

HOW DOES THE IPO INDEX IN TÜRKİYE REACT TO RISKS? ARDL AND NARDL APPROACH

Türkiye’de Halka Arz Endeksi Risklere Nasıl Tepki Verir? ARDL ve NARDL Yaklaşımı

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Abstract

This study investigates the effects of global and domestic risk factors on the initial public offering (IPO) market in Türkiye using both linear and nonlinear time-series approaches. Monthly data from June 2012 to January 2026 are analyzed using the ARDL and NARDL frameworks to examine the long-run and short-run relationships between IPO activity and selected risk indicators. ARDL results show that increases in sovereign credit risk (CDS) significantly reduce IPO activities, while geopolitical risk and domestic investor risk appetite create long-term positive effects. NARDL results reveal that IPO activity responds asymmetrically to global market volatility (VIX) and domestic investor risk appetite (RISKD), while CDS follows a symmetric long-term correction process despite exhibiting significant short-term asymmetry. Foreign investor risk appetite does not have a statistically significant effect. Overall, the results suggest that considering asymmetric risk dynamics, particularly those related to global market uncertainty and domestic investor behavior, provides a more comprehensive understanding of IPO activity in emerging capital markets and offers important implications for policymakers, regulators, and market participants.

Keywords:

Initial Public Offering,
Credit Default Swap,
Volatility Index
Geopolitical Risk,
Risk Appetite,
ARDL,
NARDL

JEL Codes:

G12, G14,
G32, G41, F51.

Öz

Bu çalışma, hem doğrusal hem de doğrusal olmayan zaman serisi yaklaşımlarını kullanarak, küresel ve yerel risk faktörlerinin Türkiye’deki halka arz (IPO) piyasası üzerindeki etkilerini arařtırmaktadır. Haziran 2012 ile Ocak 2026 arasındaki aylık veriler, IPO aktivitesi ile seçilen risk göstergeleri arasındaki uzun vadeli ve kısa vadeli ilişkileri incelemek için ARDL ve NARDL çerçeveleri içinde analiz edilmiştir. ARDL sonuçları, ülke kredi riskindeki (CDS) artışların halka arz faaliyetlerini önemli ölçüde azalttığını, jeopolitik riskin ve yerli yatırımcı risk iřtahının ise uzun vadeli olumlu etkiler yarattığını göstermektedir. NARDL sonuçları, halka arz faaliyetinin küresel piyasa oynaklığının (VIX) ve yurt içi yatırımcı risk iřtahına (RISKD) asimetrik tepki verdiğini, CDS’nin ise önemli kısa vadeli asimetri sergilemesine rağmen simetrik bir uzun vadeli düzeltme süreci izlediğini ortaya koymaktadır. Yabancı yatırımcı risk iřtahının ise istatistiksel olarak anlamlı bir etkisi bulunmamaktadır. Genel olarak, sonuçlar asimetrik risk dinamiklerini, özellikle de küresel piyasa belirsizliği ve yerli yatırımcı davranışıyla ilgili olanları dikkate almanın, geliřmekte olan sermaye piyasalarındaki halka arz faaliyetlerine iliřkin daha kapsamlı bir anlayıř sağladığını ve politika yapıcılar, düzenleyiciler ve piyasa katılımcıları için önemli çıkarımlar sunduğunu göstermektedir.

Anahtar Kelimeler:

Halka Arz,
Kredi Temerrüt
Swapları,
Volatilite Endeksi,
Jeopolitik Risk,
Risk İřtahı,
ARDL,
NARDL

JEL Kodları:

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1. Introduction

Stock markets are investment environments characterized by high volatility and uncertainty. This uncertainty, arising from macroeconomic variables, directly affects investors' risk perception and guides market movements through psychological and behavioral dynamics. The increasing integration of today's financial markets means that investor behavior is shaped not only by domestic macroeconomic indicators but also by global risk perceptions and expectations.

The VIX index is one of the most widely used indicators of financial market uncertainty and market sentiment because it reflects investors' expectations of future volatility (Whaley, 2000). Previous studies report that increases in the VIX reinforce risk aversion and place downward pressure on asset prices (Campbell and Viceira, 2002; Andersen et al., 2007). Evidence from Türkiye similarly suggests that global risk indicators negatively affect prices and investor behavior in emerging markets (Çetinkaya and Üçler, 2024; Bozdağ and Polat, 2025; Sever, 2025; Karaçayır, 2025).

Credit default swap (CDS) premiums are market-based indicators reflecting expectations regarding sovereign credit risk and serve as early warning signals (Hull et al., 2004; Longstaff et al., 2005). Rising CDS premiums increase financing costs, weaken investor confidence, and reduce investment appetite. Accordingly, previous studies consistently report a negative relationship between CDS premiums and the Turkish stock market (Saparca and Yenipazarlı, 2023; Çetinkaya and Üçler, 2024; Bozdağ and Polat, 2025; Karaçayır, 2025; Sever, 2025).

Geopolitical risk refers to uncertainty arising from political, military, and diplomatic developments. The geopolitical risk index developed by Caldara and Iacoviello (2022) shows that such events affect investment and employment. Previous studies indicate that geopolitical risk increases market volatility and influences financial stability, particularly in emerging markets (Zhang et al., 2023). The PricewaterhouseCoopers (PwC) Global Investor Survey (2025) also identifies geopolitical conflicts as a major source of financial risk. Evidence for Türkiye suggests that BIST100 is sensitive to geopolitical developments, although the magnitude of the effects differs across sectors (Nazlıoğlu, 2025; Ceyhan, 2025).

