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The Effect of Exchange Rate and Interest Rates on BIST Service Index: Evidence From ARDL Bounds Test*

Döviz Kuru ve Faiz Oranlarının BIST Hizmet Endeksi Üzerindeki Etkisi: ARDL Sınır Testinden Kanıtlar**

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Abstract: The BIST Service Index is an important tool for monitoring the performance of the service sector in Turkey, evaluating economic growth, guiding investment decisions, and portfolio diversification. Therefore, the study aims to determine the effect of exchange and interest rates on the BIST service index.

For Turkey, the long-term relationship between the exchange rate, interest rate, and BIST service index was analyzed using the Autoregressive Distributed Latency (ARDL) bounds test, using monthly data for the period 2003:01-2023:01. Toda-Yamamoto causality test was applied to determine the direction of causality between the variables. As a result of the analysis, it has been determined that there is a long-term cointegration relationship between the interest rate applied to dollars and deposits and the BIST service index. According to the Toda-Yamamoto causality test results, a one-way Granger causality relationship from the BIST service index to the interest rate was determined at the 5% significance level. A two-way Granger causality relationship was found between the exchange rate and the BIST service index, and between the exchange rate and interest rates.

Keywords: Exchange rate, Interest Rate, BIST Service Index, ARDL Bounds Test

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Özet: BİST Hizmet Endeksi, Türkiye'deki hizmet sektörünün performansını izlemek, ekonomik büyümeyi değerlendirmek, yatırım kararlarına rehberlik etmek ve portföy çeşitlendirmesi için önemli bir araç olarak kullanılmaktadır. Bu nedenle, çalışmanın amacı, döviz kuru ve faiz oranlarının BIST hizmet endeksi üzerindeki etkisini belirlemektir.

Türkiye için 2003:01-2023:01 dönemine ait aylık veriler kullanılarak döviz kuru, faiz oranı ve BIST hizmet endeksi arasındaki uzun dönem ilişkisi Otoregresif Dağıtılmış Gecikme (ARDL) sınır testi ile analiz edilmiştir. Değişkenler arasındaki nedenselliğin yönünü belirlemek için de Toda-Yamamoto nedensellik testi uygulanmıştır. Analizler sonucunda dolar ve mevduatlara uygulanan faiz oranı ile BIST hizmet endeksi arasında uzun dönemli eşbütünleşme ilişkisinin olduğu saptanmıştır. Toda-Yamamoto nedensellik testi sonuçlarına göre, %5 anlamlılık düzeyinde BIST hizmet endeksinden faiz oranına doğru tek yönlü Granger nedensellik ilişkisi tespit edilmiştir. Hem döviz kuru ile BIST hizmet endeksi arasında hem de döviz kuruyla faiz oranları arasında çift yönlü Granger nedensellik ilişkisi tespit edilmiştir.

Anahtar Kelimeler: Döviz kuru, Faiz Oranı, BIST Hizmet Endeksi, ARDL Sınır Testi.

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1. Introduction

Many studies in financial economics try to reveal the relationship between stock prices and macroeconomic variables. It is very important to reveal which systematic forces affect the pricing in the stock market. The stock market plays an important role in the economic development of a country. One of the main functions of the stock market is to act as a bridge between savers and borrowers. It influences the savings of small savers in the large savings pool and channels these funds to more advantageous investments. Thus, the preferences of lenders and borrowers are harmonized through stock exchange transactions (Yıldırım et al., 2021).

It is very important and valuable to study changes in a country's macroeconomic variables to understand how various sectors are affected. Policymakers, decision-makers, and investors are focusing more on various factors that have an impact on stock market volatility. These factors include important financial and economic factors such as exchange rates and interest rates. This study investigates the impact of exchange rates and interest rates on the BIST services index (Özyalçın and Ertürk, 2021).

The BIST Services index represents the stocks of service sector companies traded on Borsa Istanbul. The service sector includes companies involved in the provision of various services. This sector includes companies operating in tourism, retail, financial services, education, health, logistics, hospitality, food and beverage, and similar fields. The BIST Services Index is an indicator used to track the performance of the stocks of major companies operating in the services sector. The index is calculated based on the market capitalization and trading volume of companies. It reflects the general trends of the services sector and provides investors with information about the sector. The service sector can change depending on various factors such as consumer demands, economic conditions, technological advances, and demographic factors. Companies in the sector focus on factors such as the provision of various services, customer satisfaction, productivity growth, and competitive advantage (Aslan, 2023).

Investors can invest in companies in the services sector through the BIST Services Index. However, any investment decision involves risk, and investments made without proper analysis may lead to financial losses. Therefore, it is important to seek financial advice, research the sector and companies, and evaluate market conditions. Investors can evaluate the overall performance and trends of the sector by following the BIST Services index and other indicators related to the sector. In addition, it is important to assess companies' service quality, market share, growth potential, financial status, and customer satisfaction (Eyüboğlu and Eyüboğlu, 2017).

The service sector has become one of the fastest-growing sectors in Turkey, as in many parts of the world. As there are many factors affecting economies, exchange rates, and interest rates also have an impact. Therefore, exchange rates and interest rates become inevitable among the factors affecting the service sector index (Aydemir and Demirhan 2009: 208). In terms of our country, the subject of our study was chosen to reveal how the BIST Service Index, which consists of service sector components traded in Borsa Istanbul, changes and reacts to exchange rates and interest rates.

One of the most prominent issues in financial economics is the relationship between the foreign exchange market and the stock market. Fluctuations in exchange rates are considered to have significant effects on the value of companies due to changes in competitive conditions, fluctuations in input prices and changes in the value of foreign currency denominated assets. This directly affects domestic firms engaged in foreign trade transactions. Moreover, even firms without foreign trade operations may be indirectly affected by these effects. Therefore, stock prices and stock market value of companies may react to changes in exchange rates (Yılmaz, 2022).

