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Investigation of the Effect of Investor Risk Appetite Index and Macroeconomic Indicators on the BIST-100 Index

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ABSTRACT

In this study, the relationship between Borsa Istanbul 100 Index (BIST-100), Investor Risk Appetite Index (RISE), and macroeconomic indicators are tried to be determined using Autoregressive Distributed Lag (ARDL) Bounds Testing Approach with monthly data covering the periods 01/2011-08/2022. Inflation and interest rate are used as macroeconomic indicators. By taking into account the unit root test results related to the stationary conditions of the series, an econometric model is founded in which the BIST-100 was selected as a dependent variable, and a cointegration relationship was determined. In addition, the parameters of the models were estimated and evaluated. In the long and short-term forecast results, it was determined that the BIST-100 index is positively related to inflation and the RISE index, and negatively related to the interest rate.

Keywords
BIST-100, Investor Appetite Index (RISE), Inflation Rate, Interest Rate, Autoregressive Distributed Lag (ARDL) Bounds Test.

JEL Codes
C32, C51, E44

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1. Introduction

The stock market is an important financial market where transfers between savers and parties in need of funds are provided. Share markets play an important role in the reallocation of funds in different sectors of the economy and serve as a platform that supports continuity in the development of the country's economy. The optimal use of savings is also the basis for economic growth in the long term. Some macroeconomic factors, especially interest and inflation, affect the country's economy as well as the stock market returns. Therefore, policymakers and investors in the country direct their policies by considering the changes in these factors. In addition to global policies, the movements of macroeconomic variables in countries also affect the stock markets (Attari & Safdar, 2013).

With globalization, as in the whole world, the returns Turkey’s securities returns also move depending on regional developments. It is possible to say that interest rates are among the most used tools that have advantages such as having a quick effect on shaping macroeconomic targets and are among the most widely used tools decisively. Another economic factor that affects affecting the economy’s course decisions is inflation rates. Inflation rates are one of the most important factors affecting both interest and stock returns. There are two main views in terms of the direction in which inflation rates affect the stock market. Fisher (1930) put forward the view that inflation positively affects stocks. According to the author, the returns to be obtained from assets should move together with the expected inflation rates in the economy. In other words, the nominal stock return should rise with inflation and protect investors against inflation (Tripathi & Kumar, 2014).

Another view belongs to Fama (1981). The author states that there is a negative relationship between stocks and inflation. According to the author, it leads to a bad situation in economies where high inflation rates are dominant and investors will tend to sell their stocks. The selling pressure in stocks will cause a decrease in stock prices (Ahmed et al., 2015). Similarly, in periods with an increase in inflation, production costs will increase, while increased input costs will lead to a decrease in profits. As consumption expenditures will increase in general, the amount of savings will decrease, bringing negative effects on savings and investments, respectively (Tripathi & Kumar, 2014).

One of the concepts that occupy an important place in the financial literature is the concept of risk. The concept of risk, which is at the forefront at many stages until the duration of the investments planned to be made, the amounts, and the yield estimate to be obtained, can also affect the appetite of savers to invest (Köycü, 2022). In cases where volatility or uncertainty in financial markets is experienced, the investor's willingness to take risks has begun to be expressed with the concept of "risk appetite". Although it is used in the literature in the same sense as risk aversion, the concept of risk appetite is mostly used in academic studies. An increase in risk appetite means that risk aversion is decreasing, while a decrease in risk appetite means that risk aversion is increasing (Misina, 2003). It is possible to say that the concept of risk appetite is a concept that began to be used more frequently, especially after the global financial crisis in 2008 (Gontarek, 2016).

Knowing the future values of macroeconomic indicators is essential in shaping investment plans. Macroeconomic indicators of countries may differ periodically, especially due to economic, social, and political factors. This situation also affects the stock markets, which are considered indicators of economies. Investors' awareness of changes in macroeconomic indicators, as well as their tolerance and willingness to take risks, also affect their investment decisions. Investors' interpretation of the information coming to the market and their sensitivity to risk factors are the main determinants of their risk appetite. Based on this information, this study examines the effects of inflation and interest rate, which are essential macroeconomic indicators in investment planning, and investor risk appetite on the stock market. What makes this research, which was examined in Turkey, original is the use of macroeconomic indicators that may affect the stock market together with investor risk appetite.

2. Literature Review

Countries with high inflation volatility are characterized as unstable economies, and countries with low inflation volatility are characterized as stable economies (Garcia & Liu, 1999). Just as inflation has an important impact on the future of a country's economy, it is also of great importance in terms of the development of the stock market. Inflation is one of the biggest factors that cause uncertainty to increase in the economy, savings to decrease, and, accordingly, investments to decrease. In the literature, it is seen that there are many studies in which the relationship between inflation and stocks is examined, and a positive-negative or no relationship can be found between the two variables. However, when the studies are examined, it is possible to say that the number of studies that have concluded that there is an inverse relationship between inflation and the stock market is higher.