Risk appetite reflects investors' willingness to assume risk in pursuit of expected returns. Existing studies provide three main perspectives. First, market movements shape investor risk appetite (Vergili, 2023; Avcı and Çınar, 2024). Second, bidirectional relationships exist between risk appetite and some sector indices (Koçyiğit and Yaman, 2023). Third, these relationships are nonlinear and asymmetric (Topaloğlu and Kurt Cihangir, 2022; Özdemir, 2025). Moreover, domestic and foreign investors respond differently to the same information because of differences in information and investment strategies (Brennan and Cao, 1997; Hong and Stein, 1999). Çelik (2025) further reports that domestic investors exert a stronger influence on market returns than foreign investors.

Studies examining IPO markets and risk indicators remain limited. Existing evidence shows that higher VIX levels reduce IPO activity by increasing uncertainty (Beaulieu and Bouden, 2015; Açıkgöz and Karataş, 2024; Herley, 2026). Similarly, Jamaani and Alidarous (2024) and Goyal et al. (2025) demonstrate that geopolitical risk significantly affects IPO timing, pricing, and issuance strategies, although the direction of the relationship differs across studies. For Türkiye, Tunalı and Korkmaz (2024) show that CDS premiums negatively affect IPO performance, while Chiu (2008) highlights the importance of investor sentiment in IPO timing.

A review of the literature shows that VIX, geopolitical risk, CDS premiums, and investor behavior are generally examined separately. Empirical evidence simultaneously evaluating these factors within a single framework remains limited, particularly for emerging markets such as Türkiye. Structural changes in the investor base, increasing participation of domestic investors, and fluctuations in risk perception suggest that IPO markets are shaped by both macroeconomic and behavioral factors. These developments motivate the present study.

This study analyzes the effects of the VIX index, geopolitical risk (GPRTUR), CDS premiums, and investor risk tendencies on the IPO market in Türkiye using monthly data covering June 2012–January 2026. Linear relationships are examined using the ARDL bounds testing approach, whereas the NARDL model is employed to identify possible asymmetric effects. By jointly evaluating long-run and short-run dynamics together with positive and negative shocks, the study contributes to the literature on IPO markets in emerging economies. The study consists of four sections. The first section outlines the purpose of the research and its contribution to the literature by reviewing the limited literature available; the second section introduces the data set and methodology; the third section presents the empirical findings; and the final section includes general conclusions and policy recommendations.

2. Methodology and Data

This study investigates the relationship between the Initial Public Offering (IPO) Index and various risk factors using monthly data from June 2012 to January 2026. The sample starts in June 2012 because consistent and uninterrupted monthly observations for the IPO Index are available only from this date. Selecting this period ensures the use of the longest common sample with complete and comparable data for all variables included in the analysis.

2.1. Methodology

This study examines the relationships between IPOs in Turkey and global uncertainty (VIX), country risk (CDS), geopolitical risk (GPRTUR), and investor risk sentiment (RISKE, RISKD) within the framework of time series analysis, using Autoregressive Distributed Lag (ARDL) and Nonlinear ARDL (NARDL) models. Specifically, the ARDL model was chosen to investigate short-term and long-term relationships between the variables, and the NARDL model was selected to identify nonlinear effects. The ARDL approach offers the advantage of testing cointegration relationships between variables and estimating short- and long-term coefficients within the same model. However, the ARDL model assumes that the relationships between variables are symmetrical. Yet, the effects of risk factors in financial markets are often asymmetrical. The use of the NARDL model is further motivated by the expectation that positive and negative changes in financial risk indicators may exert different effects on IPO activity, which cannot be adequately captured by a symmetric ARDL specification. Therefore, in this study, the effects of positive and negative shocks to the variables were also analyzed separately using the NARDL model.

Pesaran and Shin (1999), who developed the ARDL model based on the error correction mechanism (ECM), enabled the analysis of short-term and long-term relationships when

stationary and non-stationary variables are present. The general formulation for ARDL analysis is expressed as in Equation 1.

$$\begin{aligned} \Delta IPO_t = & \beta_0 + \sum_{i=1}^n \beta_1 \Delta IPO_{t-k} + \sum_{i=0}^n \beta_2 \Delta CDS_{t-k} + \sum_{i=0}^n \beta_3 \Delta VIX_{t-k} \\ & + \sum_{i=0}^n \beta_4 \Delta RISKF_{t-k} + \sum_{i=0}^n \beta_5 \Delta RISKD_{t-k} \\ & + \sum_{i=0}^n \beta_6 \Delta GPRTUR_{t-k} + \gamma_1 IPO_{t-k} + \gamma_2 CDS_{t-k} + \gamma_3 VIX_{t-k} \\ & + \gamma_4 RISKF_{t-k} + \gamma_5 RISKD_{t-k} + \gamma_6 GPRTUR_{t-k} + \varepsilon_t \end{aligned} \quad (1)$$

In Equation 1, β_0 represents the constant term, Δ the difference operator, and ε_t the error term, while n and k represent the lag lengths. Here, the coefficients from β_1 to β_6 are short-term estimation coefficients, and those from γ_1 to γ_6 are long-term estimation coefficients (Menegaki, 2019; Yıldız, 2023).