Exchange rate fluctuations affect the competitiveness of enterprises through input and output prices. When the exchange rate increases, exporters' sales and profits will decline as they lose their competitive advantage in the international market, leading to lower stock prices. Importers will increase their profits and stock prices as they will increase their competitiveness in the domestic market. However, exchange rate depreciation will have negative effects on exporters and importers. Exchange rate depreciation has negative effects on exporters and importers. Exporters gain an advantage over exporters from other countries, increase their sales and stock prices rise. In summary, in the local stock market, an appreciation of the currency of an export-heavy and an import-heavy country can have both negative and positive effects (Sizer, 2022).

Interest rates have two different effects on corporate profits. First, since interest rates are an expense for companies, when interest rates increase, under the same conditions, the company's profit may decrease. Second, interest rates can affect corporate profits by affecting the level of economic activity (Sayılgan and Süslü, 2011). While changes in interest rates have negative effects on corporate profits, they can also negatively affect stock prices. In particular, excessive increases in interest rates may direct investors to the bond market with higher return potential, which may lead to a decline in stock prices. Therefore, an inverse relationship is expected between interest rates and stock prices (Özer et al., 2011). Research shows that unexpected interest rate changes are effective in explaining stock returns and that this effect is negative. In this context, a fall in interest rates is considered a good signal, while a rise in interest rates is considered a bad signal, and stock returns are affected accordingly. Empirical studies reveal that there is a significant relationship between stock prices and interest rates (Coşkun et al., 2016). Investors consider interest rates and equity investments as alternative instruments. Therefore, a significant and negative relationship is expected between these two variables. While increases in interest rates may lead to a tendency to decrease equity investments, decreases in interest rates may lead to an increase in equity investments (Coşkun et al., 2016).

A review of the empirical literature reveals that studies mostly examine the relationship between the BIST100 index and various macroeconomic variables. In this study, unlike the literature, the effect of exchange rates and interest rates on the BIST services index is analyzed using monthly data for the period 2003-2023.

2. Literature Review

A review of the literature reveals that many studies have recently been conducted on exchange rates, interest rates, and stock market indices. However, only a limited number of studies have examined the relationship between exchange rates and interest rates and the BIST services index. This study aims to contribute to the related literature. In this context, both domestic and foreign studies examining the relationship between exchange rates and interest rates on the stock market index are included.

Evans and Marshall (1998) examined the impact of daily changes in monetary policy on the stock market using the VAR method. They found that the interest rates set by the central banks affect stock prices in past and current period values.

Ayvaz (2006) investigated the causality relationship between BIST indices and exchange rates in Turkey by using monthly data of different periods. As a result of the study, they found that there is a long-run relationship between the exchange rate and the industrial sector, financial sector, and national 100 sectors. However, the study revealed that there is no relationship between the service sector and the exchange rate.

Özçiçek (2010) investigated the symmetric and asymmetric relationship between real stock returns and exchange rate movements in Turkey. The study revealed that there is a strong causality relationship between the exchange rate and stock returns. In addition, there is an interaction between the dollar exchange rate and stock market index prices, i.e. when the dollar exchange rate rises or the stock market indexes fall, the interaction is observed.

Halaç and Kurt (2010), in their study for Turkey, investigated the long-run dynamics of the relationship between stock prices and exchange rates by using weekly veri for the period 1988-2009 with cointegration tests. As a result of the study, they concluded that stocks and exchange rates are cointegrated in the long run.

Duran et al. (2010), in their study, compared the impact of monetary policy on stock prices using the GMM method for Turkey with the results obtained from the case study. The results are consistent with the studies in the literature: Increases in policy rates set by the central bank decrease stock prices across sectors. The study finds that there is a shift from central bank monetary policy to capital markets in Turkey. Both of these methods are based on the increase in the Monetary Policy Committee (MPC) rate after the announcement of the Monetary Policy Committee (MPC) decision by the central bank. The reason why the financial sector index is affected by policy rates more than other sectors is that the interest rate sensitivity of the firms in this sector is higher than that of other sectors.

Özer, Kaya, and Özer (2011) analyzed the relationship between the BIST100 index and interest rate, exchange rate, money supply, gold price, and industrial production index. They used least squares, Granger causality test, VEC (Vector Error Correction), and Johansen-Juselius co-integration estimation methods. They found that there is a relationship between the BIST-100 Index and macroeconomic variables. The study revealed the existence of a long-run relationship between stock prices and price index, interest rate, exchange rate, foreign trade balance of price index, money supply, gold prices, and industrial production index variables.

Albayrak, Öztürk, and Tüylüoğlu (2012) revealed the effects of capital flows such as foreign direct investments and foreign portfolio investments on the BIST-100 index. The results of the Prais-Winston Regression analysis concluded that foreign portfolio investments, gold prices, and US dollar exchange rate have an impact on the BIST-100 index.

Aktaş and Akdağ (2013) used the Granger causality test and multiple linear regression method to determine whether the main economic factors are related to stock prices by using data covering the period between 2008 and 2012. They used the BIST100 index as the dependent variable and dollar exchange rate, euro exchange rate, deposit interest rate, unemployment rate, consumer price index, industrial production index, capacity utilization rate, export amount, crude oil prices, consumer confidence index, and gold price as independent variables. The results of multiple regression analysis revealed that the consumer price index, capacity utilization rate, dollar exchange rate, and deposit interest rate have a significant effect on the BIST-100 index. In addition, the Granger causality test results revealed that the BIST-100 index and capacity utilization rate interact with each other.

Chikili and Nguyen (2014) used a regime-switching model to examine the relationship between stocks and exchange rates in BRICS countries. The results of the analysis showed two different situations: high and low stock returns.