Fama (1981) found in his study that there is an inverse relationship between stocks and inflation. Groenewold et al. (1997) examined the relationship between stock returns and inflation using data from the 1960-1991 period in Australia and concluded that there was an inverse relationship between the two variables. Spyrou (2001), on the other hand, in his study in which he compared the 1990-1995 and 1995-2000 periods in Greece separately, revealing that there was a significant and negative relationship between inflation and stock returns in the 1990-1995 period. Wongbampo & Sharma (2002) in their study of the Far East countries Malaysia, Indonesia, Philippines, Singapore, and Thailand, similar to other studies, found that there is a negative relationship between inflation and stocks in all countries analyzed. Gunasekarage et al. (2004) examined the relationship between inflation and stocks in Sri Lanka for the period 1985-2001. As a result of the study, they concluded that stocks were negatively affected by this situation as a result of the increase in inflation. Similarly; Nelson (1976), Wahlroos & Tom (1986), Sharpe (1999), Chopin & Zhong (2001), Kim (2003), Naceur & Ghazouani (2005), and Nguyen & Hanh (2012) are among other studies that concluded that there is a negative relationship between inflation and the return of stocks. Eyüboğlu & Eyüboğlu (2019) found in their study that increases in consumer prices in Turkey for the period 2006-2016 negatively affected the returns of 11 sub-indices of Borsa Istanbul. Saka Ilgın & Sarı (2020), in their study examining the 2009-2019 period, made use of the ARDL model and concluded that there is a long-term relationship between inflation and the BIST-100.

Lin (2009) concluded in his study covering the period 1957-2000 that unexpected inflation for 16 OECD countries positively affects stock returns in the short term, while negatively affecting them in the long term. Bhanja et al. (2012) argue that stock returns do not have any role in protecting against inflation. Karamustafa & Karakaya (2004) on the other hand, revealed in their studies covering the period of 1995-2003 that inflation has a positive relationship with transaction volume in the short term.

Interest rates are an important variable that affects investment and production costs. The increase in interest rates may direct investors to fixed-income securities. In this case, it can be said that there is a negative relationship between the stock market and interest rates (Banerjee & Adhikary, 2009; Peiró, 2016). Chen et al. (1986) found statistically significant results between short-term and long-term interest rate differences and stock returns. Mukherjee & Naka (1995) analyzed the relationship between the Tokyo stock market and six macroeconomic indicators using the Vector Error Correction Model. In the empirical findings, it has been determined that the Tokyo stock market is positively related to the government bond interest rate and negatively related to the loan rates. Durukan (1999) investigated the relationship between stock prices and macroeconomic indicators between the years 1986-1998. In the research findings, a strong negative relationship was determined between stock returns and interest rates. Maysami & Koh (2000) found a cointegration relationship between the Singapore stock market index and some macroeconomic indicators. In the analysis findings, it was determined that the stock market index is very sensitive to changes in interest rates. Wongbangpo & Sharma (2002) found a negative relationship between the stock markets of Thailand, Singapore, and the Philippines and short-term interest rates. Yılmaz et al. (2006) examined macroeconomic indicators and stock prices in Turkey based on the years 1990-2003. In the results of the research, the cointegration relationship between stock prices and interest rates and one-way causality from stock prices to interest rates were determined. Liu & Shrestha (2008) examined the long-term relationship between Chinese stock markets and macroeconomic indicators, including interest rates. In the research findings, a cointegration relationship between the Chinese stock market and macroeconomic indicators could not be determined. Alam & Uddin (2009) examined the relationship between interest rates and stock markets with the panel data analysis method in their research in which they examined 15 developed and developing countries. In the findings, it has been determined that the changes in interest rates affect the stock markets negatively. Özer et al. (2011) examined the relationship between macroeconomic indicators and the ISE-100 Index in their research. According to the Johansen-Juselius cointegration test, there is a long-term relationship between interest rates and the ISE-100 Index, and there is a unidirectional Granger causality from the interest rate to ISE-100. Chia & Lim (2015) examined the relationship between Malaysian stock markets and macroeconomic indicators with the ARDL bounds test. In the empirical findings, a positive relationship was found between stock prices and interest rates in the long run. In addition, there is causality from real interest rates to stock prices. Linck & Frota Decourt (2016), on the other hand, found statistically significant relationships between Brazilian stock markets and interest rates. Sayılgan & Süslü (2011) found that there was no statistically significant relationship between interest rates and stock returns in their research in which they examined stock returns and macroeconomic factors in developing countries. Yıldırım et al. (2020) found a one-way Granger causality relationship from the interest rate to the BIST Financial Index in their research. Mok (1993), Mumcu (2005), Zügül & Şahin (2009), Omağ (2009), Cherif & Gazdar (2010), Kanat (2011), Albayrak et al. (2012), Hsing & Hsieh (2012), Aktas & Akdag (2013), Ayaydin et al. (2013), Sevinç (2014), Ali (2014), Şentürk & Dücan (2014), Balı et al. (2014), Çetin & Bıtırak (2015), Poyraz & Tepeli (2015), Baydaş (2017), Khalid (2017), Yang, et al. (2018), Koyuncu (2018), Çulha (2019), Saka Ilgın & Sarı (2020) obtained results indicating that there is a negative relationship between interest rates and stock markets.