The ARDL approach consists of two stages. In the first stage, the null hypothesis, which states that there is no cointegration relationship between the variables, is tested against the alternative hypothesis, which suggests the existence of a cointegration relationship, using a bounds test. In ARDL analysis, the stationarity properties of the variables are first determined, and then the optimal lag lengths to be used in the model are identified using various information criteria. In this context, the lag length that minimizes the information criterion value is selected as the optimal lag structure for the model. The hypotheses for testing the existence of cointegration are formulated as follows.

$$H_0: \beta_1 = \beta_2 = \dots = \beta_k = 0 \quad (\text{There is no cointegration relationship})$$

$$H_1: \beta_1 \neq \beta_2 \neq \dots \neq \beta_k \neq 0 \quad (\text{There is a cointegration relationship})$$

Hypotheses formulated in this way are evaluated according to the obtained F-statistic results. If the estimated F-test results, the calculated F-test value, are higher than the upper limit value at the 1%, 5%, and 10% significance levels, it indicates cointegration among the selected study variables (Chandio et al., 2020). In the next stage, the long-term relationship between the variables is examined using a boundary test approach (İlarslan and Yıldız, 2020). The ARDL model captures linear relationships between variables over time, and the effects of increases and decreases in explanatory variables (e.g., GPRTUR, VIX, RISKD, RISKF) are symmetrical. However, this assumption may not always be valid. For example, the magnitude or direction of the impact of an increase in CDS on IPOs may differ from that of a decrease in the same CDS. At this point, the NARDL model becomes particularly useful. By decomposing each of the explanatory variables into positive and negative components, the NARDL model allows for the identification of these asymmetric effects and captures the possibility of change depending on risk conditions. With the NARDL method, the independent variables included in the model can be decomposed into positive and negative shocks, allowing for the examination of the asymmetric effects of the independent variables on the dependent variable. The NARDL method was chosen for this study because it allows for the examination of cointegration relationships even at different stationarity levels of variables, as in the ARDL method, and offers the possibility of performing an asymmetric analysis. The NARDL model allows for the analysis of asymmetric responses,

which are frequently observed in financial markets. This distinction allows the effects of increases and decreases in the variables to be analyzed separately. Thus, the effects of changes in investor behavior and risk perception are presented more realistically. The NARDL model also uses asymmetric dynamic multipliers (m_k^+ and m_k^-) to examine the responses of the dependent variable (IPO) to positive and negative changes in the explanatory variables. The nonlinear cointegration estimation equation can be written as follows:

$$\begin{aligned} IPO_t = & \alpha_0 + \alpha_1 GPRTUR_t^+ + \alpha_2 GPRTUR_t^- + \alpha_3 CDS_t^+ + \alpha_4 CDS_t^- \\ & + \alpha_5 VIX_t^+ + \alpha_6 VIX_t^- + \alpha_7 RISKD_t^+ + \alpha_8 RISKD_t^- \\ & + \alpha_9 RISKF_t^+ + \alpha_{10} RISKF_t^- + v_t \end{aligned} \quad (2)$$

In Equation 2, α_0 represents the constant term of the model, $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6, \alpha_7, \alpha_8, \alpha_9$, and α_{10} denote the corresponding coefficients, and v_t represents the error term of the model.

In this study, to examine the asymmetric relationship between the Turkish IPO index and risk indicators, GPRTUR, VIX, RISKF, RISKD, and CDS variables were decomposed into positive and negative components. The relationship between IPO activity and risk indicators is expected to be asymmetric because firms and investors do not respond equally to increases and decreases in risk. Increases in CDS, GPRTUR, and VIX tend to raise financing costs and investor risk aversion, leading firms to postpone IPO decisions. Conversely, declines in these risk indicators may not immediately stimulate IPO activity, as firms and investors generally require sustained improvements in market conditions before restoring confidence. Therefore, the effects of positive and negative changes in risk indicators are likely to differ, providing a strong rationale for employing an asymmetric modeling framework

Positive shocks: $GPRTUR^+, VIX^+, RISKF^+, RISKD^+, CDS^+$

Negative shocks: $GPRTUR^-, VIX^-, RISKF^-, RISKD^-, CDS^-$

After the equation has been estimated, the existence of cointegration should be tested using the bounds test approach proposed by Shin et al. (2014). In the bounds test approach, the test statistics are compared with the lower and upper critical values to determine whether cointegration exists. In the NARDL method, if cointegration is found, the Wald test is used to test for the presence of long-run and short-run asymmetry. Rejecting the null hypothesis indicates an asymmetric relationship between the variables in the long run.

2.2. Data

In this study, the IPO Index was used as the dependent variable as an indicator of IPO market activity in Türkiye. The independent variables consisted of financial and geopolitical risk indicators, as well as variables representing investor behavior. In this context, CDS, reflecting the country risk premium; the GPRTUR, representing the level of geopolitical risk specific to Türkiye; the VIX index, showing global financial uncertainty; RISKD, representing domestic investor risk propensity; and RISKF, reflecting foreign investor behavior, were included in the model. The logarithm of all variables included in the model was calculated.

Table 1. Data

Variable	Abbreviation	Source
Initial Public Offering Index	IPO	Investing.com (n.d.-a)
Credit Default Swap	CDS	Investing.com (n.d.-c)
Domestic Investor Risk Tendency	RISKD	Central Securities Depository of Türkiye (MKK).
Foreign Investor Risk Tendency	RISKF	Central Securities Depository of Türkiye (MKK).
Türkiye Geopolitical Risk Index	GPRTUR	Caldara and Iacoviello (n.d.)
Chicago Board Options Exchange Volatility Index	VIX	Investing.com (n.d.-b)

3. Findings

The study presents time-path graphs of the IPO, GPRTUR, VIX, RISKD, and RISKF variables. The graphs generally show a volatile structure with periodic fluctuations in the time series. Significant jumps and trend changes are observed in some series.

