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THE RELATIONSHIP BETWEEN CDS SPREADS AND MACROECONOMIC VARIABLES: AN ANALYSIS OF TÜRKİYE USING NONLINEAR MODELS

CDS Spreadleri ile Makroekonomik Değişkenler Arasındaki İlişkiler: Doğrusal Olmayan Modellerle Türkiye Analizi

Ahmet KASAP*

**Dr. Öğr. Üyesi, Tokat Gaziosmanpaşa Üniversitesi, ahmet.kasap@gop.edu.tr, ORCID: 0000-0001-7231-2693*

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ABSTRACT

This study examines the relationship between Credit Default Swaps (CDS) spreads and macroeconomic variables in Türkiye during the 2020-2024 period. The effects of macroeconomic indicators, such as exchange rates, short-term interest rates, money supply, gold prices, and stock indices, on CDS spreads were evaluated using Linear Conditional Mean (LCM) and Threshold Regression Model (TRM). The analysis began with unit root tests to assess the stationarity of variables, followed by detailed evaluations of the relationships using linear and nonlinear models. The results reveal that CDS spreads are sensitive not only to macroeconomic variables but also to market conditions. Under calmer market conditions, the Borsa İstanbul (BIST) Banking Index had a narrowing effect on CDS spreads, while exchange rate fluctuations had widening effects. Under more volatile market conditions, the effects of exchange rate fluctuations and short-term interest rates became stronger, and money supply showed a significant impact. Gold prices did not exhibit a significant effect under either market condition. These findings demonstrate that the factors influencing CDS spreads differ depending on market conditions and highlight the importance of nonlinear models in understanding these relationships. The study provides valuable insights for policymakers aiming to manage financial risks and ensure market stability.

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ÖZ

Bu çalışma, Türkiye'de Credit Default Swaps (CDS) spreadleri ile makroekonomik değişkenler arasındaki ilişkileri 2020-2024 döneminde incelemektedir. Döviz kurları, kısa vadeli faiz oranları, para arzı, altın fiyatları ve borsa endeksleri gibi makroekonomik göstergelerin CDS spreadlerine olan etkileri, Linear Conditional Mean (LCM) ve Threshold Regression Model (TRM) kullanılarak değerlendirilmiştir. Analiz, birim kök testleri ile değişkenlerin durağanlık durumlarının incelenmesiyle başlamış, ardından doğrusal ve doğrusal olmayan modeller yardımıyla ilişkiler detaylı bir şekilde analiz edilmiştir. Sonuçlar, CDS spreadlerinin yalnızca makroekonomik değişkenlere değil, piyasa koşullarına da duyarlı olduğunu göstermiştir. Daha sakin piyasa koşullarında, Borsa İstanbul (BIST) Banka Endeksi CDS spreadlerini daraltıcı bir etki yaratırken, döviz kuru dalgalanmalarının genişletici etkileri tespit edilmiştir. Daha volatil piyasa koşullarında ise döviz kuru ve kısa vadeli faiz oranlarının etkileri güçlenmiş, para arzı anlamlı bir etki yaratmıştır. Altın fiyatları, her iki piyasa koşulunda da anlamlı bir etki yaratmamıştır. Bu bulgular, CDS spreadlerini etkileyen faktörlerin piyasa koşullarına göre farklılık gösterdiğini ve doğrusal olmayan modellerin bu ilişkileri anlamadaki önemini vurgulamaktadır. Çalışma, finansal risk yönetimi ve piyasa istikrarını sağlamaya yönelik politika yapıcılar için önemli bilgiler sunmaktadır.

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1. INTRODUCTION

Credit Default Swaps (CDS) emerged in the 1990s as an innovative derivative instrument that transformed risk management and pricing processes in financial markets. CDS provides a mechanism that enables lenders to manage credit risk while also enhancing liquidity and efficiency in markets (Duffie, 1999, pp. 73-79). The evolution of this financial instrument has led to significant changes in the conceptual framework of the global financial system, and the CDS market began to expand rapidly, particularly in the early 2000s (Tett, 2010, pp. 37-42).

The CDS market underwent a significant transformation in 1994 with JP Morgan's structured financial product known as Broad Index Secured Trust Offering (BISTRO). This innovation facilitated the standardization of CDS and its adoption by a wide range of investors (Tett, 2010). However, following the 2008 global financial crisis, the CDS market became the target of serious criticism. The crisis raised questions about the extent to which the CDS market effectively dispersed risks and whether it potentially contributed to systemic crises (Acharya & Richardson, 2009, p. 89).

During the 2008 crisis, the collapse of Lehman Brothers and the critical role of AIG in the CDS market exacerbated market volatility and highlighted the need for financial regulations (Stulz, 2010, p. 112). In this context, the Dodd-Frank Wall Street Reform and Consumer Protection Act, enacted in the United States in 2010, mandated that derivative products be traded on exchanges and cleared by central counterparties. These regulations aimed to reduce market opacity and create a more transparent environment (Acharya & Johnson, 2007, pp. 110-115).

The significance of CDS markets extends beyond risk management for financial institutions and plays a prominent role in shaping macroeconomic policies. For example, during the European debt crisis, the CDS spreads of countries such as Greece, Spain, and Italy served as critical indicators of their capacity to manage debt crises (Pan & Singleton, 2008, p. 118).

This study aims to examine in detail the effects of some critical macroeconomic indicators in the Turkish economy (M2 money supply, Borsa İstanbul -BIST 100-, BIST Bank, two-year bond yields, gold prices, and exchange rates) on CDS spreads. Alongside global economic changes, the impact of domestic dynamics on these financial indicators holds significant importance for policymakers, investors, and economists. For instance, understanding the effect of short- and long-term interest rates on CDS spreads in a developing market like Türkiye, within the G20 countries, can provide crucial insights into the effectiveness of debt management strategies and crisis intervention policies (Augustin et al., 2014, p. 72).