The concept of risk has an important place in the finance literature. Savers consider many issues from the amount of the investment to the maturity while making their investments. In this and many other similar stages, investors are faced with risk. Naturally, investors' appetite for doing is also affected by these stages. On the other hand, investor risk appetite can be affected by many macroeconomic changes in both the global and local economies.

Shen & Hu (2017) emphasized that there is a significant and negative relationship between the risk appetite index and stock market returns in their study examining the relationship between the risk appetite index and stock market returns. Tobias et al. (2009) in their study, they investigated how the change in the dollar exchange rate in 23 countries, including Turkey, affects risk appetite. As a result of the study, they concluded that there is a negative relationship between risk appetite and the dollar exchange rate. Kaya & Coşkun (2015) examined the effect on the Global risk appetite index and the BIST-100 in their studies, and as a result of the analysis, they revealed that the risk appetite negatively affected the BIST-100. Çelik et al. (2017) analyzed the factors affecting risk appetite in their study. In their study, they concluded that foreign exchange reserves, money supply, exchange rate, and interest rate are effective on risk appetite. Similarly, Şahin (2018) examined the risk appetite index and BIST-100 return index and revealed that the risk appetite index was an effective variable on the BIST-100. Fettahoğlu (2019) on the other hand, examined the relationship between the CDS risk premium and the risk appetite index and found that there was a significant relationship between the two variables and the CDS risk premium decreased as risk appetite increased. Balat (2020) concluded in his study that there is a significant relationship between BIST-100 and risk appetite.

Nur (2022) examined the relationship between Risk Appetite and the BIST index using the 2008-2021 period data, and as a result of the study, he concluded that there is a long-term cointegration relationship between the two variables. Demirez & Kandır (2020) investigated the relationship between risk appetite and share returns in the period of 2009-2019 with a multiple regression model. As a result of the study in which risk appetite was measured with the RISE index, it was determined that risk appetite had a limited effect on share returns. In the study of So & Lei (2015), the effect of the global risk appetite index (VIX) on the daily stock trading volume between 1997 and 2010 was investigated by regression analysis method. As a result of the analysis, it has been determined that there is a positive relationship between VIX and trading volume, and the change in VIX significantly explains the change in trading volume.

3. Materials and Methods

This research, it is aimed to reveal the relations between BIST-100, Investor Risk Appetite Index (RISE), and macroeconomic indicators. For this purpose, using monthly data for the period 01/2011-08/2022, 140 observations of each series are included in the study. While the month-end closing price of the BIST-100 Index is included in the data set, the weekly Investor Appetite Index (RISE) has been converted into monthly data. Inflation and interest rates are used as macroeconomic indicators. The monthly Consumer Price Index (2003=100) is used to represent the inflation rate and the Central Bank of the Turkish Republic Weighted Funding Rate is used as the interest rate. The BIST-100 Index and macroeconomic indicators are taken from the Electronic Data Distribution System of the Central Bank. RISE is taken from the database of the Central Registry Office Data Analysis Platform. In the analysis, the natural logarithmic transformation is applied to the series. The variables to be analyzed are briefly taken as $lnBIST$, $lnRISE$, $lnINF$, and $lnINT$, respectively, and summarized in Table 1. E-Views 10.0 package program is used for econometric and statistical analysis.

Table 1

Series and Shortcodes

Series	Shortcode	Reference

BIST − 100	lnBIST	Electronic Data Distribution System of the Central Bank
Investor Risk Appetite Index	lnRISE	Central Registry Office Data Analysis Platform
Inflation rate	lnINF	Electronic Data Distribution System of the Central Bank
Interest rate	lnINT	Electronic Data Distribution System of the Central Bank

In the application process of the research, first of all, descriptive statistics and time path graphs related to the series are presented. The stationarity properties of the series are tested with Augmented Dickey-Fuller (ADF), Philips-Perron (PP), and Zivot-Andrews (ZA) unit root tests that take into account structural breaks. The Autoregressive Distributed Lag Models (ARDL) method is used to determine the relationships between the series by considering the unit root test results regarding the stationarity conditions of the series and by establishing the models in which the BIST-100 is the dependent variable.

Table 2

Descriptive Statistics

Series	$Mean$	$Maximum$	$Minimum$	$Median$	$Standard\ Deviation$	n
$lnBIST$	6,8350	8,06	6,24	6,7582	0,3512	140
$lnRISE$	3,8367	4,19	3,29	3,8615	0,2302	140
$lnINF$	5,7734	6,92	5,21	5,6597	0,4172	140
$lnINT$	2,3430	3,24	1,51	2,2430	0,4256	140

Descriptive statistics of the series converted to natural logarithmic form are given in Table 2. The time path graphs of the series are given in Graph 1. When the series is examined, the BIST-100 and Inflation series continued to rise in a certain trend and less fluctuating compared to other series. RISE and interest series fluctuated in a certain band during the research period.