Inci and Lee (2014) investigated the relationship between stocks and exchange rates for multinational corporations operating in Japan, Germany, France, the United States, Switzerland, Canada, Switzerland, Canada, the United Kingdom, and Italy during the period from January 1984 to December 2009. In the analysis, it is found that the lagged exchange rate value affects the stock value in most countries. The study revealed a Granger causality relationship from the exchange rate variable to stock returns.

Şentürk and Dücan (2014) applied ADF (Augmented Dickey-Fuller), KPSS (Kwiatkowski, Phillips, Schmidt, Shin), and PP (Phillips Perron) unit root tests, Granger causality analysis and variance decomposition analysis techniques based on VAR (Vector Auto Regression) model to analyze the effects of exchange rate and interest rate on stock returns in Turkey. As a result, they found that the interest rate variable and the exchange rate negatively affected the stock market return for about three months. They revealed that the interest rate was more effective than the exchange rate on stock market return.

In his study, Gökalp (2016) examined whether the monetary policy decision of the Central Bank of the Republic of Turkey (CBRT) has an impact on stock returns. In the study, the results of the estimation made with case study and GMM methods determined that decreases in the lower bound of the corridor lead to an increase in stock prices, while increases in the upper bound of the corridor lead to a decrease in stock prices. Changes in interest rates determined by central banks affect the value of stocks and allow them to be transferred to the economy.

Coşkun, Kiracı, and Muhammed (2016) examined the relationship between macroeconomic variables and stock prices in Turkey. They revealed the relationship between BIST100 and exchange rate, interest rate, gold price, industrial production index, import quantity, and export quantity variables through impulse response function and causality test. As a result, they explained that there is a unidirectional causality relationship from the exchange rate to the BIST100, and a unidirectional causality relationship from the BIST100 to the export and import quantities and the industrial production index.

In his study, Ekinci (2016) examines the impact of interest rates and dollar variability on the performance of services, banking, and industrial sectors through the GARCH model. According to the findings of the study, while the service sector is the most sensitive, the banking sector is insensitive to changes in interest rate risk. While the increase in the US dollar hurts the performance of the industrial sector, it has a positive impact on the performance of the banking sector.

Güvercin (2016) used a regression model to understand the effect of exchange rate changes on stock returns in Indonesia, South Africa, India, Turkey and Brazil between January 2002 and December 2015. According to the results of the study, the effect of US dollar price fluctuations on the stock real return index was analyzed and it was found that the changes in the stock prices of the five countries before the global crisis were caused by the change in the US dollar.

In his study, Aydın (2017) analyzed the effect of exchange rate changes on stock prices in Brazil, China, the Philippines, Mexico, Argentina, Indonesia, Turkey, and China by using data analysis. The results show that the variables differ in terms of causality in the countries considered and also the hidden relationships that cannot be obtained with symmetric tests are revealed in the study with asymmetric tests.

Özmen, Karlılar, and Kıral (2017) examined whether there is a relationship between stock returns and macroeconomic variables in Turkey. They conducted Granger causality test, VEC, and Johansen co-integration analysis. The dependent variable is BIST100 index return, while the independent variables are the consumer price index, interest rate, and exchange rate. The results of the analysis revealed that there is a long-run relationship between the variables. As a result of causality analysis, they concluded that there are bidirectional causality relations between BIST100 and interest rate, unidirectional causality relations from exchange rate to BIST100, unidirectional causality relations from BIST100 to CPI, unidirectional causality relations from CPI to interest rate, bidirectional causality relations between CPI and exchange rate and bidirectional causality relations between interest rate and exchange rate.

Bahmani-Oskooee and Saha (2018) used the ARDL approach model to understand the relationship between exchange rates and stock prices in 24 different countries. As a result of the study, it was found that the relationship between the variables is asymmetric. Güngör and Polat (2020) used time series analysis to examine the effect of macroeconomic variables on sectoral stock prices in BIST in Turkey. In the study, monthly data covering the period 2004-2017 are analyzed. Sectors in BIST are taken as the dependent variable and exchange rate, interest rate and gold price are taken as independent variables. The results show that the exchange rate affects stock prices more than the interest rate, but the effect of the gold price is not significant. Moreover, these effects are found to be the least significant in the BIST Services Index and the most significant in the BIST Financial Index.

Ilgın and Sarı (2020) analyzed the relationship between changes in interest rates, exchange rates and inflation and the relationship between BIST All, BIST Financial and BIST Services indices for the period between November 2009 and December 2019. In the study using the ARDL bounds test, a significant cointegration relationship was found between the variables. The statistical results of the short-run analysis show that the error correction coefficients are negative in all models.

Aydın and Aksoy (2023) investigated whether there is a cointegration relationship between the BIST100 index and foreign direct investments in Turkey. For this reason, quarterly BIST100, dollar exchange rate and foreign direct investment data for the period April 2005-April 2021 from the Central Bank of the Republic of Turkey database were used. According to the ARDL bounds test results, a significant long-run relationship is found between the variables.

3. Model, Data Set And Method

In this study, the relationship between exchange rates and interest rates and the BIST services index is analyzed. For this purpose, data on the variables used in the study were obtained from the sources given in Table 1. The natural logarithms of the variables used in the study were taken and included in the analysis.

