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FİNANSAL PİYASALAR VE ASİMETRİK YAPI: TÜRK HİSSE SENEDİ PİYASASI ÜZERİNE AMPİRİK BİR UYGULAMA[1]

FINANCIAL MARKET AND ASYMMETRIC STRUCTURE: AN EMPIRICAL APPLICATION ON TURKISH STOCK MARKET

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ÖZ: Bu çalışmada 2014:01-2024:01 dönemi için Borsa İstanbul gösterge endeksi (BIST100) ile seçili makroekonomik değişkenler arasındaki ilişki doğrusal olmayan formda incelenmektedir. Modelde bağımlı değişken olarak BIST100, açıklayıcı değişkenler olarak da mevduat faiz oranı (INT), sanayi üretim endeksi (IPI), M2 para arzı (M2) ve oynaklık endeksi (VIX) dikkate alınmaktadır. BIST100 ve açıklayıcı değişkenler arasındaki ilişki, asimetrik yapının dikkate alınmasına olanak sağlayan doğrusal olmayan ARDL (NARDL) yaklaşımı ile analiz edilmektedir. Elde edilen ampirik bulgulara göre BIST100 endeksi ile açıklayıcı değişkenler (INT, IPI, M2 ve VIX) arasında uzun dönemde eşbütünleşme ilişkisi bulunmaktadır. Katsayı sonuçları incelendiğinde M2'de meydana gelen artışlar BIST100 endeksini pozitif etkilemektedir. INT'de meydana gelen artışlar ise BIST100 endeksinde azalışa yol açmakta ve bu etki istatistiksel olarak anlamlı olmaktadır. Asimetrik etki gösteren IPI'da meydana gelen pozitif şoklar BIST100 üzerinde istatistiksel olarak anlamlı bir etkiye sahipken negatif şoklar ise BIST100'ü düşürücü etki doğurmakla birlikte istatistiksel olarak anlamsız bulunmaktadır. Asimetrik etki gösteren bir başka değişken olan VIX'deki negatif şokların BIST100 üzerindeki etkisi istatistiksel olarak anlamsız bulunmaktadır. Pozitif şoklar ise beklentiler dahilinde BIST100'ü düşürücü etkide bulunmaktadır. Bu bulgular, BIST100'ü tahmin edecek araştırmacılar için makroekonomik değişkenlere bakarak, endeksin ileri dönemdeki hareketleri hakkında çıkarsamalar yapmasını mümkün kılmaktadır.

Anahtar Kelimeler: Hisse senedi piyasası, BIST100, Makroekonomik göstergeler, Asimetrik ilişki, NARDL

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ABSTRACT: In this study, the relationship between Borsa Istanbul benchmark index (BIST100) and selected macroeconomic variables for the period 2014:01-2024:01 is analysed in non-linear form. In the model, BIST100 is taken as the dependent variable and deposit interest rate (INT), industrial production index (IPI), M2 money supply (M2) and volatility index (VIX) are considered as explanatory variables. The relationship between BIST100 and the explanatory variables is analysed with the non-linear ARDL (NARDL) approach, which allows the asymmetric structure to be taken into account. According to the empirical findings, there is a in the long-run cointegration relationship between BIST100 index and explanatory variables (INT, IPI, M2 and VIX). When the coefficient results are analysed, increases in M2 positively affect the BIST100 index. Increases in INT lead to a decrease in BIST100 index and this effect is statistically significant. Positive shocks in IPI, which shows an asymmetric effect, have a statistically significant effect on BIST100, while negative shocks have a downward effect on BIST100 but are statistically insignificant. The effect of negative shocks in VIX, another asymmetric variable, on BIST100 is statistically insignificant. Positive shocks, on the other hand, have a downward effect on BIST100 as expected. These findings make it possible for researchers who will forecast the BIST100 to make inferences about the future movements of the index by looking at macroeconomic variables.

Key Words: Stock market, BIST100, macroeconomic indicators, asymmetric relationship, NARDL

EXTENDED ABSTRACT

The relationship between stock markets, which provide information about the general state of the economy, and various macroeconomic factors is one of the issues that have been discussed in academic finance for many years. The development of financial markets and the increasing interest in financial markets have led to the need to investigate the factors affecting financial markets. An important question is what factors influence financial instruments in the stock market and how these variables affect prices or returns. Investors can use this information to make portfolio decisions and policy makers can use it to make economic decisions.

The connections between key macroeconomic and financial indicators in stock indices have been investigated in various studies in both international and local literature. The Turkish economy, which has increased its economic growth performance in recent years, is expected to grow by an average of 5.11% in the 2000-2022 period, outperforming the global economic growth performance of 2.94%. In addition to the expansion in economic growth, employment and exports, capital markets have also developed in terms of both volume and number of investors during this period. The large increase in the number of investors, especially in the post-pandemic period, can be seen as a turning point for Turkish capital markets.

Considering the rapid development of globalisation and technology, the increase in the number of investors and the diversity of investment instruments, it may be a rather rigid approach to accept that the relationships between economic and financial variables today can only be linear in nature. Moreover, non-linear movements in variables may occur due to crises and changes in business cycles. The general acceptance of the complexity of financial markets and the fact that the relationships between economic variables have linear or non-

linear characteristics require the application of different methods in this regard. The outputs obtained with the nonlinear approach can provide new and more useful information. Especially in an emerging economy like Turkey, where volatility in financial markets is high, nonlinear structures may occur in economic series. Therefore, the need for nonlinear methods that can accurately explain the asymmetric structure in data sets is increasing.

The main objective of this paper is to examine the asymmetric relationships between the Borsa Istanbul 100 index (BIST100) and selected macroeconomic indicators (money supply (M2), deposit interest rate (INT), industrial production index (IPI) and international risk level in financial markets (Volatility Index) (VIX)) using the non-linear ARDL (NARDL) method. NARDL analysis, which provides the opportunity to analyse the series asymmetrically, allows more precise inferences to be made by separating shocks into positive and negative. Unlike the classical ARDL method, which is frequently used in the local literature, this study aims to contribute to the literature by modelling the linkages between BIST100 and selected economic and financial variables under an asymmetric structure using the NARDL method. The analysis is based on monthly data for the period 2014:01-2024:01.

According to the results, there is a long-run cointegration link between the BIST100 index and the selected markets in the long-run. According to the long-run coefficient results, an increase in M2 increases the BIST100 index, which in turn leads to an increase in the stock market index by creating an abundance of liquidity. An increase in INT causes the BIST100 index to fall. This increase is seen as an alternative source of income for investors, and therefore, an increase in INT has a downward effect on the stock market index. Positive shocks to IPI, which has an asymmetric effect, have a statistically significant effect on the stock market, while negative shocks have a downward but insignificant effect. This finding can be interpreted as positive developments in industry, which is the engine of growth in a country, may have a positive impact on the stock market. The effect of negative shocks in the VIX index, another variable with asymmetric effect, on the stock market index is statistically insignificant. Positive shocks, on the other hand, have a decreasing effect on the stock market index within expectations. This result can be interpreted as the negative impact of unfavorable market conditions abroad on the Turkish stock market index. The results are important for understanding the linkages between the Turkish financial market index and macroeconomic variables. Therefore, changes in indicators such as M2, INT, IPI and VIX index should be carefully monitored by investors and investors should also take positions by taking shocks into account.

