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Research Article

FACTORS AFFECTING CDS PREMIUM AND FUTURES CONTRACT PRICES: EXAMPLE OF TÜRKİYE

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ABSTRACT

This study examines the relationship between the Türkiye CDS premium and the prices of USD/TL and BIST30 futures contracts traded on BIST VIOP. In addition, the national and global variables affecting these three variables were analyzed. Based on the literature, four national and eight global variables were used to explain these variables. Inflation, industrial production index, central bank external debt, and reserve data are used at the national level. The VIX and MSCI ACWI indices and CDS premiums of the USA, China, Germany, Italy, the United Kingdom, and Brazil were used at the global level. Data were collected at a monthly frequency covering the period from August 2018 to December 2024. VAR model-based, Granger causality, impulse response, and variance decomposition analyses were conducted. The results reveal a relationship between CDS and BIST30 futures with both global and national variables, while USD/TL futures are primarily influenced by national factors. The effect of the structural breaks was also significant.

Keywords: Credit default swap, Futures and options market, Futures contract, Time series analysis, Türkiye.

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INTRODUCTION

Credit risk is defined as the failure of a debtor to fulfill its obligations in a contract. Credit risk must be considered in both markets and the general order of the economy. Understanding the sources of credit risk plays a key role in developing credit risk-management strategies (Longstaff et al., 2011). The ability of institutional and individual investors to effectively manage credit risk contributes to both their own interests and the healthy functioning of the economy. Credit risk is closely related to confidence, anxiety, and liquidity in the market (Turguttopbas, 2015). Default risk leads investors to risk aversion, and as a result, market liquidity decreases. Another result of this situation is an increase in volatility (Arellano, 2008). From the creditors' perspective, there is a demand for higher interest rates to prevent possible losses.

A global perspective demonstrates how systemic risks are created when large financial institutions face defaults. One of the most striking examples of this situation is the global financial crisis of 2008. Among the effects that countries have experienced from such crises is the rise in sovereign default swaps (CDS) (Bostanci & Yilmaz, 2020). A rise in the country's CDSs, a factor that determines the risk level of the country, changes investors' behaviour and decreases the effectiveness of price discovery mechanisms. In addition to such economic fluctuations, political developments also change risk perceptions and make an effective risk management strategy necessary. Effective risk management has a positive effect on financial soundness, capital costs, and investor confidence. Derivative products are widely used in effective risk management. CDSs are risk indicators and insurance tools; however, they are also derivative instruments. The correct pricing of CDSs is important for risk perception, price discovery, and market efficiency. The spillover effect between CDSs across various countries has been measured in the literature. Although there are studies that use only CDSs, the majority of studies include bond yields in the dataset (Sabkha et al., 2019; Afonso et al., 2012; Tsuruta, 2020). There are also prominent studies that diversify the dataset by using global indices and stock market returns, in addition to bond returns (Longstaff et al., 2011; Alter & Beyer, 2012; Fabozzi et al., 2016; de Boyrie & Pavlova, 2016; Avsarlıgil & Turgut, 2021; Huyuguzel Kısla et al., 2022). Studies conducted in Türkiye examined Türkiye CDS premium using various macroeconomic indicators (Gurel, 2021; Erdas, 2022; Buz & Kucukkocaoglu, 2023). A large number of variable groups used in these studies were included in the analysis. Thus, the Türkiye CDS premium is explained by both national and global economic indicators and creates a unique value.

Futures are among the derivative instruments. Their basic principle is to protect investors from future risk and price changes. Since they are determined to meet future expectations, interest rates in the futures market, in particular, serve as a reference for determining credit spreads. The organized market in which futures are traded in Türkiye is the Borsa Istanbul Futures and Options Market (VIOP). Studies in the literature, particularly on futures in Türkiye, are limited. Most studies have investigated the relationship between futures contracts and spot markets (Celik, 2011; Ozdemir, 2011; Iseri & Kacmazer, 2016). Tas (2016) measures the efficiency of futures markets. In another study, currency futures contracts were explained using the Türkiye CDS premium and global risk indices (Elcicek, 2022). Our study includes the highest transaction volumes and USD/TL and BIST30 futures contract prices based on the literature. In ad-

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dition to the Türkiye CDS premium, the two futures contract prices with the highest transaction volumes in VIOP are explained by both national and global economic indicators, which is another factor that adds originality to our study. Both futures and CDSs are important derivative instruments that reflect risk perceptions.

This study aims to explain the Türkiye CDS premium and futures contracts with the help of various national and global variables while also examining the relationship between them. For this reason, the research question prepared is "What is the relationship between the Türkiye CDS premium, USD/TL, and BIST30 futures contract prices and how are these financial indicators affected by national and global economic factors?" National and global factors affecting CDS premiums and futures were determined based on research conducted in literature. These factors can be used to understand risk management and pricing dynamics in markets. In this respect, this study is important in terms of providing investors and policymakers with valuable information for the process of better evaluating market risks and making strategic decisions. In addition, it aims to make an original contribution to the literature by analyzing the relationship between CDS and futures contracts specific to Türkiye's market and global economic and financial indicators. The interactions between these instruments and other economic indicators in the risk management process will provide important information to market actors. In the first section, widespread studies on the subject of literature are examined. Based on the literature, the national and global factors that may affect CDS premiums and futures contracts are determined. The second section provides detailed explanations regarding the data and methods used. The third section presents the analysis and results. Finally, the results are discussed.

LITERATURE REVIEW AND THEORETICAL BACKGROUND

Owing to the subject of the study, it would be more explanatory to consider the relevant literature in two parts. The first of these studies mostly focuses on the spillover effect between CDSs, while also using variables such as inflation, reserves, bond yields, stock index returns, VIX, and exchange rates as explanatory factors. The second part of the literature includes studies on futures and is mostly used to compare asset returns in spot markets. The studies in the first group, which focused on CDSs, are given below.

The first group of literature examines various studies on the factors affecting CDS spread across different countries and periods. Longstaff et al. (2011) find that global factors, particularly US stocks and stock markets, significantly influence CDSs more than local economic measures, with default risk accounting for two-thirds of the CDS spread. Afonso et al. (2012) observe that EU government bond yields and CDS premiums react significantly to credit rating announcements, with bidirectional causality between announcements and CDS spreads. Using a spillover index, Alter and Beyer (2012) identified strong interactions between banks and countries in Europe, influenced by political developments. Fabozzi et al. (2016) note a shift in the source of volatility in CDS spreads during the European Debt Crisis from global to European factors. De Boyrie and Pavlova (2016) highlighted significant spillover effects among emerging market CDSs, particularly in Brazil and Mexico. Sabkha et al. (2019) concluded that financial crises increased market fragility, with more severe spillover effects during the Eurozone crisis. Kurt Cihangir (2020) found that national variables have

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a greater impact on Türkiye CDS premium volatility than global shocks. Tsuruta (2020) linked Eurozone countries' credit risk components to local stock markets and global banks with liquidity risk affecting bond spreads. Gurel (2021) identifies the nominal exchange rate as a key driver of CDS spreads in Türkiye. Avsarlıgil and Turgut (2021) find short-term causality between stock market indices and CDS premiums in five fragile countries, with long-term cointegration in Türkiye. Erdas (2022) reported that the BIST100 index and liquid liabilities positively affect CDS, whereas banking credit volume has a negative effect. Huyuguzel Kısla et al. (2022) linked CDS spreads to trade links and public debt-to-GDP ratios in European countries. Buz and Kucukkocaoglu (2023) find that in Türkiye, the stock market index and growth rate negatively affect CDS in the long term, while the exchange rate has a positive effect, with various causal relationships identified. There is a common theme among these studies: global and national economic factors, political developments, and market interactions greatly influence CDS spreads, with varying effects across regions and periods.

