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## The Impact of Selected Global Financial Indicators on the BIST 30 Index: An Analysis Using the Residual Augmented Least Squares (RALS) Method

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## Abstract

Uncertainty and volatility in financial markets have become significant determinants of investors' risk perceptions, particularly considering rapid global economic changes. Macroeconomic indicators and financial variables are essential for understanding market dynamics and analysing volatility. These factors influence asset returns by affecting the value of financial instruments, thereby increasing investors' sensitivity to price fluctuations. Consequently, financial indicators play a crucial role in shaping portfolio strategies and are frequently examined in academic research. This study explores the impact of global financial variables on the BIST 30 Index, considering variables such as the Global Financial Uncertainty Index (WUI), the United States 10-Year Treasury Bond Yield, the Chicago Board Options Exchange Volatility Index (VIX), the Morgan Stanley Capital International (MSCI) World Index, and Türkiye's GDP growth rate. Quarterly data from 2004 to 2022 were analysed using EViews and WinRats software. Initially, a regression analysis was conducted using the Least Squares Method, revealing that the BIST 30 Index is significantly influenced by WUI, the US 10-Year Treasury Bond Yield, the VIX, the MSCI World Index, and the GDP growth rate. However, since the normality assumption of the error terms was not satisfied, the analysis was redone using the Residual Augmented Least Squares (RALS) method, which provides more effective results when the error terms are non-normally distributed. In the revised model, the US 10-Year Treasury Bond Yield was excluded due to its lack of significance. The remaining variables, including WUI, MSCI World Index, VIX, and GDP growth rate, were found to be statistically significant in explaining the BIST 30 Index.

## Keywords

Global Financial Indicators • BIST 30 Index • RALS Method


## Author Note


This study is based on the Master's thesis written in İstanbul University, Institute of Social Sciences, Department of Money, Capital Markets and Financial Institutions named "Analysis of the relationship between BIST 30 Index and Selected Global Financial Variables with RALS" in İstanbul 2023.



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## The Impact of Selected Global Financial Indicators on the BIST 30 Index: An Analysis Using the Residual Augmented Least Squares (RALS) Method

Rapid changes in global economic balances, as well as increasing uncertainty and volatility in financial markets, have become some of the main factors shaping investors' perceptions. In this context, the effects of macroeconomic indicators on financial variables such as uncertainty, volatility, bonds, and stocks are of great importance to understand the dynamics of financial markets. With globalisation, the world is shrinking, and the tension and disorder created by this rapid change affect all countries, institutions and individuals (Sinanoğlu, 2015). Uncertainty is a term that can be defined in different ways across various fields. In general terms, uncertainty refers to a situation in which there is no certainty about the nature, timing, and consequences of future events, or situations in which the cause-effect relationships of an event and the factors that may affect it are not fully known. This unexpected effect adds more depth to the concept of uncertainty, as it has an unpredictable influence. Therefore, the presence of uncertainty becomes a fundamental factor in the decision-making process. Uncertainty complicates the calculation of situations and risks, thereby affecting the decision-making process (Alada, 2000: 123).

In recent years, volatility has also become a major focus in the financial literature. The increase in globalisation and the integration of world markets requires a detailed examination of volatility and uncertainty for an objective risk assessment. Price instabilities in markets, economic uncertainties, and inflation uncertainties cause volatility to rise and lead future economic decisions to have a negative impact on the markets (Erdem and Yamak, 2013: 66). The basic meaning of volatility is usually associated with "instability" and "uncertainty." Instability encompasses all movements, whereas uncertainty refers to unknown movements. In their study, Segal et al. (2015) focused specifically on the concepts of "good uncertainty" and "bad uncertainty." "Bad uncertainty" represents volatility that has negative effects on macroeconomic variables and is associated with low asset prices and low investments. In other words, this type of uncertainty has a negative impact on factors such as output, consumption, and profit. On the other hand, "good uncertainty" refers to volatility that has positive effects on these variables and is associated with high asset prices and high investment rates.

Macroeconomic indicators are one of the main metrics used to evaluate the health of an economy. Indicators such as inflation, unemployment, and the GDP growth rate provide an overview of a country's economic performance. These indicators reflect the resilience, growth potential, and stability of the economy, making them some leading factors affecting uncertainty in financial markets. Uncertainty and volatility in global financial markets increase investors' sensitivity to fluctuations in asset prices, and this affects the value of financial instruments, shaping the returns on assets such as bonds and stocks. Additionally, the effects of global macroeconomic indicators on these variables in financial markets play an important role in the process of determining investors' portfolio strategies.

The aim of this research is to evaluate the effects of global financial indicators on the BIST 30 Index. Understanding the complex relationships between macroeconomic indicators and financial variables allows for a better understanding of the dynamics in financial markets and helps investors make more informed decisions about the future. Considering the important connections between global financial markets and economies, it is important to reveal the extent to which the stock market index in Türkiye is affected by global financial variables. Stock markets are sensitive to economic developments, and today, with capital movements occurring at high speed and scale, the possibility of stock market indices being rapidly affected by global financial developments has increased.

The main objective of this study is to determine the extent to which the BIST 30 Index in Türkiye is affected by GDP, US 10-Year Bond Yield, MSCI, VIX, and WUI variables, reflecting volatility and uncertainty on a macroeconomic and global scale. In this context, the study aims to examine the effects of these variables on the BIST 30 Index. The literature review presents previous studies conducted on the topic, along with their methodologies, while the Data Set section supports the explanation of each variable with graphs. In this study, multiple regression analysis was initially used to reveal the linear relationships between the variables and to estimate the degree of their effects. Since the assumption of error terms was not met in the regression model, the Residual Augmented Least Squares Method, developed by Im and Schmidt (2008), was applied.

It is expected that this study will shed light on the future of Turkish financial markets, as it contributes to understanding fluctuations in the global financial environment and the impact of macroeconomic factors on the stock market index, which serves as an indicator of the Turkish economy. By providing important statistical inferences, the study also facilitates better predictions about future stock market movements.