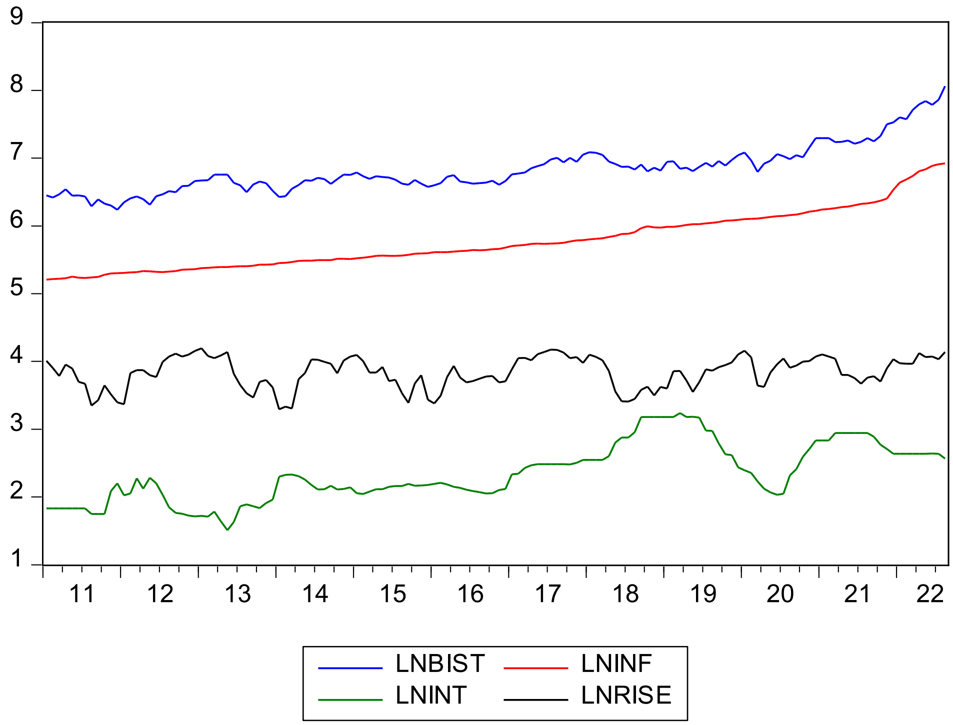

Figure 1. Time Path Indicators of the Series

While creating the research models, cointegration tests are applied to determine the long-term relationships between the series. Engle-Granger (1987), Johansen-Juselius (1990), and Johansen (1991) cointegration tests are widely used. Traditional cointegration tests want the series to be integrated at the same level when creating models (Bahmani-Oskooee & Ng, 2002: 149). In addition, traditional cointegration tests do not take into account the structural breaks in the series and have low power. To overcome these problems, the ARDL Bounds Test approach in determining the long-term relationships between the series has been used by Pesaran & Pesaran (1997), Pesaran & Smith (1998), Pesaran & Shin (1999) and Pesaran et al. (2001) developed and suggested. In this test, the cointegration relationship between the series can be detected regardless of whether the series are integrated at level I(0) or I(1) at the first difference. In addition, while the sample size is important in traditional cointegration tests, it can be applied in the ARDL test even if the sample size is small (Çağlayan, 2014).

In the research, the model established in the analysis of the relationship of the BIST-100 Index with RISE and macroeconomic indicators with the ARDL Bounds Test approach is included. In this model;

Δ denotes the first-order differences of the series, and m denotes the lag:

$$\Delta lnBIST_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{it}\, \Delta lnBIST_{t-i} + \sum_{i=0}^{m} \alpha_{2i}\, \Delta lnRISE_{t-i} + \sum_{i=0}^{m} \alpha_{3i}\, \Delta lnINF_{t-i} + \sum_{i=0}^{m} \alpha_{4i}\, \Delta lnINT_{t-i} + \beta_1\, lnBIST_{t-1} + \beta_2\, lnRISE_{t-1} + \beta_3\, lnINF_{t-1} + \beta_4\, lnINT_{t-i} + \mu_t \quad (1)$$

A boundary test is used to determine the long-term relationship between the series. In the application of this test, the lag length expressed as m should be determined. The lag length is determined using Schwart-Bayesian (SBC) and Akaike Information Criteria (AIC). The ARDL approach is based on the F or Wald statistic. The H_0 hypothesis of no cointegration is tested with the opposite H_1 hypothesis.

H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$

H_1:At least one of the β_i is nonzero (2)

The F statistic obtained in the ARDL test is Pesaran et al. (2001) compared with the upper and lower limit values in the research. If the F statistic is higher than the upper limit value, the H_0 hypothesis is rejected and the existence of a cointegration relationship between the series is accepted. If the F statistic is small at the lower bound value, the H_0 hypothesis is not rejected, and it is decided that there is no cointegration between the series. If the F statistic is located between the lower and upper limits, it is said to be in the indecision region. In addition, for this test to give a healthy result, there should not autocorrelation problem in the error terms of the established model (Çağlayan, 2014).

