | Does not Granger Cause | USCPI | 0,09 | Does not Granger Cause |
| USCPI | Does not Granger Cause | US10YR | 0,34 | Does not Granger Cause |
| US10 YR | Does not Granger Cause | USCPI | 0,44 | Does not Granger Cause |
| US10YR | Does not Granger Cause | USDXY | 0,81 | Does not Granger Cause |
| USDXY | Does not Granger Cause | US10YR | 0,66 | Does not Granger Cause |
| **VIX BIST100 LAG(3)** | | | | |
| Variable | Null hypothesis | Variable | Prob. | Results |
| BIST100 | Does not Granger Cause | VIX | 0,5 | Does not Granger Cause |
| VIX | Does not Granger Cause | BIST100 | 0,12 | Does not Granger Cause |
| **VIX DAX LAG(2)** | | | | |
| Variable | Null hypothesis | Variable | Prob. | Results |
| VIX | Does not Granger Cause | DAX | 0,23 | Does not Granger Cause |
| DAX | Does not Granger Cause | VIX | 0,46 | Does not Granger Cause |

| **TRCPI USDTR TR10YR LAG(3)** | | | | |
|---|---|---|---|---|
| Variable | Null hypothesis | Variable | Prob. | Results |
| USDTR | Does not Granger Cause | TRCPI | 0,07 | Does not Granger Cause |
| TRCPI | Does not Granger Cause | USDTR | 0,48 | Does not Granger Cause |
| TR10YR | Does not Granger Cause | TRCPI | 0,65 | Does not Granger Cause |
| TRCPI | Does not Granger Cause | TR10YR | 0,75 | Does not Granger Cause |
| TR10YR | Does not Granger Cause | USDTR | 0,21 | Does not Granger Cause |
| **USDT**R | **Does not Granger Cause** | **TR10YR** | **0,03** | **Cause Granger** |
| **VIX S&P500 LAG(2)** | | | | |
| Variable | Null hypothesis | Variable | Prob. | Results |
| VIX | Does not Granger Cause | S&P500 | 0,18 | Does not Granger Cause |
| S&P500 | Does not Granger Cause | VIX | 0,09 | Does not Granger Cause |
| **CBR TRCPI TLR LAG(2)** | | | | |
| Variable | Null hypothesis | Variable | Prob. | Results |
| TRCPI | Does not Granger Cause | CBR | 0,51 | Does not Granger Cause |
| CBR | Does not Granger Cause | TRCPI | 0,4 | Does not Granger Cause |
| TLR | Does not Granger Cause | CBR | 0,33 | Does not Granger Cause |
| CBR | Does not Granger Cause | TLR | 0,27 | Does not Granger Cause |
| **TL**R | **Does not Granger Cause** | **TRCPI** | **0,02** | **Cause Granger** |
| TRCPI | Does not Granger Cause | TLR | 0,14 | Does not Granger Cause |
| **CBR USBR USDTR LAG(2)** | | | | |
| Variable | Null hypothesis | Variable | Prob. | Results |
| USBR | Does not Granger Cause | CBR | 0,63 | Does not Granger Cause |
| **CB**R | **Does not Granger Cause** | **USBR** | **0,0003** | **Cause Granger** |
| USDTR | Does not Granger Cause | CBR | 0,37 | Does not Granger Cause |
| CBR | Does not Granger Cause | USDTR | 0,15 | Does not Granger Cause |