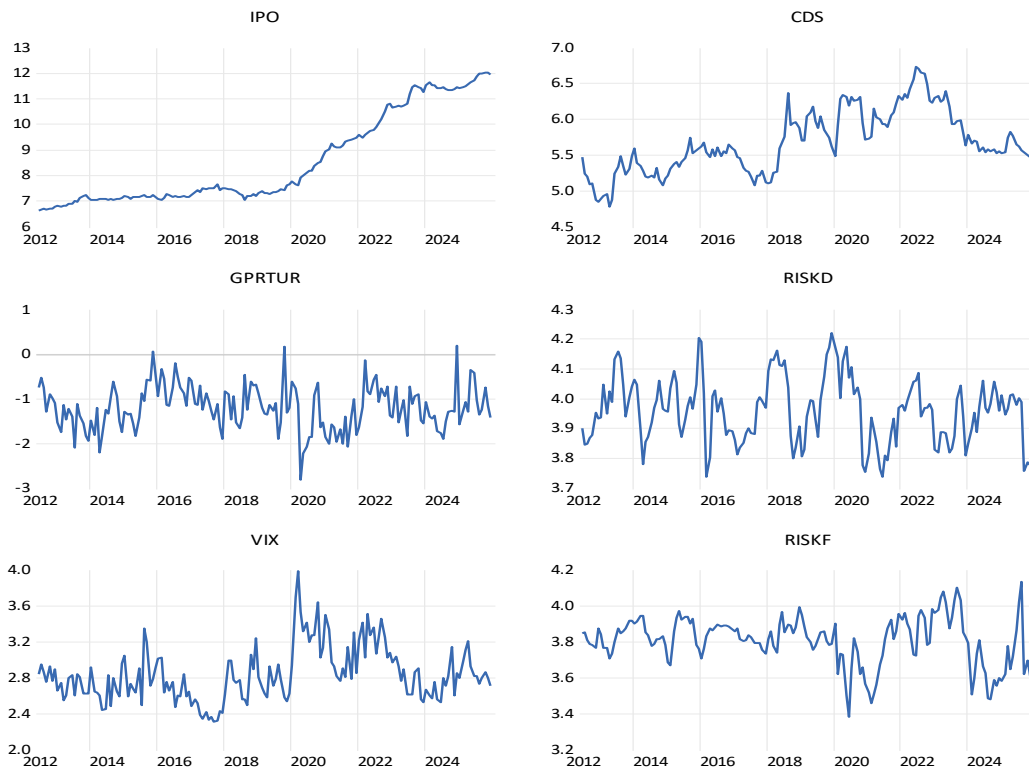


Figure 1. Time Path Graphs of the Variables

In Figure 1, the movements of the variables used in the study over time are presented. First, when the time path graph of the IPO variable is examined, it is observed that it exhibits a significant upward trend, particularly in the post-2020 period, and contains a strong increasing pattern. While the CDS variable exhibits a volatile trend, it shows sudden increases during certain periods. The increases observed particularly between 2018 and 2021-2022 indicate an increase in Turkey's risk premium and a rise in financial uncertainties. The GPRTUR variable, which represents the geopolitical risk indicator for Türkiye, exhibits high-frequency fluctuations and

does not display a clear trend. This situation shows that geopolitical risks emerge as periodic shocks rather than a persistent trend. The RISKD variable, on the other hand, moves within a certain range and exhibits a relatively stable structure. However, the occasional sudden drops and rises observed indicate that the variable is sensitive to short-term shocks. The VIX variable, an indicator of global volatility and risk, exhibits significant spikes, particularly during periods of crisis. The sharp increase observed around 2020 points to periods of increased global uncertainty, demonstrating the high sensitivity of this variable to external shocks. Finally, while the RISKF variable generally fluctuates within a narrow range, it shows upward and downward trends during certain periods. This indicates that the variable has moderate volatility and is subject to structural changes from time to time.

Table 2. Descriptive Statistics**Panel A: Descriptive Statistics Results**

	IPO	CDS	GPRTUR	VIX	RISKD	RISKF
Mean	8.547	5.678	-1.201	2.834	3.959	3.805
Median	7.481	5.592	-1.239	2.791	3.965	3.817
Maximum	12.039	6.731	0.179	3.980	4.218	4.131
Minimum	6.616	4.784	-2.807	2.310	3.737	3.378
Std. Dev.	1.785	0.431	0.495	0.299	0.108	0.134
Skewness	0.762	0.321	0.085	0.904	0.127	-0.509
Kurtosis	1.954	2.466	3.275	3.945	2.484	3.436
Jarque-Bera	23.209***	4.747*	0.716	28.326***	2.249	10.738***
Prob.	0.000	0.093	0.698	0.000	0.324	0.004
Observation	163	163	163	163	163	163

Panel B: Correlation analysis

IPO	1					
CDS	0.417	1				
GPRTUR	-0.034	0.0371	1			
VIX	0.171	0.575	0.008	1		
RISKD	-0.195	0.007	0.032	0.153	1	
RISKF	-0.161	0.076	0.194	-0.187	-0.050	1

Table 2 reports the descriptive statistics and correlation matrix of the variables. The results show that the IPO index exhibits the highest variability among the variables, indicating significant fluctuations in IPO activity during the sample period, while the CDS, VIX, GPRTUR, and local (RISKD) and foreign (RISKF) risk sensitivity indices show relatively lower variability. Skewness and kurtosis statistics reveal deviations from normality for various variables; this is further supported by the Jarque-Bera test, which shows that the assumption of normal distribution is not met for all series. According to the Jarque-Bera normality test results, the IPO ($p < 0.001$), VIX ($p < 0.001$), and RISKF ($p = 0.0046$) series do not meet the assumption of normal distribution, while the CDS ($p = 0.0931$), GPRTUR ($p = 0.6988$), and RISKD ($p = 0.3247$) series are found to conform to normal distribution.