The second group of studies examines the relationship between futures and spot markets in Türkiye, focusing on volatility, price efficiency, and economic variables. Özdemir (2011) discovered a bidirectional volatility relationship, in which futures markets had different effects on IMKB30 and USD/TL. Similarly, Celik (2011) and İseri and Kacmazer (2016) investigated causality relationships using Celik (2011) finding predictive power in USD/TL futures contracts, but not in VOB30 contracts, while İseri and Kacmazer identified causality running from spot to futures markets in the BIST30 index. Tas (2016) evaluated the efficiency of the futures market and found that artificial neural network models provide more accurate price estimates than traditional econometric models. Elcicek (2022) examined the relationship between USD/TL and EUR/TL futures contracts and economic variables, revealing that contract prices are positively influenced by CDS spreads in the long term and by the economic confidence index in the short term but negatively affected by the VIX index. The Granger Causality test was used to measure the relationship between the spot and futures markets.

While the ARMA-GARCH methodology was preferred, especially for short-term relationships, the VECM methodologies were mainly followed for long-term relationships. However, cointegration relationships are mandatory for the application of VECM. In the studies measuring the spillover effect, the Diebold and Yılmaz (2011) methodology was mostly followed. On the other hand, VAR (Vector Autoregression) methodology often involves variance decomposition, impulse-response analysis, and Granger causality tests. Using these methods, the intensity and direction of the variables' effects on each other were determined.

Futures and options markets provide investors with the opportunity to generate speculative income in addition to managing risks. However, CDSs are essential indicators of the risk of a country or company defaulting on debt. Because CDSs are also derivative instruments (swaps), they are used for hedging and speculation purposes, such as futures contracts. The main difference at this point is the type of risk. While futures are used to manage market risk, CDSs manage default risk. Another difference is that while futures are traded in organized markets, country CDSs are traded in over-the-counter (OTC) markets. While counterparty risk is high in CDSs, there is collateral from the clearinghouse in futures contracts. When their differences and common points are evaluated,

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their use provides integrated risk management. Additionally, changes in CDS can affect the price discovery of futures by changing the market's perception of risk. (Blanco et al., 2005).

Although the literature on these two relationships is limited, Elcicek (2022), examines the relationship between futures contract prices and CDS premiums. Gok et al. (2023) analyze the financial interconnectedness of the volatility shock spread of futures contracts with the CDS premium. Future contracts reflect future risk perceptions, thus affecting CDS premiums. Since CDS reflects risk perception, its increase may cause TL and stock market indices to lose value. Rising CDS may trigger foreign investors to exit stock markets. Both Elcicek (2022) and Gok et al. (2023) find a positive relationship between CDS premiums and USD/TL futures. Moreover, Gok et al. (2023) find a negative relationship between BIST30 futures and CDS premiums. According to the literature and our expectations, CDS will have a positive relationship with USD/TL futures and a negative relationship with BIST30 futures.

While futures contracts are usually compared with spot markets, some studies examine the relationship between futures contracts to determine whether they exist. (Bryant et al., 2006; Kayali & Akarim, 2010). Information transfer is significant because these two contracts trade in the same market. Since most companies in BIST30 have foreign exchange positions, changes in exchange rates affect companies' financial performance. Companies that import and export are likely to be affected by their exchange rates. Since an increase in the exchange rate affects firms with foreign exchange open positions and foreign exchange surpluses differently, the relationship between USD/TL futures prices and BIST30 futures prices may be positive or negative in direction. This indirectly affects the stock market index.

Although most studies reveal the relationship with global factors due to the CDS spillover effect, some studies highlight the relationship with country-specific macroeconomic indicators. (Gurel, 2021; Erdas, 2022; Buz & Kucukkocaoglu, 2023). An increase in industrial production is an indicator of economic growth. This may have had a positive effect. On the contrary, high inflation is likely to have a negative impact on CDS premiums. While the increase in the Central Bank's reserves has a positive effect on the CDS premium, an increase in debt can also have a negative effect on the CDS premium (Kurt Cihangir, 2020). The VIX is an indicator of risk perception; therefore, when it rises, investors avoid risky assets. Emerging markets (including Türkiye) are perceived as risky. This causes CDS premiums to increase. The relationship is particularly strong during global crisis periods, and a similar effect is observed in most developing countries. Consequently, investors tend to seek safe havens, leading to capital outflows from emerging markets. This contributes to an increase in CDS premiums. Our expectations and the literature suggest that there is a positive relationship between the Türkiye CDS premium and the VIX (Yang et al., 2018; Kurt Cihangir, 2020; Kartal, 2020). The MSCI ACWI (All Country World Index) shows the overall performance of global stock markets. An increase in the index indicates an increase in the global risk appetite. Increased risk appetite increases interest in developing countries. This leads to a decrease in CDS premiums. The relationship strengthens as global market optimism increases. This becomes more pronounced in periods when the risk perception decreases. Similar effects have also been observed in other developing countries. When the MSCI ACWI

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rises, demand for risky assets increases. Capital flows into emerging markets and contributes to a decrease in CDS premiums. Based on this information and the literature, we expect a negative relationship between the MSCI ACWI and CDS premiums (Yang et al., 2018; Kartal, 2020).

Many factors explain the interaction between the CDS premiums. In addition to similar economic structures and common risk factors in countries, global investor behaviour is among these factors. CDS interactions are also affected by factors, such as geographic proximity, trade relationships, perceptions of global risk, and financial market integration. This relationship becomes stronger, especially during periods of global crisis. In these periods, when risk perception increases, the correlation increases and the financial contagion effect becomes more pronounced (Sabkha et al., 2019; Kamıslı & Esen, 2019). Based on the literature, a positive relationship is expected between CDSs in developing country CDSs. Since developed countries have a higher impact on global risk perception, they are expected to have an indirect positive relationship with the Türkiye CDS premium.

In addition, the relationship between futures contracts and national and global macroeconomic indicators is tested. For USD/TL futures contracts, the depreciation of the TL is the main reason for this increase. For this reason, increasing inflation and central bank debt will have a negative impact on TL, which will increase USD/TL futures contracts. However, since the increase in industrial production and central bank reserves will be economically positive, it will have a negative relationship with USD/TL futures. From a global perspective, an increase in the VIX will increase risk perception, which will result in an outflow from emerging markets. Therefore, USD/TL futures prices will increase as TL loses its value. In this case, a positive relationship is expected between the VIX and USD/TL futures. When the MSCI ACWI increased, the global risk appetite increased. There is a capital inflow to emerging markets. USD/TL futures prices decrease as TL gains value. Therefore, a negative relationship is expected between the MSCI ACWI and USD/TL futures.