Table 1: Information on the Variables Used in the Study

Variables	Variable / Description	Source Utilized
XUHIZ	BIST Service Index	"Central Bank of the Republic of Turkey Electronic Data Distribution System (EVDS)"
USD	US Dollar	"Central Bank of the Republic of Turkey Electronic Data Distribution System (EVDS)"
INT	Interest rate applied to TL deposits opened by banks	"Central Bank of the Republic of Turkey Electronic Data Distribution System (EVDS)"

In this study, the relationship between the US Dollar (USD/TRY) exchange rate and interest rate and the BIST Services Index (XUHIZ) is analyzed using monthly data for the period 2003:01-2023:01. In the study, the period 2003-2023 was chosen due to both the aftermath of the 2001 crisis and the single party government. The model structure of equation (1) below is used to examine the relationship.

$$XUHIZ_t = \alpha_0 + \alpha_1 USD_t + \alpha_2 INT_t + u_t \quad (1)$$

4. Econometric Methodology

In the econometric analysis phase of the study, firstly, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests are used to determine the stationarity levels of the data. Then, the Autoregressive Distributed Lag (ARDL) bounds test model is used to examine the short and long-run cointegration relationships between the data. Finally, Toda-Yamamato causality test is used to determine the direction of the relationship between the variables.

4.1. ARDL Bounds Test

In order to examine the short and long run relationship between the exchange rate and interest rate and the BIST services index, the error correction model is estimated. For this purpose, equation (1) is redesigned by the ARDL model proposed by Peseran et al. (2001) and given in equation (2).

$$\Delta XUHIZ_t = \alpha_0 + \alpha_1 t + \alpha_2 XUHIZ_{t-1} + \alpha_3 USD_{t-1} + \alpha_4 INT_{t-1} + \sum_{i=1}^{p} \beta_{1,i} \Delta XUHIZ_{t-i} + \sum_{i=0}^{q} \beta_{2,i} \Delta USD_{t-i} + \sum_{i=0}^{r} \beta_{3,i} \Delta INT_{t-i} + \varepsilon_t \quad (2)$$

Equation (2) denotes the long-run coefficients a_0 constant term and parameters a_2, a_3, a_4 the short-run coefficients $\beta_1, \beta_2, \beta_3$, the deterministic trend t, the appropriate lag length (p, q, r), the difference operator Δ and the error term e_t. To obtain significant long-run forecasts, the existence of a long-run interaction between variables is important. Pesaran et al. (2001) proposed two tests to detect cointegration between variables. The first test is the F-bound test and includes lower and upper critical values. In this test, if the calculated test statistic is greater than the upper critical value, the cointegration relationship between the variables is accepted and the null hypothesis is rejected. In this case, the existence of a long-run interaction is inferred. In the second test, variables are expected to converge to their long-run equilibrium values in the error correction model. Therefore, equation (3) is estimated. The error correction coefficient (λ) in the model is expected to be statistically significant and negative, because in this case, the variables are expected to converge towards the long-run equilibrium value.

$$XUHIZ_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{m} \beta_{1,i} XUHIZ_{t-i} + \sum_{i=0}^{q} \beta_{2,i} USD_{t-i} + \sum_{i=0}^{r} \beta_{3,i} INT_{t-i} + \lambda ECM_{t-1} \varepsilon_t \quad (3)$$

The coefficients $\beta_1, \beta_2, \beta_3$ in equation (3) denote the short-run coefficients that allow the model to reach equilibrium.

4.2. Toda-Yamamoto Causality Test

VAR (Vector Autoregressive Models), a method frequently used by practitioner researchers to investigate the validity of economic theories and to develop policy recommendations, is quite common. However, in VAR analysis, hypothesis tests are not valid when there is a cointegration relationship or unit root among the variables under investigation. Generally, stationary series are analyzed by VAR analysis and then Granger Causality test is performed using the traditional F statistic. However, Toda-Yamamoto (TY, 1995) showed in his study that when there is a cointegration relationship between variables, the F-statistic may not fit the standard distribution and lose its validity. TY (1995) stated that in cases where economic theories are analyzed or econometric models are constructed, VAR analysis should be performed by using the level values of these variables even if the variables contain unit roots and the Wald test can be used here. TY (1995) also states that when there is a cointegration relationship between variables, there will be an error correction system (ECM). However, in most applications, the degree of integration, cointegration, and stationarity properties of variables are not known in advance. As a result, to examine Granger causality relationships, unit root analysis is first performed, and then the cointegration relationship is investigated. Then, causality relationships are examined with VAR analysis.

TY (1995) noted that pretests are sometimes difficult to implement and can lead to misleading results. To overcome these problems, TY (1995) suggests the construction of a VAR model of order (k+dmax). Where k is the appropriate lag length to ensure stability conditions and dmax is the maximum degree of integration of the relevant series (Mert & Çağlar, 2019: 344-345). The TY(1995) test exhibits χ^2 asymptotic distribution with lag length k. In order to apply the TY(1995) test correctly, k and dmax should be determined correctly. The correct determination of these two indicators is important for the success of causality analysis (Mert and Çağlar, 2019). The TY(1995) causality test equations for Y and X variables are given below:

$$Y_t = \sum_{i=1}^{k+dmax} \varphi_i Y_{t-i} + \sum_{i=1}^{k+dmax} \gamma_i X_{t-i} + \varepsilon_{1t} \quad (4)$$

$$X_t = \sum_{i=1}^{k+dmax} \psi_i X_{t-i} + \sum_{i=1}^{k+dmax} \gamma_i Y_{t-i} + \varepsilon_{2t} \quad (5)$$

Equations (4) and (5) assume that the error terms ε_{1t} and ε_{2t} exhibit a clean sequence process and are free of autocorrelation.

$$H_0: \gamma_i = 0$$
$$H_1: \gamma_i \neq 0 \quad (6)$$

The null hypothesis for the causality relationship for model (4) is given in equation (6). Rejection of the null hypothesis implies that there is a Granger causality relationship from variable X_t to variable Y_t. These hypotheses are tested with the help of the Wald test that fits the χ^2 distribution with k degrees of freedom (Toda & Yamamoto, 1995: 228-229).