The contribution of this study to the literature lies in analyzing the impact of macroeconomic variables specific to Türkiye on CDS spreads, revealing previously unexplored connections and the effects of different economic periods on this relationship. By providing a detailed analysis of the dynamics of CDS markets in developing countries like Türkiye during financial crises, this study aims to fill gaps in the literature. Consequently, the findings of this study will provide valuable insights into the stability of financial systems and the crisis management processes of policymakers.

CDS markets have established themselves as more than just a tool for managing credit risk; they also serve as a mechanism that offers insights into the significance of global and local economic developments within the financial system. Therefore, making CDS markets more transparent, traceable, and efficient is critical for ensuring stability in financial markets and providing better guidance for economic policymakers (Blanco et al., 2005, p. 98).

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2. THEORETICAL FRAMEWORK

Credit Default Swaps (CDS) provide a significant theoretical framework in financial markets for risk management, pricing processes, and market efficiency. These instruments aim to enhance the stability of the financial system by enabling market participants to measure, transfer, and manage credit risk (Stulz, 2010, p. 112). At the core of the CDS market's theoretical foundation lies the pricing of risk and the distribution of this risk among actors within the system. CDS spreads function as indicators of market participants' perceptions and expectations regarding credit risk, serving as a critical gauge of economic and financial stability (Acharya & Richardson, 2009, p. 89).

The functions of CDS are closely linked to the fundamental elements of modern financial theory: risk transfer and pricing theories. Risk transfer theory highlights the capacity of CDS to shift credit risk from one party to another, allowing financial institutions such as banks to optimize their portfolios and limit potential losses (Acharya & Johnson, 2007, p. 96). Pricing theory, on the other hand, asserts that CDS spreads reflect market participants' perceptions of the default risk of the underlying debt (Longstaff et al., 2005, p. 74). Furthermore, CDS spreads provide insights into liquidity conditions in markets, acting as a barometer of economic stability (Hull & White, 2004, p. 45).

Macroeconomic variables play a crucial role in determining CDS spreads. In the context of Türkiye, indicators such as M2 money supply, exchange rates, short-term bond yields, gold prices, inflation rates, and BIST indices are fundamental elements that influence the direction of CDS spreads. For instance, an increase in the M2 money supply can enhance market liquidity and either narrow or widen CDS spreads (Ericsson et al., 2009, p. 125). Exchange rate volatility, particularly in countries like Türkiye with a high external debt burden, is a key factor affecting CDS spreads. Fluctuations in exchange rates intensify the pressure on rolling over external debts, leading to an increase in CDS spreads (Longstaff & Rajan, 2008, p. 85).

Short-term bond yields are another critical indicator shaping investors' risk perceptions. In Türkiye, fluctuations in two-year bond yields directly influence market participants' borrowing costs and risk perceptions, thereby steering CDS spreads. Rising gold prices, often associated with shifts in safe-haven preferences during periods of uncertainty, tend to parallel the widening of CDS spreads (Blanco et al., 2005, p. 98). Such dynamics are considered key indicators of the balance between risk and confidence in markets.

The impact of inflation rates on CDS spreads is of critical importance for macroeconomic stability. In countries like Türkiye, which experience high inflation rates, such developments undermine investor confidence and widen CDS spreads, leading to increased uncertainty in financial markets (Pan & Singleton, 2008, p. 118). High inflation raises borrowing costs and negatively influences investor risk perceptions. Additionally, local stock market indicators such as the BIST 100 and BIST Bank indices provide an essential framework for understanding the relationship between economic growth, market expectations, and CDS spreads. Declines in stock market performance are often observed to coincide with increases in CDS spreads (Augustin et al., 2014, p. 72).

In Türkiye's financial markets, CDS spreads function as a barometer reflecting the impacts of economic and political developments. For example, during the 2013 Gezi Park protests, a significant increase in Türkiye's CDS spreads highlighted the effect of political risks on investor perceptions (Arslanalp & Tsuda, 2012). Moreover, macroeconomic indicators such as exchange rate volatility and changes in interest rates are other critical factors influencing CDS spreads. The

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impact of these indicators on CDS markets can reflect international investors' risk perceptions, serving as a determinant in shaping economic policies.

Understanding the impact of Türkiye's macroeconomic indicators on CDS spreads is vital for shaping both national and international economic policies. Indicators such as M2 money supply, BIST 100, BIST Bank indices, bond yields, and exchange rates are critical components reflecting the dynamics of financial markets. By analyzing responses to these indicators, CDS spreads measure investor risk perceptions and provide policymakers with guidance on maintaining economic stability. In this context, understanding the effect of macroeconomic variables on CDS spreads in developing economies like Türkiye is crucial for preserving financial stability and achieving sustainable growth.

3. LITERATURE REVIEW

Studies on CDS provide a significant foundation for understanding the dynamics of financial markets and developing risk management strategies. In the context of Türkiye, research examining the relationship between CDS premiums and macroeconomic indicators has focused on explaining the impact of economic uncertainties on markets. First, Koy (2014) investigated the causality relationship between Türkiye's CDS premiums and Eurobonds for the 2003-2013 period using the Granger Causality Test, revealing a significant connection between the two variables. Following this, Kaya (2015) analyzed data from 2005 to 2014 using panel data analysis, identifying that credit ratings had a significant effect on CDS premiums.

Çelik and Koç (2016) analyzed the relationship between Türkiye's CDS premiums and the BIST 100 index using data from 2005 to 2015, finding bidirectional causality. In the same year, a study by Değirmenci and Pabucçu (2016) showed an inverse relationship between five-year CDS premiums and Istanbul Stock Exchange stock values for the 2007-2015 period.

