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THE NEXUS BETWEEN CDS PREMIUMS AND EXCHANGE RATES: EVIDENCE FROM BRICS COUNTRIES AND TÜRKİYE*

CDS Primleri ile Döviz Kurları Arasındaki Bağlantı: BRICS Ülkeleri ve Türkiye'den Kanıtlar

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Keywords:
BRICS-T, Exchange Rate, CDS Premiums, RALS-LM Unit Root Test, RALS-EG Cointegration Test

JEL Kodları:
C22, C58, F31, G17, G19.

Abstract

This study investigates the long-term relationship between Credit Default Swap (CDS) premiums and exchange rates among the BRICS-T countries (Brazil, Russia, India, China, South Africa, and Turkey) known for their significant impacts on both regional and global dynamics, advanced industrialization, rapid economic growth, and considerable profit potential. Utilizing the RALS-LM unit root test and the RALS-EG cointegration test, and Hacker and Hatemi-J bootstrap causality test, this research circumvents the limitations commonly associated with traditional econometric approaches. A comprehensive and up-to-date dataset, reflecting intensive global and regional movements, was employed, consisting of daily data from January 2020 to June 2024. The findings indicate a long-term relationship between CDS premiums and exchange rates in all countries except Turkey. As the relationship is positive, it can be interpreted that an increase in the exchange rate will increase the CDS premium of countries. In terms of causality, strong evidence that the CDS premium is the cause of the exchange rate is only valid for Turkey. For Brazil, Russia, China and South Africa, we find that the exchange rate is the cause of the CDS premium. As a result, it is concluded that exchange rate movements may affect CDS premiums in these countries.

Anahtar Kelimeler:
BRICS-T, Döviz Kuru, CDS Primleri, RALS-LM Birim Kök Testi, RALS-EG Eşbütünleşme Testi

JEL Codes:
C22, C58, F31, G17, G19.

Öz

Bu çalışmada bölgesel ve küresel çaptaki dinamiklerde önemli etkilere sahip, sanayileşme yolunda ilerlemiş, hızlı büyüyen ve yüksek kazanç imkânı sunan gelişmekte olan ülkelerden oluşan BRICS-T (Brezilya, Rusya, Hindistan, Çin, Güney Afrika ve Türkiye) grubu ülkelerinin CDS primleri ile döviz kuru arasındaki uzun dönem ilişkisi analiz edilmektedir. Analizler, geleneksel ekonometrik testlerin kısıtlamalarını barındırmayan RALS-LM birim kök testi, RALS-EG eşbütünleşme ve Hacker ve Hatemi-J (2012) bootstrap nedensellik testi ile gerçekleştirilmiştir. Küresel ve bölgesel hareketlerin yoğun olarak yaşandığı geniş ve güncel bir veri seti kullanılmıştır. Veri seti Ocak 2020 – Haziran 2024 dönemini kapsayan günlük frekanslı verilerden oluşmaktadır. Elde edilen bulgular Türkiye hariç diğer ülkelerde (Brezilya, Rusya, Çin ve Güney Afrika) CDS pirimi ile döviz kuru arasında uzun dönemli bir ilişki olduğunu göstermektedir. İlişkinin pozitif olması neticesinde, döviz kurundaki bir artışın ülkelerin CDS primini yükselteceği yorumu yapılabilir. Nedensellik ilişkisi açısından, CDS priminin döviz kurunun nedeni olduğuna yönelik güçlü kanıtlar sadece Türkiye için geçerlidir. Brezilya, Rusya, Çin ve Güney Afrika içim döviz kurunun CDS priminin nedeni olduğu bulgusuna ulaşılmıştır.

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1. Introduction

Derivatives function as hedging instruments aimed at mitigating counterparty risks and various other risks. Credit derivatives are employed to provide protection and insurance against the risk of default by borrowers. Among these, Credit Default Swaps (CDS) are the most commonly traded instruments worldwide (Hull and White, 2000). CDS instruments, first designed by Blythe Masters, a former executive at JP Morgan, in 1994, were developed to transfer the risk of the borrower failing to meet their payment obligations (Corte et al., 2021; Saparca and Yenipazarlı, 2023). CDS premiums serve as a measure of the likelihood of default by the borrowing party, enabling risk assessment.

CDS premiums serve as a measure of the likelihood of default by the borrowing party, enabling risk assessment. Similarly, exchange rates reflect the strength of a national currency and the economic-political stability of a country. Fluctuations in exchange rates occur in response to distortions in economic indicators and changes in risk perception. Notably, the depreciation of a country’s national currency is often associated with increased country risk, which can prompt investors to withdraw from the market (Hui and Chung, 2011). Therefore, understanding the relationship between CDS premiums and exchange rates is crucial for assessing economic stability and managing risks in financial markets.

CDS premiums can vary according to market conditions and are updated on a daily basis. A high premium indicates a higher level of counterparty risk (Çonkar and Vergili, 2017). Following the 2008 global financial crisis, these derivative instruments were suggested as alternatives to credit rating agency assessments (Financial Stability Board, 2010). This is attributed to the ability of CDS premiums to reflect the instantaneous response of credit risk to rapidly changing market conditions, whereas credit ratings are updated more slowly and less frequently.