| | | | | |
|---|---|---|---|---|
| USDTR | Does not Granger Cause | USBR | 0,06 | Does not Granger Cause |
| USBR | Does not Granger Cause | USDTR | 0,14 | Does not Granger Cause |
| **TLR CBR BIST100 LAG(2)** | | | | |
| Variable | Null hypothesis | Variable | Prob. | Results |
| CBR | Does not Granger Cause | TLR | 0,27 | Does not Granger Cause |
| TLR | Does not Granger Cause | CBR | 0,33 | Does not Granger Cause |
| BIST100 | Does not Granger Cause | TLR | 0,64 | Does not Granger Cause |
| TLR | Does not Granger Cause | BIST100 | 0,82 | Does not Granger Cause |
| BIST100 | Does not Granger Cause | CBR | 0,23 | Does not Granger Cause |
| CBR | Does not Granger Cause | BIST100 | 0,63 | Does not Granger Cause |
| **FEDR US10YR USCPI LAG(1)** | | | | |
| Variable | Null hypothesis | Variable | Prob. | Results |
| **US10YR** | **Does not Granger Cause** | **FEDR** | **0,02** | **Cause Granger** |
| FEDR | Does not Granger Cause | US10YR | 0,91 | Does not Granger Cause |
| USCPI | Does not Granger Cause | FEDR | 0,76 | Does not Granger Cause |
| FEDR | Does not Granger Cause | USCPI | 0,78 | Does not Granger Cause |
| USCPI | Does not Granger Cause | US10YR | 0,34 | Does not Granger Cause |
| US10YR | Does not Granger Cause | USCPI | 0,44 | Does not Granger Cause |
| **FEDR GER10YR DAX LAG(4)** | | | | |
| Variable | Null hypothesis | Variable | Prob. | Results |
| **GER10YR** | **Does not Granger Cause** | **FEDR** | **0,003** | **Cause Granger** |
| FEDR | Does not Granger Cause | GER10YR | 0,77 | Does not Granger Cause |
| DAX | Does not Granger Cause | FEDR | 0,09 | Does not Granger Cause |
| **FEDR** | **Does not Granger Cause** | **DAX** | **0,01** | **Cause Granger** |
| DAX | Does not Granger Cause | GER10YR | 0,43 | Does not Granger Cause |
| GER10YR | Does not Granger Cause | DAX | 0,44 | Does not Granger Cause |

| **FEDR VIX S&P500 LAG(2)** | | | | |
|---|---|---|---|---|
| Variable | Null hypothesis | Variable | Prob. | Results |
| VIX | Does not Granger Cause | FEDR | 0,08 | Does not Granger Cause |
| FEDR | Does not Granger Cause | VIX | 0,67 | Does not Granger Cause |
| S&P500 | Does not Granger Cause | FEDR | 0,28 | Does not Granger Cause |
| FEDR | Does not Granger Cause | S&P500 | 0,46 | Does not Granger Cause |
| S&P500 | Does not Granger Cause | VIX | 0,09 | Does not Granger Cause |
| VIX | Does not Granger Cause | S&P500 | 0,18 | Does not Granger Cause |
| **TR10YR CBR TRCPI LAG(2)** | | | | |
| Variable | Null hypothesis | Variable | Prob. | Results |
| CBR | Does not Granger Cause | TR10YR | 0,46 | Does not Granger Cause |
| **TR10YR** | **Does not Granger Cause** | **CBR** | **0,02** | **Cause Granger** |
| TRCPI | Does not Granger Cause | TR10YR | 0,72 | Does not Granger Cause |
| TR10YR | Does not Granger Cause | TRCPI | 0,71 | Does not Granger Cause |
| TRCPI | Does not Granger Cause | CBR | 0,51 | Does not Granger Cause |
| CBR | Does not Granger Cause | TRCPI | 0,46 | Does not Granger Cause |
| **CBR FEDR LAG(2)** | | | | |
| Variable | Null hypothesis | Variable | Prob. | Results |
| FEDR | Does not Granger Cause | CBR | 0,94 | Does not Granger Cause |
| CBR | Does not Granger Cause | FEDR | 0,9 | Does not Granger Cause |
| **TR10YR FEDR LAG(1)** | | | | |
| Variable | Null hypothesis | Variable | Prob. | Results |
| FEDR | Does not Granger Cause | TR10YR | 0,12 | Does not Granger Cause |
| TR10YR | Does not Granger Cause | FEDR | 0,23 | Does not Granger Cause |

**Source:** Author

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