When inflation increases, corporate costs increase, interest rate hikes are expected, and BIST30 futures prices are expected to fall. When central bank debt increases, risk perception increases, financial stability concerns increase, and BIST30 futures prices are expected to fall. Thus, BIST30 contracts are expected to have a negative relationship with inflation and central bank debt. An increase in the industrial production index signals economic growth, company performance improves, and BIST30 futures prices increase. When central bank reserves increase, financial confidence increases, exchange rate stability expectations strengthen, and BIST30 futures prices increase. Therefore, central bank reserves and the industrial production index are expected to be positively correlated with BIST 30 futures. From a global perspective, when the VIX rises, global risk perception increases, capital outflows from emerging markets, and BIST30 futures prices fall. When the MSCI ACWI rises, optimism in global markets increases, and BIST30 futures prices rise. Therefore, USD/TL futures are expected to have a negative relationship with VIX and a positive relationship with MSCI ACWI.

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RESEARCH METHODOLOGY

Dataset

The dataset of the research is at the monthly frequency, which is the most frequent frequency possible, and consists of 77 observations and 15 variables covering August 2018 to December 2024. Because there was a significant structural break in the data for Türkiye in mid-2018, the data were taken to include the period after this date. The model of the study included three separate equations, and each equation included one dependent variable. These dependent variables are the Türkiye CDS premium, Türkiye Futures and Options Market USD/TL contract price, and Türkiye Futures and Options Market XU30 contract price. Two dummy variables are added for July 2022 and November 2022 based on structural breaks in the futures contract series. These two futures contracts are preferred because of their widespread use in the literature, compliance with data frequency, and high transaction volumes. All variables other than these were independent variables. It is possible to collect relevant variables under these three headings. The first is the CDS data of countries and consists of six countries (USA, China, UK, Germany, Italy, and Brazil). The preferred countries are large economies, but Brazil was also chosen for comparisons with emerging markets. Among other major economies, Japan is highly similar to China. France has a high degree of similarity to Germany. For this reason, these two countries were not included in the dataset. Canada and India were not included in the dataset because their data were incomplete. The reference asset for all the CDSs is the 5-year USD bond. The variables in the second group can be considered internal variables of Türkiye. These data are inflation, the industrial production index, the Central Bank of the Republic of Türkiye (CBRT) Reserve, and external debt. The third group includes two economic variables at the global level. These are the Morgan Stanley Capital International All Country World Index (MSCI ACWI) and the Chicago Board Options Exchange Volatility Index (VIX), which is also accepted as the fear index. While the country CDS data, VIX index, and MSCI ACWI index are obtained from the Thompson Reuters Eikon database, the VIOP data are obtained from investing.com. While inflation data, CBRT reserves, and external debt data were accessed from tcmb.gov.tr, industrial production index data were accessed from the TÜİK Statistical Data Portal.

Vector Autoregression (VAR) Model

The VAR model was preferred as the study method. Impulse response and variance decomposition analyses were then used. The present value of a variable may depend on both its own past and the past values of other variables. The VAR model attempts to estimate the future values of variables by taking this into account. Thus, it is possible to estimate future values for a time series and evaluate various scenarios (Sims, 1980).

Using the VAR model, we can define the dynamic relationships between stationary variables. The VAR model is a system of equations in which the variables are used and their lagged values are found on the right-hand side of the equation. This means that the variables are affected not only by their own lagged values but also by the lagged values of other variables. In multivariate time-series analyses, GARCH and VECM models can also be used as alternatives to the VAR model. However, the GARCH model is used for volatility modelling. As our study focused on the relationship between variables, this method was not

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preferred. The VECM model can be used in cases where there is a cointegration relationship between the dependent variables. As there is no cointegration relationship between our dependent variables, the VAR model was preferred. The VAR model provides flexibility and less dependence on theoretical constraints because it does not require strict theoretical assumptions such as structural macroeconomic models. Additionally, it provides the opportunity to examine the effect of a shock in one variable on other variables using impulse response analysis and variance decomposition. The VAR equations according to the model variables are as follows:

$$(1)\ Y_{1,t} = \alpha_1 + \varphi_{11} \cdot Y_{1,t-1} + \varphi_{12} \cdot Y_{2,t-1} + \varphi_{13} \cdot Y_{3,t-1} + \Sigma k_{=1 \to 12}\, \beta_{1,k} \cdot X_{k,t} + \delta_1 \cdot D_{1,t} + \delta_2 \cdot D_{2,t} + \varepsilon_{1,t}$$

$$(2)\ Y_{2,t} = \alpha_2 + \varphi_{21} \cdot Y_{1,t-1} + \varphi_{22} \cdot Y_{2,t-1} + \varphi_{23} \cdot Y_{3,t-1} + \Sigma k_{=1 \to 12}\, \beta_{2,k} \cdot X_{k,t} + \delta_1 \cdot D_{1,t} + \delta_2 \cdot D_{2,t} + \varepsilon_{2,t}$$

$$(3)\ Y_{3,t} = \alpha_3 + \varphi_{31} \cdot Y_{1,t-1} + \varphi_{32} \cdot Y_{2,t-1} + \varphi_{33} \cdot Y_{3,t-1} + \Sigma k_{=1 \to 12}\, \beta_{3,k} \cdot X_{k,t} + \delta_1 \cdot D_{1,t} + \delta_2 \cdot D_{2,t} + \varepsilon_{3,t}$$

Model Specifications

The model assumes that each variable can be explained by its own lag and other variables. D_1,t and D_2,t represent dummy variables at structural breakpoints. The multiple structural breaks and Chow break tests were performed for the dependent variables with structural breaks, USD/TL futures contracts, and BIST30 futures contracts. The test results for the USD/TL futures contract are presented in Tables 1 and 2.

Table 1
Breakpoint Test for USD/TL Futures Contract

Number of breakpoints ranked by F Statistics		
Breakpoint	**F-Statistics**	**Critical Value****
0 vs. 1*	269.4677	12.29
1 vs. 2*	123.6861	13.89
* Significance at 0.01 level		
** Bai-Perron Critical Value		
Breakpoint Dates		
1 2022M07		
2 2023M07		

Source: Authors' own data

When the results were examined, the Bai-Perron critical values showed a significance level of 1% for points 0 vs. 1 and 1 vs. 2. Therefore, structural breaks occur.

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Table 2
USD/TL Futures Contract Chow Test

Breakpoint Date	F-Stat.	Log Likelihood Ratio	Wald Stat.	Prob.
2022M07	269.4677	117.3874	269.4677	0.0000*
2023M07	252.7117	113.5478	252.7117	0.0000*

* H0: There is no structural break on the specified date

Source: Authors' own data

Based on the test results, a dummy variable was added to the model to eliminate the structural break problem on the determined dates. Because the dummy variable (D1) was added for July 2022, a dummy variable was not added for July 2023. Tables 3 and 4 show the break test results for BIST30 futures contracts.