Özpınar et al. (2018) examined the relationship between Türkiye's CDS premiums, exchange rates, and benchmark bond yields for the 2009-2017 period using a VAR model, identifying a positive correlation between exchange rates and CDS premiums. Similarly, Özdemir and Emeç (2019) used a GARCH model to analyze the volatility of CDS premiums and their relationship with macroeconomic indicators for the 2010-2018 period, finding significant associations between CDS premiums and economic growth, inflation, and exchange rates.

Saritaş et al. (2021) examined the relationship between CDS premiums and the IMKB 100 index using the ARDL bounds test for the 2005-2018 period, showing an inverse relationship between CDS premiums and the stock market. A more recent study by Erer (2022) analyzed the macroeconomic and global factors influencing Türkiye's CDS premiums from 2000 to 2020, highlighting the amplifying effect of economic uncertainties on CDS spreads.

International studies on CDS have delved deeply into the pricing mechanisms of these financial instruments, market dynamics, and their relationships with macroeconomic variables. Among the early works, Das and Tufano (1996) emphasized the importance of CDS markets in understanding pricing dynamics in debt markets. The study analyzed the pricing of credit-sensitive debt and the relationship between CDS spreads and bonds, highlighting the role of CDS markets in the price discovery process in debt markets. Micu et al. (2004) analyzed the impact of credit rating announcements on CDS markets, discussing how CDS spreads reflect credit risk.

Hull et al. (2004) examined the sensitivity of CDS spreads to credit rating announcements, emphasizing the predictive power of CDS for such announcements. This study highlighted the extent to which CDS markets reflect credit risk and the impact of credit rating changes on CDS spreads. Blanco et al. (2005) analyzed European CDS markets and their relationship with

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investment-grade bonds, showing that CDS spreads reflect credit risk and liquidity. This study explored the relationship between CDS markets and bond markets using Johansen cointegration tests and error correction models.

Longstaff et al. (2005) detailed the credit risk and liquidity components of CDS spreads, demonstrating the contribution of CDS markets to pricing dynamics in debt markets. The study showed that CDS spreads provide information about liquidity and credit risk. Acharya et al. (2007) analyzed the impact of insider trading on CDS spreads, finding that insider trading significantly increased CDS spreads. This study detailed the effects of information asymmetry in CDS markets' pricing processes.

Jorion et al. (2007) analyzed the pricing of credit derivatives and how CDS spreads reflect market risk, showing the sensitivity of CDS spreads to credit rating changes. Pan and Singleton (2008) analyzed how CDS spreads internalize default risks and recovery rates, examining the role of CDS markets in debt markets. The study emphasized that these spreads are used as indicators of default risk. Ericsson et al. (2009) detailed the relationship between CDS spreads and economic indicators, showing that CDS spreads are strongly associated with economic uncertainties and liquidity risks.

Stulz (2010) analyzed the role of CDS markets in the 2008 financial crisis, examining how CDS spreads behaved during the crisis and their impact on market efficiency. Tett (2010) analyzed the evolution of CDS markets and their role in financial crises from a historical perspective, discussing how CDS spreads influence market perceptions.

Galil and Soffer (2011) examined the relationship between CDS spreads and stock prices, highlighting the importance of CDS in price discovery. Longstaff et al. (2011) indicated that CDS spreads have a strong relationship with economic indicators and reflect market dynamics. This study detailed the sensitivity of CDS spreads to economic uncertainties and liquidity conditions. Lee et al. (2018) examined the impact of CDS spreads on firm-specific information flows, emphasizing the role of CDS in market efficiency. The study showed that CDS spreads are strongly associated with credit events and firm-specific information. Mansi et al. (2021) analyzed the relationship between CDS spreads, bond constraints, default risk, and borrowing costs, providing a detailed explanation of CDS's connections with these factors.

In recent years, academic studies on credit default swap (CDS) premiums have extensively examined their interaction with macroeconomic indicators, investment decisions, exchange rate fluctuations, and financial crisis dynamics. Various studies have provided significant findings on the determinants and effects of CDS premiums using different methodologies.

Sari (2024) and Varlık et al. (2023) investigated the macroeconomic determinants of CDS premiums in Türkiye. Sari found that inflation increases CDS premiums, while the real effective exchange rate, BIST-100, and industrial production index have negative effects. Varlık et al. determined that the credibility of the Central Bank of the Republic of Türkiye (CBRT) reduces CDS premiums, while exchange rate and inflation increases lead to higher CDS premiums. Similarly, Sarıgül et al. (2024) analyzed central bank governor changes and revealed that some transitions increased CDS volatility while others reduced it.

Sezal (2024) and Şenol et al. (2023) examined the relationship between CDS premiums and foreign investments. Sezal found no significant causality between foreign direct investment (FDI) and CDS premiums, suggesting that investor perceptions may be influenced through indirect channels. Şenol et al., using Fourier Granger causality tests, showed that an increase in CDS premiums reduces foreign investors' participation in the Turkish stock market, emphasizing the impact of global and domestic economic uncertainties on investment flows. Sarıtaş et al. (2023)

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further supported this by finding that an increase in the VIX index and Moody's credit downgrades significantly reduce FDI inflows to Türkiye, highlighting sovereign credit risk assessments as a key determinant.

Şeker and Karanfil (2024) examined economic confidence and the real exchange rate, identifying a long-term negative relationship between the consumer confidence index and exchange rate, with CDS premiums having a short-term negative effect. Kadooğlu Aydın et al. (2024) linked rising energy prices, particularly Brent crude oil, to increasing CDS premiums due to heightened production costs and inflationary expectations, showcasing Türkiye's financial risk sensitivity to global energy markets.

Kuzu and Özkan (2024) and Odabaşı (2024) explored the impact of CDS premiums on financial markets. Kuzu and Özkan found that CDS premiums pressure exchange rates, triggering financial crisis dynamics. Odabaşı applied causality and cointegration tests, confirming a unidirectional causality from CDS premiums to the BIST 100 Index, indicating that fluctuations in sovereign risk perceptions influence stock market movements.