1. INTRODUCTION

The relationship between stock markets, which provide information about the general state of the economy, and various macroeconomic factors has been one of the topics discussed in academic finance for many years. Investors who take a certain amount of risk in these markets make their investment decisions by first assessing the general state of the economy, then making sector and stock assessments. Hence, investors make judgements about the country's economy and consider a number of macroeconomic variables when deciding whether to buy or sell stocks. The forces that drive financial markets can gain a better understanding by closely monitoring the macroeconomic variables that affect stock markets. Stock markets, which allow

investors to allocate their savings to productive investments based on a risk-return trade-off, have become as important an indicator of economies as macroeconomic indicators (Imegi, 2014: 80; Yildiz and Sanli, 2023: 628, and Nazlioglu, 2024: 141). As a result of financial liberalisation and the increasing integration processes brought about by globalisation, financial markets have become more prominent in countries.

The development of financial markets and the increasing interest in financial markets have led to the need to study the factors affecting financial markets. An important question is what factors affect financial instruments in the stock market and what variables affect prices or returns and how. Investors can use this information to make portfolio decisions, policymakers can use it to make economic decisions, and researchers can use it to develop new research questions. The linkages among stock markets and various macroeconomic indicators are examined around the literature, extensively. However, if we look at global economic, political, and geopolitical events, the changes in economic life caused by these events show that new studies are needed for markets and investors and that this area will remain topical. Deposit rates (INT), which effect stock markets (Senturk and Ducan, 2014), are a key economic indicator that affects consumers and businesses. Movements in INT are closely watched by investors, and increasing in interest rates attract investors. Movements in industrial production (IPI) (Alper and Kara, 2017) are an important indicator of economic health. It is possible to obtain knowledge around general condition of the economic system by analysing changes in IPI. Another important macroeconomic variable that affects stock markets is the money supply (M2) (Sevinc, 2014). Given the importance of liquidity to stock markets, it is important for equity investors to track liquidity through variations around M2. The volatility index (VIX), developed using options on the S&P 500 index, reflects uncertainty in the market and is often referred to as the fear index. Variations on the VIX, that is an exogenous variable affecting the stock market index, are considered to be one of the most important factors effecting stock market indexes in terms of reflecting changes in market volatility and investor fear (Sarwar, 2012).

The Turkish economy, which has increased its economic growth performance in recent decades, grew by an average of 5.11% over the period 2000-2022, outperforming the global economic growth performance of 2.94% (WDI, 2024). This situation gives Turkey the opportunity to be in a remarkable position in terms of trade and investment. Besides to the economic growth and enlarging in investment, employment and exports, interest in capital markets is increasing during this period. The large increase in the number of investors, especially in the post-pandemic period, can be seen as a turning point for Turkish capital markets. The increase in the amount of investors and the volume of dealing also brings records in the stock market index. In dollar terms, Borsa Istanbul ranked first among emerging markets in terms of return in 2022, making its investors profitable (TCMA, 2024a).

Borsa Istanbul, which has significantly increased its market value over time, stands out as an important stock exchange among the countries in the region. With a market value of $385 billion, Borsa Istanbul ranks 24th in the world (TCMA, 2024b). In terms of market value to GDP ratio, it has a ratio of 30% at the cut off 2023 and grades 45th around the worldwide.

Given the high-speed development of globalisation and technology, the enlarge in the number of investors and the variety of investment instruments, it may be a very rigid approach to accept that the relationships between economic and financial variables today can only have linear characteristics. In addition, non-linear movements in variables can occur because of crises and changes in the business cycle (Caglar, Yavuz, Mert and Kilic, 2022: 10527). The fact that the complexity of financial markets is generally accepted and that the relationships between economic variables have linear or non-linear characteristics requires the application of different methods in this respect. In cases where the relationships between security prices or the relationships in the stock markets are non-linear, extraordinary returns can be obtained from investments. (Koy, Güngör and Simsek, 2022: 65). The information obtained from non-linear model analyses can provide new and more useful information. The basic target of this paper scrutinizes the asymmetric linkages among the Borsa Istanbul 100 index (BIST100) and selected macroeconomic indicators using the non-linear ARDL (NARDL) method. NARDL analysis, which takes account of the non-linear relationships between series, allows more precise inferences to be drawn by separating shocks as positive and negative.

Accordingly, in this paper, BIST100, which is the Turkish stock market, and selected macroeconomic factors (M2, INT, IPI) and VIX variables, that is a substantial pointer regarding financial markets, are used. In the paper, the linkages among the indicators are inquired utilizing the NARDL method through the period 2014:01-2024:01, based on monthly data. According to the results, a long-run cointegration linkage is found among the BIST100 index and the selected pointers. Regarding to long-term coefficient results, increases in M2 money supply increase the BIST100 index, so this increase creates liquidity abundance and causes the stock market index to rise. Rising in INT lead to a fall in the BIST100 index. This increase is seen as alternative income for investors, and hence increasing in INT have a downward effect on the stock market index. Positive shocks to the IPI, which have an asymmetric effect, have a statistically substantial impact on the stock market, while negative shocks have downward impact, but insignificant. This finding can be interpreted as meaning that positive developments in a country's industry, which is the engine of growth, can also have a positive impact on the stock market. The impact of negative shocks in VIX, which is another variable with an asymmetric effect, on the stock market index is statistically insignificant. Contrary, positive shocks have decreasing impact on the stock market index, within expectations. This result can be

evaluated as negative market conditions abroad have dissentious impact towards the stock market index in Türkiye.

Although the relationship between the BIST100 and its explainers in the Turkish sample has been examined many times, it still does not reach a certain saturation. In this context, this study contributes to this limited literature. By considering the asymmetric effects between selected macroeconomic variables and the Turkish stock market index this article differs from the literature. Furthermore, is that this paper covers the most recent period.

The remainder part of the study is constructed as bellows. 2nd section holds the literature review, and the 3rd section presents around the data analyse and econometric methodology. The section 4th of the study exhibits the empiric findings and conclusively the 5th section presents the consequence

2. EMPIRICAL LITERATURE

The relationship between basic macroeconomic and financial indicators on stock market indexes are investigated in various studies in both international and Turkish literature. It is observed that different econometric methods are utilized in empirical studies addressing these relationships and the findings obtained differ depending on the country/country group and the period analyzed. In this respect, in Panel A of Table 1 presents the articles in the international literature that investigate the linkages among different financial and macroeconomic indicators and equity market indices for country/country groups. Then, Panel B presents a literature review of studies analyzing the linkages between various financial and macroeconomic indicators and the BIST100 index representing the Turkish stock market. In addition, examining the impacts of various macroeconomic and financial variables on stock market indexes within these studies allows these relationships to be analyzed from different perspectives and dimensions.