Correlation analysis shows a moderately positive relationship between the IPO index and CDS, while the relationships between the IPO index and other risk indicators are relatively weak. Furthermore, all pairwise correlation coefficients are well below the widely accepted threshold of 0.80, suggesting that multicollinearity is unlikely to pose a significant problem in subsequent econometric analyses.

Table 3. Unit Root Tests

		Augmented Dickey-Fuller (ADF)		Phillips-Perron (PP)		Result
Variable		Constant	Trend&Const.	Constant	Trend&Const.	
IPO	Level	1.5581 (0.9994)	-1.0756 (0.9290)	1.5581 (0.9994)	-1.0756 (0.9290)	I (1)
	Difference	-10.8979 (0.0000)***	-11.1543 (0.0000)***	-10.8883 (0.0000)***	-11.15865 (0.0000)***	
CDS	Level	-2.0372 (0.2728)	-2.1547 (0.5111)	-2.0311 (0.2734)	-2.2077 (0.4817)	I (1)
	Difference	-12.4283 (0.0000)***	-12.4313 (0.0000)***	-12.6498 (0.0000)***	-12.7571 (0.0000)***	
RISKD	Level	-5.642208 (0.0000)***	-5.76012 (0.0000)***	-4.59249 (0.0002)***	-4.62978 (0.0013)***	I(0)
	Difference	-9.9896 (0.0000)***	-10.001 (0.0000)***	-19.234 (0.0000)***	-20.3986 (0.0000)***	
RISKF	Level	-4.5663 (0.0001)***	-4.6975 (0.0010)***	-4.7288 (0.0001)	-4.8658 (0.0005)***	I (0)
	Difference	-5.3998 (0.0000)***	-5.4022 (0.0001)***	-16.0813 (0.0000)***	-16.0570 (0.0000)***	
VIX	Level	-4.0090 (0.0018)***	-4.2101 (0.0055)***	-5.3883 (0.0000)***	-5.6465 (0.0000)***	I (0)
	Difference	-8.8834 (0.0000)***	-8.8545 (0.0000)***	-29.5732 (0.0001)***	-29.4696 (0.0001)	
GPRTUR	Level	-7.9091 (0.0000)***	-7.8843 (0.0000)***	-8.1859 (0.0000)***	-8.1638 (0.0000)***	I (0)
	Difference	-7.4006 (0.0000)***	-8.8545 (0.0000)***	-30.5088 (0.0001)***	-30.4637 (0.0001)***	

Note: *** indicates a significance level of 1%.

Table 3 presents the results of the ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) unit root tests for the series. When the analyses performed at the level values (I(0)) are examined, it is determined that the IPO and CDS series are not statistically significant ($p > 0.05$) under both the constant and constant-trend models in the ADF and PP tests, and that they contain a unit root. In contrast, the GPRTUR, VIX, RISKF, and RISKD series were found to be stationary at the 1% significance level in both tests ($p < 0.01$). In the analyses performed by taking the first differences (I (1)), it was determined that all series became stationary at the 1% significance level under both the constant and constant-trend models according to both the ADF and PP tests ($p < 0.01$).

Table 4. IPO variable Zivot-Andrews Test Results

Model	Test Stat.	Break Time	%1 Critical Value	%5 Critical Value	%10 Critical Value
Constant	-3.039	2020m9	-5.34	-4.80	-4.58
Trend	-3.121	2018m7	-4.93	-4.42	-4.11
Const. and trend	-3.412	2017m11	-5.57	-5.08	-4.82
Constant	-11.865	2019m11	-5.34	-4.80	-4.58
Trend	-11.436	2022m11	-4.93	-4.42	-4.11
Const. and trend	-12.112	2020m4	-5.57	-5.08	-4.82

Table 4 presents the results of the Zivot-Andrews structural break unit root test for the IPO series. In the analyses performed at the level value (I(0)), all of the test statistics calculated for

the constant, trend, and constant and trend models did not exceed the relevant critical values in absolute terms, and it was determined that the series is not stationary at the level even when structural breaks are considered. According to the test results, the possible structural break dates were determined as 2020M09 for the constant model, 2018M07 for the trend model, and 2017M11 for the constant and trend models. However, when the first difference of the series was taken (I(1)), it was observed that the test statistics calculated for all models were smaller than the 1% critical value (larger in absolute terms), and it was determined that the series is stationary in its first difference under structural breaks. The structural break dates determined at the first difference level were obtained as 2019M11 for the constant model, 2022M11 for the trend model, and 2020M04 for the constant and trend models, respectively. The findings show that the IPO series has an integration degree of I(1) when structural fracture is considered. In addition, the 2020M4 break date determined under the constant and trend models in the I(1) level series was used as the basis for creating the dummy variable representing the structural break in the analyses. To control for the structural shock associated with a dummy variable taking the value 1 after 2020 M4 and 0 otherwise was incorporated. April 2020 was chosen because it represents a period when the pandemic significantly altered the functioning of the IPO market and investor behavior in Türkiye. During this period, the economic and financial uncertainties created by the pandemic, along with the decline in interest rates, accelerated the influx of domestic investors into capital markets, while digital applications and regulatory facilitations implemented by the Capital Markets Board increased participation in IPO processes. Since these developments led to a significant change in the structure of the IPO market, a dummy variable was included in the model to control for the impact of the pandemic-induced structural break and to increase the reliability of the coefficient estimates.