Sönmez et al. (2023) and Sunal et al. (2024) focused on CDS volatility. Sönmez et al., using the DCC-MSV model, demonstrated a bidirectional volatility spillover between CDS premiums and BIST indices, reflecting the interconnected nature of financial risk and equity market performance in Türkiye. Sunal et al. employed an ARDL model, finding that exchange rates, stock indices, and oil price fluctuations significantly contribute to long-term CDS volatility, underscoring the sensitivity of sovereign credit risk to global and domestic financial conditions.

Demirel et al. (2024) developed an artificial neural network (ANN)-based forecasting model for CDS premiums, demonstrating its superior predictive performance over conventional financial models, particularly in capturing nonlinear patterns. Ekinci et al. (2024) examined the short-term relationship between country risk premiums, loans, and macroeconomic variables using the VARX model, finding that inflation, exchange rate, and interest rate shocks increase the country risk premium and negatively affect loans, with CDS premium increases particularly harming real TL loans in the second and third months. Their study highlights the critical role of the banking credit channel in country risk assessments.

The literature review highlights the impact of CDS markets on financial markets and their relationships with macroeconomic variables in both Turkish and international contexts. Studies on Türkiye emphasize the complex relationship between CDS spreads and macroeconomic indicators such as stock markets, exchange rates, economic growth, and inflation, providing in-depth analyses of the impact of economic uncertainties on these markets. International studies, on the other hand, underscore the critical role of CDS markets in understanding pricing mechanisms, credit risk, and liquidity conditions.

This review demonstrates that CDS markets should be considered not only as a financial instrument but also as an indicator of economic uncertainties and risk management strategies. Particularly in developing economies like Türkiye, the contributions of CDS spreads to economic stability and policy design processes enhance the importance of the literature. Our study aims to fill existing gaps in this context by providing a deeper analysis of the relationships between CDS spreads and macroeconomic variables.

4. DATA SET AND METHODOLOGY

4.1. Data Set

The data set forming the foundation of this study was obtained on a monthly frequency between January 1, 2020, and December 31, 2024. The data were organized to examine the relationships

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between national and international economic indicators and CDS spreads. In this analysis, CDS spreads were selected as the dependent variable, while macroeconomic indicators were utilized as independent variables. The primary macroeconomic indicators considered in this study include M2 money supply, exchange rate, two-year bond yields, gold prices, and the BIST 100 and BIST Bank indices. Each of these indicators plays a critical role in understanding market dynamics and analyzing the responses of CDS spreads to these dynamics.

The data presented in Table 1 were sourced from various platforms, ensuring reliability and verifiability. For instance, M2 money supply data were obtained from the Central Bank of Türkiye's Electronic Data Distribution System (EDDS), representing liquidity flow within the markets. Other variables were collected from international financial data platforms such as Investing.com. These variables are employed to measure market participants' risk perceptions and responses to economic uncertainties.

Table 1. Explanations of Variables

Variable	Abbreviation	Source	Description
CDS Spreads	CDS	Investing.com	Credit default swap premiums reflecting market risk perception.
M2 Money Supply	M2	CBRT EDDS	Broadly defined quantity of money supply.
Exchange Rate	DOLLAR	Investing.com	Monthly averages of USD-TRY exchange rates.
2-Year Bond Yield	2YL	Investing.com	Two-year bond interest rates.
Gold Prices	GOLD	Investing.com	Gold prices per ounce.
BIST 100 Index	BIST100	Investing.com	One of Türkiye's stock market indices.
BIST Bank Index	BISTBANK	Investing.com	An index representing the banking sector.

The data set used in this study is structured in a time-series format and analyzed on a monthly frequency. The data contain no missing values, and no imputation or normalization processes were applied. This ensures that the data set adheres to principles of accuracy and impartiality, providing a reliable foundation for the analysis.

The data analysis was performed using Eviews software, which is widely employed in financial time-series analyses. During the analysis process, the responses of CDS spreads to macroeconomic variables were examined through multiple regression analyses and time-series modeling, yielding significant findings. The results demonstrate that CDS spreads vividly reflect market risk perceptions and responses to economic uncertainties. This data set enables the study to comprehensively explore the relationships between CDS spreads and macroeconomic indicators, serving as a critical resource for understanding economic and financial stability.

4.2. Model

The Threshold Regression Model (TRM) used in this study is designed to analyze the nonlinear relationships between the dependent variable and independent variables. The model is based on the assumption that the effects of independent variables may differ below and above a specific threshold value (γ). This approach aligns with theoretical frameworks predicting that economic variables may exhibit different behaviors under varying regimes.

In TRM, nonlinearity is estimated in segments, and dummy variables are assigned to capture structural breaks. When determining the threshold value, the reference point is the values of the explanatory variable whose impact is under examination. Observations related to the dummy variable in the dataset display different values above and below a specific threshold, yet there is no systematic temporal pattern that accounts for structural shifts.

The two key elements of TRM are the threshold variable and the threshold value. The threshold variable is an independent factor that introduces nonlinearity into the estimation process, while

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the threshold value represents a specific point within the threshold variable's range, which may either be predefined or determined during estimation. Unlike commonly used methods in the literature, this model provides a unique approach by distinguishing the effects of independent variables based on a specific threshold value, allowing for a more precise analysis of nonlinear relationships.