5. Empirical Findings

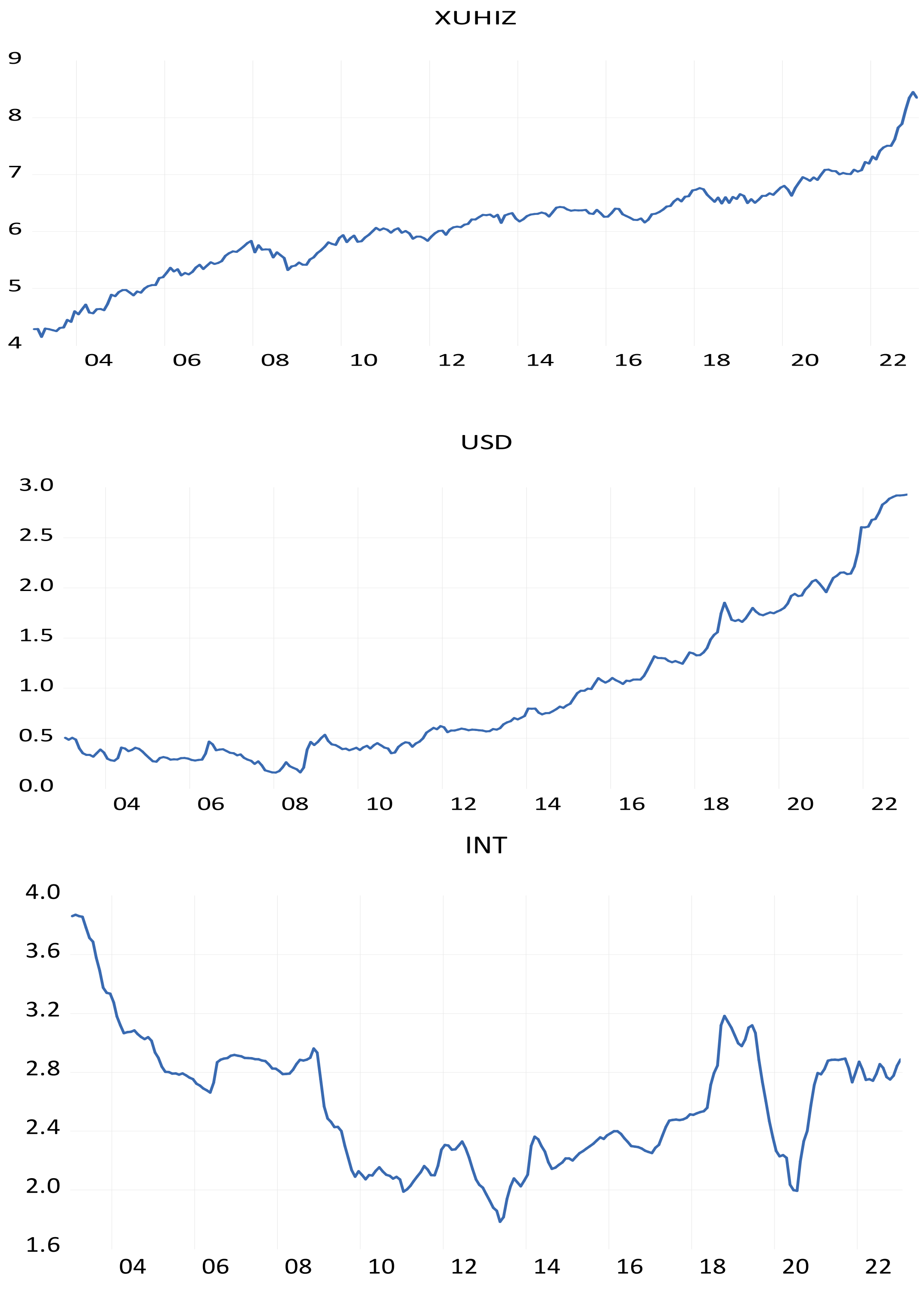
The natural logarithms of all variables used in the study were taken and included in the analysis. At the beginning of the analysis, descriptive statistics are given in order to have more information about the variables. Then, ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) unit root tests are applied to determine the degree of integration of the variables. For the ARDL bounds test, the variables used in the model should not be I(2). In this case, if it is determined that the variables are not I(2) according to ADF and PP unit root tests, only ADF and PP unit root tests are used in the study since there is no need for unit root tests with structural breaks. After determining the degree of stationarity of the variables, ARDL bounds test and Toda-Yamamoto causality test were conducted.

Table 2: Descriptive Statistics of USD-INT-XUHIZ Variables

	XUHIZ	USD	INT
Mean	6.045311	0.951483	2.583088
Median	6.159803	0.596676	2.529880
Maksimum	8.452025	2.931598	3.872034
Minimum	4.148441	0.157377	1.782719
Standard Deviation	0.820180	0.737442	0.428557
Skewness	-0,05744	1.079618	0.591314
Kurtosis	3.260430	3.151185	3.183945
Jarque-Bera	0.813568	47.04677	14.38414
Probability	0.665788	0.000000	0.000753

Table 2 presents the descriptive statistics of the variables. Table 2 shows that the standard deviation of the BIST services index and exchange rate are close, but the standard deviation of interest rates is lower. In addition, when we look at the Jarque-Bera values, it is understood that the BIST service index is normally distributed. Still, the exchange rate and interest rates are not normally distributed.

Time path graphs of XUHIZ, USD, and INT variables are presented in Graph 1. As can be seen from the graph, BIST service index and exchange rate variables have an increasing trend over time. Looking at the graph of interest rates, it is seen that there was a decline until 2013, but it exhibited an increasing trend between 2013-2019, and after 2019, it increased again after a sudden decline.