Multicollinearity among the explanatory variables was examined using the Variance Inflation Factor (VIF). This diagnostic measure identifies the extent to which an explanatory variable is linearly correlated with the other regressors in the model. High VIF values indicate potential multicollinearity problems that can inflate coefficient standard errors and adversely affect the accuracy and stability of the estimated parameters. To assess multicollinearity among the explanatory variables, Variance Inflation Factors (VIFs) were computed from an auxiliary OLS regression using the contemporaneous explanatory variables.

Table 5. Variance Inflation Factor (VIF) Results

Variable	VIF
GPRTUR	1.043
VIX	1.680
CDS	1.594
RISKD	1.036
RISKF	1.138

The VIF values presented in Table 5 range from 1.036 to 1.680. While the highest VIF value belongs to the VIX variable, all values are well below the commonly accepted thresholds of 5 and 10 in the literature (O'Brien, 2007). This result indicates that there is no multicollinearity problem among the explanatory variables in the model that would distort the coefficient estimates. The VIF analysis was performed on the unlagged explanatory variables, excluding the lagged terms of the dependent variable and the ARDL model.

The findings show that the IPO and CDS variables have an integration degree of $I(1)$, while the other variables have an integration degree of $I(0)$. The fact that none of the series are integrated at the $I(2)$ level indicates that the necessary precondition for applying the ARDL bounds test approach, which allows the use of $I(0)$ and $I(1)$ series with different integration degrees, is met. The optimal lag length for the ARDL model was determined using the Akaike Information Criterion (AIC). AIC was preferred because it generally performs better in small and medium-sized samples by selecting lag structures that adequately capture the dynamic relationships between variables while maintaining model efficiency. The maximum lag length was set to four for both the dependent variable and the regressors. The optimal lag structure of each ARDL and NARDL specification was then selected automatically using the Akaike Information Criterion (AIC). The corresponding model-selection results are reported in Tables A1 and A2. Next, the existence of cointegration relationships between the variables was examined.

First, bounds tests were conducted using the ARDL approach for linear cointegration and the NARDL approach for nonlinear cointegration. Table 6 summarizes the estimated symmetric and asymmetric results, and the existence of cointegration is confirmed by the F-statistics for both linear and asymmetric cases.

Table 6. ARDL and NARDL Cointegration Test Results

	F-stat.	%10		%5		%1		Result
		I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	
ARDL Model	7.823	2.08	3.00	2.39	3.38	3.60	4.15	Cointegration at 1%
NARDL Model	3.339	1.76	2.77	1.98	3.04	2.41	3.61	Cointegration at 5%

Note: $I(0)$ and $I(1)$ denote the lower and upper critical bounds, respectively. The null hypothesis of no cointegration is rejected when the F-statistic exceeds the corresponding $I(1)$ upper bound.

The results of the bounds test for the ARDL and NARDL models reveal the existence of a long-term cointegration relationship between the variables. The calculated F-statistic (7.823) for the ARDL model exceeds the upper critical value at all significance levels, indicating strong cointegration. Similarly, the F-statistic (3.339) for the NARDL model exceeds the upper critical value of 3.04 at the 5% significance level but remains below the critical value at the 1% significance level. These findings reveal that the variables move together in both linear and nonlinear model frameworks and that the long-term equilibrium relationship is statistically significant.

The Wald test was employed to determine whether positive and negative shocks exert statistically different effects in the long and short run. Table 7 reports the Wald symmetry test results for the NARDL model. Long-run symmetry is rejected for VIX and RISKD, indicating statistically significant asymmetric effects. GPRTUR exhibits weak evidence of long-run asymmetry at the 10% significance level. By contrast, CDS and RISKF display symmetric long-run effects. In the short run, CDS exhibits significant lag asymmetry, while the symmetry-by-sum test provides only marginal evidence of asymmetry.

Table 7. Wald Symmetry Test Results

Variable	Long-run F	Short-run (Sum) F	Short-run (Lag) F	Conclusion
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CDS	1.195 (0.276)	3.577 (0.061)*	2.988 (0.033)**	Symmetric in the long run; significant short-run lag asymmetry
VIX	7.441 (0.007)***	—	—	Long-run asymmetry
RISKD	9.908 (0.002)***	—	—	Long-run asymmetry
RISKF	0.759 (0.385)	—	—	Symmetric
GPRTUR	3.001 (0.085) *	—	—	Weak long-run asymmetry

Notes: The null hypothesis states that the effects of positive and negative shocks are symmetric. Wald statistics test whether the coefficients associated with positive and negative partial sums are equal. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Following the determination of the cointegration relationship, short-run and long-run coefficient estimates were performed within the scope of the model, and the findings are reported in Table 8.