Table 3
Break Test for BIST30 Futures Contract Series

Number of breakpoints ranked by F Statistics		
Breakpoint	**F-Statistics**	**Critical Value****
0 and 1*	393.0199	12.29
1 and 2	119.5519	13.89

* Significance at the level of 0.01

** Bai-Perron Critical Value

Breakpoint Dates
1 2022M11
2 2024M01

Source: Authors' own data

When the results were examined, the Bai-Perron critical values showed a significance level of 1% for 0 vs. 1 and 1 vs. 2. Therefore, there were structural breaks at points 0 vs. 1 and 1 vs. 2.

Table 4
BIST30 Futures Contract Chow Test

Breakpoint Date	F-Stat.	Log Likelihood Ratio	Wald Stat.	Prob.
2022M11	205.7555	129.8533	205.7555	0.0000*
2024M01	135.8905	79.60653	135.8905	0.0000*

*H0: There is no structural break on the specified date

Source: Authors' own data

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Since dummy variable (D2) was added for November 2022, it was not added for January 2024.

Various tests were conducted to evaluate the consistency of the model. These include lag length, autocorrelation, stationarity, and heteroscedasticity. The test results to determine the optimal lag length for the model are listed in Table 5.

Table 5
VAR Model Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-914.8263	55.82817*	20646766*	25.32016	27.14650*	26.05068*
2	-907.1086	10.82479	21773178	25.35347	27.45376	26.19357
3	-898.9622	10.79132	22856509	25.37564	27.74989	26.32532
4	-887.4872	14.30651	22179932	25.31136	27.95955	26.37061
5	-878.3861	10.63763	23107057	25.30873*	28.23088	26.47756
6	-872.8024	6.091272	26670001	25.39747	28.59356	26.67588
7	-869.3740	3.472936	32986996	25.54218	29.01223	26.93017
8	-861.8657	7.020778	37280762	25.58093	29.32493	27.07849

Source: Authors' own data

Based on the table, it was concluded that the number of lags that met the most criteria was 1, and the model was designed according to this value.

Autocorrelation or serial correlation is the systematic relationship of data in a time series with its past or future values. The autocorrelation status of these models was tested using the Lagrangian Multiplier (LM) test. For the test, the null hypothesis states that there is no autocorrelation if the probability value is above 0.05; the hypothesis is accepted, and there is no autocorrelation at the relevant lag order. The details of the test results are presented in Table 6.

Table 6
VAR Model LM Autocorrelation Test Results

Lag	LM Statistics	Prob. Value
1	7.469702	0.5883
2	12.25357	0.1994
3	17.03868	0.0481

Source: Authors' own data

According to the results, when the lag length is 1, the probability value is 0.5883, and because it is greater than 0.05, the hypothesis cannot be rejected, and it is concluded that there is no autocorrelation problem at the relevant lag point.

Stationarity implies that the statistical properties (mean, variance, and covariance) of a time series do not change over time and remain constant. In non-stationary time series, the mean and variance change over time and do not converge to a specific point. Stationarity analysis is important for modelling and estimating time series and understanding changes over time (Gujarati, 1999: 713).

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However, even if the series are not stationary at this level, the fact that the structures they form together are cointegrated should also be considered. To detect such situations, the stability of the error terms was tested. The variables e_1,t, ε_2,t and ε_3,t included in the equations are the error terms. If stationarity is provided for the variables in question, it can be concluded that the series shows co-motion behaviour and does not need to be different. The results of the group unit root test performed on the error terms of the research model are presented in Table 7.

Table 7
VAR Error Terms Group Unit Root Test Results

Method	Statistic	Prob*	Cross-sections	Obs.
Levin, Lin & Chu	-12.9579	0.0000	3	226
Im, Pesaran and Shin W	-13.0662	0.0000	3	226
What ADF-Fisher does	91.0712	0.0000	3	226
What PP-Fisher does	78.5590	0.0000	3	228

* Probabilities for Fisher tests are calculated using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Source: Authors' own data

In the VAR model, three error term series (res1, res2, res3) of the dependent variables are tested using the Schwarz Information Criterion (SIC). Because the probability values are less than the 1% significance level in all methods, the null hypothesis that there is a unit root is rejected. Therefore, the series of error terms is stationary.

If the variance of the error terms is not constant, it is called heteroscedasticity. Heteroscedasticity poses a problem in terms of the consistency of the model. The details of the test results to determine whether there is a variance problem are listed in Table 8.

Table 8
VAR Model Error Terms Heteroskedasticity Test

Joint Test		
Degree of Freedom	**Chi-sq**	**Prob.**
216	245.4579	0.0824
Individual Components		
Variable	**Chi-sq**	**Prob.**
Res1*res1	44.69480	0.1517
Res2*res2	46.48671	0.1132
Res3*res3	50.84611	0.0515
Res2*res1	48.43054	0.0807
Res3*res1	42.56764	0.2093
Res3*res2	49.33579	0.0684

Source: Authors' own data

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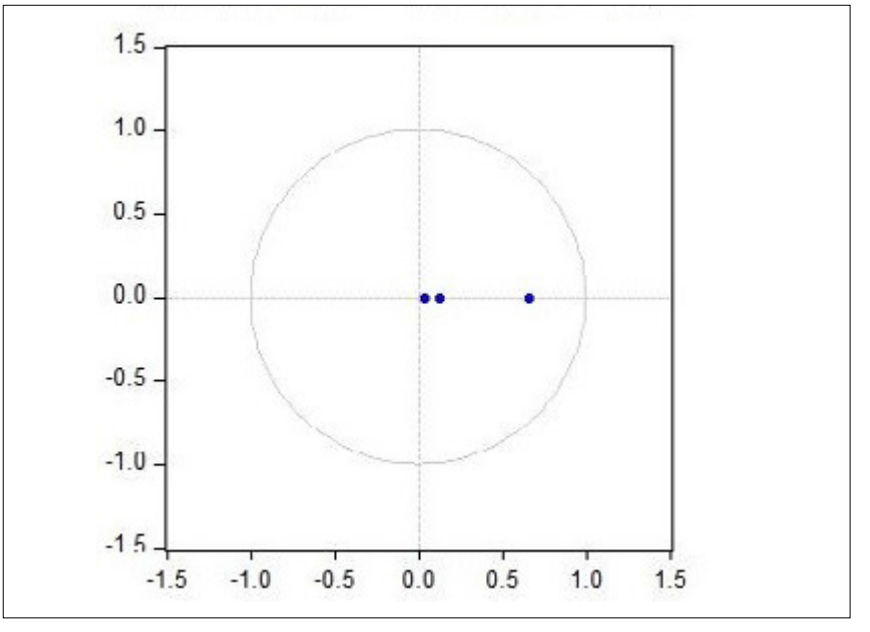
When the common test and individual test results were examined, it was observed that all chi-square probability values were above 0.05. Therefore, there is no problem with heteroscedasticity in the model.

Finally, the inverse characteristic roots of both models were examined. To determine the stability of the VAR model, its inverse characteristic roots are examined. The details of the results are shown in Figure 1.

Figure 1
VAR Model Inverted Characteristic Roots



Source: Authors' own data

To ensure the stability of the model, the inverted characteristic roots must be located inside the unit circle. The results indicate that the roots are represented by circles. Therefore, the model was stable.