## Literature Review

In emerging financial markets, especially in many markets, investors are confronted with possible volatility that affects decision-making processes and causes risk and uncertainty problems for policymakers. This is called volatility and is important in financial markets for investors to shape their decisions and predict returns on financial assets such as stock returns and exchange rate returns. Investors have focused on various studies in measuring and estimating risk and uncertainty in order to maximise profits and minimise losses in their assets or securities by managing this situation. In a financial context, the concept of volatility refers to the volatility and fluctuations observed in the prices of securities or in developed and emerging financial markets over a period of time (Değirmenci, 2015: 1).

Becker et al. (2009) dealt with the jump diffusion component of the S&P 500 volatility and the VIX. This study addresses two issues related to the information content of the S&P 500 VIX projected volatility index. The findings show that the VIX contains both information about past contributions to total volatility and positive information about future activity.

The study by Şahin and Sekmen (2013) examined the effect of exchange rate uncertainty on stock returns in Türkiye with an experimental approach using a time series data set. This study focused on the link between exchange rate uncertainty and stock market returns. The study was first eliminated from the trend effect by unit root testing of the series. Then, the exchange rate uncertainty was examined using the ARCH/GARCH models. Whether there is a relationship between exchange rate uncertainty and the variables that are indicators of stock market return was evaluated by regression analysis with the Engle-Granger co-integration test.

Baker and Bloom (2013) used five different measures of uncertainty to examine the relationship between GDP growth and uncertainty in 60 countries. These are the volatility of stock index daily returns, the difference between firm daily stock returns, the daily volatility of sovereign bond yields, the daily volatility of the exchange rate, and the GDP forecast discrepancy. By comparing these measures of uncertainty to the country's GDP growth, they concluded that uncertainty is higher when the GDP growth rate is below its long-term average. They also found that equity market returns and equity market volatility have a significant causal effect on economic activity. It has been stated that these findings are also valid for developing countries.

Yıldız and Aksoy (2014) aimed to determine the co-integration relationship between the MSCI Emerging Markets Index and the BIST Index. According to the results of the cointegration analysis, the indices move

together in the long run, that is, there is cointegration. This suggests that periods of crisis do not have a significant effect on the cointegration relationship between these two indices. The study carried out by Bayramoğlu and Abasız (2017) aimed to analyse the interaction between stock market indices of emerging markets with the VAR-EGARCH method and MSCI Indices were used during this time. According to the results of the econometric analysis, the AR parameter values show that permanent deviations occur in the return volumes of the stock markets after the shocks in the markets.

Soper's (2015) study examines the impact of the VIX on the U.S. Treasury bonds, particularly during periods of Quantitative Easing. The dependent variable of the study is the 10-year Treasury bond. According to the results of the analysis, it was seen that the changes in the VIX predicted the changes in the Treasury bonds.

Baker et al. (2016) used the forecast disagreement in inflation and government spending to reflect monetary and fiscal policy uncertainty. They compared the S&P VIX with the economic policy uncertainty index and reported that the EPU (Economic Policy Uncertainty) Index had a 0.58% correlation with the VIX. According to Baker et al. (2016), this result suggests that the EPU reflects policy uncertainty, while the VIX reflects uncertainty about equity returns, and that the news-based EPU indices contain more insight into the nature of economic policy uncertainty.

Öztürk (2018) presented an analysis using the Johansen co-integration test on the co-integration between the BIST 30 Index and the MSCI Emerging Markets Index between January 2003 and July 2017. In the study, the acceptance of the MSCI Index as a reference in emerging markets emphasises that the relationship between Borsa Istanbul and this index is essential for portfolio managers. In addition, in order to analyse the long-term impact of the global financial crisis between Borsa Istanbul and emerging markets, the sample period was divided into two sub-periods: pre-crisis and post-crisis. According to the overall results of the study, there is a significant long-term relationship between the BIST 30 Index and the MSCI Emerging Markets Index for the whole period, but there are no signs of cointegration in the pre-crisis period. However, the results of the post-crisis period show that the BIST 30 Index and the MSCI Index are co-integrated in the long term.

Eyüboğlu (2018) tested the relationship between US 10-year bond yields and emerging market stock markets using the Seemingly Unrelated Regression (SUR) method. The results revealed that US 10-year bond yields influenced the stock market indices of five developing countries including Türkiye.

Şişman (2020) aims to understand the relationship between the 2-Year Bond Yield and BIST 100 Index over the monthly price changes between 2014 and 2018. The aim of the study is to determine whether there is a potential relationship between the 2-Year Bond Yield and BIST 100 Index and the causality relationship between these variables. The Granger Causality Test was used to determine if there was a causal relationship between these two variables. Because of the analysis, it has been determined that the 2-Year Bond Yield is not the reason for the BIST 100 Index.

Kaya and Yarbaşı (2020) examined the Lead-Lag relationship between the MSCI Emerging Markets Index and the BIST 100 Index. Using the Granger Causality Test, a two-way bilateral causality relationship was determined between the variables. Using the created VAR (Vector Autoregression) models, the direction and degree of the relationship were estimated. While the MSCI variable was affected by the shocks of the BIST 100 Index by less than 1%, the BIST 100 Index was affected by the shocks of the MSCI variable by approximately 21%.

Büberkökü (2021) used the Toda and Yamamoto (1995) causality test and found no statistically significant causality relationship between the VIX and the MSCI Frontier Markets Index at traditional significance levels. However, it has been determined that there is a one-way causality relationship between the VIX and the

MSCI Emerging Markets Index, and there is a one-way causality relationship between the VIX and the MSCI G7 Index.

Dew-Becker et al. (2021) examined the pricing of uncertainty and volatility shocks using a broad set of options contracts covering various markets. When uncertainty shocks perceive negatively by investors, they should often carry negative risk premiums. However, empirically, uncertainty risk premiums are positive in most markets. Conversely, historically, the occurrence of large fundamental shocks has carried a negative premium. The findings show that the return premium for gamma is negative and positive for vega. That is, it reveals that exposure to bounces measured by gamma is the factor influencing the marginal utility of investors, not forward uncertainty shocks measured by vega, and results show that innovations in realised volatility identify the states of the world that investors view as actually negative, whereas surprise increases in implied volatility, which is high in other, mostly unrelated, states of the world, are not on average perceived as bad.

Camgöz's (2022) study aims to examine the asymmetric effects of global uncertainty factors on BIST stock prices. In the study, NARDL (Nonlinear Lag Distributed Autoregressive) model was used to reveal asymmetric effects. According to the empirical findings, a long-term asymmetric co-integration relationship was found between stock prices and global uncertainty factors. This affects stock prices over the long term. In addition, in both long-term and short-term analyses, it has been observed that uncertainty factors affect stock prices asymmetrically in different directions and to different extents.