Table 8. Long-Run Coefficient Estimates of the ARDL and NARDL Models

Variable	ARDL Results		NARDL Results	
	Coefficient	Probability	Coefficient	Probability
CDS	-0.304	0.001***		
CDS +			-0.511	0.096*
CDS -			-0.022	0.964
GPRTUR	1.157	0.012**		
GPRTUR+			0.120	0.384
GPRTUR-			-0.012	0.397
VIX	-0.325	0.699		
VIX+			0.022	0.914
VIX-			-0.797	0.016**
RISKD	2.461	0.028**		
RISKD+			-1.473	0.081*
RISKD-			1.518	0.013**
RISKF	0.051	0.369		
RISKF+			-0.563	0.327
RISKF-			0.195	0.690

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

The long-run ARDL and NARDL model results presented in Table 8 reveal both linear and asymmetric relationships between the variables. The long-run ARDL results presented in Table 8 indicate that CDS has a statistically significant and negative effect on IPO activity, suggesting that increases in CDS discourage firms from going public by increasing financing costs and reducing investor confidence. In contrast, GPRTUR exerts a positive and statistically significant influence on IPO activity, implying that geopolitical developments were associated with higher IPO activity during the sample period. RISKD also has a positive and statistically significant long-run effect, indicating that greater willingness to bear risk among domestic investors stimulates IPO activity. Conversely, neither VIX nor RISKF exhibits a statistically significant long-run effect. Overall, the ARDL results suggest that CDS, geopolitical risk, and domestic investor risk appetite constitute the principal long-run determinants of IPO activity in Türkiye.

The long-run NARDL results, together with the Wald symmetry tests, indicate that long-run asymmetry is present only for VIX and RISKD, whereas CDS and foreign investor risk appetite RISKF exhibit symmetric long-run effects. GPRTUR provides only weak evidence of long-run asymmetry. Although the positive CDS component is individually significant, the Wald test does not support asymmetric long-run effects, suggesting that CDS influences IPO activity symmetrically. By contrast, the significant Wald statistics for VIX and RISKD confirm that positive and negative shocks to these variables affect IPO activity differently over the long run. Specifically, only negative VIX shocks significantly reduce IPO activity, while domestic investor risk appetite exhibits pronounced asymmetric responses to positive and negative changes. Overall, the findings suggest that long-run asymmetry is driven primarily by VIX and RISKD, whereas CDS and RISKF follow symmetric long-run adjustment processes.

Table 9. Short-Run Error Correction Estimates of the ARDL and NARDL Models

Variable	ARDL Results		NARDL Results	
	Coefficient	Probability	Coefficient	Probability
ΔCDS	-0.179	0.001***		
ΔCDS^+			-0.187	0.019**
ΔCDS^-			-0.147	0.190
$\Delta CDS^+(-1)$			0.113	0.175
$\Delta CDS^-(-1)$			-0.314	0.003***
$\Delta CDS^+(-2)$			-0.087	0.306
$\Delta CDS^-(-2)$			-0.207	0.035**
$\Delta GPRTUR$	0.020	0.120		
$\Delta RISKD$	0.106	0.294		
$\Delta RISKD(-1)$	-0.130	0.135		
$\Delta RISKD(-2)$	-0.255	0.004***		
Dummy	-0.187	0.000***	-0.198	0.000***
CointEq(-1)	-0.037	0.000***	-0.133	0.000***
Panel B: Model Statistics				
Statistics	ARDL		NARDL	
R^2	0.286		0.374	
Adj. R^2	0.258		0.294	
DW	1.984		1.948	

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

The short-run ARDL results (Table 9) indicate that changes in CDS have an immediate and statistically significant negative effect on IPO activity ($p < 0.01$), suggesting that increases in country risk reduce IPO activity in the short run. In contrast, short-run changes in GPRTUR are statistically insignificant. Similarly, RISKD is generally insignificant, except for its second lag, which exerts a significant negative effect, indicating a delayed adjustment process. Furthermore, the dummy variable is negative and statistically significant, implying that the structural event represented by the dummy adversely affected IPO activity during the sample period. Finally, the error-correction term (ECT) is negative and significant, confirming the existence of a stable long-run equilibrium and indicating that short-run deviations are gradually corrected over time.

The short-run NARDL results reveal that the effects of CDS on IPO activity are asymmetric. Positive CDS shocks exert an immediate and statistically significant negative effect on IPO activity ($\beta = -0.187$, $p < 0.05$), whereas the contemporaneous effect of negative CDS shocks is statistically insignificant. However, the first and second lagged negative CDS shocks

are negative and statistically significant, indicating that reductions in sovereign risk affect IPO activity through a gradual adjustment process rather than instantaneously. These findings are consistent with the Wald symmetry test, which provides evidence of significant short-run lag asymmetry for CDS. The dummy variable remains negative and statistically significant, suggesting that the structural event represented by the dummy adversely affected IPO activity during the sample period. Finally, the error-correction term is negative and significant ($\text{CointEq}(-1) = -0.133$, $p < 0.01$), confirming the existence of a stable long-run equilibrium relationship. The coefficient indicates that approximately 13.3% of short-run disequilibrium is corrected in each period. Overall, the short-run NARDL results demonstrate that IPO activity responds asymmetrically to changes in CDS, with the adjustment to decreases in country risk occurring more gradually than the response to increases in risk.