Foreign currency liabilities are frequently regarded as a financial fragility in emerging markets. It is widely acknowledged that these liabilities intensified the Mexican Debt crisis (1994), the Russian Ruble Crisis (1998), and the East Asian crisis of the late 1990s (Eichengreen and Hausmann, 1999). The management of these debts is critically dependent on exchange rate policies (Bordo et al., 2010). Furthermore, fluctuations in exchange rates also represent a market-based measure of a country’s default risk. The risk of default is determined by the country’s asset and debt levels. Exchange rates are directly related to the ability to service debts. An increase in the exchange rate indicates a depreciation of the national currency against foreign currencies, which results in a higher burden of foreign-denominated debts. This, in turn, raises the likelihood of default and the associated country risk. Additionally, a rising exchange rate signals a deterioration in the country’s financial system and can trigger capital flight, further increasing default probabilities (Wang et al., 2022). In this context, an increase in the exchange rate is expected to elevate CDS premiums. Overall, understanding the relationship between exchange rates and CDS premiums is a significant step in evaluating the value of a national currency and its impact on economic stability. This relationship can aid investors in developing risk management strategies and mitigating uncertainties in financial markets.

This study analyzes the long-term relationship between CDS premiums and exchange rates within the BRICS-T group (Brazil, Russia, India, China, South Africa, and Turkey), comprised of emerging economies with significant impacts on regional and global dynamics, advanced industrialization, rapid growth, and substantial profit potential. The general acceptance of the countries concerned as investment factors, the lack of consensus among previous studies on the relationship between the relevant parameters, the unprecedented processes both regionally and globally in the countries concerned, the introduction of new methods that can analyze the relevant process or time and overcome the limitations of traditional empirical methods to a large extent constitute the motivation for the current study and the reason for the analyses. The analyses are conducted using the RALS-LM Unit Root Test and the RALS-EG Cointegration Test, which do not carry the limitations of traditional econometric tests, through a comprehensive and current dataset reflecting extensive global and regional movements. The study includes a literature review summarizing previous research, a methodology section detailing the dataset and tests employed, empirical findings reporting the test results, and a conclusion section providing a general evaluation of the study and its findings.

2. Literature Review

Multiple studies in the literature investigate the relationship between CDS premiums and various variables. Table 1 below includes studies that are directly related to this topic. It is apparent that interest in this issue has risen, particularly in recent years. The incorporation of many variables and approaches in the analytical process aims to evaluate the subject from diverse viewpoints.

Table 1. Literature Summary

Author (Year)	Country	Variable	Method	Period	Findings
Longstaff et al., 2011	26 Countries	CDS, Stock Market Index, Exchange Rate, etc.	Clustering and Regression Analysis	10.2000-01.2010	In emerging markets, CDS and exchange rates mutually affect each other.
Silva and Paulo, 2015	Brazil	CDS, Stock Market Index, VIX, National Currency FX Volatility, etc.	Linear Regression	05.2009-05.2014	There is a linear relationship between CDS and National Currency FX Volatility
Başarır and Keten, 2016	12 Developing Countries	CDS, Exchange Rate (USD), Stock Market Index	Granger Causality, Kao, Pedroni Panel Cointegration	01.2020-01.2016	CDS → Exchange Rate
Çonkar and Vergili, 2017	Turkey	CDS Exchange Rate (Currency Basket)	Johansen Cointegration, Granger Causality	01.2010-08.2015	Exchange Rate (USD) → CDS
Aksoylu and Görmüş, 2018	9 Developing Countries	CDS, Exchange Rate (USD), Interest Rate, VIX Index	Granger Causality, Hatemi J Causality	06.2005-07.2015	CDS ↮ Exchange Rate
Özpınar et al., 2018	Turkey	CDS, Exchange Rate (USD), Interest Rate	Granger Causality, Johansen Cointegration	09.2005-02.2017	Exchange Rate → CDS, There is a positive cointegration between exchange rate and CDS.
Şengül, 2020	Turkey	CDS, Exchange Rate (USD)	Hatemi J - Roca Causality	05.2013-10.2020	CDS → Exchange Rate, $ER^- \rightarrow CDS^-$, $CDS^+ \rightarrow ER^+$
Uzunoğlu et al., 2020	Turkey	CDS Exchange Rate (Currency Basket), Foreign Political Actors	Granger Causality, GARCH	01.2007-3.2020	CDS ↔ Exchange Rate
Bayhan et al., 2021	Turkey	CDS, Exchange Rate (USD)	Frequency Domain Causality	03.2020-04.2021	Long Term: Exchange Rate → CDS

Table 1. Continued

Calice and Zeng, 2021	29 Countries	CDS, Exchange Rate (USD), Stock Market Index, etc.	Fama-MacBeth Regression	12.2007-06.2017	In general, country CDSs affect the exchange rate in emerging markets and can be used to forecast the exchange rate.
Corte et al., 2021	8 Developed and 12 Developing Countries	CDS, Exchange Rate	Linear Regression	01.2003-11.2003	There is a strong bidirectional relationship between CDS and exchange rate. Moreover, an increase in the CDS spread decreases the value of the local currency.
Çetin, 2022	Turkey	CDS, Exchange Rate (USD), Stock Market Index, Interest rate	VAR Granger Causality	04.2010-01.2021	CDS → Exchange Rate
Wang et al., 2022	Latin American Countries	CDS, Exchange Rate (USD), Interest rate, VIX, etc	Granger Causality	01.2004-09.2010	CDS ↔ Exchange Rate
Buz and Küçükkocaoğlu, 2023	Turkey	CDS, Exchange Rate (USD), Stock Index, Inflation, Interest Rate, Current Account Balance, GDP	Toda-Yamamoto Causality	01.2005-11.2020	CDS ↮ Exchange Rate
Saparca and Yenipazarlı, 2023	Turkey	CDS, Exchange Rate (USD), Stock Market Index	Toda-Yamamoto Causality	01.2009-03.2023	CDS ↔ Exchange Rate
Sarı, 2024	Turkey	CDS, Exchange Rate (USD), Stock Market Index, Inflation, Current Account Balance, Industrial Production Index	RALS Regression, Granger Causality	01.2008-08.2023	CDS ↮ Exchange Rate