The study, conducted by Önem and Yorgancı (2023), aims to examine the relationships between the US 10-year bond yield and energy prices (Brent oil, American natural gas futures). In addition, the causality relationships of these variables with selected stock market indices such as BIST100, DAX, FTSE100 and ES50 were also investigated. The study includes daily data from 3 January 2017 to 7 February 2022. The VAR Granger causality test was used to determine causality relationships. According to the findings of the study, a bidirectional causality relationship was found between the US 10-year bond yield and the DAX and FTSE100 indices. A one-way causality relationship was found between the US 10-year bond yield and the BIST100, Brent oil and American natural gas futures prices. A one-way causality relationship was found from the US 10-year bond yield to the ES50 index. A bidirectional causality relationship was found between Brent oil and the DAX, FTSE100 and ES50 indices. A one-way causality relationship was determined between American natural gas futures prices and the DAX index.

Güneş (2022) aimed to examine the causality relationship between the VIX, the Dollar Index, and the US 10-Year Government Bond Yield. The Toda-Yamamoto test was used to determine the causality relationship. According to the results of the analysis, it has been determined that the VIX affects the US 10-Year Government Bond Yield and there is a one-way causality relationship between the VIX and the US 10-Year Government Bond Yield. No causality relationship was found among the other variables.

Prasad et al. (2022) examined the impact of macroeconomic factors in the U.S. on the CBOE VIX. The main objective of this study is to understand how various macroeconomic factors affect the volatility index. These factors influence stock market volatility, creating an impact on the VIX. Machine learning classification problems were used to predict daily and weekly VIX trends.

Varlık (2023) aimed to examine the effects of global uncertainty shocks on macroeconomic variables in the Turkish economy. WUI was used in the study. These variables are as follows: global uncertainty indicator, economic growth rate, inflation rate, unemployment rate and interest rate. According to the findings of the study, the increase in global uncertainty has created a negative and meaningful response to real GDP growth, real consumption growth, real investment growth and real credit growth. On the other hand, the inflation

rate, unemployment rate and interest rate reacted positively and meaningfully to the increase in global uncertainty.

Chatterjee's (2023) study explores whether World Uncertainty Indices provide superior predictive capability to stock and bond market indicators of U.S. GDP growth forecasts. The study's hypothesis is that when there is a report of uncertainty in the press, stock and bond traders may be aware of it, and trading data on safety may reflect that uncertainty. The study found that U.S. equity market returns predict U.S. GDP growth more accurately than the World Uncertainty Indices.

## Data Set

In the study, we used global financial variables and macroeconomic indicators like Global Financial Uncertainty Index (WUI), the US 10-Year Bond Interest rate, the CBOE Volatility Index (VIX), the Morgan Stanley Capital International (MSCI) World Index and Türkiye's GDP growth rate variables to determine the effect on the BIST 30 Index in Türkiye. All variables used in the study consist of quarterly data for the period between 2004 and 2022. The BIST 30 Index value, US 10-Year Bond yield rate, VIX value, and MSCI World Index values used within the scope of the study were obtained from the Bloomberg Data terminal. These data are published as monthly values, and they were used in taking three-month arithmetic average values in order to convert them into quarterly data. In addition, the GDP growth rate, which is considered a macroeconomic indicator for Türkiye, was obtained from the Turkish Statistical Institute database and used in the study. The BIST 30 Index consists of the stocks of 30 companies traded on Borsa Istanbul and represents the export, import, production, banking, industry and service sectors. With this feature, it reflects the determining sectors of the Turkish economy well. Since the BIST 100 Index covers a wider range of companies, the impact of individual company movements is felt less in the BIST 30 Index. In addition, the BIST 30 Index is in a more decisive position than the BIST 100 Index in terms of daily transaction amount and transaction volume. Therefore, it is thought that the BIST 30 Index has been monitored for many years as one of the fundamental indicators of the Turkish economy and its relationship with global variables can be determined more accurately. In this context, it was evaluated that it would be appropriate to use the BIST 30 Index in the study.

**World Uncertainty Index (WUI):** The global financial uncertainty index was obtained from the study "World Uncertainty Index (WUI)" published by Ahir, H., N. Bloom, and D. Furceri (2022). WUI is an indicator that measures volatility in financial markets. Therefore, it allows the impact of global factors on stock markets to be investigated. WUI is included as a predictor because uncertainty in the global financial system can affect investor sentiment and stock market performance (Huang et al., 2020). The WUI considers uncertainty based on four primary sources: Economic policy uncertainty, financial market uncertainty, geopolitical risk, and uncertainty derived from news articles. High levels of uncertainty have been associated with a decrease in stock indices, as investors tend to avoid riskier assets during uncertain periods (Kang et al., 2014). Therefore, it is assumed that increases in WUI will be associated with changes in the BIST 30 Index.

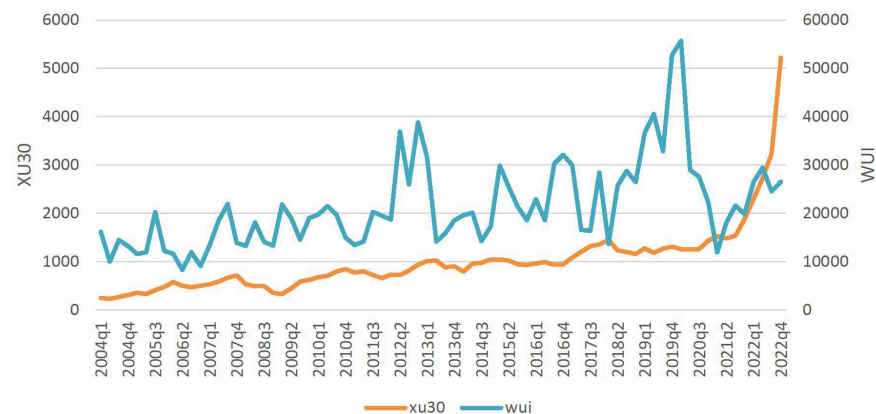
**Figure 1***BIST 30 (XU30) Index and WUI*

Figure 1 shows the change in the BIST-30 (XU30) Index and WUI between 2004 and 2022. Accordingly, when the long-term trend is examined in general, there is a decrease in the XU30 Index with the increase in WUI. Therefore, the increase in economic uncertainty negatively affects stock market indices. Especially in the period after the 2008 global crisis, both indices and uncertainty indicators decreased significantly. However, in some short-term periods, there have been periods when the stock market showed resistance despite the increase in uncertainty. In 2021-2022, during the post-pandemic recovery period, the XU30 reached record levels while the WUI rose. In parallel with the decrease in uncertainty in the last quarter of 2022, the rise in stock market indices also accelerated. In general, the decrease in uncertainty in the long term positively affects the performance of the stock market, while in the short term, it can be observed that it shows resistance except in moments of crisis.