Table 1: Summary of Empirical Literature for Stock Markets and its Descriptors

Author(s)	*Sample*	*Period*	*Methods*	*Variables*	*Findings*
Panel A: International Literature Review					
Bagchi (2012)	India	2007-2009 (Daily)	Multiple Regression Method	6 Portfolio returns VIX	The linkage among portfolio return and the VIX follows positive.
Sarwar (2012)	USA and BRIC	1993-2007	Multiple Regression Method	Stock returns VIX	Detecting a strong connection among stock returns and VIX that is under asymmetric framework.
Shu and Zhang (2012)	USA	26.03.2004-20.05.2009 (Daily)	Engle-Granger Cointegration ECM Non-linear Causality	VIX futures market	VIX futures prices lead spot VIX. Detected bi-directional causality between VIX and VIX futures prices.
Tsai (2014)	5 Developed Country	1990:01-2013:05	VAR Model	Stock Indexes VIX	The spread of the US stock market to other countries' stock markets is highly correlated with the VIX.
Chandra and Thenmozhi (2015)	India	01.03.2009-30.11.2012 (Daily)	Quantile Regression ARCH, GARCH & EGARCH	Nifty Returns India VIX	Detecting a connection among VIX and Nifty returns that is under asymmetric framework.
Basher and Sadorsky (2016)	23 Developing Country	04.01.2000-31.07.2014 (Daily)	GO-GARCH	Stock prices Gold prices Oil prices Bond Prices VIX	There is a positive leverage effect between equity markets and oil prices and possibility to hedge the risks associated with equities with oil transactions.
Neffelli and Resta (2018)	USA and BRIC	03.01.2007-01.02.2018	GMM	Stock Indexes VIX	Equity markets are affected by the VIX and the VIX increased during the 2008 Financial Crisis.
Ruan (2018)	USA and BRIC	16.03.2011-09.12.2016 (Daily)	ADF, PP & KPSS STCC Model	S&P 500 BRIC Stock Market Indexes Oil VIX Gold VIX	The connection among stock markets is effected by VIX.
Shahzad, Aloui and Jammazi (2020)	USA	14.12.2007-21.09.2018 (Daily)	Wavelet Approaches	11 Different Sectors For Stock Indexes and CDS Indexes VIX	There is a strong negative (positive) linkage in the long-run for CDS-stock (CDS-VIX) pairs.
Iskenderoglu and Akdag (2020)	G20	01.03.2011-31.12.2017 (Daily)	Granger Causality	Stock Indexes VIX	There is more causal relationship in developed countries in comparison to developing countries.
Bhuiyan and Chowdhury (2020)	USA and Canada	2000-2018 (Monthly)	VECM	Stock Indexes of different sectors IPI Money Supply Interest Rate	Long-term linkages among selected macroeconomic indicators and different sector indexes detected for USA, but not for Canada.
Asravor and Fonu (2021)	Ghana	1992-2017 (Annual)	ARDL Bounds Test	Stock Index Money Supply	The stock market development is positively

				Interest Rate Inflation Human Capital FDI	effected by foreign direct investment and interest rate while the money supply, inflation rate and human capital is vice-verse.
Shahzad, Bouri, Rehman, and Roubaud (2022)	BRICS	19.07.2010-02.07.2020 (Daily)	Cross-quantilogram approach	BRIC Stock Market Indexes VIX Futures	During the COVID-19 outbreak, gold appears to have more stable diversification benefits in China, conversely, VIX futures offer higher diversification benefits the other countries.
Prasad, Bakhshi and Seetharaman (2022)	USA	2007:05-2021:12 (Daily)	Machine Learning & Logistic Regression	Selected Macroeconomic and Financial Indicators VIX	There is a positive relationship among the TED spread, Financial Stress Index, and Equity Market Volatility with VIX.
Vergili and Celik (2023)	20 Emerging Markets	2013:02-2020:03 (Monthly)	ARDL Bounds Test	DJSEMUP VIX	There is a long-run linkages among the DJSEMUP Index and the VIX with a negatively.
Panel B: Literature review for Turkey					
Hatipoglu and Tekin (2017)	Türkiye	07.02.2002-29.12.2016 (Daily)	Quantile Regression	BIST100 Exchange Rate Oil Prices VIX	Volatility index in all quantiles has impacted BIST100. An asymmetric linkage among BIST index and oil prices has not detect, only meaningful during middle quantile.
Sadeghzadeh (2018)	Türkiye	2004:01-2018:04	Causality Analysis	BIST100 CCI VIX	The causality link is from BIST100 and VIX to CCI.
Akdag (2019)	Türkiye	2007:01-2018:09	Cointegration Analysis Causality Analysis	BIST100 Exchange rate IPI BBIR RAI RSCI CCI PMI VIX	The VIX and other indicators move together in the long run. The change in the VIX is the granger cause of the change in all variables (except the BBIR).
Saritas and Nazlioglu (2019)	Türkiye	02.01.2009-12.11.2018 (Daily)	VAR Model Causality Analysis	BIST100 Exchange rate VIX	BIST100 responds negatively to the VIX shock, while the exchange rate responds positively. The causality link runs from the VIX to the BIST100 and the exchange rate.
Gulhan (2020)	Türkiye	13.12.2015-12.01.2019 (Weekly)	VAR Model	BIST100 Exchange rate Oil prices Gold prices VIX	There is bi-directional causality between BIST100 and oil prices variables. Except for VIX, other variables are granger causes of gold prices.
Telek (2020)	Türkiye	2004:01-2019:04	ARDL Bounds Test	Portfolio investments Exchange rate	While the VIX moves together with portfolio investments in the long run,

				VIX	but VIX has no relationship with the exchange rate.
Tuncel and Gürsoy (2020)	Türkiye	06.08.2010-06.01.2020 (Daily)	Toda-Yamamoto Causality Analysis	BIST100 Bitcoin price VIX	Bitcoin price does not have a significant effect on both variables; however, causality link is from the VIX to the BIST100.
Gungor (2021)	Türkiye	2009:01-2021:10	ARDL Bounds Test	Portfolio investments Exchange rate VIX	There is a long-run relationship between VIX, exchange rate and portfolio investments.
Saritas et al. (2021)	Türkiye	2010:02-2020:02	ARDL Bounds Test	BIST100 CDS premiums, credit ratings	It is concluded that CDS premiums, credit ratings and BIST 100 index move together.
Munyas and Bektur (2021)	Türkiye	03.01.2005-31.12.2019 (Daily)	ARDL Bounds Test	BIST100 CDS Exchange rates Gold price VIX	Except for the euro exchange rate, there is a positive long-run relationship between the VIX and other variables, but a negative long-run relationship with the dollar exchange rate.
Bayrakdaroglu and Turkun Kaya (2021)	BRICS-T	2004-2019	Panel Data Analysis	Composite stock market index Exchange rate CCI Freedom index VIX	VIX and exchange rate negatively affect the composite stock market index.
Pazarci, Kar, Kilic, and Umut (2022)	Türkiye	2002:01-2022:02	ARDL Bounds Test	BIST100 CDS Exchange rate VIX	BIST100 are affected positively by the exchange rate and the VIX, but CDS premium dissentiously.
Munyas (2022)	BRIC-T	2009:01-2020:06	Cointegration Analysis VECM	Stock Market Indexes VIX	By the changing on the VIX that is the most impacted to BIST100. VIX affects stock markets carry on to be high-up in the short-run and lower in the long-run.
Duvar and Eygu (2022)	Türkiye	2009:01-2019:12	VAR Model Cointegration Analysis Causality Analysis	BIST100 Exchange Rate Oil Prices Gold Prices VIX	While there is no causality relationship between BIST100 and oil prices and the VIX; The causality link runs from exchange rate and gold prices to BIST100.
Bildirici, Salman and Ersin (2022)	Türkiye	04.01.2000-13.03.2020 (Daily)	MS-GARCH	BIST100 Returns Exchange Rate Oil Prices Gold Prices VIX	Türkiye's financial markets the BIST100 does not Granger cause the returns of oil and exchange rates to have no effects on the oil prices determined in the world markets.
Kazak (2023)	Türkiye	01.01.2019-25.05.2023 (Daily)	Fourier Toda-Yamamoto Causality Analysis	BIST100 BIST Participation50 VIX	The causality link runs from the VIX to the BIST100 and BIST Participation50 indexes.

Notes**:** BBIR: Bond Benchmark Interest Rate. CCI: Consumer Confidence Index. DJSEMUP: Dow Jones Sustainability Emerging Markets Index IPI: Industrial Production Index. PMI: Purchasing

Managers Index. RAI: Risk Appetite Index. RSCI: Real Sector Confidence Index. STCC: Smooth Transition Conditional Correlation. VAR: Vector Autoregressive. VECM: Vector Error Correction Mechanism.