It is possible to perform an impulse response analysis using error terms. The variance decomposition technique is used to measure the extent to which the forecast errors of the variables at a given time come from their own shocks and from external factors in multivariate time-series VAR models.

ANALYSIS AND FINDINGS

Impulse Response Analysis

The Generalized Impulse Response (GIR) technique was used in this study. The graphs containing the reactions of the Türkiye CDS premium (TÜRKİYE), which is the first set of impulse-response analysis graphs for the VAR model, to the effects of the Türkiye CDS premium and other dependent variables are given in Figure 2. Figure 3 shows the reactions of the USD/TL Futures Contract (VIOPUSDTL), whereas Figure 4 shows the reactions of the BIST 30 Futures Contract (VIOPXU30).

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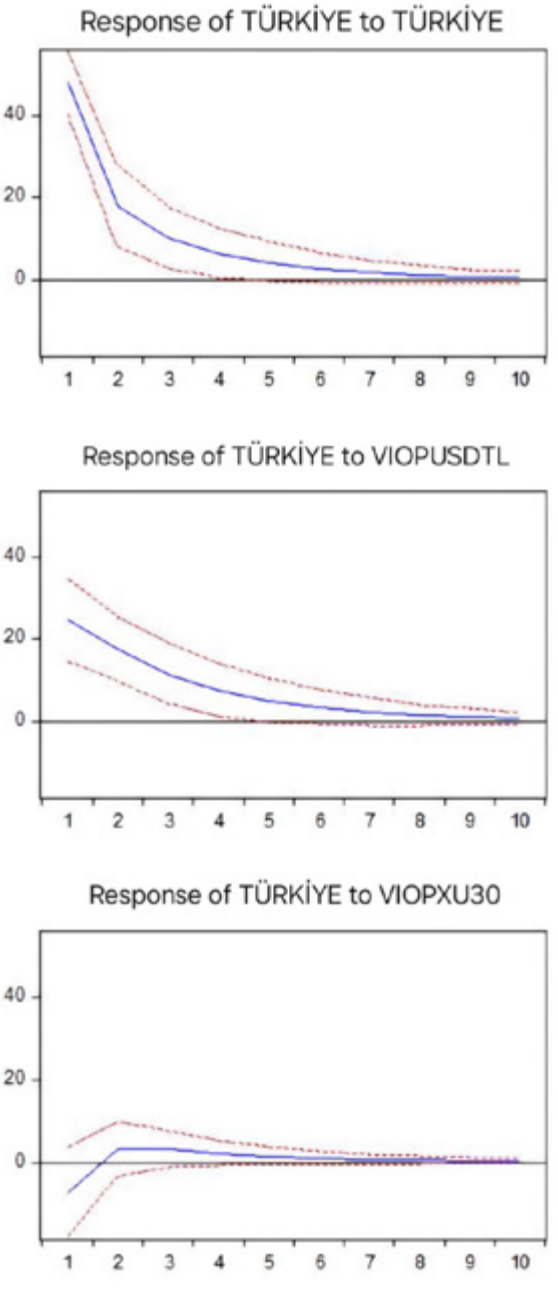
Figure 2
Reactions of Türkiye CDS Premium



Source: Authors' own data.

The uncertainty was low because the confidence intervals were narrow in all three graphs. The responses of the Türkiye CDS premium to its internal dynamics are stronger.

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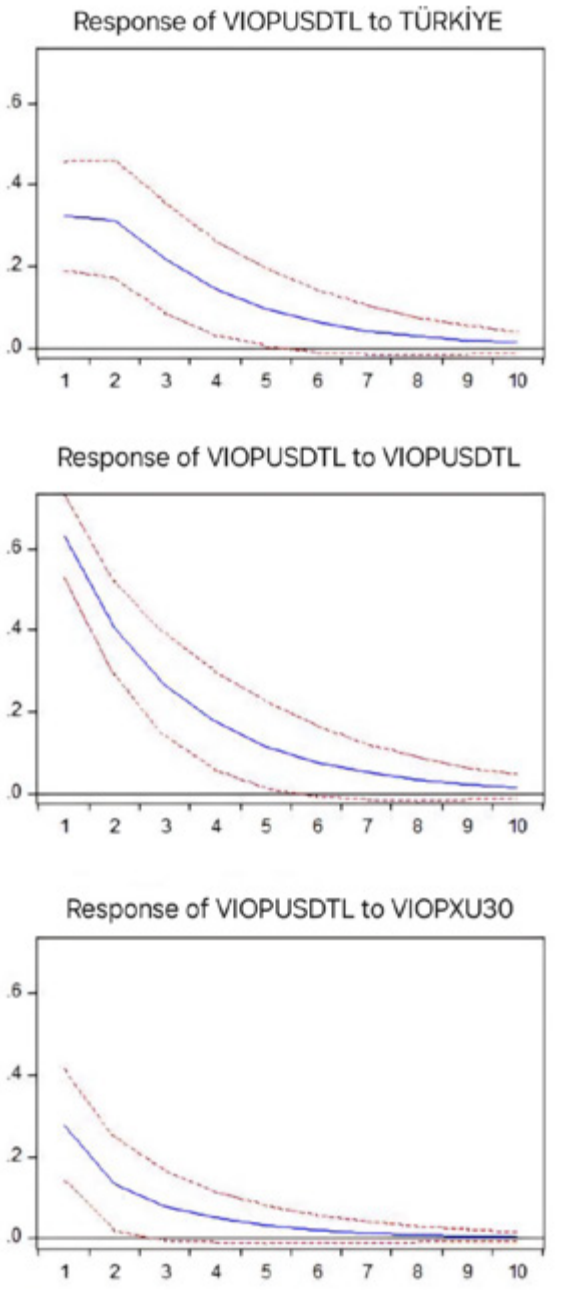
Figure 3
Reactions of the USD/TL Futures Contract



Source: Authors' own data

In all graphs, the reactions had values in the range of 0-1. The responses approaching equilibrium in the medium term reach the equilibrium point, and zero in the long term. Market shocks can be absorbed in the medium term. This shows that the market reacts to sudden changes in the short term, but that the correction mechanism works naturally.