**Volatility Index (VIX):** Another global financial indicator used in the study is the volatility index published by the Chicago Board Options Exchange (CBOE). It is known that the VIX reflects the volatility in the US markets and is therefore effective in the decision-making of international investors (Arouri et al., 2014). Periods of high implied volatility coincide with declines in stock prices as uncertainty increases. High VIX levels are also associated with lower returns on emerging market indices (Manela and Moreira, 2017). Therefore, it is assumed that high VIX values will correlate with Türkiye's stock market performance. The VIX is a variable that is derived based on the volatility that investors in the market foresee for the future, rather than the volatility measures that are classically derived from the variability of past rates of return. In this respect, the VIX is a variable that shows the risk that investors expect for the future and is also called the fear index (Yaşar Akçalı et al, 2019).

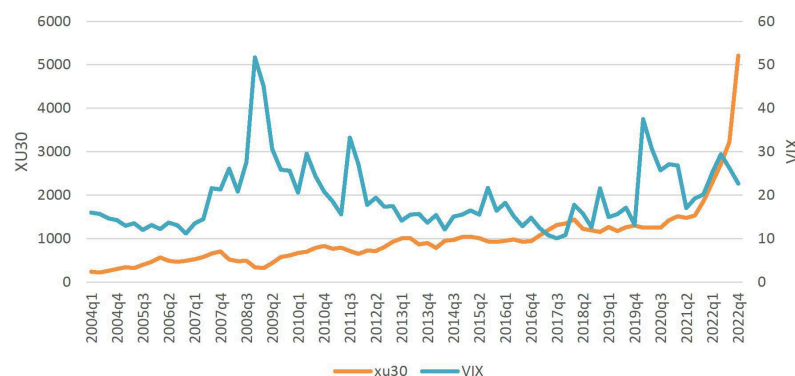
**Figure 2***BIST 30 (XU30) Index and VIX*

Figure 2 shows the change in the BIST-30 (XU30) Index and VIX between 2004 and 2022. Accordingly, when the long-term trend is examined in general, it is observed that increases in the VIX led to decreases in the XU30 Index. Therefore, the increase in market volatility negatively affects the stock market performance. Especially after the 2008 global financial crisis, there were significant decreases in both indicators. However, in some short-term periods, it was also observed that the XU30 remained resilient despite the VIX rising. However, during the post-pandemic recovery period in 2021-2022, VIX increased and the XU30 reached historical peaks. In general, the decrease in market uncertainty in the long term is positively reflected in the index performance; apart from moments of crisis, resilience has also been observed in the short term. Therefore, the relationship between the VIX and the XU30 supports the volatility-return relationship in the academic literature (İskenderoğlu and Akdağ, 2020; Bekaert and Hoerova, 2014; Qadan, et al., 2019).

**US 10-Year Bond Yield Rate:** Another global financial indicator used within the scope of the study is the US 10-year government bond yield rate. The US 10-year government bond yield rate is an important economic indicator that expresses the repayment rate of 10-year government bonds issued by the U.S. Treasury in the market. This rate reflects the interest cost that the US government will repay after 10 years. Therefore, it provides clues about the general condition and expectations of the economy. An increase in the rate of return generally indicates a slowdown in the economy or an increase in inflation expectations (Bandholz et al., 2009: 542). The US 10-year bond yield is an important reference point for global markets, especially for other country bond markets. As a matter of fact, Eyüboğlu and Eyüboğlu (2018) stated that the US 10-year government bond yield has an impact on the stock market in developing countries. US bonds have a market that stands out with its liquidity and depth. In addition, this rate closely affects the interest rate decisions of central banks and the course of the stock markets. Therefore, the US 10-year government bond yield is an important indicator that keeps the pulse of the US economy and can be considered a global financial indicator.

**Figure 3**

*BIST 30 (XU30) Index and the US 10-Year Bond Yield*

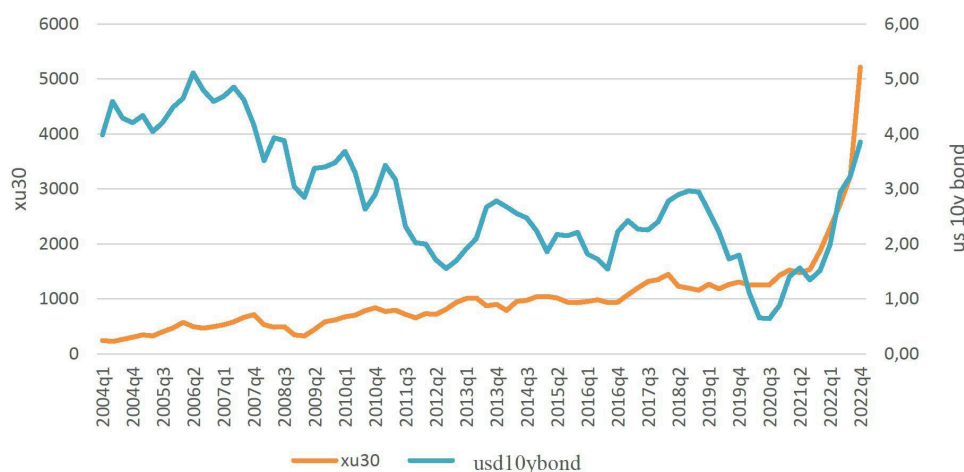


Figure 3 shows the change in the BIST 30 (XU30) Index and the US 10-year government bond yield rate between 2004 and 2022. When the relationship between the BIST 30 Index and the US 10-year government bond yields in the 2004-2022 period is examined, US bond yields tend to increase in the long-term trend, while decreases are observed in the XU30 Index. After 2008, when the impact of the global economic crisis was felt, there were significant decreases in both variables. It is noteworthy that during the pandemic period, the XU30 The index increased despite the low level of bond yields. While the index broke a record despite the increase in bond yields in 2022, the long-term relationship has weakened. Although there is

generally a negative relationship in the long term, periods of short-term resistance of the index have also been observed.