Upon reviewing Table 1, which summarizes the literature, it is noteworthy that there is a lack of consensus regarding the findings of the studies. From a causality perspective, some studies report that CDS premiums are the cause of the exchange rate (Başarır and Keten, 2016; Şengül, 2020; Çetin, 2022), while others attribute the causality to the exchange rate itself (Çonkar and Vergili, 2017; Özpınar et al., 2018; Bayhan et al., 2021). Additionally, some research reports the existence of a bidirectional relationship (Uzunoğlu et al., 2020; Wang et al., 2022; Saparca and Yenipazarlı, 2023), In contrast, other research suggests that there is no causal relationship between the two variables (Aksoylu and Görmüş, 2018; Sarı, 2024). The presence of differing perspectives and findings in the literature underscores the need for novel tests that transcend the limitations of traditional econometric methods. Given the recent experiences of unprecedented regional and global impacts, coupled with the significance of the topic, it has become essential to contribute original evaluations to the literature. This study has been prepared with these factors in mind.

3. Econometric Methodology

This section summarizes the econometric methodology of the study. Financial time series are created by arranging sequentially observed data from financial markets according to their chronological order. Prior to performing the econometric analysis of a financial time series, it is crucial to assess the stationarity levels of the series (Tatoğlu, 2013: 199). Unit root tests, utilized to assess the stationarity of time series, generally presuppose that the error terms follow a normal distribution. Im et al. (2014) observed in their study that, although the asymptotic distribution of test statistics in unit root tests is unchanged, the non-normal distribution of error terms must not be overlooked.

This paper assessed the stationarity levels of financial time series utilizing the RALS-LM unit root test, as formulated by Meng et al. (2014), which yields more robust outcomes in the presence of violations of the normality assumption for error terms. Following the determination of the stationarity levels of the variables, the presence of long-term cointegration relationships among them was examined utilizing the RALS-EG cointegration test established by Lee et al. (2015). Based on the results of the RALS-EG cointegration test, long-term coefficient estimation was conducted to determine the direction and magnitude of the relationships among the series that were found to move together in the long run. The Dynamic Ordinary Least Squares (DOLS) and Fully Modified Ordinary Least Squares (FMOLS) techniques were utilized to estimate the long-term coefficients. In the concluding phase of the empirical analysis, Hacker and Hatemi-J (2012) bootstrap causality test was used to identify the causal relationships between the variables.

3.1. Data Set

This study examines the relationship between exchange rates and CDS premiums for BRICS-T nations utilizing daily frequency data from January 2020 to June 2024. The need for foreign resources, particularly foreign exchange, due to their status as developing economies, along with the regional and even global scope of their influence, are critical factors in determining the sample. The analysis period, spanning from January 2020 to June 2024, was determined by practical factors such as data availability, the adequacy of historical records, and the consistency of data publication. Table 2 presents the abbreviations, definitions, data periods, and data sources for the variables utilized in the analysis.

Table 2. Variables Information

Variable	Description	Country	Data Source	Freq.	Period
CDSTR	Turkiye Credit Default Swap	Türkiye	Investing	Daily	2020:01-2024:06
USDTL	USD/Turkish Lira Exchange Rate	Türkiye	Investing	Daily	2020:01-2024:06
CDSBRG	Brazil Credit Default Swap	Brazil	Investing	Daily	2020:01-2024:06
USDBRL	USD/Brazilian Real Exchange Rate	Brazil	Investing	Daily	2020:01-2024:06
CDSRUG	Russia Credit Default Swap	Russia	Investing	Daily	2020:01-2022:05
USDRUB	USD/Russian Ruble Exchange Rate	Russia	Investing	Daily	2020:01-2022:05
CDSCNG	China Credit Default Swap	China	Investing	Daily	2020:01-2024:06
USDCNY	USD/Chinese Yuan Exchange Rate	China	Investing	Daily	2020:01-2024:06
CDSZAG	South Africa Credit Default Swap	S. Africa	Investing	Daily	2020:01-2024:06
USDZAR	USD/South African Rand Exc. Rate	S. Africa	Investing	Daily	2020:01-2024:06

The study focuses on the relationship between exchange rates and CDS spreads within the context of the BRICS-T countries. Data for CDS spreads and exchange rate variables for Brazil, China, South Africa, and Turkey is available for the period from January 2020 to June 2024. For Russia, data is available for the period from January 2020 to May 2022. However, data for India has been excluded from the dataset due to irregularities in data publication and supply, resulting in significant data losses. This study employed the logarithmic transformation of the data in econometric analyses to achieve more consistent and efficient empirical results, while also ensuring a more stable representation of the series.

3.2. RALS-LM Unit Root Test

Financial time series refers to sequences of consecutive data observed in financial markets, arranged in the order of their occurrence. Stock prices, stock market indices, interest rates, and exchange rates exemplify financial time series. The time series structure and dynamics of financial variables are of great importance for understanding and analyzing the data generation processes of these data (Çil, 2018: 5). Unit root tests used in econometric time series analysis assume that the error terms of the test regressions conform to a normal distribution. In their study, Im, Lee, and Tieslau (2014) emphasized that, although the asymptotic distributions of test statistics in unit root tests remain unaffected, the normality assumption should not be disregarded (Hepsağ, 2022: 203).