Graph 1: Graph of XUHIZ, USD and INT Variables

5.1. ADF and PP Unit Root Tests

Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests developed by Dickey and Fuller were used to determine the stationarity level of the variables. Firstly, according to the results of ADF and PP unit root tests applied to the variables in Table 3 and Table 4, USD and XUHIZ variables are not stationary at level values. After differencing, they were stationary at 1% significance level. However, it is observed that the interest rate variable is stationary at 5% significance level in the model with constant.

Table 3: Results of ADF Unit Root Tests

	Constant			Constant and Trend		
	t statistic	Lag Length	p-value	t statistic	Lag Length	p-value
USD	3.153708	2	1.0000	-0.616062	2	0.9769
ΔUSD	*-10.79599****	*1*	*0.0000*	*-11.76257****	*1*	*0.0000*
XUHIZ	0.618872	0	0.9900	-0.745171	0	0.9679
ΔXUHIZ	-16.42918***	0	0.0000	-16.45088***	0	0.0000
INT	-3.27753**	1	0.0170	-2.911886	1	0.1606

Note: Δ: indicates that the first differences of the series are taken, **: significant at 5%, ***: significant at 1%.

Table 4: Results of PP Unit Root Tests

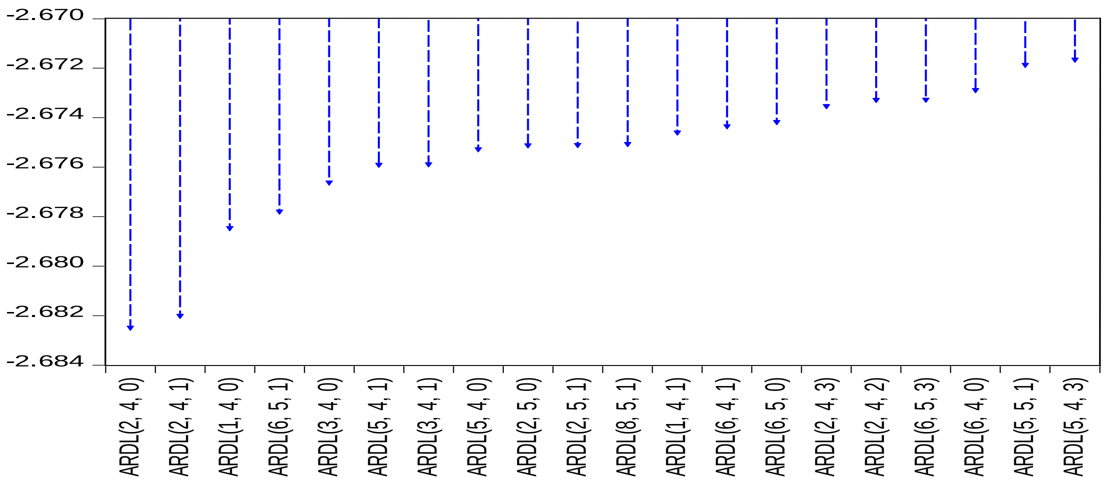
	Constant			Constant and Trend		
	t statistic	Lag Length	p-value	t statistic	Lag Length	p-value
USD	3.403393	7	1.0000	-0.540598	7	0.9811
ΔUSD	-9.977015***	8	0.0000	-10.1749***	14	0.0000
XUHIZ	0.54696	5	0.9880	-1.032403	6	0.9364
ΔXUHIZ	-16.43899***	6	0.0000	-16.45789***	6	0.0000
INT	-2.97780**	7	0.0384	-2.497956	7	0.3290

Note: Δ: indicates that the first differences of the series are taken, **: significant at 5%, ***: significant at 1%.

When the stationarity levels of the variables are analyzed, it is determined that the USD and XUHIZ variables are I(1), while the INT variable is I(0). In other words, after determining that none of the variables are I(2), ARDL bounds test can be applied.

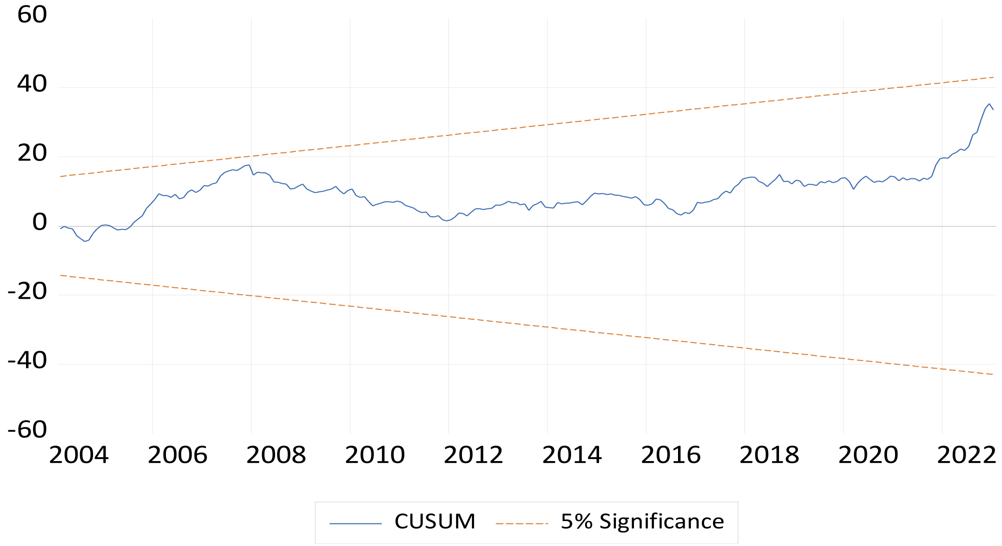
5.2. ARDL Bounds Test Results

In this study, XUHIZ BIST Services Index series is used as the dependent variable. Dollar and interest rates are included in the analysis as independent variables. In the ARDL model estimation, the lag length is set as a maximum 12 and the ARDL (2, 4, 0) model is selected according to the AIC criterion. In this way, the most appropriate model was determined among 2028 possible models. In the model selection process, a general-to-specific approach was adopted and the model with the lowest AIC value was preferred. The ranking of the top 20 models according to the Akaike Information Criterion is presented in Graphic 2.