A general review of the international literature reveals which the VIX fear index has an impact on the equity market of countries/country groups. While some studies (Bagchi, 2012; Tsai, 2014; Neffelli and Resta, 2018; Shahzad, Aloui and Jammazi, 2020; Bhuiyan and Chowdhury, 2020; Asravor and Fonu, 2021; Prasad, Bakhshi and Seetharaman 2022; Vergili and Celik, 2023) use linear models, some studies (Sarwar, 2012; Shu and Zhang, 2012; Chandra and Thenmozhi, 2015; Shahzad, Bouri, Rehman, and Roubaud, 2022) use non-linear models to reveal this effect in an asymmetric structure. Panel A also shows that the international literature on the subject has evolved towards non-linear models rather than the use of linear models.

In empirical studies on Türkiye, generally found that there are various links between various macroeconomic variables and the VIX fear index, which exhibitions degree of risk through international financial markets, and BIST100 index. The reason for the differentiation of these relationships obtained for Türkiye can be interpreted as the different methodological approaches (cointegration analysis, causality analysis, VAR model and quantile regression approach) and the different periods analyzed. Thus, the application of different econometric methodologies affects time series characteristics of variables towards Türkiye and reveals the relationships between the BIST100 index and macroeconomic and financial variables in different directions. Except for Hatipoğlu and Tekin (2017), Kazak (2023) and Bildirici, Salman and Ersin (2022), studies for Türkiye utilize linear methods. Since linear methods used in these studies do not take into account the asymmetric structure of variables, they may lead to biased estimates of the size and conducting of the linkages among indicators. Regarding that framework, studies in the developing empirical literature on Türkiye should use non-linear models for national and international investors to plan their portfolio diversification more accurately. Especially in an emerging market economy with high volatility in financial markets such as Türkiye, nonlinear structures may occur in economic series. Therefore, the need for non-linear methods that can accurately explain the asymmetric structure in data sets is increasing. In this context, the study aims to analyze the effects of money supply, interest rate, industrial production index and VIX, which indicates the level of international risk in financial markets, on the BIST100 index using the NARDL method. Hence, the article targets to conduce on the literature by modeling linkages among the BIST100 and selected economic and financial variables under an asymmetric structure by using the non-linear ARDL method contrary to the classical ARDL method frequently used in the literature on Türkiye.

3. DATA AND METHODOLOGY

3.1. Data

The dataset that utilized on the paper are presented around Table 2. Given the data availability of the variables, the period analysed in the study is 2014:01-2024:01.

Table 2: Definition of Variables

Variables	Abbreviation	Definition	Data source
Dependent variable			
Stock Prices	$BIST100_t$	(PRICE) BIST 100 Index (BIST100), Based on Closing Prices (January 1986=0.01)-Level	EVDS[1]
Independent variables			
Interest Rates	INT_t	Up to 1 Month Maturity (Deposits Opened in Turkish Lira) (Flow %)-Level	EVDS[2]
Industrial Production Index	IPI_t	Total industry-Level	
Money Supply	$M2_t$	M2(Thousand TL)-Level	
Volatility Index	VIX_t	Volatility Index	FRED[3]

In Table 3, descriptive statistics which regarding the data are exhibited. When looking at the table, the average value of the BIST100 index is seen as 1802 points through research period, it peaks at 8496 points and has its lowest levels at 618 points. In the same period, the average deposit interest rate is 14.071%, peaks at 44.205% and reaches its lowest value at 6.946%. The industrial production index is at an average level of 86.692, with the highest value being 108.5482 and the lowest value being 58.567. M2 money supply was worth an average of 3.4 million TL in this period. While values of 20 and below observed in the VIX, which is substantial pointers regarding fear and enthusiasm on marketplaces, represent times of low volatility, values of 30 and above are seen as periods of high volatility. The index, which had an average value of 18.081 in the examined period, had the highest value of 57.736, representing the period when volatility peaked, and the lowest value was 10.125 points. While M2 money supply is the variable with the peak standard deviation, the fact that the skewness is positive in all variables indicates a right-tailed distribution. While M2 money supply is the variable with the peak standard deviation that positive skewness is in whole variables indicates a right-tailed distribution. Negative surplus kurtosis (K<3) in the industrial production index indicates the entity of a platykurtic distribution, other variables (K>3) indicate a leptokurtic distribution. The Jarque and Bera (1987) (JB) normality test shows that the null value of normality is rejected through indicators, outfitting evidence towards non-Gaussian distributions. According to the results of Broock, Scheinkman, Dechert, and

[1] TCMB, EVDS, https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket (Accessed date: 21.05.2024).
[2] TCMB, EVDS, https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket(Accessed date: 21.05.2024).
[3] FRED, https://fred.stlouisfed.org/series/VIXCLS (Accessed date: 21.05.2024).

LeBaron (1996) (BDS) test, it allows the use of a non-linear testing framework by rejecting the null hypothesis of linearity for all variables. In line with the results obtained from descriptive statistics and a priori tests, it points to a structure with high volatility, tailed and non-linear structure in Borsa Istanbul and macroeconomic indicators in Turkey. These results encourage us to apply the NARDL approach, in which the asymmetric structure can be reflected.

Table 3: Descriptive Statistics and Preliminary Tests

							Test of normality	Test of linearity
Varib.	Mean	Max.	Min.	SD	S	K	JB	BDS
$BIST100_t$	1802.88	8496.66	618.10	1877.45	2.30	7.24	197.24 [a][0.000]	13.55 [a][0.000]
INT_t	14.07	44.21	6.95	6.80	2.04	8.30	225.16 [a][0.000]	37.71 [a][0.000]
IPI_t	86.69	108.55	58.57	12.99	0.28	1.87	7.93[b][0.019]	92.85 [a][0.000]
$M2_t$	3438786	13751101	926478	3236992	1.71	5.02	79.62 [a][0.000]	19.19 [a][0.000]
VIX_t	18.08	57.74	10.13	6.71	2.30	12.40	552.34 [a][0.000]	19.75 [a][0.000]

Notes: JB refers to Jarque and Bera (1987) normality test. BDS is the Broock et al. (1996) linearity statistic. S skewness, K kurtosis and SD standard deviation. The values in square brackets represent probability values. [a], [b], and [c] denotes the significance level at 1%, 5%, and 10%, respectively. The statistics in the table are calculated with raw data.

At last, the Figure 1 shows linkages among BIST100 index and selected macroeconomic indicant. Regarding Figure 1, the BIST100 index and M2 money supply could be seen moving together for the period 2014-2024. Regarding at the relationship between the BIST100 index and the IPI, it is worth noting the sharp decline in the IPI between February 2020 and July 2020. This period coincides the Covid-19 pandemic' the announcement and start of the bans. In general, both the index and the IPI are in an upward trend. If we look at the linkages among BIST100 and VIX, that generally no linear relationship. These indicators, in some periods there is a movement in the same direction and in other periods vice versa. In the relevant period, the VIX peaked at 57 points in March 2020, indicating risk level on marketplace. The BIST100 index also fall, over the same period. Since October 2020, the VIX has been trending down and the BIST100 index has been trending up in the same period. If we look at the chart of the BIST100 index and the deposit rate, we can see that there was a common movement until 2018. There is an increasing trend between the two variables from July 2022 onwards. While the BIST100 index remained horizontal for a long time in the period 2014-2021, the index value starts to increase especially after September 2021. This period coincides with the easing of prohibitions that through the Covid-19 pandemic and resumption on economic activity. Regarding rates of interest, they remain horizontal until May 2018 and start to rise from June 2018. In the period 2018-2022, it follows a fluctuating course, but starts to increase again as of December 2022 and continues to increase continuously.