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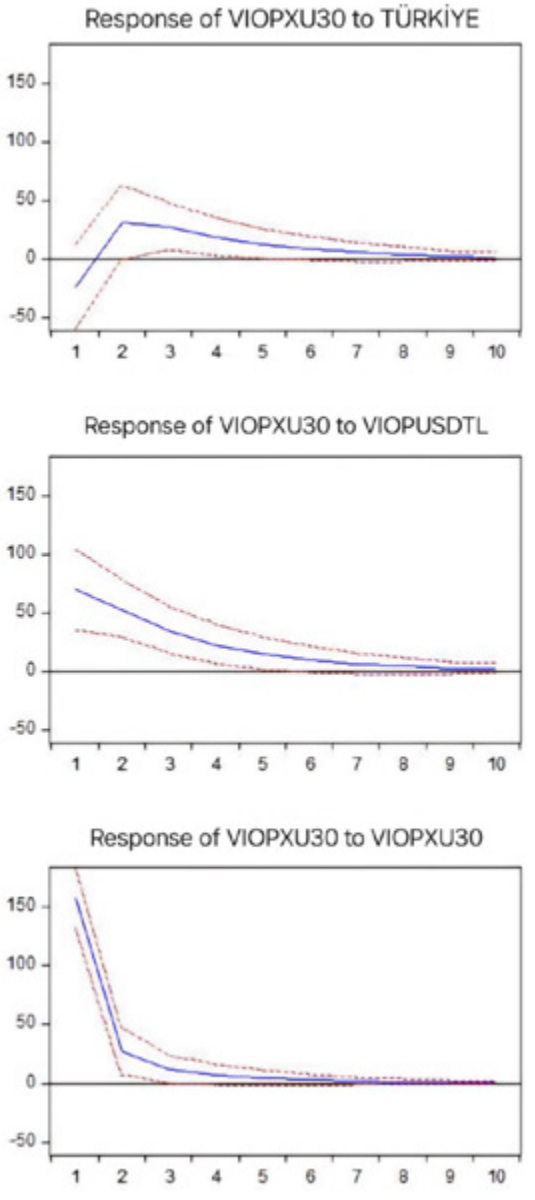
Figure 4
Reactions of the BIST 30 Futures Contract



Source: Authors' own data

Uncertainty was low in all charts. In the last chart, there is an equilibrium path close to zero in the medium term, whereas the other two graphs reach the equilibrium point and zero in the long term. According to the analysis, the market absorbs shocks in the medium-term. This shows that market activity is high.

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Variance Decomposition Analysis

The details of the variance decomposition analysis, in which each dependent variable is ordered first, are as follows. Table 9 shows the results of variance decomposition, where the Türkiye CDS premium is ordered first.

Table 9
Türkiye CDS Premium Variance Decomposition Analysis

Period	Standard Error	TÜRKİYE	VIOPUSDTL	VIOPXU30
1	47.91663	100.0000	0.000000	0.000000
2	52.01623	96.69596	3.303363	0.000680
3	53.49713	94.94798	5.050009	0.002011
4	54.11558	94.19117	5.806110	0.002716
5	54.38135	93.86796	6.129015	0.003029
6	54.49645	93.72893	6.267901	0.003165
7	54.54644	93.66880	6.327978	0.003223
8	54.56816	93.64271	6.354043	0.003249
9	54.57761	93.63137	6.365367	0.003260
10	54.58172	93.62645	6.370290	0.003265

Source: Authors' own data

When the table is examined, it is seen that the self-disclosure level of the Türkiye CDS premium in the first period is 100%. Although this rate has been decreasing, it has resulted in a high rate of 93.62% in the 10th period. The effect of USD/TL futures contracts, on the other hand, has recently been around 6%, although it has increased over time. The effect of the BIST30 futures contract is negligible. The results show that the Türkiye CDS premium is highly explained by internal dynamics and is less sensitive to external shocks. In the long term, there is a low exchange rate effect.

Table 10 shows the results of the analysis, in which the USD/TL Futures Contract ranks first.

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Table 10
USD/TL Futures Contract Variance Decomposition Analysis

Period	Standard Error	TÜRKİYE	VIOPUSDTL	VIOPXU30
1	0.630435	26.18148	73.81852	0.000000
2	0.759947	34.99693	64.98907	0.014001
3	0.811184	38.01618	61.96683	0.016996
4	0.832613	39.16663	60.81541	0.017961
5	0.841774	39.63598	60.34568	0.018339
6	0.845728	39.83423	60.14727	0.018497
7	0.847442	39.91935	60.06209	0.018565
8	0.848187	39.95615	60.02525	0.018594
9	0.848511	39.97212	60.00927	0.018607
10	0.848651	39.97906	60.00233	0.018613

Source: Authors' own data

According to the results, VIOPUSDTL was explained by its internal dynamics during the first period. Although there is no VIOPXU30 effect, the effect of the TÜRKİYE series is approximately 26%. In the long term, its influence enters a continuous downward trend and falls to the level of 60%. The effect of the TÜRKİYE series, on the other hand, enters an upward trend and increases in the long term, reaching 40% in the 10th period. The findings show that, in the short term, the USD/TL futures contract is mostly explained by its internal dynamics, but it has a significant CDS effect. In the long run, these effects result in a decrease in internal dynamics and an increase in CDS effects. However, the effect of BIST30 did not exceed 1%.

Finally, Table 11 shows the results of the analysis of which the BIST30 Futures Contract ranks first.

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Table 11
BIST30 Futures Contract Variance Decomposition Analysis

Period	Standard Error	TÜRKİYE	VIOPUSDTL	VIOPXU30
1	157.8430	2.294731	36.16780	61.53746
2	166.7009	5.414467	39.23818	55.34735
3	170.6666	7.706824	39.48430	52.80888
4	172.4071	8.753467	39.49773	51.74881
5	173.1628	9.205707	39.49585	51.29844
6	173.4908	9.400815	39.49440	51.10479
7	173.6333	9.485291	39.49372	51.02099
8	173.6953	9.521953	39.49342	50.98463
9	173.7222	9.537884	39.49329	50.96883
10	173.7339	9.544810	39.49323	50.96196

Source: Authors' own data

Although the self-disclosure level of the BIST30 futures contract is approximately 61% in the first period, it follows a downward trend and reaches 50% in the 10th period. Although the effect of CDS is low, it follows an upward trend and has recently increased to 9%. Another striking result is the effect of USD/TL futures contracts. The effect, which started at the level of 36%, followed an upward trend until the 5th period, and then reached 39% with an extremely low downtrend. The results show that futures contracts interact while the impact of CDS is low.

Granger Causality Test

Table 12 presents the results of the Granger Causality Test performed according to the VAR model.

Table 12
Granger Causality Test

Relationship	Chi-Square	Prob.
VIOPUSDTL → TÜRKİYE	5.676169	0.0172*
VIOPXU30 → TÜRKİYE	0.004718	0.9452
VIOPUSDTL + VIOPXU30 → TÜRKİYE	8.212091	0.0165*
TÜRKİYE → VIOPUSDTL	4.154648	0.0415*
VIOPXU30 → VIOPUSDTL	0.119746	0.7293
TÜRKİYE + VIOPXU30 → VIOPUSDTL	4.263867	0.1186
TÜRKİYE → VIOPXU30	0.252945	0.6150
VIOPUSDTL → VIOPXU30	8.707721	0.0032*
TÜRKİYE + VIOPUSDTL → VIOPXU30	16.19839	0.0003*
* statistical significance at the 5% level ($p < 0.05$)		

Source: Authors' own data

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The Granger causality test results revealed significant relationships between the variables. A bidirectional causal relationship was found between VIOPUSDTL and TÜRKİYE. There is a strong causal relationship between VIOPUSDTL and VIOPXU30. In addition, the effects of TÜRKİYE and VIOPUSDTL on VIOPXU30 were also statistically highly significant. Similarly, the combined effects of VIOPUSDTL and VIOPXU30 on TÜRKİYE were also found to be significant. On the other hand, no significant effect of VIOPXU30 alone on TÜRKİYE and VIOPUSDTL. These results emphasize the important role of VIOPUSDTL in the system and its strong interactions with other variables.