Graphic 2: Top 20 Models According to Akaike Information Criterion

After determining the appropriate model, we can proceed to the estimation results of the ARDL(2,4,0) model. For this purpose, it would be better to first present the diagnostic test results of the model. The results in Table 5 show that the model has a normal distribution, there is no autocorrelation problem, but there is a problem of changing variance. Thus, this problem is neutralized by using the ARDL method as the covariance matrix and robust standard errors.



Graphic 3: CUSUM Graph for ARDL(2, 4, 0) Model

To decide whether the estimated parameters satisfy the stability condition, the CUSUM graph in Chart 3 is analyzed. When the graph is analyzed, since the parameter estimates do not go beyond the confidence limits, the estimates meet the stability condition.

Table 5: Estimation Results of ARDL(2,4,0) Model

	Coefficient	Standard Error	Test Statistic	p-value
ΔXUHIZ t-1	0.819012	0.066781	12.26407	0.0000
ΔXUHIZ t-2	0.12676	0.065125	1.946413	0.0528
ΔUSD	-0.601877	0.11629	-5.175641	0.0000
ΔUSD t-1	1.031623	0.200723	5.13954	0.0000
ΔUSD t-2	-0.691057	0.218481	-3.163004	0.0018
ΔUSD t-3	0.577815	0.202502	2.853377	0.0047
ΔUSD t-4	-0.244299	0.116137	-2.103548	0.0365
ΔINT	-0.035015	0.016454	-2.128055	0.0344
C	0.372639	0.117975	3.158626	0.0018
Diagnostic Tests:	LM		Probability	
Autocorrelation	$X^2_{BG} = 0.998359$		0.3701	
Variable Variance	$X^2_{ARCH} = 1.816251$		0.0033	
Normality Test	$X^2_{Ramsey} = 3{,}412241$		0,181569	

Table 6 shows the results of the bounds test to investigate the existence of cointegration relationship between the variables.

Table 6: Boundary Test Results for ARDL(2,4,0) Model

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	7.046734	10%	3.17	4.14
k	2	5%	3.79	4.85
		1%	5.15	6.36

The F value calculated for the F-Boundary test observed in Table 6 is 7.046734. Since this value is greater than the critical upper values of all error levels (F > I(1)), the null hypothesis of "no cointegration" is rejected. In other words, according to the F-Boundary test, the series are cointegrated. This means that the variables move together in the long run. The long-run estimation results between the series are presented in Table 7.

Table 7: Long-run Estimation Results

Dependent Variable: XUHIZ	Coefficient	Standard Error	Test Statistic	p-Value
USD	1.331486	0.160441	8.298921	0.0000
INT	-0.645687	0.196767	-3.281483	0.0012

The results in Table 7 show that the long-run coefficients obtained for the analyzed period indicate that there is a statistically significant positive interaction between the dollar exchange rate and the BIST Services Index. Similarly, it is statistically significant that there is a negative interaction between interest rates and BIST Services Index. According to these results, when the exchange rate increases by 1%, the BIST Services Index increases by 1.33%. On the other hand, a 1% increase in interest rates will decrease the BIST Services Index by 0.64%.

Table 8 shows the results of the error correction coefficients of the ARDL (2,4,0) model indicating the short-run relationship of the variables.

Table 8: Estimation Results of ARDL (2,4,0) Error Correction Model

	Coefficient	Standard Error	Test Statistic	P-Value
ΔXUHIZ t-1	-0.126760	0.063342	-2.001211	0.0466
ΔUSD	-0.601877	0.112836	-5.334109	0.0000
ΔUSD t-1	0.357541	0.127812	2.797406	0.0056
ΔUSD t-2	-0.333516	0.124989	-2.668355	0.0082
ΔUSD t-3	0.244299	0.113744	2.147799	0.0328
ECM t-1	-0.054229	0.011743	-4.617970	0.0000

When the estimation results of the ARDL (2,4,0) error correction model in Table 8 are analyzed, the error correction coefficient is calculated as ECM_{t-1}=-0.054229. According to this value, the error correction coefficient indicating the short-term interaction between BIST Services Index (XUHIZ) and Dollar exchange rate (USD) is less than 1 and negative. It is also statistically significant. In this case, it is determined that approximately 5% of the imbalances that may occur in the short run will be corrected after one month. In other words, the effect of a short-run shock will be corrected after (1/0.054=18.51), i.e. approximately 19 months, and return to the long-run equilibrium.

5.3. Results of Toda-Yamamoto Causality Test

According to the results obtained in Table 3 and Table 4, the USD and XUHIZ variables were found to be I(1), while the INT variable was found to be I(0). Therefore, the maximum lag length for the VAR model is calculated as $d_{max} = 1$.

In addition, the appropriate lag length for the VAR model was decided by looking at the Likelihood Ratio (LR), Akaike (AIC), Schwarz (SC), and Hannan-Quin (HQ) information criteria. The results obtained according to these information criteria are given in the table below.

Table 9: Determination of Appropriate Lag Length for VAR Model

Lag	LR	AIC	SC	HQ
0	NA	3.209856	3.254290	3.227774
1	2826.478	-9.055588	-8.877852	-8.983917
2	201.4804	-9.869841	-9.558803*	-9.744417
3	30.55670*	-9.929613*	-9.485274	-9.750436*
4	4.887096	-9.874574	-9.296933	-9.641643

*: Indicates the optimal lag length.