**Morgan Stanley Capital International (MSCI) World Index:** The last variable used as a global financial indicator within the scope of the study is the MSCI World Index published by Morgan Stanley Capital International. MSCI tracks the stock prices of large and medium-sized companies in the world's developed markets. The MSCI World Index covers the markets of 23 developed countries such as the USA, Japan, Canada and other European countries. It is considered one of the largest indices in the world in terms of total market value. It forms the basis of the investment instruments used by investors to monitor the general trend of global markets. Various investment instruments such as stocks and bonds are closely related to the MSCI World Index and technically reflect price changes in the overall market (Neukirch, 2008: 5-9). Therefore, the MSCI World Index is considered an important reference index reflecting the performance of the stock and global capital markets.

**Figure 4**

*BIST 30 (XU30) Index and MSCI World Index*

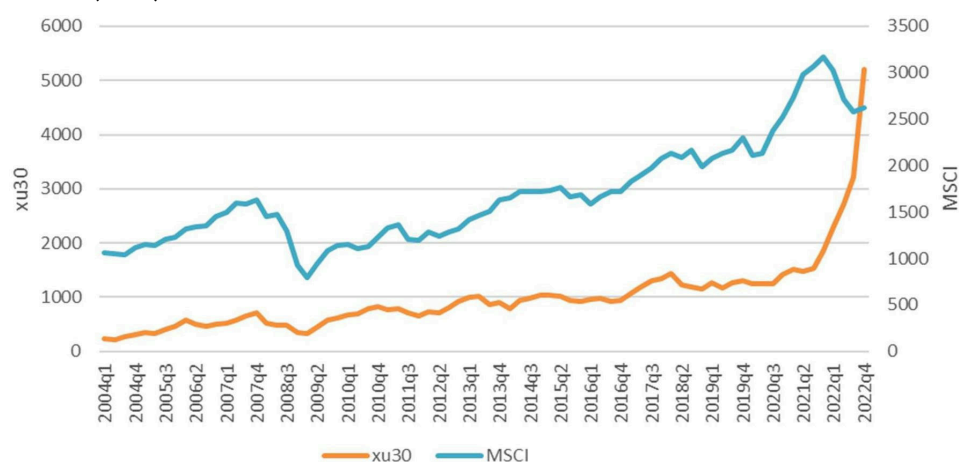


Figure 4 shows the change in the BIST-30 (XU30) Index and the MSCI World Index between 2004 and 2022. Accordingly, it has been observed that there is generally a same-directional relationship in the long term. Increases in global markets also positively affect the local market. However, after the 2008 global crisis, both indices showed a significant decline, and the impact of the crisis was observed on a global scale. In 2020, the indices entered a recovery trend during the COVID-19 pandemic. However, while geopolitical tensions in 2022 weakened the MSCI World Index, XU30 Index broke records. As a matter of fact, the Central Bank of the Republic of Türkiye (CBRT) interest rate and investment incentives may have stimulated the local market during these periods. Although there is generally a positive correlation between these two variables in the long term, different dynamics can be observed in crisis environments and in the short term. The sensitivity of the local market, which acts in harmony with global markets, to macropolicies also attracts attention.

**Gross Domestic Product (GDP):** Within the scope of the study, the gross domestic product (GDP) growth rate was used as a macroeconomic indicator for Türkiye. GDP is the main macroeconomic indicator that shows the economic size of a country. The relationship between the BIST 30 and GDP gives a clue about the course of the economy. If GDP grows, company profitability and the stock market index may also increase. Therefore, the BIST 30-GDP relationship is an important tool in understanding the general situation of the economy and the course of the stock market. Additionally, a strong economy with healthy GDP growth typically correlates positively with the stock market as company earnings and demand grow (Cevik and Teksoz, 2013). Therefore, it is assumed that higher GDP growth will be positively correlated with the BIST 30 Index.

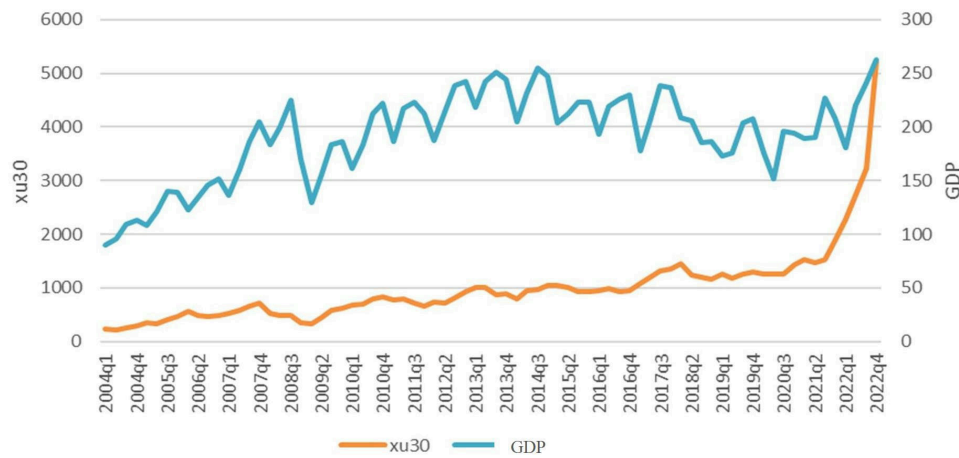
**Figure 5***BIST 30 (XU30) Index and GDP*

Figure 5 shows the BIST-30 (XU30) Index and GDP change between 2004 and 2022. When XU30 Index and GDP changes in the 2004-2022 period are examined together, the increase in the XU30 Index was generally observed in the same way as the increase in GDP eventually. Therefore, economic growth positively affects the stock market. However, after the 2008 global crisis, a significant decline was observed in both GDP and the stock market index. The crisis affected both variables. Although GDP decreased with the COVID-19 epidemic in 2020, XU30 Index has shown a recovery. In addition, with the rapid growth of GDP recently, XU30 Index has broken a record. The increase in GDP has positively stimulated the stock market. In general, there is a positive relationship between the two variables eventually. However, in crisis environments, different dynamics can be observed in the short term. As a result, economic growth has a stimulating effect on the stock market.