The long-term ARDL model established to determine the long-term relationship between the series is as follows;

$$lnBIST_{\boldsymbol{t}} = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i}\, lnBIST_{t-i} + \sum_{i=0}^{m} \alpha_{2i}\, lnRISE_{t-i} + \sum_{i=0}^{m} \alpha_{3i}\, lnINF_{t-i} + \sum_{i=0}^{m} \alpha_{4i}\, lnINT_{t-i} + \mu_t \quad (3)$$

The ARDL model, which was established to determine the short-term relationships between the series, is analyzed with the error correction model approach. In the short-term ARDL test, the ECM_{t-1} in the model shows the error term. The coefficient of the error term (λ) shows how much of the short-term imbalances will be corrected in the long term. The sign of this coefficient should be negative and statistically significant (Gazel, 2017).

$$\Delta lnBIST = \alpha_0 + \sum_{i=1}^{m} \alpha_{it}\, \Delta lnBIST_{t-i} + \sum_{i=0}^{m} \alpha_{2i}\, \Delta lnRISE_{t-i} \; \sum_{i=0}^{m} \alpha_{3i}\, \Delta lnINF_{t-i} + \sum_{i=0}^{m} \alpha_{4i}\, \Delta lnINT_{t-i} + \lambda ECM_{t-1} + \mu_t \quad (4)$$

4. Application

If econometric studies are to be conducted with time series, it is important to first determine the stationarity of the series. The fact that the series is not stationary causes the model to be installed incorrectly and the statistical results to be meaningless. The property that a time series has over a long period is revealed by determining the value that a variable received in the previous period, and in what way it affects this period. Although many methods have been developed for this, the stationarity of the series can be determined by unit root tests in econometrics (Tarı, 2010). In this research, to analyze the series with the ARDL bound test, the series must satisfy the stationarity condition. Augmented Dickey-Fuller (ADF-1984), Philips-Perron (PP-1988), and Zivot-Andrews (ZA-1992) unit root tests, which are widely used in the determination of stationarity, are applied.

Table 3

ADF and PP Unit Root Test Results

Series		ADF		PP	
		With Constant	*With Constant* & *Trend*	*With Constant*	*With Constant* & *Trend*
$lnBIST$	**At Level**	1.331269 (0.9987)	-0.615642 (0.9763)	2.533307 (1.0000)	-0.428729 (0.9856)
	At First Difference	-11.35781 (0.0000)*	-11.57592 (0.0000)*	-11.34166 (0.0000)*	-11.60735 (0.0000)*
$lnRISE$	**At Level**	-4.437782 (0.0004)*	-4.619197 (0.0014)*	-3.913312 (0.0025)*	-4.118766 (0.0075)*
	At First Differences	-	-	-	-
$lnINF$	**At Level**	2.898351 (1.0000)	1.394689 (1.0000)	4.072552 (1.0000)	2.736045 (1.0000)
	At First Difference	-3.375075 (0.0135)*	-4.027569 (0.0100)*	-5.564109 (0.0000)*	-6.248825 (0.0000)*
$lnINT$	**At Level**	-1.838178 (0.3608)	-2.414600 (0.3704)	-1.916747 (0.3239)	-2.629195 (0.2682)
	At First Difference	-8.991620 (0.0000)*	-8.971932 (0.0000)*	-9.190249 (0.0000)*	-9.169456 (0.0000)*

With constant and with constant and trend models of ADF and PP unit root tests are established and the results are given in Table 3. BIST-100, inflation, and interest series contain unit roots at a 5% significance level. When their first difference is taken, they become stationary. It has been determined that the RISE series does not contain a unit root. It was observed that BIST-100, Inflation, and Interest series became I(1) stationary at the first difference. It was determined that the RISE series became stationary at level I(0). This situation indicates that the ARDL Bounds Test approach can be applied safely.

One of the reasons for the non-stationarity in the time series is that structural breaks are observed in terms of different samples throughout the population regression equation (Sevüktekin & Nargeleçekenler, 2010). Due to structural breaks, it is necessary to be careful when applying unit root tests in the periods examined in the research (Tarı, 2010). When applying traditional unit root tests, the presence of structural breaks is not taken into account. For this reason, the calculated test statistics are affected by structural breaks and a stationary series may seem not stationary (Özdemir & Kula, 2021). If there is a structural break in the series during the research, it is possible that the unit root tests performed will give incorrect results. Considering this possibility, it was decided to apply the ZA (1992) unit root test, which takes into account structural fractures. The RISE series, which is stationary at the level of ADF and PP unit root tests, is not included in the ZA unit root test. The basic hypothesis of this test is "The series has a unit root with a structural break, that is, there is no stationarity". Here, the decision is determined by comparing the test statistic with the critical value. If the test statistic is greater than the absolute critical value, the hypothesis is rejected. The results of this test are given in Table 4.