The RALS-LM test, proposed by Meng, Im, Lee, and Tieslau (2014), is an adaptation of the Residual Augmented Least Squares (RALS) method developed by Im and Schmidt (2008) for use in the LM-type unit root test. The RALS-LM unit root test, which does not account for structural breaks, follows a two-step estimation procedure. In the first step, the conventional LM test regression, as developed by Schmidt and Phillips (1992), is estimated using the least squares method, and the residual series from this regression is obtained (Hepsağ, 2022: 211). The LM unit root test statistic is typically derived from the following regression, in accordance with the LM (score) principle (Meng vd., 2014: 346-348):

$$\Delta y_t = \delta' \Delta z_t + \phi \tilde{y}_{t-1} + \varepsilon_t \tag{1}$$

where $\tilde{y}_t = y_t - \tilde{\psi} - z_t \tilde{\delta},\ t = 2, \ldots, T$; $\tilde{\delta}$ is the vector of coefficients in the regression of Δy_t on Δz_t, To address autocorrelated error terms, it is possible to include the terms $\Delta \tilde{y}_{t-1}$ in equation (1), where j=1,…,p, and the testing regression is expressed as follows:

$$\Delta y_t = \delta' \Delta z_t + \phi \tilde{y}_{t-1} + \sum_{j=1}^{P} c_j \Delta \tilde{y}_{t-j} + e_t \tag{2}$$

The term $Z_t = [1, k]$ in Equation (2) represents the deterministic component, which includes the constant term and the trend function. Equation (3) illustrates the calculation of the second and third moments of the residual series:

$$m_2 = \frac{\sum_{t=1}^{T} \hat{\varepsilon}_t^2}{T}, \quad m_3 = \frac{\sum_{t=1}^{T} \hat{\varepsilon}_t^3}{T} \tag{3}$$

In Equation (3), T represents the number of observations, m2, and m3 are the second and third moments of the residuals, respectively. While $\hat{\varepsilon}_t^2$ represents the squared residuals obtained in the first stage of the test, $\hat{\varepsilon}_t^3$denotes the cubed residuals. After the second and third moments of the residual series are calculated, the variables $(\widehat{w}_{2t})$ and $(\widehat{w}_{3t})$ referred to as residual-augmented variables, are computed as shown below.

$$\widehat{w}_t = [\hat{e}_t^2 - m_2, \hat{e}_t^3 - m_3 - 3m_2 \widehat{e_t}]' \tag{4}$$

In the second step of the test, the residual-augmented variables $(\hat{w}_{2t})$ and $(\hat{w}_{3t})$ are included into the standard LM test regression defined in Equation (2), resulting in the RALS-LM test regression, which does not account for structural breaks:

$$\Delta y_t = \delta' \Delta z_t + \phi \tilde{y}_{t-1} + \sum_{j=1}^{p} g_j \Delta \tilde{y}_{t-1} + \hat{w}'_t \gamma + e_t \tag{5}$$

The RALS-LM statistic is derived from the conventional least squares estimation method applied to Equation (5). The test statistic used to assess the presence of a unit root in the series is calculated as follows:

$$\tau_{RLM} \rightarrow \rho \tau_{LM} + \sqrt{1-\rho^2}\, N\,(0,1) \tag{6}$$

In the equation (5), τ_{RLM} represents the test statistic calculated for the case without structural breaks, while τ_{LM} denotes the conventional LM test statistic. The parameter estimated as $\rho^2, \hat{p}^2 = \hat{\sigma}_u^2 / \hat{\sigma}_\varepsilon^2$ is calculated as the ratio of the variance estimate of the error term in the RALS-LM equation to the variance estimate of the error term in the conventional LM equation, and it determines the distribution of the τ_{RLM} test statistic.

In the RALS-LM unit root test, the null hypothesis indicating the presence of a unit root $(\emptyset = 0)$ is tested against the alternative hypothesis that the series is stationary $(\emptyset < 0)$. If the calculated τ_{RLM} test statistic is less in absolute terms than the critical value determined based on ρ^2, the null hypothesis cannot be rejected, and it is concluded that the time series follows a unit root process. Conversely, if the τ_{RLM} test statistic exceeds the critical value established by ρ^2 in absolute terms, the null hypothesis is rejected, and it is concluded that the time series follows a stationary process.

3.3. Lee, Lee and Im (2015) RALS Cointegration Test

The cointegration test introduced by Engle and Granger (1987) (EG) is a method used to investigate whether two or more series exhibit a common movement trend in the long term. It is assumed that the error terms of regression tests used in cointegration analysis, which investigates the long-term relationship between variables, follow a normal distribution. When the error terms of regression tests used in cointegration analysis do not follow a normal distribution, the asymptotic distributions of the test estimators remain unaffected. Therefore, cointegration tests can be applied even if the normality assumption is not met. In the study by Lee et al. (2015), it is stated that although the asymptotic distribution of test statistics in cointegration analysis remains unchanged, incorporating non-normality information into the analysis process can yield more efficient estimators and enhance the robustness of cointegration tests (Hepsağ, 2022: 235).

Lee et al. (2015) enhanced the power of the EG approach by developing RALS-based cointegration tests through the adaptation of the RALS method. The four test regressions and their names considered in the RALS cointegration tests developed by Lee et al. (2015) are as follows (Lee et al., 2015: 5):

$$ECM\colon \Delta y_{it} = d_{it} + \delta_1 z_{t-1} + \emptyset' \Delta y_{2t} + \hat{w}'_t \gamma + v_t \tag{7}$$

$$ADL\colon \Delta y_{1t} = d_{1t} + \delta_1 y_{1,t-1} + \gamma' y_{2,t-1} + \emptyset' \Delta y_{2t} + \hat{w}'_t \gamma + v_t \tag{8}$$

$$EG: \Delta\hat{u}_t = d_{1t} + \delta_1\hat{u}_{t-1} + \hat{w}'_t\gamma + v_t \quad (9)$$

$$EG2: \Delta\hat{u}_t = d_{1t} + \delta_1\hat{u}_{t-1} + \emptyset'\Delta y_{2t} + \hat{w}'_t\gamma + v_t \quad (10)$$