## Econometric Method

In this study, the impact of selected global financial indicators on the BIST 30 index was analysed using the Residual Augmented Least Squares (RALS) method. The Residual Augmented Least Squares (RALS) Method was first proposed by Im and Schmidt (2008) as an alternative to the Least Squares Method when error terms are not normally distributed. This method is based on the calculation of second and third moments of residuals that are not normally distributed from regression models. By calculating the second and third moments of  $\varepsilon_t$  in equation (1), incremental variables are created as in equation (2):

$$Y_t = \beta_0 + \beta_1 X_t + \varepsilon_t \quad (1)$$

$$m_j = \frac{\sum \hat{\varepsilon}_t^j}{n}, j = 2 \rightarrow m_2 = \frac{\sum \hat{\varepsilon}_t^2}{n}, \quad j = 3 \rightarrow m_3 = \frac{\sum \hat{\varepsilon}_t^3}{n} \quad (2)$$

w1 and w2 in equation (3) are variables augmented by the residuals.

$$w_1 = \hat{\varepsilon}_t^2 - m_2, w_2 = \hat{\varepsilon}_t^3 - m_3 - 3m_2\hat{\varepsilon}_t \quad (3)$$

Equation (4) includes the newly established Residual Augmented Least Squares (RALS) Method to which new independent variables are added.

$$Y_t = \beta_0 + \beta_1 X_t + \beta_2 w_{1t} + \beta_3 w_{2t} + u_t \quad (4)$$

## Empirical Findings

In the study, multiple regression analysis was used to examine the effect of the MSCI World Index, VIX, WUI, US 10-Year bond yield and GDP growth rate on the BIST 30 Index. Regression analysis is an empirical

method in which the relationship between the dependent variable and one or more independent variables is examined. In cases where there is a single independent variable, the univariate linear regression model is used, while in cases where there is more than one independent variable, the multiple linear regression analysis method is applied (Wooldridge, 2019: 157). In economics, a macroeconomic indicator tends to be affected by more than one underlying factor. At the same time, there may be cause-effect relationships between these basic determinants. In this context, the multiple regression method, in addition to revealing the linear relationship between variables, provides the opportunity to estimate the independent contribution of each explanatory variable to the dependent variable. Thus, complex economic relations can be analysed better (Stolzenberg, 2004: 181). In this study, multiple regression analysis was performed because there was more than one variable that could impact the BIST 30 Index. In the regression analysis, the relationship between the independent variables as model inputs and the dependent variables as model outputs is examined. The BIST 30 Index variable was used as the dependent variable in the study. The independent variables of the study were determined as GDP, WUI, US 10-Year Bond yields, VIX and MSCI World Index. The variables used in the study and their abbreviations used in the analyses are given in [Table 1](#).

**Table 1***Variables Used in the Study and Their Abbreviations*

Variable Names	Variable Types	Abbreviations
<b>BIST 30 Index</b>	Dependent variable	xu30
<b>GDP</b>	Independent variable	gdp
<b>WUI</b>	Independent variable	wui
<b>US 10-year bond yield</b>	Independent variable	us10y
<b>VIX</b>	Independent variable	vix
<b>MSCI World Index</b>	Independent variable	msci

In the study, first, the independent variables that may be related to the dependent variable were determined, and then the model was created with the help of the dataset obtained. The model revealed by the regression analysis method used at this stage allows the estimated values of the dependent variable to be obtained. At the same time, by subjecting the model to significance tests, the importance of the independent variables that have an effect on the dependent variable and the amount of influence can be determined. Thus, regression analysis not only reveals the relationship between the variables but also determines the relative weight of each explanatory factor on the dependent variable. Therefore, the analytical depth of the study is increased (Mills and Markellos, 2008: 241).

The model used in the study is as follows:

$$(xu30)_t = \alpha + \beta_1(gdp)_t + \beta_2(wui)_t + \beta_3(us10y)_t + \beta_4(vix)_t + \beta_5(msci)_t + \varepsilon_t \quad (5)$$

In the study, with the help of descriptive statistics, it was examined whether the variables showed normal distribution after logarithmic transformation. The descriptive statistical values of the logarithmic transformed variables are given in [Table 2](#).

**Table 2***Descriptive Statistics of the Logarithmic Transformed Variables*

	xu30	gdp	wui	us10y	vix	msci
<b>Mean</b>	67216	52294	98899	0.9485	29044	73778
<b>Median</b>	68157	52894	98774	0.9810	28212	73733
<b>Max.</b>	85589	55708	10927	16308	39459	80613
<b>Min.</b>	54102	45003	90161	-0.4436	23145	66824

	<b>xu30</b>	<b>gdp</b>	<b>wui</b>	<b>us10y</b>	<b>vix</b>	<b>msci</b>
<b>Std. Dev.</b>	0.5820	0.2414	0.3950	0.4521	0.3448	0.3172
<b>Skew.</b>	0.1466	-0.1068	0.2716	-0.8117	0.7138	0.2709
<b>Kurtosis</b>	36695	36788	28229	37819	31182	24052
<b>JB</b>	16920	59784	10342	12827	24996	20499
<b>p</b>	(0.4291)	(0.1106)	(0.5962)	(0.5850)	(0.3871)	(0.3588)
<b>Obs.</b>	76	76	76	76	76	76

Skewness and kurtosis values provide information about whether the variables show a normal distribution. As emphasised in the studies, the closeness of the skewness value to zero and the kurtosis value close to three indicate the normal distribution. When the probability value of the Jarque-Bera test was examined for all variables, it was concluded that all variables showed a normal distribution at a significance level of 5%. A full logarithmic model was used in the study. In full logarithmic models, the proportional change in the dependent variable (xu30) can be determined in response to the proportional change in the independent variables. In this direction, we tried to determine the proportional change in the xu30 value against a 1% change in the independent variables.

The estimation results obtained are shown in Table 3. The values that test the significance of the model as a whole and show the coefficient values of the variables are shown in a single table.