In Table 9, the lowest value according to all information criteria except the SC information criterion shows that the model with 3 lags is appropriate. In other words, the lag length to be used in the model is determined as k=3. After determining the lag length, the Autocorrelation LM test was performed to determine whether there is an autocorrelation problem according to the lag length determined. As can be seen from Table 10, there is no autocorrelation problem.

Table 10: Results of Autocorrelation LM Test

Lag	LM-Statistic	Prob.
1	10.25710	0.3301
2	9.212220	0.4179
3	6.369835	0.7024
4	11.22412	0.2607
5	3.229305	0.9545

Given the chosen lag length, the error terms of the VAR model should be tested for autocorrelation. Autocorrelation may lead to bias in the estimated parameters and may lead to misleading results. To prevent this situation, the inverse roots of the error terms of the estimated model should be examined. If the error term is not autocorrelated, the inverse roots will be smaller than 1. This is an important indicator to increase the reliability of the model. Table 11 below shows the results of the inverse roots of the error terms.

Table 11: Inverse Roots of Error Terms

Root	Modulus
0.951868	0.951868
0.878915	0.878915
0.642859	0.642859
0.397756 - 0.288052i	0.491105
0.397756 + 0.288052i	0.491105

As seen in Table 11, the inverse roots of the error terms are smaller than 1, which means that the model is dynamically consistent. Therefore, since no problem is detected in the preliminary tests to perform the Toda-Yamamoto causality test, causality analysis can be performed.

Therefore, according to the unit root test and VAR lag length results, the $k + d_{max}$ value required for the Toda-Yamamoto causality test is 4. The results of the Toda-Yamamoto causality test obtained by considering these conditions are given in Table 12 below.

Table 12: Toda-Yamamoto Causality Results

Direction of Causality	Lag Length	χ^2 Test Statistic Value	Prob. Value
INT→ XUHIZ	(k=3)+(d_{max} = 1) = 4	3.331	0.50
USD→ XUHIZ	(k=3)+(d_{max} = 1) = 4	21.811	0.00
XUHIZ→ INT	(k=3)+(d_{max} = 1) = 4	636.567	0.00
USD → INT	(k=3)+(d_{max} = 1) = 4	35.356	0.00
XUHIZ→ USD	(k=3)+(d_{max} = 1) = 4	15.661	0.00
INT → USD	(k=3)+(d_{max} = 1) = 4	11.690	0.02

As can be seen in Table 12, when the probability values of the calculated χ^2 test statistic value are analyzed, a unidirectional causal relationship is observed from the BIST services index to the interest rate variable, while a bidirectional causal relationship is detected between the exchange rate and the BIST services index, and a bidirectional causal relationship between the exchange rate and the interest rate variable. In other words, there is a unidirectional Granger causality relationship from the BIST services index to the interest rate variable at the 5% significance level. Moreover, there is a bidirectional Granger causality relationship between the exchange rate and BIST services index and between the exchange rate and interest rate variable.

6. Conclusion

The service sector is a rapidly growing and important sector in the economies of many countries, including Turkey. Among the most important factors affecting this sector are exchange rates and interest rates. Today's technological developments and globalization have increased the ease of traveling and investing between countries. Investors have been able to go beyond geographical borders and invest in the stock markets of different countries. Since these investments are realized in national currencies, they provide foreign exchange inflows to the investing country. In addition, the service sector plays an important role in terms of countries' balance of payments and current account deficits and contributes to the increase in the employment rate at home.

This study investigates the long-run relationship between the dollar exchange rate (USD/TRY), the interest rate applied to deposits by the Central Bank of the Republic of Turkey, and the BIST Services Index using monthly data for the period 2003:01-2023:01 in Turkey. For this purpose, the stationarity of the variables is tested using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. The long-run relationship between the variables is analyzed by the ARDL bounds test and the Toda-Yamamoto causality test is applied for the causality relationship between the variables.

After determining the stationarity levels of the variables, the ARDL Boundary Test was applied, and the results of the boundary test to investigate whether there is a cointegration relationship between the variables were calculated.

According to the results obtained, a long-run relationship was found between the variables. In the long-run coefficients obtained for the analyzed periods, it is concluded that the positive interaction between the dollar exchange rate and the BIST Services Index is statistically significant, and there is a negative interaction between the interest rate applied to deposits by the Central Bank of the Republic of Turkey and the BIST Services Index. Here, if the exchange rate increases by 1%, the BIST services index increases by 1.33%. In addition, it was concluded that as a result of a 1% increase in interest rates, the BIST service index will decrease by 0.64%, which is a negative inverse statistical result.

As a result of the findings, Halaç and Kurt (2010), Albayrak, Öztürk and Tüylüoğlu (2012), Aktaş and Akdağ (2013), Gökalp (2016), Coşkun, Kiracı and Muhammed (2016), Acar Boyacıoğlu and Çürük (2016), Güvercin (2016), Aydın (2017), Özmen, Karlılar and Kıral (2017), Bahmani-Oskooee and Saha (2018), Güngör and Polat (2020) and Ilgın and Sarı (2020), but not Ayvaz (2006), Chikili and Nguyen (2014), Şentürk and Dücan (2014) and Ekinci (2016).

As a result, our study reveals that interest rates hurt the stocks in the BIST services index, while the exchange rate has a positive effect on the BIST services index. It can be used as a recommendation for individual and institutional investors. The variables used in the study will contribute to the studies and literature by utilizing different methods with data to be obtained from different periods.

Etik Beyanı

Bu makalede hiçbir insan çalışması sunulmamıştır.

Yazar Katkıları

Yazarlar bu çalışmaya eşit düzeyde katkı sağlamış ve yayın için onaylamıştır.

Çıkar çatışması

Yazarlar, araştırmanın potansiyel bir çıkar çatışması olarak yorumlanabilecek ticari veya finansal ilişkilerin yokluğunda yürütüldüğünü beyan etmektedir.

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