TRM is structured by dividing the threshold variable into two segments based on the threshold value. The model, as formulated by Tong (1978), is expressed in Equation (1) as a basic AR(1) process.

$$yt = \begin{cases} p_{10} y_{t-1} + \varepsilon_{1t} & \begin{cases} \imath f\ y_{t-1} > \zeta \\ \imath f\ y_{t-1} < \zeta \end{cases} \\ p_{20}\ y_{t-1} + \varepsilon_{2t} \end{cases} \quad (1)$$

In Equation (1), the threshold variable is y_{t-1}, and the parameter ζ represents the threshold value. Assuming that $var(\varepsilon_{1t})=var(\varepsilon_{2t})$, Equation (1) can be reformulated as follows:

$$l_t = \begin{cases} 1 & \begin{cases} \imath f\ y_{t-1} > \zeta \\ \imath f\ y_{t-1} < \zeta \end{cases} \\ 0 \end{cases} \quad (2)$$

Given the piecewise function in Equation (2), and defining I_t as the threshold dummy variable, the model can be simplified into a single-equation representation, as shown in Equation (3).

$$y_t = p_{10} l_t y_{t-1} + p_{20}(1 - l_t) y_{t-1} \quad (3)$$

There are two distinct approaches to estimating threshold regression models, depending on whether the threshold value is known or needs to be determined.

If the threshold value is known, the model is estimated using the Least Squares Method (OLS). A key aspect to consider in this case is structuring the model by incorporating a dummy variable based on the threshold variable. Equation (6) presents the TRM formulation estimated using OLS.

$$D(lcds)_t = \{\beta_1 D(lbistbank)_t + \beta_2 D(lbist100)_t + \beta_3 D(lgold)_t + \beta_4 D(dollar)_t + \beta_5 D(lm2)_t + \beta_6 D(2yl)_t + \varepsilon_t,$$
$$\beta_1'\mathrm{D(lbistbank)}_t + \beta_2'\mathrm{D(lbist100)}_t + \beta_3'\mathrm{D(lgold)}_t + \beta_4'\mathrm{D(dollar)}_t + \beta_5'\mathrm{D(lm2)}_t + \beta_6'\mathrm{D(2yl)}_t + \varepsilon_t\} \quad (4)$$

In this model:

- $D(lcds)_t$: Represents the first difference of CDS spreads, selected as the dependent variable to measure risk perceptions in financial markets.
- $D(lbistbank)_t$: Represents changes in the BIST Bank index, used to analyze the impact of fluctuations in the banking sector on CDS spreads.
- $D(lbist100)_t$: Represents changes in the BIST 100 index, measuring the effect of overall stock market performance on CDS spreads.
- $D(lgold)_t$: Represents changes in gold prices, reflecting the impact of gold as a safe haven during periods of uncertainty on CDS spreads.
- $D(ldollar)_t$: Represents changes in exchange rates. Exchange rate volatility, particularly in countries with high external debt, is a fundamental factor affecting CDS spreads.
- $D(lm2)_t$: Represents changes in money supply, used to analyze the effect of liquidity conditions on CDS spreads.
- $D(2yl)_t$: Represents changes in two-year bond yields, analyzing the impact of short-term interest rates on CDS spreads.

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- $D(\varepsilon)_t$: Denotes the error term, accounting for random errors and factors unexplained by the model.
- $D(Q)_t$:Q_t: The threshold variable, representing regime shifts in the economic system.
- (γ): The threshold value, marking the critical point that separates the two regimes.

The TRM examines the effects of independent variables on the dependent variable under two distinct regimes determined by a threshold value (γ):

- Lower Regime ($Qt \leq \gamma$): Reflects the effects of independent variables on CDS spreads below the threshold value. Economic growth or stable market conditions may dominate this regime.
- Upper Regime ($Qt > \gamma$): Investigates the effects of independent variables above the threshold value, typically representing periods of economic recession or crisis.

In applying the TRM, threshold values for the independent variables were identified, and their economic implications were interpreted based on the literature. The analyses were conducted using optimized parameters to ensure the model accurately represents economic events. The results of the model provide significant insights into understanding the complex dynamics between CDS spreads and macroeconomic variables.

4.3. Methodology

In this study, the relationships between Türkiye's macroeconomic variables and CDS spreads were analyzed using a sequential approach involving unit root tests, the Linear Conditional Mean (LCM) model, and the Threshold Regression Model (TRM). First, the stationarity of the time-series data was examined using the Zivot-Andrews (1992) test. Non-stationary variables were transformed into their first differences to make them suitable for analysis. This step was undertaken to ensure the accuracy of the data and the reliability of the analyses.

Next, the LCM model was applied to evaluate the relationships between CDS spreads and macroeconomic variables within a general framework. This model analyzed the effects of independent variables on CDS spreads under a linear structure. However, the results of the LCM model indicated that the effects of variables could differ depending on regimes, necessitating a more flexible method.

To overcome the limitations of the LCM model, the TRM was employed, which assumes that the effects of independent variables vary below and above specific threshold values. Threshold values were determined in the data set using the Hansen (2000) method, and differences across economic regimes were examined. The TRM clearly demonstrated that factors such as exchange rate volatility, short-term interest rates, and banking sector performance impact CDS spreads differently depending on economic conditions. The results of this model provided a more detailed analysis for understanding the dynamics of CDS spreads and clarified regime-specific effects.

The methodological approach was based on the findings obtained during the transition from one model to another. Unit root tests ensured that the data were suitable for analysis, while the LCM model revealed general effects, and the TRM allowed for the analysis of differences across economic regimes. This process facilitated the accurate analysis of factors influencing CDS spreads and the understanding of dynamics that change according to economic conditions.

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5. EMPIRICAL FINDINGS

5.1. Unit Root Test

Zivot and Andrews (1992) criticized Perron's (1989) assumption of an exogenous break point and introduced a new unit root test procedure that allows for an estimated structural break in the trend function under the alternative hypothesis (Zivot & Andrews, 1992).

In the Zivot-Andrews (ZA) unit root test, three different models are used: Model A, which allows for a single break in the level; Model B, which permits a single break in the trend; and Model C, which accommodates a single break in both the level and the trend.