In the first stage of the RALS cointegration test, the test regressions in equations (7), (8), (9), and (10) are estimated. Thereafter, the second and third moments of the residual series are calculated to address non-normality. The second and third moments of the residual series are computed as follows:

$$m_2 = \frac{\sum_{t=1}^{T} \hat{\varepsilon}_t^2}{T} \quad (11)$$

$$m_3 = \frac{\sum_{t=1}^{T} \hat{\varepsilon}_t^3}{T} \quad (12)$$

In equations (11) and (12), m2 and m3 denote the second and third moments of the residuals, respectively. Once the second and third moments are calculated, $(\hat{w}_{2t})$ and $(\hat{w}_{3t})$, referred to as residual-augmented variables, are computed as follows:

$$\hat{w}_{2t} = \hat{\varepsilon}_t^2 - m_2 \quad (13)$$

$$\hat{w}_{3t} = \hat{\varepsilon}_t^3 - m_3 - 3m_2\hat{\varepsilon}_t \quad (14)$$

In the second stage of the RALS cointegration tests, the residual-augmented variables $(\hat{w}_{2t})$ and $(\hat{w}_{3t})$ are incorporated into the conventional test regressions presented in equations (7), (8), (9), and (10). Lee, Lee, and Im (2015) derived the distributions and critical values for the residual-augmented versions of all four conventional tests presented above. However, they found that the RALS-EC and RALS-EG cointegration tests exhibit size distortion and possess very low power. Consequently, they recommend the use of the RALS-ADL and RALS-EG2 cointegration tests in their study (Hepsağ, 2022: 237):

$$RALS - ADL: \Delta y_t = d_t + \delta y_{t-1} + \emptyset\Delta x_t + \sum_{i=1}^{k} a_i\Delta y_{t-i} + \gamma_2\hat{w}_{2t} + \gamma_3\hat{w}_{3t} + u_t \quad (15)$$

$$RALS - EG2: \Delta\hat{u}_t = d_t + \delta\hat{u}_{t-1} + \emptyset\Delta x_t + \sum_{i=1}^{k} a_i\Delta u_{t-i} + \gamma_2\hat{w}_{2t} + \gamma_3\hat{w}_{3t} + u_t \quad (16)$$

After estimating the test regressions in equations (15) and (16) using ordinary least squares, the test statistics for testing the presence of a unit root are calculated as follows:

$$\tau_{RALS-ADL} = \rho\tau_{ADL} + \sqrt{1-\rho^2}Z \quad (17)$$

$$\tau_{RALS-EG2} = \rho\tau_{EG2} + \sqrt{1-\rho^2}Z \quad (18)$$

In equations (17) and (18), ρ^2 represents the square of the long-term correlation coefficient, estimated as $\hat{\rho}^2 = \hat{\sigma}_{u\varepsilon}^2 / \hat{\sigma}_u^2\hat{\sigma}_\varepsilon^2$.

In the RALS-ADL and RALS-EG2 cointegration tests, the null hypothesis, which indicates the absence of cointegration (δ = 0), is tested against the alternative hypothesis, which suggests the presence of cointegration (δ <0). If the calculated $\tau_{RALS-ADL}$ and $\tau_{RALS-EG2}$ test statistics are smaller than the critical value determined by the ρ^2 value, the null hypothesis cannot be rejected, leading to the conclusion that no cointegrated relationship exists. Conversely, if the $\tau_{RALS-ADL}$

and $\tau_{RALS-EG2}$ test statistics exceed the critical value determined based on ρ^2, The null hypothesis is dismissed, signifying the existence of a cointegrated relationship.

3.4. Hacker and Hatemi-J (2012) Causality Test

The causality test is a method employed to ascertain the direction and impact of the relationship among two or more variables. One of the most commonly used and earliest methods in this field is the Granger causality test, introduced to the literature by Granger (1969) (Kutlar, 2019: 20). In Granger causality analysis, the stationary versions of the series are employed to ascertain the direction of the relationship between two variables. The Toda and Yamamoto (1995) causality test, founded on the Vector Autoregressive (VAR) model framework established in the empirical literature, accommodates series with varying integration orders. The bootstrap causality test proposed by Hacker and Hatemi-J (2006) follows the Toda-Yamamoto causality test protocol, with critical values obtained by bootstrap Monte Carlo simulation. However, the lag length of the VAR model used in the Hacker and Hatemi-J (2006) bootstrap causality test is determined exogenously. To address this limitation, the authors improved the test in 2012 by introducing the Hacker and Hatemi-J (2012) test, which allows for the endogenous determination of lag length.

Hacker and Hatemi-J (2012) employ the following Vector Autoregressive (VAR) model to test for Granger causality (Hacker and Hatemi-J, 2012: 146):

$$y_t = B_0 + B_1 y_{t-1} + \cdots + B_k y_{t-k} + u_t \tag{19}$$

Here, y_t, B_0 and u_t represent, respectively, the n x 1 vector, the n x n coefficient matrix for $B_i, i \geq 1$, and the error term u_t with an expected value of zero. The error vector u_t has an expected value of zero and is assumed to be independent and identically distributed with a non-singular covariance matrix Ω that satisfies the condition $E|u_{it}|^{2+\lambda} < \infty$ for some $\lambda > 0$. Here, u_t denotes the i-th element of u_t. This assumption is necessary to ensure appropriate testing conditions. Non-Granger causality from the r-th element of y_t to the j-th element of y_t holds only if the following condition is satisfied:

$$H_0: \text{the element in } B_i\text{'s row j, column r is zero for } i = 1, \ldots, k. \tag{20}$$