VAR Outputs

The outputs of the VAR model, which include three dependent variables, are interpreted specifically for each dependent variable. Table 12 shows the results for the Türkiye CDS premium.

Table 13
VAR Analysis Results (Dependent Variable TÜRKİYE)

Variable	Coefficient	Std. Error	T-Statistic	Prob.
TÜRKİYE(-1)	0.257832	0.115572	2.230912	0.0296
VIOPUSDTL(-1)	17.26194	7.245393	2.382471	0.0206
VIOPXU30(-1)	0.001096	0.015951	0.068690	0.9455
Fixed Term	-285.0339	258.1373	-1.104195	0.2741
BRAZIL	0.932404	0.233664	3.990353	0.0002
CHINA	-0.705190	0.760046	-0.927826	0.3574
DUM1	410.1780	150.3605	2.727963	0.0085
DUM1VIOPUSDTL	-22.94168	8.478972	-2.705715	0.0090
DUM2	-133.8428	94.75829	-1.412465	0.1632
DUM2VIOPXU30	0.000265	0.016578	0.016007	0.9873
INFLATION	-0.291176	2.871917	-0.101387	0.9196
GERMANY	-7.325822	3.388861	-2.161735	0.0349
ITALY	0.395208	0.343901	1.149190	0.2553
MSCI_ACWI	-0.332001	0.238720	-1.390754	0.1697
INDUSTRY	6.547866	3.022185	2.166600	0.0345
TCMB_DISBORC	-0.002872	0.002204	-1.302942	0.1978
TCMB_REZERV	-0.000845	0.000825	-1.024878	0.3098
UK	0.512449	1.505576	0.340367	0.7348
USA	3.312956	1.305292	2.538095	0.0139
VIX	1.957707	1.018488	1.922169	0.0596
R-squared	0.914290	R-squared		435.9705

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Adjusted R-squared	0.885721	Adjusted R-squared	141.7432
S.E. of regression	47.91663	S.E. of regression	10.79553
Sum squared resid	130872.2	Sum squared resid	11.40431
Log likelihood	-395.6279	Log likelihood	11.03904
F-statistic	32.00194	F-statistic	1.708689
Prob(F-statistic)	0.000000		

Source: Authors' own data

The fact that the CDS premium is affected by its historical value shows the market's sensitivity to its own internal dynamics. This indicates that market participants consider future risk perceptions. The positive effect of USD/TL futures contract lag shows that exchange rate expectations increase risk perception. The positive effect of the Brazilian CDS premium shows that Türkiye has a similar risk perception as other emerging markets. The negative correlation with the German CDS premium arises from investors' use of Germany as a safe haven amid the rising global risk. In particular, the debt ceiling crisis, inflation, and interest rate hikes in the US in the 22-23 period, may have directed investors to Germany. The positive correlation of the USA CDS premium and the VIX index with the Türkiye CDS premium also supports this finding. A positive correlation of the industrial production index is an indicator of inflationary growth and temporary or unhealthy growth, based on external resources and external debt. Therefore, contrary to expectations, this creates a positive correlation with CDS premiums. In addition, the negative correlation between the structural break in July 2022 and the interaction term of the USD/TL futures contract is remarkable. This shows that the effect of the exchange rate on CDS decreases over a certain period. No significant relationships were found with other variables.

Table 14
VAR Analysis Results (Dependent Variable VIOPUSDTL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TÜRKİYE(-1)	0.003099	0.001521	2.038295	0.0462
VIOPUSDTL(-1)	0.515728	0.095327	5.410088	0.0000
VIOPXU30(-1)	7.26E-05	0.000210	0.346043	0.7306
Fixed Term	-11.84384	3.396291	-3.487287	0.0009
BRAZIL	0.000554	0.003074	0.180214	0.8576
CHINA	0.014771	0.010000	1.477168	0.1451
DUM1	-7.316973	1.978281	-3.698651	0.0005
DUM1VIOPUSDTL	0.503673	0.111557	4.514932	0.0000
DUM2	0.369276	1.246727	0.296197	0.7682
DUM2VIOPXU30	-1.78E-05	0.000218	-0.081505	0.9353
INFLATION	0.093408	0.037786	2.472047	0.0164

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GERMANY	-0.087132	0.044587	-1.954197	0.0556
ITALY	0.003142	0.004525	0.694436	0.4902
MSCI_ACWI	-0.002155	0.003141	-0.686181	0.4954
INDUSTRY	0.147784	0.039763	3.716658	0.0005
TCMB_DISBORC	-1.39E-06	2.90E-05	-0.048047	0.9618
TCMB_REZERV	1.35E-05	1.08E-05	1.247485	0.2173
UK	-0.000468	0.019809	-0.023621	0.9812
USA	0.011073	0.017174	0.644787	0.5217
VIX	0.013008	0.013400	0.970748	0.3358
R-squared	0.996997	Mean dependent var		15.11780
Adjusted R-squared	0.995996	S.D. dependent var		9.963174
S.E. of regression	0.630435	Akaike info criterion		2.133914
Sum squared resid	22.65456	Schwarz criterion		2.742694
Log likelihood	-62.15567	Hannan-Quinn criteria		2.377420
F-statistic	996.0209	Durbin-Watson stat		2.115719
Prob(F-statistic)	0.000000			

Source: Authors' own data

The fact that past values of the Türkiye CDS premium affect exchange rate expectations indicates that risk perception is reflected in the foreign exchange market, similar to the results of the previous dependent variable. Additionally, the strong influence of its lagged value indicates the sensitivity of the foreign exchange market to its internal dynamics. The structural break in July 2022 also exhibited a positive correlation. When inflation increases, the exchange rate also increases. This positive correlation shows that economic conditions increase the exchange rate expectations. A positive correlation of the industrial production index is an indicator of inflationary growth and temporary or unhealthy growth, based on external resources and external debt. The negative correlation of the German CDS premium was similar to that of the previous dependent variable, the Türkiye CDS premium, but the significance level was below the 5% level. Apart from this variable, no other variable yields significant results.

Table 15
VAR Analysis Results (Dependent Variable VIOPXU30)

Variable	**Coefficient**	**Std. Error**	**T-Statistic**	**Prob.**
TÜRKİYE(-1)	0.191472	0.380709	0.502937	0.6169
VIOPUSDTL(-1)	70.42929	23.86718	2.950885	0.0046
VIOPXU30(-1)	0.056464	0.052544	1.074603	0.2871
Fixed Term	-1065.228	850.3346	-1.252716	0.2154