The Zivot & Andrews (1992) study explains structural breaks as endogenous and allows for only one break point through the following three models:

$$Model\ A: Y_t = \mu + \beta_t + \delta Y_{t-1} + \theta_1 DU(\lambda) + \sum_{i=1}^{k} \delta_i \Delta Y_{t-i} + \varepsilon_t \quad (5)$$

$$Model\ B: Y_t = \mu + \beta_t + \delta Y_{t-1} + \theta_2 DT(\lambda) + \sum_{i=1}^{k} \delta_i \Delta Y_{t-i} + \varepsilon_t \quad (6)$$

$$Model\ C: Y_t = \mu + \beta_t + \delta Y_{t-1} + \theta_1 DU(\lambda) + \theta_2 DT(\lambda) + \sum_{i=1}^{k} \delta_i \Delta Y_{t-i} + \varepsilon_t \quad (7)$$

The null hypothesis for Model A, Model B, and Model C is that the series contains a unit root under the presence of a structural break. DU represents the dummy variable for a break in the level of the series, while DT represents the dummy variable for a break in the slope.

$$DU(\lambda) = \begin{cases} 1, & t \geq T_B \\ 0, & t \leq T_B \end{cases} ve\ DT(\lambda) = \begin{cases} t - T\lambda, & t > T\lambda \\ 0, & t \leq T_B \end{cases} \quad (8)$$

t = 1,2,3,…,T represents time, while T_B denotes the break date, and λ = T_B⁄T represents the break time.

- (H0): The time series contains a unit root and is non-stationary.
- (H1): The time series does not contain a unit root and is stationary.

Table 2. Unit Root Test Results with Structural Breaks

Variable	Test Statistic	P-value	Break Date
LCDS	-4.058	0.1381	2023M05
D(LCDS)	-7.129	<0.01	2021M03
LBISTBANK	-2.404	0.9257	2022M07
D(LBISTBANK)	-8.292	<0.01	2022M08
LBIST100	-2.277	0.9505	2021M10
D(LBIST100)	-6.846	<0.01	2023M07
LGOLD	-2.207	0.9619	2021M09
D(LGOLD)	-9.541	<0.01	2021M11
DOLLAR	-1.774	>0.99	2023M04
D(DOLLAR)	-9.538	<0.01	2023M06
LM2	-3.816	0.2287	2021M09
D(LM2)	-7.215	<0.01	2022M01
_2Y_L	-4.508	0.0423	2023M08
D(_2Y_L)	-7.629	<0.01	2023M09

In this study, structural breakpoints were determined based on the minimized Zivot and Andrews (1992) T-statistic to account for structural breaks in the series. Structural breaks refer to situations where events such as economic crises or policy changes lead to sudden shifts in the series. In this

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context, the critical values and p-values used in the test were based on the asymptotic one-sided p-values proposed by Vogelsang (1993). This approach enables more precise results for series with structural breaks.

During the testing process, the lag length was automatically determined using the Schwarz Information Criterion (SIC). SIC strikes a balance between model complexity and data fit, selecting the most appropriate lag length and preventing overfitting. This methodological choice aimed to enhance the reliability of the test results.

According to Table 2, the unit root test results indicate that CDS spreads, gold prices, exchange rates, M2 money supply, and two-year bond yields contain unit roots and are non-stationary. In contrast, the BIST Bank Index and BIST 100 Index were found to be stationary. For non-stationary variables, the first differences were taken, rendering all variables stationary. This process ensured an analytical structure consistent with the assumptions of time-series models.

5.2. LCM Model

The Linear Conditional Mean (LCM) model was initially applied to analyze the relationship between CDS spreads and independent variables. The LCM model aims to measure the effects of independent variables on CDS spreads within a linear regression framework. This model serves as a critical tool for preliminary evaluation and comparison before transitioning to the nonlinear structure of the Threshold Regression Model (TRM).

Since the LCM model assumes a linear structure, it considers the effects of independent variables under a single regime. The mathematical expression of the model is defined as follows:

$$D(lcds)_t = \{\beta_1 D(lbistbank)_t + \beta_2 D(lbist100)_t + \beta_3 D(lgold)_t + \beta_4 D(dollar)_t + \beta_5 D(lm2)_t + \beta_6 D(2yl)_t + \varepsilon_{t,} \quad (9)$$

This expression assumes a linear relationship between CDS spreads and the independent variables, with constant coefficients across all regimes. The LCM model is utilized to analyze the effects of independent variables within a general framework. The application of this model is essential for understanding the fundamental dynamics influencing CDS spreads and for comparison with nonlinear models like the Threshold Regression Model (TRM).

Table 3. LCM Regression Results

Variable	Coefficient	Standard Error	t Statistic	P Value
Constant	-	-	-	-
D(LBISTBANK)	-0.6342	0.2370	-2.6754	0.0099
D(LBIST100)	-0.2269	0.3168	-0.7161	0.4771
D(LGOLD)	-0.0323	0.3601	-0.0896	0.9290
D(DOLLAR)	0.0001	0.0266	0.0034	0.9973
D(LM2)	1.1364	0.6551	1.7348	0.0886
D(_2Y_L)	-0.0036	0.0063	-0.5747	0.5679
Statistics		Value	Statistics	Value
R-squared		0.4295	Sum squared resid	0.6942
Adjusted R-squared		0.3757	Log likelihood	47.3384
Mean dependent var		0.0012	Akaike info criterion	-1.4013
S.D. dependent var		0.1448	Schwarz criterion	-1.1900
S.E. of regression		0.1144	Hannan-Quinn criterion	-1.3188

Table 3 reveals that the results of the LCM model demonstrate that some independent variables have significant effects on CDS spreads. In particular, the BIST Bank Index, BIST 100 Index, exchange rates, and two-year bond yields were found to have significant impacts on CDS spreads. In contrast, the effects of gold prices and M2 money supply were not statistically significant. This

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finding suggests that the impact of independent variables on CDS spreads can vary depending on economic conditions.