Hacker and Hatemi-J, in order to express a Wald test statistic that can be used to test the null hypothesis defined by Equation (20) in a compact form, assume that there are k pre-sample values available for each of the $y_{-k+1,\ldots,}y_0$ variables and define the following matrixes (Hacker and Hatemi-J, 2012: 159-160):

$$Y := (y_{1,\ldots,}y_t) \quad (n\ x\ T)\ matrix, \tag{21}$$

$$D := (B_{0,}B_{1,\ldots,}B_k) \quad (n\ x\ (1+nk))\ matrix, \tag{22}$$

$$Z_t := \begin{bmatrix} 1 \\ y_t \\ y_{t-1} \\ \vdots \\ y_{t-k+1} \end{bmatrix} ((1+nk)x1) matrix, for\ t = 1, \ldots, T. \tag{23}$$

$$Z := (Z_0, \ldots, Z_{T-1}) \quad ((1+nk)xT) matrix, and \tag{24}$$

$$\hat{\delta} := (\hat{\varepsilon}_1, \ldots, \hat{\varepsilon}_T) \ (n\ x\ T) matrix. \tag{25}$$

The null hypothesis of the Hacker and Hatemi-J (2012) test is stated as "no causality," and the Wald test statistic (W) necessary to test this hypothesis is derived using Equation (26).

$$W = \left(Q\hat{\beta}\right)'[Q((Z'2)^{-1} \otimes S_U)Q']^{-1}(Q\hat{\beta}) \tag{26}$$

Here, ⊗ represents the Kronecker product, which denotes the multiplication of all elements of the matrices, and Q is a matrix with dimensions k x n(1+nk). S_U; is the variance-covariance matrix of the error terms of the unrestricted VAR model and is defined as $S_U = S_U \delta S'/T - (1 + nk)$.

In the Hacker and Hatemi-J (2012) test, the suitable lag length is ascertained endogenously, and the Schwarz Bayesian Criterion (SBC) applied is defined as follows (Hacker and Hatemi-J, 2012: 147):

$$SBC = \ln\left(det\,\widehat{\Omega}_j\right) + k\left(\frac{n^2 \ln T}{T}\right) \tag{27}$$

Here, det $\widehat{\Omega}_k$ represents the determinant of the estimated variance-covariance matrix of the error term vector u_t when the VAR model is evaluated with a lag order of k. T is the quantity of observations (time periods) utilized to estimate the VAR model.

4. Empirical Findings

In this study, the conventional LM test was initially applied to determine the stationarity levels of the series, and the results are reported in Table 3. Examination of the descriptive statistics for the residual series obtained from the conventional LM test regression indicated, based on the Jarque-Bera test, that the residuals do not conform to a normal distribution. This finding suggests that the results obtained from the conventional LM test may not be reliable and are open to interpretation. Following the conventional LM test, due to the lack of normality in the residuals of the auxiliary regression models, the stationarity levels of the series were reassessed using RALS-LM tests, with the results presented in Table 3.

The τ-RALS-LM test statistic in Table 3 is compared with the critical values. If the calculated test statistic is less than the critical values, the null hypothesis indicating the presence of a unit root cannot be rejected. According to the RALS-LM unit root test results in Table 3, for all variables at their level values, the test statistics calculated at the 5% statistical significance level are, in absolute terms, smaller than the critical values based on ρ2, and thus, the null hypothesis cannot be rejected. Based on this result, it can be inferred that the series in the study follow a unit root process. The presence of a long-term cointegration relationship among the variables deemed non-stationary at level values by the RALS-LM unit root test was assessed using the RALS-EG (2015) cointegration test, and the results are reported in Table 4.

Table 3. Results of Conventional LM and RALS-LM Unit Root Tests

Country	Variable	Conventional LM Unit Root Test		RALS-LM Unit Root Test		
		τ-LM	JB	τ-RALS-LM	p^2	Decision
Türkiye	CDS	-2.03848	5153.94*	-1.03302	0.80	I(1)
	ΔCDS	-4,75673	1954.04*	-4.37834	0.70	I(0)
	USDTL	-1.59268	448420.96*	-1.28828	0.30	I(1)
	ΔUSDTL	-6.44397	25824.87*	-5.26209	0.30	I(0)
Russia	CDS	-1.24322	865425.27*	-0.12314	0.40	I(1)
	ΔCDS	-3,75487	24385.61*	-3.55029	0.40	I(0)
	USDRUB	-4.28477	738632.64*	-2.64064	0.40	I(1)
	ΔUSDRUB	-4.83062	31759.74*	-3.70213	0.60	I(0)
China	CDS	-2.92818	7641.95*	-3.12806	0.60	I(1)
	ΔCDS	-7.78085	4476,44*	-9.24561	0.60	I(0)
	USDCYN	-1.52421	810.99*	-0.77891	0.80	I(1)
	ΔUSDCYN	-5.45726	700.85*	-5.34966	0.80	I(0)
Brazil	CDS	-2.17485	19087.21*	-2.05003	0.60	I(1)
	ΔCDS	-4.93293	20551.42*	-5.06656	0.60	I(0)
	USDBRL	-1.27903	47.86*	-1.15126	0.90	I(1)
	ΔUSDBRL	-3.98717	48.56*	-3.75562	0.90	I(0)
S. Africa	CDS	-3.24087	6490.07*	-3.32271	0.60	I(1)
	ΔCDS	-3.67710	6660.41*	-3.60065	0.70	I(0)
	USDZAR	-1.40531	792.19*	-0.57607	0.80	I(1)
	ΔUSDZAR	-6.26974	773.01*	-6.58102	0.80	I(0)

Note: The critical values for the RALS-LM unit root test are sourced from Meng et al. (2014). For τ-RALS-LM with ρ^2=0.3, the critical values at the %1, %5 and % significance levels are: -3.205, -2.568 and -2.234 respectively. For ρ^2=0.4, the critical values at the %1, %5 and %10 % significance levels are: -3.299, -2.677 and -2.352. For ρ^2=0.6, the critical values at the %1, %5 and %10 significance levels are: -3.428, -2.836 and -2.535. ρ^2=0.7, the critical values at %1, %5 and %10 significance levels are: -3.474, -2.897 and -2.605. ρ^2=0.8, the critical values at %1, %5 and %10 significance levels are: -3.510, -2.947 and -2.667. ρ^2=0.9, the critical values at %1, %5 and % significance levels are: -3.538, -2.990 and -2.715. The difference operator (Δ) shows the difference of the variable. * It indicates that the null hypothesis of normal distribution is rejected at the 5% significance level.