Table 4

Zivot-Andrews Unit Root Test Results

Model	***With Constant***		***With Constant & Trend***	
Series	***Test Statistic*** (%5 ***Critical Value***)	***Breaking Date***	***Test Statistic*** (%5 ***Critical Value***)	***Breaking Date***
$lnBIST$	-2.29 (-5.34)	2020M11	-3.95 (-5.08)	2020M02
$lnINF$	0.199 (-4.93)	2020M10	-2.446 (-5.08)	2020M12
$lnINT$	-3.947 (-4.93)	2019M09	-4.152 (-5.08)	2018M04
$\Delta lnBIST$	-5.088 (-4.93)*	2020M11	-5.628 (-5.08)*	2018M03
$\Delta lnINF$	-4.27 (-4.93)	2019M10	-5.174 (-5.08)*	2020M06
$\Delta lnINT$	-9.25 (-4.93)*	2020M04	-9.607 (-5.08)*	2020M08

As a result of the ZA unit root test, it is seen that the series are not stationary at the level, and after the first difference is taken, they become stationary as a result of the test. These results are consistent with traditional unit root tests, and. The fluctuations in exchange rates in 2018-2019 and the effects of the Covid-19 pandemic in 2020 on financial and macroeconomic indicators caused structural breaks. The dummy variable was included in the established ARDL model by taking into account the dates of structural breaks.

The general equation of the ARDL model is given in Table 5. As a result of the analysis, it was decided that the model would be ARDL $(5,1,5,1,0)$. The $F-$ statistic of this ARDL model was found to be significant at the 5% significance level.

Table 5

ARDL (5,1,5,1,0) Model Results

$Series$	$Coefficient$	$Standard\ error$	$t-statistic$	$Probability$
$lnBIST(-1)$	0.089196	0.102953	0.866372	0.3881
$lnBIST(-2)$	0.490070	0.114313	4.287072	0.0000
$lnBIST(-3)$	-0.070025	0.090375	-0.774827	0.4400
$lnBIST(-4)$	0.192836	0.089850	2.146203	0.0339
$lnBIST(-5)$	0.115165	0.078187	1.472934	0.1435
$lnINF$	0.913888	0.302116	3.024955	0.0031
$lnINF(-1)$	-0.640280	0.307076	-2.085083	0.0392
$lnINT$	-0.109811	0.051773	-2.121	0.0360
$lnINT(-1)$	0.090476	0.076441	1.183607	0.2390
$lnINT(-2)$	0.091860	0.076448	1.201601	0.2319
$lnINT(-3)$	-0.017918	0.076663	-0.233729	0.8156
$lnINT(-4)$	0.068736	0.075849	0.906223	0.3667
$lnINT(-5)$	-0.161588	0.051425	-3.142210	0.0021
$lnRISE$	0.409812	0.045499	9.007118	0.0000
$lnRISE(-1)$	-0.184794	0.052938	-3.490749	0.0007
$DUMMY$	-0.023642	0.017077	-1.384430	0.1689
C	-1.027316	0.287004	-3.579444	0.0005
$@TREND$	-0.000878	0.000483	-1.818794	0.0715
$R-squared$	0.984034	$Akaike\ Information\ Criteria$		-3.138962
$Adjusted\ R-squared$	0.981714	$Schwarz\ Information\ Criteria$		-2.751592
$Log\ L$	229.8799	$Hannan-Quinn\ Information\ Criteria$		-2.981545
$F-statistic$	424.1832	$Durbin-Watson$		1.928901
$Probability$	0.000000			

The ARDL Boundary Test was applied to detect the presence of cointegration in the established ARDL (5,1,5,1,0) model. The maximum number of lags in the model was determined as five and the AIC was used. First of all, for the existence of cointegration, the $F-$ statistic value of the model should be above the upper limit determined at the significance levels of 1%, 2.5%, 5%, and 10%. Table 6 shows the results of the ARDL Boundary Test. According to these results, the F-statistical value is (9.148889) %1, %2.5, %5, and it is seen that the critical values at the significance level of 10% are greater than the upper limits of I(1). For this reason, the hypothesis that there is no cointegration between the series is rejected. As a result of the ARDL bounds test, a cointegration relationship (long-term relationship) was determined between the series.

Table 6

ARDL (5,1,5,1,0) Bounds Test Results

$Model$	$Explanatory\ Variable\ Number\ (K)$	$Maximum\ number\ of\ lags\ (M)$	$F-Statistic$	$Significance\ Level$	$Lower\ Bound\ I(0)$	$Upper\ Bound\ I(1)$
$ARDL$ (5,1,5,1,0)	4	5	9.148889	%1	3.03	4.06
				%2,5	3.47	4.57
				%5	3.89	5.07
				%10	4.4	5.72

Long-term and short-term parameters of the series, which are proven to be cointegrated, can be estimated by the error correction model. Before obtaining the long and short-term parameters, diagnostic tests were applied to test the reliability of the model and its accuracy, and the results of these tests are given in Table 7. According to the Ramsey RESET test, there is no model building error. According to the Jarque-Bera Normality test, the error terms have normal distribution. It was determined that there was no autocorrelation problem in the series with the Brusch-Godfrey LM test, and finally, there was no problem of non-constat variance with the Brusch-Pagan-Godfrey test.