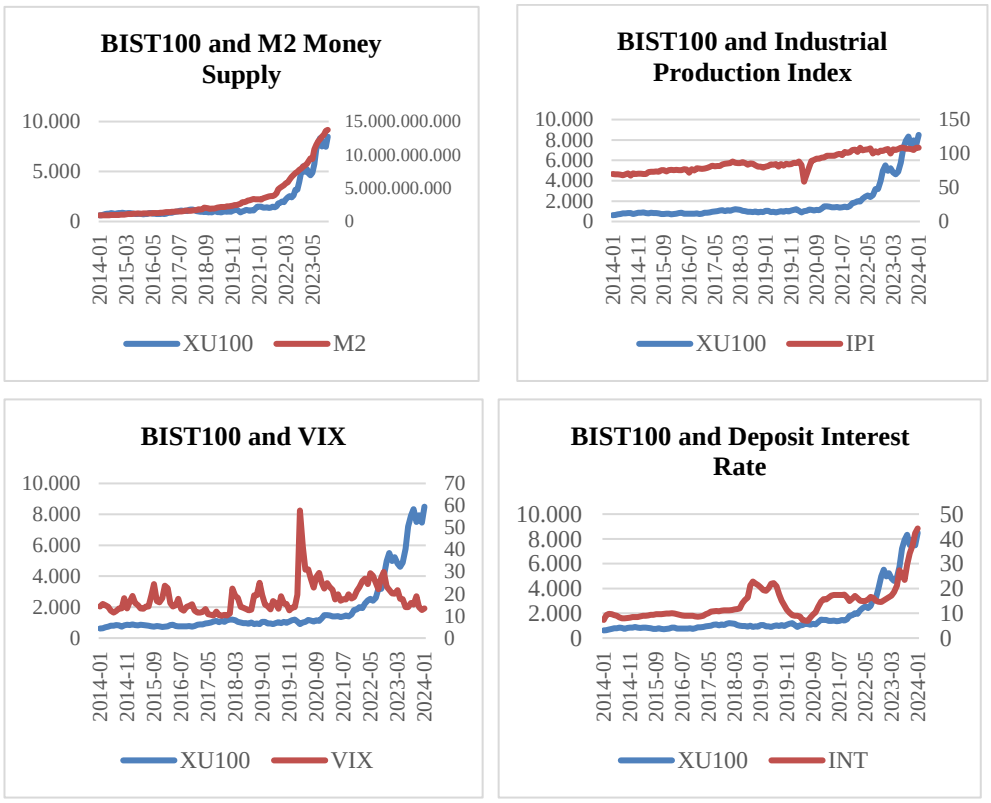

Figure 1: Relationship Between the BIST100 (XU100) Index and Selected Macroeconomic and Financial Variables

3.2. Methodology

The relationship between the BIST100 and its descriptors (INT, IPI, M2, and VIX) is examined using ARDL a co-integration approach that proposed by Pesaran, Shin, and Smith (2001). This approach provides the theoretical basis for examining cointegration relationship with stationary series at different levels (dependent variable I(1), independent variables I(0) or I(1)). Moreover, no variable must stationarity of I(2) or higher. The ARDL approach also has advantages such as the ability to obtain the ECM model, the opportunity it provides in determining the lag lengths, and its robust to endogeneity and serial correlation.

The linear linkages among variables could be modelled utilizing the ARDL approach. Nevertheless, crises or developments in the business cycle can lead to non-linear fluctuations in the variables. An asymmetric process can arise from these activities. Granger and Yoon (2002) and Fareed, Meo, Zulfiqar, Shahzad, and Wang (2018) found out that ignoring the existing asymmetry will lead to bias. Anoruo

(2011) noted that only linear relationships between variables can be captured by linear models but in time series there are non-linear movements.

Shin, Yu and Greenwood-Nimmo (2014) extend the ARDL model for asymmetric effects to compensate for this shortcoming. Following Shin et al. (2014), the NARDL equation modelling the relationship between the BIST100 and its macroeconomic explanators is as follows:

$$\Delta lnBIST100_t = c_0 + bt + \theta_1 lnINT_{t-1} + \theta_2 lnM2_{t-1} + \theta_3^+ lnIPI^+{}_{t-1}$$
$$+\theta_4^- lnIPI^-{}_{t-1} + \theta_5^+ lnVIX^+{}_{t-1} + \theta_6^- lnVIX^-{}_{t-1}$$
$$+\sum_{i=1}^{m} \beta_{1i} \Delta lnINT_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta lnM2_{t-i} + \sum_{i=1}^{P} \delta_{1i}^+ \Delta lnIPI^+{}_{t-i}$$
$$+\sum_{i=1}^{q} \delta_{2i}^- \Delta lnIPI^-{}_{t-i} + \sum_{i=0}^{r} \delta_{3i}^+ \Delta lnVIX^+{}_{t-i} + \sum_{i=0}^{S} \delta_{4i}^- \Delta lnVIX^-{}_{t-i} + \varepsilon_t \quad (1)$$

where Δ and ln denote the difference operator and the logarithmic function, respectively. m, n, p, q, r and s are presented as lag orders. θ_1 and θ_1, represent the long-term and β_1 and β_2 represent short-term coefficients. θ_3^+, θ_4^-, θ_5^+, and θ_6^- are coefficient for long run adjustment of symmetry, and δ_1^+, δ_2^-, δ_3^+, and δ_4^- coefficient for short run adjustment of symmetry. c_0 and b indicate constant term and trend coefficient, respectively. ε_t is the error terms. The symmetry adjustment coefficients in Equations 1 are calculated as follows:

$$IPI_t^+ = \sum_{k=1}^{t} \Delta IPI_k^+ = \sum_{k=1}^{t} \max\ (\Delta IPI_k, 0) \quad (2)$$

$$IPI_t^- = \sum_{k=1}^{t} \Delta IPI_k^- = \sum_{k=1}^{t} \min\ (\Delta IPI_k, 0) \quad (3)$$

$$VIX_t^+ = \sum_{k=1}^{t} \Delta VIX_k^+ = \sum_{k=1}^{t} \max\ (\Delta VIX_k, 0) \quad (4)$$

$$VIX_t^- = \sum_{k=1}^{t} \Delta VIX_k^- = \sum_{k=1}^{t} \min\ (\Delta VIX_k, 0) \quad (5)$$

The existence of cointegration relationship is tested by very similar to ARDL Bound test. However, the stationarity levels of the variables should be determined

first. At this point, the unit root test that reveal Dickey and Fuller (1979) (ADF) is utilized within the study. After the stationarity levels of the variables are determined the null hypothesis of no co-integration ($H_0: \theta_1 = \theta_2 = \theta_3^+ = \theta_4^- = \theta_5^+ = \theta_6^- = 0$) is tested against alternative hypothesis of co-integration ($H_0: \theta_1 \neq \theta_2 \neq \theta_3^+ \neq \theta_4^- \neq \theta_5^+ \neq \theta_6^- \neq 0$). After determining the existence of cointegration, the statistical significance of the short and long run asymmetric effect is examined by Wald test and if it is significant, it is taken into account by NARDL model. At last, asymmetric cumulative dynamic multiplier impacts are calculated with the equations displayed as follows:

$$b_k^+ = \sum_{j=0}^{k} \frac{\Delta lnBIST100_{t+j}}{\Delta lnIPI_{t-1}^+}, \qquad b = 1, 2, 3, \dots, \infty \tag{6}$$

$$b_k^+ = \sum_{j=0}^{k} \frac{\Delta lnBIST100_{t+j}}{\Delta lnIPI_{t-1}^-} \tag{7}$$

$$b_k^+ = \sum_{j=0}^{k} \frac{\Delta lnBIST100_{t+j}}{\Delta lnVIX_{t-1}^+}, \; b = 1, 2, 3, \dots, \infty \tag{8}$$

$$b_k^+ = \sum_{j=0}^{k} \frac{\Delta lnBIST100_{t+j}}{\Delta lnVIX_{t-1}^-} \tag{9}$$

4. EMPIRICAL FINDINGS

In this paper, the NARDL method recommended by Shin et al. (2014) is used to analyse the macroeconomic variables affecting on the BIST100 index. Unlike traditional linear methods, NARDL takes into account that the effects could be asymmetric.