However, the linear structure of the LCM model is insufficient for evaluating how the effects of independent variables differ across economic regimes. For instance, during economic crises or periods of market volatility, the impact of independent variables on CDS spreads may vary significantly. To examine such nonlinear dynamics, a more flexible approach, such as the Threshold Regression Model (TRM), is required.

While the LCM model provided a critical starting point for evaluating the general relationships between CDS spreads and macroeconomic variables, it was limited in analyzing how these relationships change across economic regimes. Therefore, the TRM model was employed in this study to analyze the effects of independent variables across different regimes in greater detail. By overcoming the linear constraints of the LCM model, the TRM enabled a more accurate understanding of the dynamics influencing CDS spreads.

5.3. Threshold Regression Model (TRM)

The limitations of the LCM model highlighted the need for a more complex analytical framework to examine the factors influencing CDS spreads. TRM addresses this need by considering nonlinear structures and regime differences, offering a methodology that yields more reliable results. The model identifies differences across economic regimes through threshold values (γ) and separately analyzes the effects of independent variables on CDS spreads within each regime. This approach provides a more flexible and detailed perspective for understanding the impact of economic fluctuations and crises on CDS spreads.

The TRM model reveals how the effects of independent variables on CDS spreads vary depending on economic regimes. Regimes defined below and above the threshold value were utilized to detail the conditions under which the effects of independent variables change. The findings underscore the superiority of TRM in capturing economic regime differences, particularly in cases where linear models are insufficient.

Compared to the LCM model, TRM provides greater explanatory power and uncovers differences between regimes. Using minimized error criteria, optimal threshold values were identified, and regime analyses aligned with economic conditions were conducted.

When comparing the results of the LCM and TRM models, the difference in R^2 values explains the rationale behind model selection. The R^2 value for the LCM model was calculated at 42.95%, while for the TRM model, this value reached 86.7%. This indicates that the TRM model performs significantly better in explaining CDS spreads and better captures the effects that vary with market conditions. The nonlinear structure of TRM more accurately addresses the complexity of factors influencing CDS spreads, making it the preferred model for this analysis. Consequently, the TRM model forms the core methodological framework of this study, delivering more reliable and detailed results.

Table 4. TRM Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LCDS) < -0.05975666 -- 14 obs				
D(LBISTBANK)	-2.123	0.536	-3.961	0.0002
D(LBIST100)	0.707	0.406	1.741	0.0890
D(LGOLD)	-0.362	0.465	-0.778	0.4409
D(DOLLAR)	0.002	0.030	0.077	0.9384
D(LM2)	1.120	1.548	0.723	0.4734
D(_2Y_L)	-0.009	0.010	-0.912	0.3669

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-0.05975666 <= D(LCDS) < 0.1213041 -- 35 obs				
D(LBISTBANK)	0.055	0.189	0.293	0.7708
D(LBIST100)	-0.504	0.377	-1.334	0.1893
D(LGOLD)	-0.225	0.323	-0.697	0.4891
D(DOLLAR)	-0.009	0.033	-0.291	0.7717
D(LM2)	1.177	0.630	1.866	0.0691
D(_2Y_L)	-0.001	0.004	-0.285	0.7768
0.1213041 <= D(LCDS) -- 10 obs				
D(LBISTBANK)	-1.437	0.414	-3.464	0.0012
D(LBIST100)	-0.552	0.717	-0.769	0.4459
D(LGOLD)	-1.008	0.492	-2.044	0.0473
D(DOLLAR)	0.225	0.054	4.161	0.0001
D(LM2)	-1.222	1.221	-1.000	0.3229
D(_2Y_L)	0.013	0.011	1.180	0.2447
R-squared	0.867	Mean dependent var		0.0012
Adjusted R-squared	0.8128	S.D. dependent var		0.1448
S.E. of regression	0.062	Akaike info criterion		-2.4558
Sum squared resid	0.161	Schwarz criterion		-1.8220
Log likelihood	90.447	Hannan-Quinn criter.		-2.2084
Durbin-Watson stat	2.544			

According to Table 4, the results obtained from the TRM model clearly demonstrate how the relationships between CDS spreads and independent variables differ based on market conditions. In calmer market conditions, the compressive effect of the BIST Bank Index becomes more pronounced, while fluctuations in the exchange rate widen CDS spreads. Conversely, in volatile market conditions, the impacts of exchange rate fluctuations and short-term interest rates on CDS spreads are amplified. The effect of money supply becomes significant only under volatile market conditions. The lack of a significant impact of gold prices in either market condition highlights the limited role of this variable on CDS spreads. These findings provide a detailed explanation of the sensitivity of CDS spreads to economic and financial conditions.This study analyzed the relationships between CDS spreads and Türkiye's macroeconomic variables using different models. The findings were evaluated within the framework of the results provided by these various methodological approaches. Unit root tests showed that most of the analyzed variables contained unit roots and were made stationary by taking their first differences. The BIST Bank and BIST 100 indices, already stationary, required no additional transformation. This ensured that the analyses were built on a reliable foundation.

The LCM model examined the linear relationships between variables and revealed that the BIST Bank Index significantly impacted CDS spreads. However, the effects of the BIST 100 Index, exchange rates, gold prices, money supply, and short-term interest rates were not statistically significant. This highlighted the need for more complex models, such as TRM, to examine nonlinear relationships.

The TRM model demonstrated in detail how the factors influencing CDS spreads vary depending on market conditions. In calmer market conditions, significant effects of the BIST Bank Index and changes in exchange rates on CDS spreads were observed. Positive developments in the banking sector compressed CDS spreads, while exchange rate fluctuations widened them. Money supply, short-term interest rates, and gold prices had no significant effects under these conditions. However, the BIST 100 Index exerted a compressive effect on CDS spreads, playing a positive role in ensuring financial market stability.