**Table 3**

*Results of Regression Analysis- Estimation by the Least Squares Method*

<b>Dependent variable xu30</b>	<b>Coeff.</b>
<b>gdp</b>	$\beta_1$ 0.8873*** (0.0000)
<b>wui</b>	$\beta_2$ 0.2067*** (0.0070)
<b>us10y</b>	$\beta_3$ 0.1210* (0.0974)
<b>vix</b>	$\beta_4$ 0.1680** (0.0231)
<b>msci</b>	$\beta_5$ 1.2678*** (0.0000)
<b>c</b>	$\alpha$ -9.92045 *** (0.000)
<b>R<sub>2</sub></b>	0.88
<b>F-Stat.</b>	109.1869***
<b>Prob(F-stat.)</b>	0.0000

Note: \* 90% confidence level, \*\* 95% confidence level, \*\*\* 99% confidence level is statistically significant.

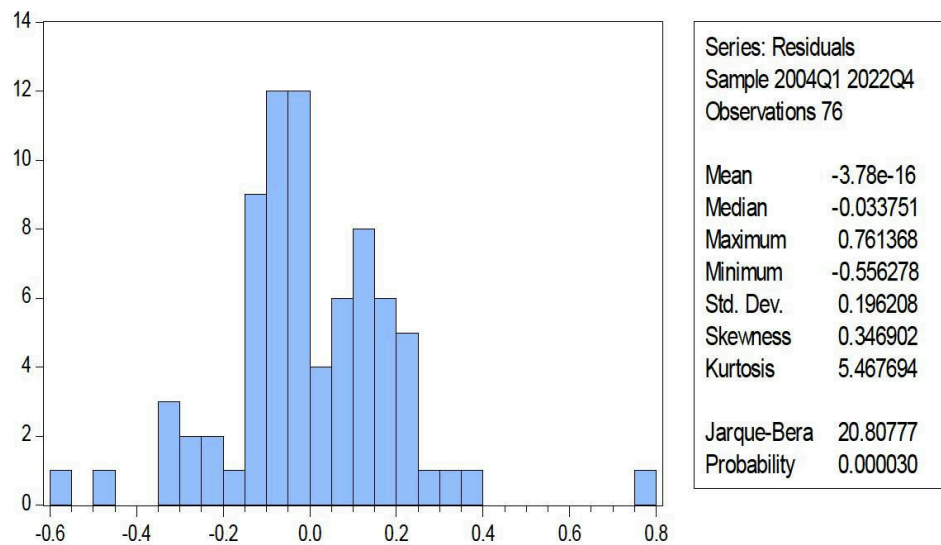
According to the estimated results from the Least Squares Method, the coefficients of gdp, wui, vix and msci, which are the independent variables, were effective on the dependent variable xu30 in the logarithmic regression model and were found to be statistically significant ( $p < 0.05$ ). However, the coefficient of the us10y variable remained at the significance level of only 90% ( $p < 0.10$ ). In this direction, it was determined that each independent variable used in the model had a significant effect on the dependent variable. According to the estimation results, the regression equation is as follows.

$$(xu30)_t = -9,920 + 0,887(gdp)_t + 0,207(wui)_t + 0,121(us10y)_t + 0,168(vix)_t + 1,268(msci)_t + \varepsilon_t(6)$$

According to the estimation results, 1% changes in the independent variables *gdp*, *wui*, *vix*, *us10y* and *msci* cause changes in the dependent variable *xu30* in the same direction and at rates such as 0.89%, 0.21%, 0.17%, 0.12% and 1.27%, respectively. The regression constant was also found statistically significant. According to the results, the  $R^2$  value in the model, the explanatory power of the model, is 88%. According to the F-statistic, which expresses the general significance of the model, the model was found to be significant ( $p < 0.01$ ). However, the validity and significance of these results estimated by the least squares method are possible by providing the assumptions of the least squares method. The most important of these assumptions are those regarding the residuals of the model (Çakmak and Yılmaz, 2018: 280).

**Figure 6**

Histogram Chart



In the histogram above created to determine the normality assumption of the residuals of the model, it was concluded that the residuals did not conform to the normal distribution at the 1% significance level according to the Jarque-Bera test.

**Table 4**

Results of Regression Analysis-Estimation by RALS

	Coeff.	St. Error	T-Stat.	Signif.
<b>Constant</b>	-8.591305***	0.832412	-1032097	0.00000
<b>gdp</b>	0.873495***	0.082652	1056829	0.00000
<b>msci</b>	1.188702***	0.070676	1681888	0.00000
<b>vix</b>	0.167154***	0.054869	304639	0.00329
<b>us10y</b>	0.048656	0.057234	0.85013	0.39823
<b>wui</b>	0.147834***	0.052273	282810	0.00614
<b>w1</b>	-0.962121***	0.319602	-301036	0.00365
<b>w2</b>	2.754848***	0.361895	761227	0.00000

F stat.=171.9604\*\*\*; Sig. Level of F = 0.0000; R2 =0.9465 Note: \* 90% confidence level, \*\* 95% confidence level, \*\*\* 99% confidence level is statistically significant.

In this model, the RALS Method was used because the residuals were not in the normal distribution in the first regression model. The dependent variable is *xu30*, the independent variables are *gdp*, *msci*, *vix*

and wui, and the constant parameter is statistically significant. In addition, the probability values expressed in the augmented form of the residuals added to the w1, w2 model are the independent variables, and they are also significant. According to the results, the  $R^2$  value in the model, the explanatory power of the model, is 95%. According to the F-statistic, the model is statistically significant ( $p < 0.01$ ). However, all other independent variables were found to be significant individually in the model, and the probability value of the us10y variable was  $0.39 > 0.05$ , so it was found to be statistically insignificant, and it was removed from the model.