According to the RALS-EG cointegration test results presented in Table 4, for Turkey, ρ2 is 0.7, and the critical value at the 5% significance level for a single independent variable is -3.535. Since the calculated τ-RALS-EG test statistic of -2.33223 is smaller in absolute terms than the critical value, the null hypothesis, which states the absence of a cointegration relationship, cannot be rejected. Based on this result, it is concluded that there is no long-term relationship between the CDS premium and the exchange rate for Türkiye.

Table 4. Results of the RALS-EG Cointegration Test

Country	Test Statistic	ρ2
$\text{RALS-EG}_{\text{TÜRKİYE}}$	-2,33223	0,70
$\text{RALS-EG}_{\text{BRAZIL}}$	-3,43401	0,50
$\text{RALS-EG}_{\text{RUSSIA}}$	-4,78972	0,60
$\text{RALS-EG}_{\text{CHINA}}$	-3,68877	0,60
$\text{RALS-EG}_{\text{S.AFRICA}}$	-3,94600	0,60

Note: The critical values are derived from the study by Lee et al. (2015). For the RALS-EG test, the critical values are as follows: for ρ^2=0.5, the critical value at the 5% significance level is-3.274; for ρ^2=0.6, the critical value at the 5% significance level is -3.428; and for ρ^2=0.7, the critical value at the 5% significance level is -3.535.

For Brazil, ρ2 is 0.5, and the critical value at the 5% significance level for a single independent variable is -3.274. As the calculated τ-RALS-EG test statistic of -3.43401 is larger in absolute terms than the critical value, the null hypothesis of no cointegration relationship is rejected. Consequently, it is inferred that a long-term relationship exists between the CDS premium and the exchange rate for Brazil.

For Russia, China, and South Africa, ρ2 is 0.6, with a critical value of -3.428 at the 5% significance level for a single independent variable. The separately calculated τ-RALS-EG test statistics for these three countries (-4.78972, -3.68877, and -3.94600, respectively) are all larger in absolute terms than the critical value, leading to the rejection of the null hypothesis of no cointegration relationship. This result indicates the presence of a long-term relationship between the CDS premium and the exchange rate for Russia, China, and South Africa.

To assess the magnitude of the detected long-term relationship, long-term coefficient estimates were obtained, and the results are presented in Table 5. Upon assessing the long-term coefficients derived from the DOLS and FMOLS methodologies presented in Table 5, it is evident that the findings are very analogous, signifying a positive impact of the exchange rate on the CDS premium for each nation. Based on this finding, it can be inferred that an increase in the exchange rate is likely to raise the CDS premium of the countries.

Table 5. Long-Term Coefficient Estimation Results

Variable	**Dynamic OLS (DOLS)**		**Fully Modified OLS (FMOLS)**	
	Coefficient	**Probability**	**Coefficient**	**Probability**
USD/BRL	2,418055*	0,000	2,417829*	0,000
USD/RUB	4,592034*	0,000	4,505400*	0,000
USD/CNY	3,918522*	0,000	3,881196*	0,000
USD/ZAR	2,045475*	0,000	2,024724*	0,000

Note: *, **, and *** denote significance levels of 1%, 5%, and 10%, respectively.

In the causality test developed by Hacker and Hatemi-J (2012), where the lag length is determined endogenously, the MWALD statistic—indicating causality from the first to the second variable—is compared against critical values obtained through the bootstrap method. If the MWALD statistic falls below these critical values, the null hypothesis (H0), which asserts the absence of a causal relationship, cannot be rejected, thus leading to the conclusion that no causality exists between the variables. In this study, the Hacker and Hatemi-J (2012) causality test was conducted, and the results are presented in Table 6.

Upon examining the results in Table 6, according to the Hacker and Hatemi-J (2012) bootstrap causality test results, Except for Türkiye, a statistically significant causality from exchange rates to CDS premiums at the 5% significance level has been observed in other countries. This finding suggests that exchange rate movements influence country risk premiums in BRICS nations, exerting a meaningful impact on CDS premiums. However, in the analysis conducted for Turkey, no significant causality from exchange rates to CDS premiums was identified, indicating that exchange rate fluctuations do not have a notable effect on CDS premiums in the Turkish context.

The Hacker and Hatemi-J (2012) bootstrap causality test results in Table 6 indicate that, at the 5% statistical significance level, there is no significant causal association from CDS premiums to exchange rates in BRICS countries, with the exception of Turkey. This finding suggests that CDS premiums have no effect on exchange rates in BRICS countries.