In order to present the results in a comparative way, the predictions are first made using the standard ARDL method developed by Pesaran et al, (2001). Also, to carry out NARDL estimation procedures, unit root analysis must first be carried out on the series. This is because, to apply the NARDL method, the dependent variable must be I(1) and the independent variables must not be I(2), although they may be stationary at different levels.

Table 4 shows the results of the unit root analysis of the series. According to the findings, the BIST100 index, the interest rate and the M2 money supply variables are stationary at first difference, while the IPI and the VIX variables are stationary at level. It is also assumed that none of the variables are second order stationary.

These results show that the necessary unit root conditions for the NARDL method are satisfied.

Table 4: Unit Root Analysis Results - ADF (1979)

	Level				***Firs Differences***			
	C		C&T		C		C&T	
Varibles	ADF	p-val	ADF	p-val	ADF	p-val	ADF	p-val
$lnBIST100_t$	2.028 (0)	0.999	0.141 (0)	0.997	-9.597 [a] (0)	0.000	-9.972 [a] (0)	0.000
$lnINT_t$	-1.093 (3)	0.716	-2.831 (3)	0.189	-6.260 [a] (0)	0.000	-6.407 [a] (0)	0.000
$lnIPI_t$	-1.607 (0)	0.475	-4.457 [a] (0)	0.002	-12.250 [a] (0)	0.000	-12.198 [a] (0)	0.000
$lnM2_t$	4.629 (0)	0.999	0.244 (0)	0.998	-8.670 [a] (0)	0.000	-10.001 [a] (0)	0.000
$lnVIX_t$	-3.553 [a] (0)	0.008	-3.809 [b] (0)	0.019	-11.549 (0)	0.000	-11.507 [a] (0)	0.000

Notes: The maximum lag length is determined as 6. Schwarz information criterion is used to determine the fitting number of lags. Values in parentheses give the appropriate lag length. a, b, and c denote the significance level at 1%, 5%, and 10%, respectively.

Table 5 shows the empirics of the ARDL (6, 4, 0, 6, 4) model. Looking at the results, since the F-statistic (6.550) is greater than the upper limits of all the significance levels, the null hypothesis of no co-integration is rejected, and detect co-integrated linkage. Hence, the BIST100 index and the interest rate, money supply, industrial production index and VIX variables move together in the long run. Looking at the long-run coefficients of the model, rising interest rates have a downward effect on the stock market index. This situation can be interpreted as interest rates offering alternative returns to investors. Although an increase in the industrial production index has a positive impact on the stock market, it is not statistically significant. Increasing in the money supply have an increasing effect on the stock market index. This can be interpreted as the increasing in liquidity having a positive effect on the BIST100 stock market. The Turkish stock market is negatively affected by a positive change in the VIX. This finding can be evaluated as the increasing in volatility in foreign markets negatively affecting the Turkish stock markets. The ARDL method, which analyses the relationship between variables linearly, has weak performance characteristics as it does not take asymmetry into account. At this point, we prefer to estimate our model using the NARDL model.

Table 5: Co-integration Analysis Results - ARDL (2001)

Model	ARDL Bound test			
$lnBIST100_t = f(lnINT_t, lnIPI_t, lnM2_t, lnVIX_t)$				
Optima lag length	F-stat.	Sig. Level	LB	UB
ARDL (6, 4, 0, 6, 4)	6.550 [a]	%1	4.40	5.72
		%5	3.47	4.57
		%10	3.03	4.06

Long term parameters

Variable	Coefficient	SD	p-val.
$lnINT_t$	-0.215 [b]	0.102	0.037
$lnIPI_t$	0.629	0.497	0.208
$lnM2_t$	2.057 [a]	0.153	0.000
$lnVIX_t$	-0.455 [a]	0.101	0.000

Short term parameters

Variable	Coefficient	SD	p-val.	Variable	Coefficient	SD	p-val.
ΔlnBIST100(-1)	0.142	0.090	0.119	ΔlnM2	-0.144	0.236	0.543
ΔlnBIST100(-2)	0.138	0.090	0.127	ΔlnM2(-1)	-0.232	0.271	0.396
ΔlnBIST100(-3)	-0.032	0.088	0.718	ΔlnM2(-2)	-0.495 [c]	0.262	0.062
ΔlnBIST100(-4)	-0.169 [c]	0.086	0.053	ΔlnM2(-3)	-0.719 [a]	0.264	0.008
ΔlnBIST100(-5)	-0.180 [b]	0.090	0.048	ΔlnVIX	-0.169 [a]	0.032	0.000
ΔlnIPI	-0.127	0.163	0.439	ΔlnVIX(-1)	0.093 [b]	0.039	0.018
ΔlnIPI(-1)	-0.274	0.174	0.119	ΔlnVIX(-2)	0.048	0.038	0.203
ΔlnIPI(-2)	-0.232	0.172	0.181	ΔlnVIX(-3)	0.064 [c]	0.038	0.092
ΔlnIPI(-3)	-0.110	0.149	0.461	C	-11.686 [a]	1.994	0.000
ΔlnIPI(-4)	0.146	0.145	0.317	@trend	-0.007 [a]	0.001	0.000
ΔlnIPI(-5)	-0.174	0.137	0.205	ECT	-0.319 [a]	0.055	0.000

Diagnostic test	F-stat..	p-val.
Heteroscedasticity: White Test	0.881	0.629
Normality: Jarque-Bera Test	0.781	0.677
Serial correlation test: Breusch-Godfrey LM	0.114	0.892
Specification test: Ramsey Reset	1.313	0.255

Notes: In model estimation, the maximum lag length is taken as 6. The fitting number of lags is determined depend on Adjusted R^2 criteria. SD indicates standard deviation. ECT is an abbreviation for error correction term. LB and UB indicate the lower and upper bond, respectively. a, b, and c denote the significance level at 1%, 5%, and 10%, respectively.

Table 6 shows the empiric findings of the cointegration results for NARDL model. According to results obtained, the null hypothesis that there is no

cointegration is rejected for t and F test. In another saying, the long-run cointegration linkages among BIST100 and its explanatory variables have been detected.

Table 6: Co-integration Analysis Results - NARDL (2014)

	NARDL Bound test			
	t-stat.		F-stat.	
	-6.038 [a]		6.745 [a]	
	Critical Values			
	t-stat.		F-stat.	
Sig. level	LB	UB	LB	UB
%1	-3.96	-5.31	3.60	4.90
%5	-3.41	-4.69	2.87	4.00
%10	-3.13	-4.37	2.53	3.59

Notes: In model estimation, the maximum lag length is taken as 6. The fitting number of lags is determined depend on Adjusted R^2 criteria. Due to heteroscedasticity problem in the model, the White estimator is used to avoid deviations in the estimates. LB and UB indicate the lower and upper bond, respectively. [a], [b], and [c] denote the significance level at 1%, 5%, and 10%, respectively.