Table 7

Diagnostic Test Results of the Model

$Breusch-Godfrey\ Serial\ Correlation\ LM\ Test$			
$F-statistic$	0.651579	$Prob.F(2,115)$	0.5231
$Obs*R-squared$	1.512654	$Prob.Chi-Square(2)$	0.4694
$Heteroskedasticity\ Test: Breusch-Pagan-Godfrey$			
$F-statistic$	1.161284	$Prob.F(17,117)$	0.3070
$Obs*R-squared$	19.49036	$Prob.Chi-Square(17)$	0.3011
$Scaled\ explained\ SS$	18.43273	$Prob.Chi-Square(17)$	0.3620
Jarque-Bera Normality Test			
$F-statistic$	1.611725	$Probability$	0.446702
$Ramsey\ Reset\ Test$			
	$Value$	df	$Probability$
$t-statistic$	0.4862	(116)	0.6843
$F-statistic$	0.2546	(1, 116)	0.6843

The structural break problem and the stability of the long-term coefficients in the model are tested with the CUSUM and CUSUMQ specification tests. If the limit value in the graphics is exceeded in the CUSUM and CUSUMQ tests, it is accepted that there is a structural error in the model. According to the test results in Figure 2, it has been determined that the graphics are within the 5% critical limits and do not contain structural breaks.

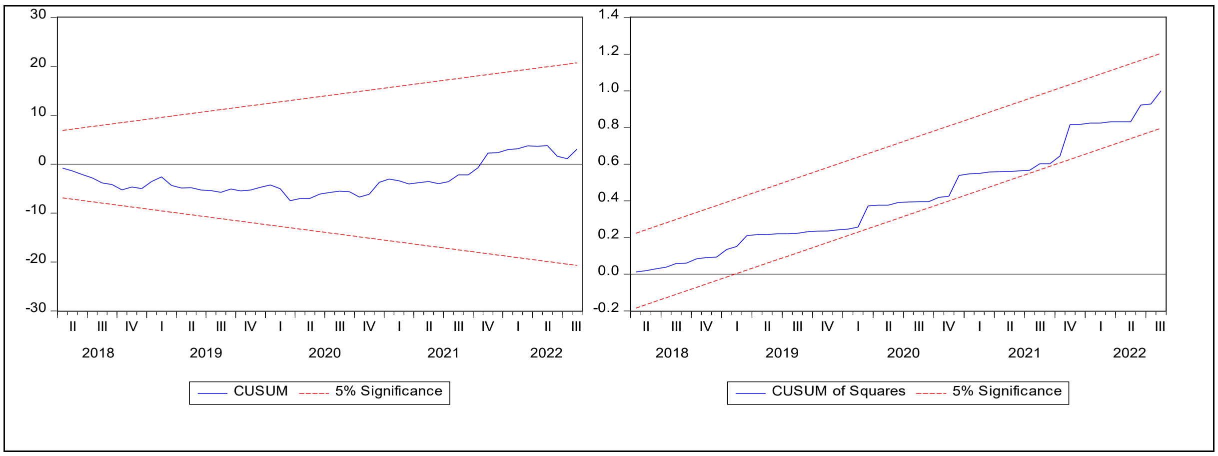

Figure 2. CUSUM and CUSUMQ Test Results

The long-term and short-term parameters of the model were estimated after determining the existence of a cointegration relationship between the series as a result of the ARDL Bounds Test and presenting the diagnostic tests of the model. The parameters estimate of the model is given in Table 8 and the 5% significance level of these parameters is taken into account. A positive and statistically significant relationship was found between BIST-100, inflation, and RISE. While there is a negative relationship between interest and DUMMY and BIST-100. The relationship between them is statistically insignificant. When the long-term parameters of the ARDL model are analyzed, a one-percent change in inflation, interest rates, and investor risk appetite led to a change of 1.497, -0.209, and 1.231 percent in the BIST-100 Index, respectively. The inflation and Investor Risk Appetite index have a positive effect on the BIST-100, while the interest rate has a negative effect.

Banerjee et al. (1998) stated that the error correction coefficient (CointEq(-1)) should be negative and statistically significant. This confirms that the error correction model works correctly and indicates how much of the short-term deviations will reach a balance in the long term. According to Table 8, it is seen that the CointEq(-1) coefficient has a negative sign (-0.182758) and is statistically significant ($p<0.05$). This result indicates that shocks or imbalances occurring in the short term will recover by 18.2% in the next period. It is seen that the short-term imbalances (1/0.182758) were eliminated in the 5.47 period.

When the short-term parameters are evaluated, the one-percent change in inflation, interest rate, and RISE has resulted in a change of 0.913888, -0.109811, and 0.409812 percent in the BIST-100 Index, respectively.