Table 6. Results of the Hacker and Hatemi-J (2012) Bootstrap Causality Test[a]

Hypotheses	MWALD Test Statistic	Bootstrap Critical Values[b]			Decision
		1%	5%	10%	
USDTRY ≠> CDSTR	1.603	13.327	6.778	4.660	Fail to Reject H_0
CDSTR ≠> USDTRY	26.873*	13.582	7.072	4.741	Reject H_0
USDBRL ≠> CDSBRL	15.257*	9.287	5.905	4.536	Reject H_0
CDSBRL ≠> USDBRL	5.580***	9.367	6.042	4.652	Fail to Reject H_0
USDRUB ≠> CDSRUS	34.408*	11.243	6.392	4.690	Reject H_0
CDSRUS ≠> USDRUB	3.559	10.758	6.105	4.570	Fail to Reject H_0
USDCNY ≠> CDSCHI	7.144**	9.465	5.961	4.637	Reject H_0
CDSCHI ≠> USDCNY	1.369	9.562	6.109	4.720	Fail to Reject H_0
USDZAR ≠> CDSSAF	5.160**	6.482	3.888	2.674	Reject H_0
CDSSAF ≠> USDZAR	2.808***	6.670	3.848	2.672	Fail to Reject H_0

Note: a: The optimal lag length is found by the HJC information criterion. Bootstrap critical values are derived from 10,000 iterations. *, **, and *** denote the existence of a causal association from the first variable to the second variable at the 10%, 5%, and 1% significance levels, respectively. The notation ≠> in the table denotes the hypothesis of no causality in the specified direction between the respective variables.

5. Conclusion and Recommendations

This study examines the relationship between CDS premiums and exchange rates in BRISC-T countries from 2020:01 to 2024:06 utilizing daily frequency data. The study tests financial time series stationarity with the RALS-LM unit root test, which yields robust results even for non-normally distributed series. After confirming series stationarity, the RALS-EG (2015) cointegration test is used to determine cointegration. The long-term RALS-EG (2015) cointegration test shows that CDS premiums and exchange rates move together in Brazil, Russia, China, and South Africa except Turkey. DOLS and FMOLS approaches estimate the long-run coefficient of the exchange rate variable for each nation after determining the cointegration between CDS premiums and exchange rates. The long-run coefficients of DOLS and FMOLS are consistent, and exchange rates and CDS premiums are positively and statistically meaningfully related. The study's findings align with those of Bayhan et al. (2021), Çonkar and Vergili (2017), and Özpınar (2018). The findings for Turkey align with studies by Aksoylu and Görmüş (2018), Buz and Küçükkocaoğlu (2023), and Sarı (2024). This study uses the Hacker and Hatemi-J (2012) bootstrap causality test to examine CDS premiums and exchange rates. At the 5% statistical significance level, Hacker and Hatemi-J (2012) bootstrap causality tests reveal that exchange rates cause CDS premiums in BRICS nations except Turkey. This suggests that exchange rate swings affect country risk premiums and CDS premiums statistically. Hacker and Hatemi-J (2012) bootstrap causality test shows that CDS premiums do not affect exchange rates in BRICS countries at the statistically significant level, but they do in Turkey at the 1% level.

According to the study's empirical analysis, currency rate changes can have an impact on the adequacy of foreign exchange reserves and the payback duration for external debt. When a country's currency rapidly depreciates, the default risks of institutions with foreign currency-denominated debt rise due to increased costs, resulting in higher CDS premiums. Investors may demand an increase in the country's CDS premiums as a result of increased risk perception caused by financial market uncertainty.

The empirical analysis of the study demonstrates that Turkey varies from BRICS countries. In August 2018, Turkey implemented restrictions on swap transactions to prevent fluctuations and speculative trades in the foreign exchange market. To avert the depreciation of the TL and maintain financial stability, foreign entities were prohibited from supplying TL liquidity in foreign currency. This occurred due to foreign investors generating speculative fluctuations in the TL by supplying foreign currency liquidity in the swap market. The imposition of this limitation on the swap market curtailed foreign investors' access to the Turkish lira and inhibited speculative activities. The limits on the swap market effectively diminished volatility in the foreign currency market in the near term; nevertheless, they also resulted in adverse consequences, including foreign investor withdrawals, liquidity problems, and a decline in domestic market dynamics.

The relationship between CDS premiums and exchange rates is essential for comprehending sovereign risk and market sentiment. Policymakers must consider the relationship between CDS premiums and the exchange rate, since it directly influences a nation's borrowing costs and investor risk perception, in their efforts to maintain economic and financial stability. Increased CDS premiums reflect heightened economic uncertainties, political risks, and financial difficulties within a country, signaling a decline in market confidence. Therefore, CDS premiums can be used as an indicator to assess the effectiveness of economic policies implemented by policymakers. The reflection of fiscal or monetary policy outcomes on CDS premiums demonstrates how such policies are perceived and assessed by financial markets. Stabilizing CDS premiums is crucial for ensuring the healthy functioning of a country's financial markets. To reduce CDS premiums and maintain stability, policymakers must implement strategies focused on controlling inflation, ensuring budget discipline, promoting economic growth, strengthening the financial system, and stabilizing financial markets. Furthermore, strategies to improve the investment climate play a critical role in achieving these objectives. Since CDS premiums are influenced not only by domestic factors but also by global economic developments and geopolitical risks, policymakers should consider external factors and global market sentiments alongside internal dynamics when formulating or adjusting economic and monetary policies. From the investors' perspective, an increase in CDS premiums signifies a heightened risk level for the country, which correlates with an elevated risk of local currency depreciation. The correlation between exchange rates and CDS premiums offers significant insights into the influence of economic and financial risks on financial markets. This opens a new subject of study for future research. Furthermore, in light of advancements in econometrics literature, subsequent research can be enhanced by employing novel econometric methodologies on an expanded dataset and diverse nation cohorts.

Declaration of Research and Publication Ethics
This study which does not require ethics committee approval and/or legal/specific permission complies with the research and publication ethics.

Researcher's Contribution Rate Statement
The authors declare that they have contributed equally to the article.

Declaration of Researcher's Conflict of Interest
There is no potential conflicts of interest in this study.

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