**Table 5***Results of Linear Regression -Estimation by RALS*

	<b>Coeff.</b>	<b>St. Error</b>	<b>T-Stat.</b>	<b>Signif.</b>
<b>Constant</b>	-8.032721***	0.510035	-1574934	0.00000
<b>gdp</b>	0.855256***	0.079659	1073647	0.00000
<b>msci</b>	1.160540***	0.062306	1862618	0.00000
<b>vix</b>	0.148676***	0.050279	295699	0.00425
<b>wui</b>	0.131711***	0.048613	270935	0.00849
<b>w1</b>	-0.858169***	0.294692	-291208	0.00483
<b>w2</b>	2.723733***	0.359316	758032	0.00000

*F stat.=201.3090\*\*\*; Sig. Level of F = 0.0000;  $R^2$  =0.9459 Note: \* 90% confidence level, \*\* 95% confidence level, \*\*\* 99% confidence level is statistically significant.*

When a new model is established with the RALS Method, the number of observations is 76, the  $R^2$  value is 95%, and within the F-statistic, the model is statistically significant. According to the estimation results, 1% changes in the independent variables gdp, msci, vix, and wui cause changes in the dependent variable xu30 in the same direction and at rates such as 0.85%, 1.16%, 0.14%, and 0.13%.

Although there is no direct study using the same variables and the same method in the literature, when the results obtained from the study are compared with similar studies in the literature, it is seen that similar results are reached with the study of Yıldız and Aksoy (2014), who examined the relationship between the MSCI Emerging Markets Index and BIST Index and with the study of Bayramoğlu and Abasız (2017) in which they tested the volatility interaction between MSCI Indexes and stock market indices. On the other hand, a similar result is reached with the study of Öztürk (2018) who tested the relationship between the BIST 30 Index and the MSCI Emerging Markets Index with the Johansen co-integration test. Kaya and Yarbaşı (2020) also reached a similar conclusion that the BIST 100 Index is affected by the shocks of the MSCI variable in their study where they tested the relationship between the MSCI Emerging Markets Index and the BIST 100 Index with the Granger Causality Test. In the study by Camgöz (2022) examining the asymmetric effects of global uncertainty factors on BIST stock prices, a similar conclusion was reached that uncertainty factors affect stock prices in the long term. Eyüboğlu (2018) tested the relationship between the stock market indices of five developing countries, including Türkiye, and the US 10-year bond yields and concluded that the US 10-year bond yields affected the stock market indices of the five developing countries. However, the US 10-year bond yield variable was not found to be significant in this study. While a one-way causality relationship was found between the US 10-year bond yield and BIST100 in the study of Önem and Yorgancı (2023), this variable was found to be insignificant in the model established with RALS in this study.

## Conclusions

This study aims to determine the extent to which the BIST 30 Index in Türkiye is affected by selected global financial indicators. Quarterly data for the period from 2004 to 2022 were analysed using regression

analysis. According to the results of the Least Squares Method, it was determined that the GDP growth rate, WUI, VIX, MSCI World Index, and US 10-year bond yield rate had a statistically significant effect on the BIST 30 Index value, which is the dependent variable. However, one of the econometric assumptions, the assumption of normal distribution of error terms, was not met. Thus, statistical results were obtained using the RALS Method with the WinRats programme. In the first model established with the RALS Method, the US 10-year bond yield variable was not statistically significant and was removed from the model. Consequently, a new model was established with the other variables. In this model, the dependent variable is the BIST 30 Index value, and the independent variables are the GDP growth rate, WUI, VIX, and MSCI World Index, which were found to be significant.

The findings obtained from the study show that Turkish markets are sensitive to global developments and the domestic economic environment. This situation can be evaluated from several aspects. As a matter of fact, in the globalising world, financial markets across countries have become more integrated. Crises and waves of uncertainty rapidly spread to other countries, and this situation also applies to Türkiye. In addition, Türkiye's economy is based on imports, and its export markets depend on the global climate. When global growth slows down, exports decrease, and this affects Turkish markets. Foreign investors have a significant share in Turkish markets. Therefore, when global uncertainty increases, capital outflows may occur. The Turkish Government and the Central Bank consider global developments into consideration in their policy decisions. Turkish companies are in the global supply chain, and for this reason, external economic conditions affect company performances and, therefore, market values. Thus, Turkish markets appear sensitive to global developments due to globalisation and the interaction between open economies, investors and supply channels.

Within the scope of the study, although it is seen that changes in the WUI and VIX variables have an impact on the BIST 30 Index, it was observed that increases in the global financial uncertainty and fear index level also slightly increase the stock market index value after sudden volatility in price movements. The stock market index appears to increase due to the rise in the fear and uncertainty index. This indicates that the stock market does not fall, even as fear and uncertainty indices rise while stock markets fall, and the markets recover quickly, revealing investors' confidence in the market in times of uncertainty and fear. It is also suggested that the VIX and WUI variables are not a cause but a result.

In addition, many factors may play a role in the observed increase in global risk indicators such as the VIX and WUI affecting the BIST 30 Index. When global uncertainty increases, investors may look for different regions and asset classes in addition to traditional safe havens. Turkish stocks may become attractive in times of global uncertainty by offering alternative investment opportunities. Investors may see periods of increased uncertainty as opportunities. According to the study by Dew-Becker et al. (2021), results show that innovations in realised volatility describe world situations that investors actually see as negative, but it shows that surprise increases in implied volatility, which are high in other mostly unrelated states of the world, are not perceived as bad on average. Stocks at low price levels may be attractive to long-term investors, and this may contribute to the increase in the BIST 30 Index. In addition, global uncertainties often lead Central Banks to make policy changes that can support the local economy and positively affect stock markets. Global risks may even cause a depreciation in the Turkish Lira in some cases, which may increase the competitive advantage of exported goods and services. When these factors come together, the impact of the increase in global risk fear on the BIST 30 Index emerges from a broader perspective.

Although the other variable, the US bond yield, was not found to be statistically significant because the RALS method gives more reliable, more significant and accurate results. Furthermore, it was determined that the increases in the MSCI World Index had a positive impact on the Turkish markets. As a result, the study

reveals that Turkish markets are sensitive to global developments, and the domestic economic environment is the most important determinant. However, the financial uncertainty factor also increases volatility in the markets. The findings obtained because of the analysis reveal that Turkish Capital Markets are highly integrated into global financial markets and are significantly affected by global market movements.

Moreover, the most important statistical determinant is the MSCI World Index. This situation is thought to arise from the deepening globalisation as well as the increase in the presence of foreign investors and the determining role of institutional investors' preferences. However, it has been observed that internal dynamics also shape market movements. Overall, the findings reveal that Turkish Capital Markets have a dynamic structure resulting from the interaction of multiple factors.



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