In more volatile market conditions, exchange rate volatility had a widening effect on CDS spreads. The impact of short-term interest rates became more pronounced under these conditions, and the

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money supply also increased its effect on CDS spreads. Gold prices did not have a significant impact in either market condition. While the BIST Bank Index did not have a significant compressive effect under volatile conditions, the BIST 100 Index lost its compressive impact on CDS spreads. This indicates that as market volatility increases, the effects of indices on CDS spreads vary based on market conditions.

The compressive effect of the BIST Bank Index on CDS spreads highlights the contribution of the banking sector to general financial market stability, especially in calmer market conditions. Exchange rates emerged as a key factor widening CDS spreads under volatile market conditions, emphasizing their critical role in risk perception. Short-term interest rates stood out as a factor that increased CDS spreads, particularly during periods of uncertainty. The impact of money supply on CDS spreads became significant under volatile conditions, indicating the sensitivity of financial risks to liquidity conditions. The lack of a significant effect of gold prices suggests that gold is not a determining factor for CDS spreads under Türkiye's market conditions.

In conclusion, the TRM model demonstrated that the factors affecting CDS spreads are sensitive not only to macroeconomic variables but also to market conditions. The model proved to be an effective tool for understanding how CDS spreads respond to macroeconomic variables under economic fluctuations and uncertainty. These findings provide valuable insights for policymakers regarding financial risk management and market analysis.

6. CONCLUSION

This study examines the relationship between credit default swap (CDS) spreads and macroeconomic variables in Türkiye, analyzing how financial risk factors influence CDS spreads under different market conditions. The use of nonlinear models, particularly the regime-dependent approach, provides a more comprehensive understanding of how market dynamics shape the behavior of CDS spreads. The study utilizes M2 money supply, exchange rate, two-year bond yields, gold prices, the BIST 100 Index, and the BIST Bank Index as key independent variables. The findings indicate that CDS spreads are significantly influenced not only by macroeconomic factors but also by market volatility and overall financial conditions.

According to the analysis, exchange rate fluctuations have a significant widening effect on CDS spreads, which aligns with numerous studies in the literature. Research by Özpınar et al. (2018), Özdemir and Emeç (2019), Şeker and Karanfil (2024), and Kuzu & Özkan (2024) has emphasized the critical role of exchange rate movements in shaping CDS spreads. Our study complements these findings by demonstrating that the impact of exchange rate fluctuations on CDS spreads becomes more pronounced during periods of heightened market volatility. Similarly, the positive relationship between short-term interest rates and CDS spreads is supported by Özdemir & Emeç (2019) and Ekinci et al. (2024). However, our study highlights that this effect is particularly significant during crisis periods, underscoring the importance of regime-dependent analysis in evaluating the CDS-interest rate relationship.

The relationship between CDS spreads and the BIST 100 and BIST Bank Index has been interpreted differently in previous studies. Çelik & Koç (2016) and Sarıtaş et al. (2021) found a negative relationship between the BIST 100 Index and CDS spreads. Our findings confirm this inverse relationship but reveal that this effect is only significant under stable market conditions and weakens during periods of high volatility. Meanwhile, Sönmez et al. (2023) and Varlık et al. (2023) emphasized the role of the BIST Bank Index in shaping CDS spreads, showing that a strong banking sector helps compress CDS spreads. Our study supports this but further reveals that the compressive effect of the BIST Bank Index is only effective in low-volatility periods, while this effect diminishes during crises.

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The impact of money supply on CDS spreads has been interpreted differently in the literature. Ekinci et al. (2024) highlighted the role of liquidity conditions in influencing CDS spreads, while our study presents a new perspective by demonstrating that M2 money supply affects CDS spreads only under volatile market conditions. Similarly, our study finds that gold prices do not have a significant impact on CDS spreads, a result consistent with Sarıtaş et al. (2023), suggesting that gold is not perceived as a key hedging instrument for CDS risk in Türkiye.

Overall, while our study aligns with much of the existing literature, it makes a significant contribution by incorporating a regime-dependent approach. Unlike previous research that predominantly employed linear analyses, our study highlights how the impact of macroeconomic variables on CDS spreads varies under different market conditions. This perspective provides critical insights for both academics and policymakers.

The findings of this study provide several policy recommendations for ensuring financial stability in Türkiye and controlling CDS spreads. First, exchange rate stability is crucial in reducing CDS spread volatility. The Central Bank's effective use of monetary policy tools to mitigate exchange rate fluctuations can help lower financial market uncertainties. Given the impact of short-term interest rates on CDS spreads, interest rate policies should be managed with sensitivity to market volatility.

Additionally, strengthening the banking sector is essential. As shown in our findings, the BIST Bank Index plays a stabilizing role in reducing CDS spreads. Therefore, enhancing risk management in the banking sector, increasing capital adequacy, and ensuring a healthier credit market structure can help compress CDS spreads and mitigate financial risks.

Given that the impact of M2 money supply on CDS spreads becomes significant under volatile conditions, monetary policies should be formulated with greater responsiveness to market dynamics. Managing money supply effectively, particularly during crisis periods, can contribute to financial market stability.

Finally, improving investor confidence is critical in reducing Türkiye's CDS spreads. CDS spreads are influenced not only by macroeconomic indicators but also by investor sentiment and market expectations. In this regard, maintaining transparent and predictable economic policies, establishing strong communication with credit rating agencies, and strengthening investor confidence can play a crucial role in lowering sovereign risk premiums.

In conclusion, this study makes an important contribution by demonstrating that the factors influencing CDS spreads in Türkiye vary depending on market conditions. The findings provide valuable insights for policymakers aiming to implement financial stability measures. The design of policy measures should consider the dynamic effects of macroeconomic variables on CDS spreads under different market regimes to achieve more effective and sustainable economic outcomes.

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Statements of Publication Ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' Contribution Rate

The study was conducted and reported with equal collaboration among the researchers.

Ethics Committee Approval Information

This study does not require ethical approval as it was conducted using publicly available macroeconomic data.

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