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BRAZIL	-1.759364	0.769718	-2.285724	0.0260
CHINA	9.707341	2.503679	3.877230	0.0003
DUM1	2199.355	495.3053	4.440402	0.0000
DUM1VIOPUSDTL	-81.86501	27.93073	-2.931001	0.0049
DUM2	-3457.230	312.1449	-11.07572	0.0000
DUM2VIOPXU30	0.976816	0.054610	17.88714	0.0000
INFLATION	11.36833	9.460431	1.201671	0.2345
GERMANY	-1.718138	11.16331	-0.153909	0.8782
ITALY	-1.009549	1.132851	-0.891158	0.3766
MSCI_ACWI	-0.857383	0.786373	-1.090301	0.2802
INDUSTRY	25.04353	9.955432	2.515564	0.0147
TCMB_DISBORC	-0.003695	0.007262	-0.508867	0.6128
TCMB_REZERV	0.001950	0.002716	0.717843	0.4758
UK	0.403722	4.959544	0.081403	0.9354
USA	-1.466285	4.299785	-0.341014	0.7343
VIX	-2.458072	3.355021	-0.732655	0.4668
R-squared	0.998577	R-squared		4029.026
Adjusted R-squared	0.998102	Adjusted R-squared		3623.431
S.E. of regression	157.8430	S.E. of regression		13.17981
Sum squared resid	1420122.	Sum squared resid		13.78859
Log likelihood	-487.4225	Log likelihood		13.42331
F-statistic	2104.896	F-statistic		1.860396
Prob(F-statistic)	0.000000			

Source: Authors' own data

USD/TL futures contracts have strong positive effects on BIST30 futures contracts. This finding shows that exchange rate expectations are associated with stock markets. While there is a negative relationship with the Brazilian CDS premium, there is a positive one with the Chinese CDS premium. This situation shows that risk perceptions in emerging markets reflect differently on BIST30 futures contracts. The industrial production index has a positive effect. This increase also increases the stock market because it supports economic growth. In addition, structural breaks have a significant effect. The relevant breakouts caused serious fluctuations in the BIST30 futures contract prices. There were no significant relationships among the other variables.

CONCLUSION

This study aims to explain the dynamics of futures markets and risk perception in Türkiye using local and global factors. In the analysis, effective economic indicators at the global and national levels are used to reveal the interrelationships

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between USD/TL futures contracts, BIST30 futures contracts, and Türkiye CDS premiums.

The results show a bidirectional positive relationship between the Türkiye CDS premium and USD/TL futures. Elcicek (2022) reached a similar conclusion: This positive relationship shows that an increase in risk perception is reflected in the exchange rate. However, risk relationships were not fixed. In the period of structural breakage, USD/TL futures contracts negatively affect CDS premiums. This may be because of several factors. In the structural breakpoint period of July 2022, the increase in CDS premiums quickly turned downward. The Central Bank's intervention in foreign exchange and transition to a currency-protected deposit system are policies that support the Türkiye economy. This situation may have changed investors' risk perceptions. In addition, various measures were taken to reduce the effects of the global energy crisis due to Russia's invasion of Ukraine during the relevant period. The fact that Türkiye is a transit country at this point had a positive effect. There is no significant relationship between the Türkiye CDS premium and the BIST30 futures. However, according to the Granger test, BIST30 futures affect the Türkiye CDS premium, when considered together with USD/TL futures. It was concluded that the Türkiye CDS premium is affected by both internal dynamics and global economic indicators. Among the national indicators, only the industrial production index has a significant and positive effect on CDS premiums. Gurel (2021) also concludes that the index of industrial production is an explanatory factor for the spread of CDS. Although the increase in the industrial production index shows economic growth, the continuation of the CDS increase shows concerns about the sustainability of growth. On the other hand, an increase in production and growth may bring about new financial costs, which may increase the CDS premium. From a global perspective, the VIX and MSCI ACWI do not have a significant impact on the Türkiye CDS premium. However, the effects of CDS premiums in other countries exist. There is no significant relationship with the UK, Italy, or China. There is a positive relationship between Brazil and the USA, and the effect of the USA is more severe on the Türkiye CDS premium. Longstaff et al. (2011) and de Boyrie and Pavlova (2016) obtained similar results. This situation points to a connection between developing and developed countries' markets. The increase in risk in the United States has a global impact. This situation negatively affects the confidence environment in emerging markets such as Türkiye and Brazil. The impact of the German CDS premium is higher than that of other countries' CDS premiums and negative. Germany's CDS premium is quite low, and its volatility is low during the analysis period. On the other hand, the CDS premium in Türkiye is quite high and volatile during the relevant period. In times of increased global uncertainty and risk, investors are likely to turn to safe havens such as Germany.

When the analyses are examined in the USD/TL futures contracts section, as previously emphasized, there is a positive bidirectional relationship between USD/TL futures and the Türkiye CDS premium. The analysis shows no significant directional relationship between BIST30 futures and USD/TL futures. From a national perspective, there is a positive relationship between inflation and industrial production index. The rise in nominal asset prices and economic growth has an increasing effect on demand for foreign currency. Dependence on imports for production may also have created this result. These results show that

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USD/TL futures contract prices are related to the internal dynamics and national macroeconomic variables. Global variables have no significant impact on the USD/TL futures market.

Finally, when BIST30 futures are examined, there is no direct relationship between BIST30 futures and Türkiye CDS premiums in both the causality test and VAR model. There is causality from USD/TL futures to BIST30 futures, according to the Granger test. Although the Türkiye CDS premium does not have a direct effect on BIST30 futures, USD/TL futures and Türkiye CDS premiums jointly have a causal effect on BIST30 futures. The disclosure level of USD/TL futures in BIST30 futures is high. This indicates the impact of foreign exchange on stock markets. According to the VAR model, there is a highly positive relationship between USD/TL and TL futures contracts. Investors may have turned to stock market investments during periods when the Turkish Lira lost value. Moreover, many companies in the BIST30 index exported significantly. An increase in the exchange rate increases the income these companies earn from their sales in foreign currency. When we look at the structural break periods, the fact that BIST30 futures are positively related to their own interaction term shows that the increase in BIST30 futures after the breakpoint is consistent with the model. The negative correlation with USD/TL futures contracts shows that the effect of USD/TL futures contracts on BIST30 futures contracts decreased during this period. In November 2022, another period, the prices of BIST30 futures contracts have a positive effect and increase. At the national level, an increase in the industrial production index is positively correlated with the stock market. This implies that economic growth may have increased the sales and profitability of BIST30 companies. From the global effect perspective, there is a significant positive relationship with the Chinese CDS premium. The rise in risk perception in China has led investors to adopt alternative emerging markets, such as Türkiye. The negative relationship with Brazil can be explained by the decrease in global risk appetite. Brazil, similar to Türkiye, has emerging market dynamics. The risk perception in emerging markets may have directed investors toward safe havens.

The findings show that the Türkiye CDS premium is associated with more global and national variables. The six countries in the model are in a relationship with 3 of three CDS premiums. This indicates the spillover effect of CDSs. It is noteworthy that USD/TL futures contracts are related only to national variables. Additionally, the effects of structural breaks have come to the fore. BIST30 futures contracts, on the other hand, are only related to the industrial production index at the national level, while they are related to the Brazilian and Chinese markets at the global level. The most important finding is the highly positive relationship with USD/TL futures contracts. This indicates the movement of these two assets into the same market. These findings provide important information to market makers and investors. Further research may consider including high-volume traded commodities and crypto assets. Artificial neural network can be used methodologically with the help of developing technology.

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Ethical Commission Approval

This study did not require approval from an ethics committee as it did not involve human participants, animals, or sensitive personal data. All data used in this research were obtained from publicly available sources.

Conflict of Interest Statement

There is no conflict of interest with any institution or person within the scope of this study.

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