After this stage, the presence of asymmetric effects and model assumptions (heteroscedasticity, autocorrelation, normality assumption, model building error and stability condition) should be tested before moving on to coefficient estimation. The results for asymmetry and diagnostic tests are listed in Table 7. Accordingly, the presence of asymmetric effects is tested with the WALD test. As a result of the asymmetry analysis, variables with statistically significant asymmetric effects are added asymmetrically to the model. Looking at the results of the asymmetry tests, the Wald test has been performed that asymmetric effect is significant for IPI ($Long\ run: W_F = 21.129, P = 0.000;\ W_{\chi^2} = 21.129, P = 0.000, Short\ run: W_F = 2.757, P = 0.101;\ W_{\chi^2} = 2.757, P = 0.097$) and VIX ($Long\ run: W_F = 17.895, P = 0.000;\ W_{\chi^2} = 17.895, P = 0.000, Short\ run: W_F = 13.069, P = 0.001;\ W_{\chi^2} = 13.069, P = 0.000$) for long and short run. This result confirms that positive and negative shocks to the IPI and VIX have different effects on the BIST100. On the contrary, the asymmetry effect for M2 is insignificant ($Long\ run: W_F = 0.002, P = 0.965;\ W_{\chi^2} = 0.002, P = 0.965, Short\ run: W_F = 0.363, P = 0.549;\ W_{\chi^2} = 0.363, P = 0.547$) and INT ($Long\ run: W_F = 0.313, P = 0.578;\ W_{\chi^2} = 0.313, P = 0.576$) in both the long and short term. This result indicates that the positive and negative components of INT and M2 on BIST100 are equal in the long and short term. At this point, predictions are made by adding the IPI and VIX variables in asymmetric form and other variables in linear form to the model. According to the specification tests, there is no autocorrelation (Breusch-Godfrey LM Test) ($\chi^2 = 1.151, P = 0.322$) problem in the model, the errors are normally distributed (Jarque-Bera Testi) ($\chi^2 = 2.228, P = 0.328$), there is no model construction error (Ramsey Reset Test) ($\chi^2 =$

$1.344, P = 0.250$) and the stability condition (CUSUM Figure 2) is satisfied, but it is noted that there is a heteroskedasticity (White Testi) ($\chi^2 = 1.684, P = 0.028$) problem. For this reason, heteroscedasticity correction is applied, and predictions are made using the White estimator to avoid deviations that may arise from heteroscedasticity in the model.

Table 7: Asymmetry Test and Diagnostic Tests for NARDL Model

Asymmetry Test	Long run		Short run	
Variables	F-stat.	χ^2	F-stat.	χ^2
lnINT	0.313(0.578)	0.313(0.576)	-	-
lnIPI	21.129 [a](0.000)	21.129 [a](0.000)	2.757(0.101)	2.757 [c](0.097)
lnM2	0.002(0.965)	0.002(0.965)	0.363(0.549)	0.363(0.547)
lnVIX	17.895 [a](0.000)	17.895 [a](0.000)	13.069 [a](0.001)	13.069 [a](0.000)

Diagnostic test	*Statistic*	*p-val.*
Heteroscedasticity: White Test	1.684 [b]	0.028
Normality: Jarque-Bera Test	2.228	0.328
Serial correlation test: Breusch-Godfrey LM	1.151	0.322
Specification test: Ramsey Reset	1.344	0.250
Stability (cusum)	Stable	

Notes: Values in parentheses indicate p-values for F and χ^2 tests. [a], [b], and [c] denote the significance level at 1%, 5%, and 10%, respectively.

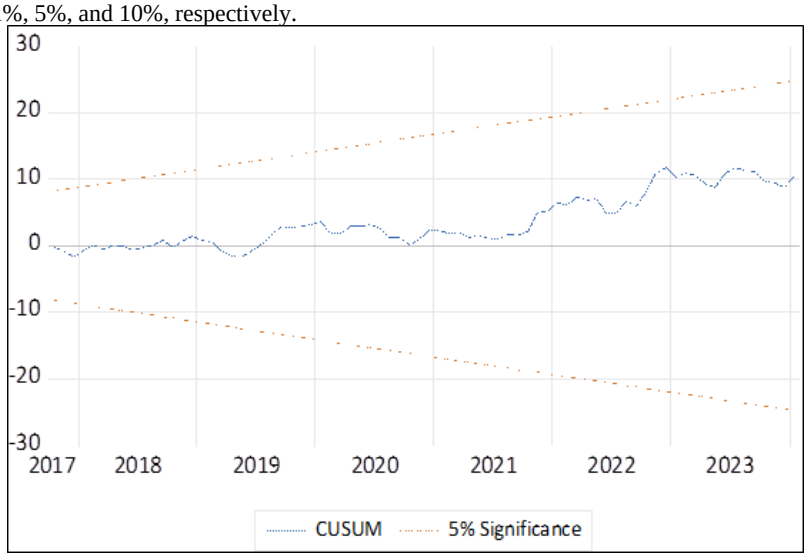

Figure 2: CUSUM Chart for The Parameter Stability

The entity of a long-run relation between the BIST100 index and selected macroeconomic indicators is established and the most appropriate model for the data structure is determined using asymmetry and specification tests. The outcome of the

short- and long-run coefficient estimation for the identified model are presented in Table 8.

Looking at the long run coefficient results, a 1% increase in M2 increases the BIST100 index by 1.225%. This result, which is in line with expectations, shows that an increase in the money supply causes the stock market to rise more than it does. Investors wishing to invest in the stock market index should pay close attention to the money supply indicator. Indeed, it seems possible that rallies in the stock market index will occur as a result of abnormal increases in the money supply indicator. A 1% rise in interest rates causes the BIST100 index to fall by 0.183%, and this effect is statistically significant. This result is also in line with theoretical expectations. Interest rates are an indicator of the cost of borrowing for companies and increasing in interest rates can affect companies' investment decisions by raising the cost of financing. In this case, less investment may bring less profit and affect the market value of companies. In addition, rising interest rates create a dilemma for investors between deposit rates and the stock market, and high interest rates become attractive for investors who do not want to take risks. While positive shocks to the industrial production index, which have an asymmetric effect, have a statistically significant effect on the stock market, negative shocks have a negative effect but statistically insignificant effect. An increasing of 1% in the industrial production index during periods of positive shocks leads to a larger increase of 1,170% in the stock market index. This result is in line with theoretical expectations and positive developments in industry, which is the growth engine of a country, can also have a positive impact on the stock market. This is arising from the increasing in output leads to more goods being sold, and the rising in sales lead to stronger balance sheet expectations and hence expectations that the firm's value will increase. While the effect of negative shocks to the VIX, another variable with an asymmetric effect, on the stock market index is statistically insignificant. In contrary, positive shocks to the VIX have a negative impact on the stock market index, within expectations. An increasing of 1% in the number of periods with positive shocks to the VIX reduces the stock market index by 0.790%. This result can be interpreted as the BIST100 index being negatively affected by the increasing in volatility in foreign markets.

Before turning to the results for short-term coefficients, it should be noted that short-term effects do not have an exact economic equivalent and are therefore not interpreted as strongly as long-term coefficients. Looking at the results for short-term coefficients, the BIST100 index is positively affected by its own lagged values. This situation suggests that the positive sentiment in the stock market will continue in the future. Increasing in the stock market index can create an optimistic atmosphere and lead to positive expectations for the future. In the short run, the second and third lags of M2 have a negative impact on the stock market index. This is not what we expected. The IPI- has a negative impact on the stock market index

in the current period and this result is in line with our expectations. In other words, declines in industrial production have a negative impact on the BIST100 index. The first and second lags of the IPI+ also have a negative effect, and these results are not in line with my expectations. In the current period, the VIX+ has a negative impact on the index, and the VIX- also has a negative impact. In the short-run model, the error correction coefficient is less than 1 and negative. Hence, in the event of a deviation from equilibrium, the model returns to equilibrium.