Table 8

ARDL Model Parameters

Long Term Parameters				
Series	***Coefficient***	***Std. Error***	***t − Statistic***	**Prob.**
$lnINF$	1.497106	0.316387	4.731876	0.0000
$lnINT$	-0.209270	0.112472	-1.860636	0.0653
$lnRISE$	1.231235	0.329839	3.732839	0.0003
$DUMMY$	-0.129362	0.090486	-1.429642	0.1555
Estimated Equation	EC = lnBIST - (1.4971*lnINF -0.2093*lnINT + 1.2312*lnRISE -0.1294*DUMMY)			

Short Term Parameter				
Variable	***Coefficient***	***Std. Error***	***t − Statistic***	**Prob.**
C	-1.027.316	0.148536	-6.916292	0.0000
$@TREND$	-0.000878	0.000197	-4.461867	0.0000
$D(lnISE(-1))$	-0.728046	0.085337	-8.531472	0.0000
$D(lnISE(-2))$	-0.237976	0.082106	-2.898388	0.0045
$D(lnISE(-3))$	-0.308001	0.072706	-4.236269	0.0000
$D(lnISE(-4))$	-0.115165	0.073124	-1.574920	0.1180
$D(lnINF)$	0.913888	0.266906	3.424006	0.0009
$D(lnINT)$	-0.109811	0.047942	-2.290505	0.0238
$D(lnINT(-1))$	0.018910	0.048845	0.387142	0.6994
$D(lnINT(-2))$	0.110770	0.048781	2.270760	0.0250
$D(lnINT(-3))$	0.092852	0.050602	1.834936	0.0691
$D(lnINT(-4))$	0.161588	0.049255	3.280651	0.0014
$D(lnRISE)$	0.409812	0.041985	9.760934	0.0000

$CointEq(-1)*$	-0.182758	0.026571	-6.878107	0.0000
$\boldsymbol{R-squared}$	0.583221	**Mean dependent var**		0.011966
$\boldsymbol{Adjusted\ R-squared}$	0.538443	**S.D. dependent var**		0.068533
$\boldsymbol{S.E.of\ regression}$	0.046560	$\boldsymbol{Akaike\ Information\ Criteria}$		-3.198221
$\boldsymbol{Sum\ squared\ resid}$	0.262309	$\boldsymbol{Schwarz\ Information\ Criteria}$		-2.896933
$\boldsymbol{Log\ likelihood}$	2.298.799	$\boldsymbol{Hannan-Quinn\ Information\ Criteria}$		-3.075786
$\boldsymbol{F-statistic}$	1.302.474	$\boldsymbol{Durbin-Watson}$		1.928901
$\boldsymbol{Prob(F-statistic)}$	0.000000			

The F statistical value shows that the model is established statistically significant.

5. Conclusions and Recommendations

In this study, the relationship between BIST-100, RISE, and macroeconomic variables was investigated using monthly data for the period 01/2011-08/2022. In the model where BIST-100 is the dependent variable, RISE, interest, and inflation rate are included in the model as independent variables. The study aims to determine the effect of monthly changes in RISE, interest, and inflation rates on BIST-100. For this purpose, firstly, the stationarity test of the series is carried out with unit root tests. It has determined that the BIST-100, inflation, and interest series became I(1) stationary at the first difference, while the RISE series is stationary at level I(0). The existence of a long-term and short-term relationship between the variables was determined with the ARDL bounds test approach. The fluctuations in exchange rates in 2018-2019 and the effects of the Covid-19 pandemic in 2020 on financial and macroeconomic indicators caused structural breaks. For this reason, a dummy variable (DUMMY) was added to the ARDL model by considering the structural break dates. When the long-term parameters of the ARDL model are analyzed, a one-percent change in inflation, interest rates, and investor risk appetite led to a change of 1.497, -0.209, and 1.231 percent in the BIST-100 Index, respectively. While inflation and RISE affect the BIST-100 Index positively, interest rates negatively affect the BIST -100 Index within the long-term parameters. The error correction coefficient was found to be negative, significant, and quite low. It has been determined that the imbalances occurring in the short term will be corrected by 18.2% in the next period and the imbalances will be eliminated in the 5.47 period. When the short-term parameters are evaluated, the one-percent change in inflation, interest rate, and RISE has resulted in a change of 0.913888, -0.109811, and 0.409812 percent in the BIST -100, respectively.

The positive relationship between the inflation rate and BIST is similar to the studies of Karamustafa & Karakaya (2004) and Lin (2009). The negative relationship between interest rate and BIST is similar to the studies of Mok (1993), Mumcu (2005), Zügül & Şahin (2009), Omağ (2009), Cherif & Gazdar (2010), Kanat (2011), Albayrak et al. (2012), Hsing & Hsieh (2012), Aktaş & Akdağ (2013), Ayaydin et al. (2013), Sevinç (2014), Ali (2014), Şentürk & Dücan (2014), Balı et al. (2014), Çetin & Bıtırak (2015), Poyraz & Tepeli (2015), Baydaş (2017), Khalid (2017), Yang, et al. (2018), Koyuncu (2018), Çulha (2019), Saka Ilgın & Sarı (2020). The positive relationship between RISE and BIST coincides with the studies of Demirez & Kandır (2020) and Nur (2022).

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