Table 8: Short and Long Run Coefficients for NARDL Model

Model

$lnBIST100_t = f(lnINT_t, lnM2_t, lnIPI^+{}_t, lnIPI^-{}_t, lnVIX^+{}_t, lnVIX^-{}_t)$

Opt. lag length

(6, 4, 0, 4, 6)

Long term parameters – Dependent variable=lnBIST100

Variable	Coefficient	p-val.
$lnINT_t$	-0.183 [a][0.055]	0.001
$lnM2_t$	1.225 [a][0.128]	0.000
$lnIPI^+{}_t$	1.170 [a][0.381]	0.003
$lnIPI^-{}_t$	-0.847[0.517]	0.104
$lnVIX^+{}_t$	-0.790 [a][0.083]	0.000
$lnVIX^-{}_t$	0.131[0.116]	0.261

Short term parameters – Dependent variable =ΔlnBIST100

Variable	Coefficient	p-val.	Variable	Coefficient	p-val.
ΔlnBIST100(-1)	0.263 [a][0.092]	0.005	ΔlnM2(-3)	-0.846 [a][0.250]	0.001
ΔlnBIST100(-2)	0.252 [a][0.091]	0.007	$\Delta lnVIX^+$	-0.158 [a][0.043]	0.000
ΔlnBIST100(-3)	0.113[0.089]	0.209	$\Delta lnVIX^-$	-0.234 [a][0.082]	0.005
ΔlnBIST100(-4)	-0.067[0.087]	0.442	$\Delta lnVIX^+(-1)$	0.387 [a][0.087]	0.000
ΔlnBIST100(-5)	-0.140[0.085]	0.106	$\Delta lnVIX^-(-1)$	-0.328 [a][0.099]	0.001
$\Delta lnIPI^+$	0.230[0.444]	0.606	$\Delta lnVIX^+(-2)$	0.189 [b][0.078]	0.017
$\Delta lnIPI^-$	-0.438 [c][0.243]	0.075	$\Delta lnVIX^-(-2)$	-0.237 [b][0.094]	0.014
$\Delta lnIPI^+(-1)$	-1.164 [a](0.432]	0.009	$\Delta lnVIX^+(-3)$	0.244 [a][0.069]	0.001
$\Delta lnIPI^-(-1)$	0.198[0.321]	0.540	$\Delta lnVIX^-(-3)$	-0.290 [a][0.088]	0.002
$\Delta lnIPI^+(-2)$	-0.818 [b][0.402]	0.045	$\Delta lnVIX^+(-4)$	0.070[0.067]	0.297
$\Delta lnIPI^-(-2)$	-0.085[0.334]	0.800	$\Delta lnVIX^-(-4)$	-0.204 [b][0.087]	0.022
$\Delta lnIPI^+(-3)$	-0.433[0.336]	0.201	$\Delta lnVIX^+(-5)$	0.024[0.058]	0.674
$\Delta lnIPI^-(-3)$	-0.134[0.347]	0.701	$\Delta lnVIX^-(-5)$	-0.186 [b][0.077]	0.019
ΔlnM2	-0.216[0.232]	0.355	C	-11.993 [a][1.685]	0.000
ΔlnM2(-1)	-0.308[0.263]	0.245	@trend	0.022 [a][0.003]	0.000
ΔlnM2(-2)	-0.728 [a][0.252]	0.005	ECT	-0.649 [a][0.091]	0.000

Notes: In model estimation, the maximum lag length is taken as 6. The fitting number of lags is determined depend on Adjusted R^2 criteria. Values in square brackets indicate standard deviations. ECT is an abbreviation for error correction term. [a], [b], and [c] denote the significance level at 1%, 5%, and 10%, respectively.

5. CONCLUSION

In this study, the asymmetric relationships between BIST100 and selected macroeconomic variables and VIX index are analysed using the NARDL method using monthly data for the period 2014:01-2024:01. In the model, BIST100 index is taken as the dependent variable and M2 money supply, deposit interest rate, industrial production index and VIX index are considered as explanatory variables. The results show that there is a long-term cointegration relationship between the variables. When the results of the long-term coefficients are analysed, it is concluded that increases in the interest rate have a negative effect on the BIST100 index. A 1% increase in the interest rate leads to a -0.183% decrease in the stock market index. On the other hand, expansion in money supply has a positive effect on the stock market index. A 1% increase in money supply leads to a 1.225% increase in the stock market index. Positive shocks to the industrial production index, which has an asymmetric effect, have a statistically significant and positive effect on the stock market. When the coefficient results are analysed, a 1% increase in the industrial production index leads to a 1.170% increase in the stock market index. However, negative shocks do not have a statistically significant effect. While negative shocks to VIX, another asymmetric variable, have a statistically insignificant effect on the BIST100 index, positive shocks have a significant downward effect on the BIST100 index. When the coefficient results are analysed, a 1% increase in the VIX index leads to a -0.790% decrease in the stock market index. These results allow researchers forecasting the stock market index to make inferences about the future movements of the BIST100 index by looking at the macroeconomic variables and the VIX index in the model.

A series of political and economic events in Turkey during the period under review led to changes in macroeconomic indicators. In this period, the 15 July military coup attempt, the 2018 Pastor Brunson crisis, which is a problem in bilateral relations with the USA, the 2020 COVID-19 Pandemic, which affected the whole world, and the recent regional conflicts (the war between Russia and Ukraine in 2022 and the tensions in the Middle East in 2023). In the face of these developments, there have been fluctuations in the BIST100 index along with global indicators. According to the empirical findings, the different interactions between the variables show that the stock market index is affected by different dynamics in periods when the stock market index falls and when it rises. The co-movement and asymmetric structure between the analysed macroeconomic variables and the stock market index provide valuable information for investors and policy makers. For example, it allows investors to make investment decisions according to different periods. In particular, while the VIX index, which represents global volatility, has no effect on the stock market index during periods of decline, it is observed that the index loses value during periods of increased risk. This finding is interesting and can be interpreted as

the Turkish stock market is affected by negative movements in foreign markets but not by positive movements. In other words, the stock market index is affected in periods of high volatility compared to periods of low volatility in foreign markets, and this effect is negative. Another remarkable finding is the effect of increases and decreases in the industrial production index on the stock market index. While increases in industrial production have a positive effect on the index, decreases are statistically insignificant.

With the increase in the number of investors in the post-pandemic period, the importance of macroeconomic variables in the decision-making processes of investors is increasing. Investors make inferences about the direction of the stock market index by analysing various macroeconomic indicators. Investors who take stock positions based on these inferences aim to achieve above-market returns, and in this context, this evaluation is important in terms of recognising the links between the Turkish financial market benchmark stock market index and macroeconomic variables. In addition, the study found that ignoring the existence of non-linear relationships using the NARDL model leads to incomplete results. In conclusion, changes in indicators such as M2 money supply, deposit interest rate, industrial production index and VIX should be carefully monitored by investors. In addition, investors may be advised to take positions by taking shocks into account. In future studies, different macroeconomic and financial variables can be used in the variable selection, as well as the period difference used in the model. Differentiating the frequency periods and using up-to-date methods can provide useful information and insights to the literature, policy makers, investors and researchers.

Ethical Declaration

In this study, all the rules stated in the "Higher Education Institutions Scientific Research (Türkiye) and Publication Ethics Directive" were followed.

Ethics Committee

Approval The author declare that the research is one of the studies that does not require ethical committee approval.

Conflict of Interest and Funding

No conflict of interest and funding has been declared by the authors.

Authorship Contribution Declaration

All stages of the study were designed and prepared by the authors.

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