Table 10. Diagnostic Tests

Diagnostic Test	Statistic	Probability
Breusch–Godfrey (LM test)	0.025	0.975
Ramsey RESET	0.433	0.660
Breusch-Pagan-Godfrey	2.098	0.183
Jarque–Bera	4.816	0.112
ARCH test	1.411	0.165

Diagnostic tests conducted to evaluate the validity of the model show that the model has a suitable econometric structure (Table 10). According to the Breusch–Godfrey serial correlation LM test results ($p=0.975$), the null hypothesis cannot be rejected, and it is understood that there is no autocorrelation problem in the model. Ramsey RESET test results ($p=0.660$) reveal that the functional form of the model was correctly determined and that it does not contain any specification errors. The Breusch-Pagan-Godfrey heteroskedasticity test result ($p=0.183$) indicates that the error terms have constant variance and that there is no heteroskedasticity problem in the model. According to the Jarque–Bera normality test result ($p=0.112$), the error terms satisfy the assumption of normal distribution. Examining the ARCH test results ($p=0.165$), the null hypothesis cannot be rejected, and it is concluded that there is no heteroskedasticity or volatility clustering problem in the model. This finding supports the fact that the error terms have constant variance and the reliability of the model estimates. Figure 2 shows the results of the CUSUM and CUSUM-SQ tests applied to evaluate the parameter stability of the model.

Examination of the graphs reveals that the cumulative sum curves remain within the critical limits at the 5% significance level. This indicates that the model coefficients are stable over time and do not exhibit any structural breaks, as seen in the CUSUM tests.

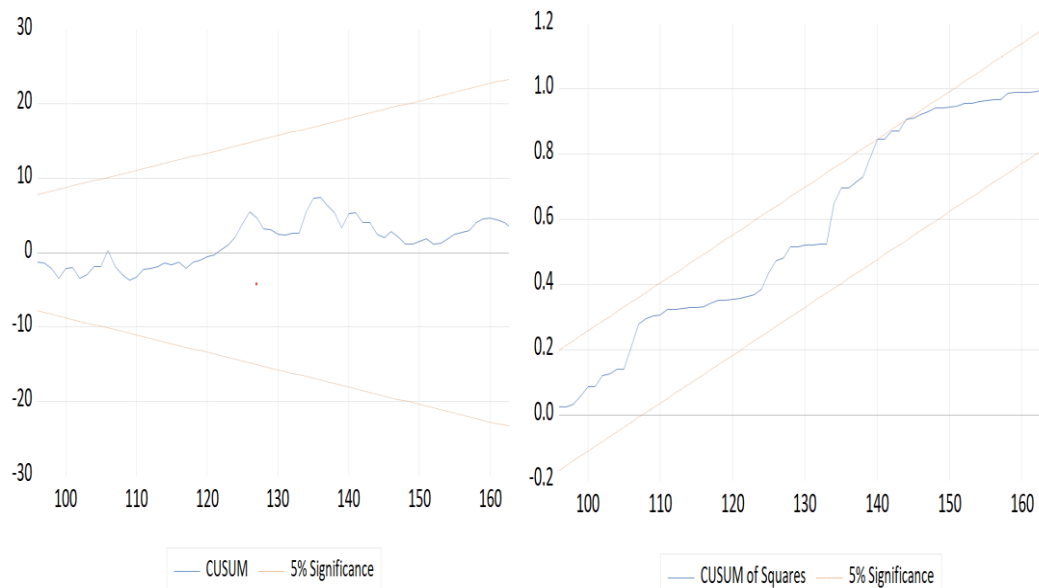


Figure 2. CUSUM and CUSUM-SQ Test Results

The parameter stability of the estimated model was evaluated using the CUSUM and CUSUMSQ tests. The results show that CUSUM and CUSUMSQ remain within the 5% critical limits throughout the sample period. Although the CUSUMSQ statistic shows a clear upward trend in the middle part of the sample (July 2023–May 2024), it does not exceed critical limits. This period coincides with a period in which macroeconomic conditions and monetary policy changed significantly in the Turkish economy. Both CUSUM and CUSUMSQ statistics remain within the 5% critical bounds throughout the sample period, providing no evidence of parameter instability. Therefore, the null hypothesis regarding parameter stability cannot be rejected, and it is concluded that the estimated ARDL/NARDL model does not show structural instability throughout the sample period.

4. Discussion and Conclusion

This study analyzes the relationships between risk indicators that are thought to potentially affect the IPO index using ARDL and NARDL models within the framework of time series methods. The findings show that the effects of risk indicators and investor behavior on the IPO market differ in both direction and magnitude. Although the results are broadly consistent with the existing literature, they also reveal several important differences. Correlation analysis indicates that the selected risk indicators capture complementary dimensions of the risk environment rather than overlapping information. While CDS reflects sovereign default risk, VIX represents global market uncertainty, geopolitical risk captures political uncertainty, and RISKD and RISKF capture investor risk sentiment and behavioral responses. The relatively low correlations among these variables support their joint inclusion in the ARDL and NARDL models and strengthen the robustness of the empirical analysis.

Both the linear ARDL and nonlinear NARDL models consistently identify CDS as one of the most influential determinants of IPO activity. The negative long-run and short-run effects

indicate that increases in sovereign risk discourage firms from going public by raising financing costs and reducing investor confidence. These findings are consistent with the theoretical role of CDS premiums as market-based indicators of sovereign risk proposed by Hull et al. (2004) and Longstaff et al. (2005). They also support the empirical evidence reported by Saporita and Yenipazarlı (2023), Çetinkaya and Üçler (2024), Bozdağ and Polat (2025), Karaçayır (2025) and Sever (2025), all of whom document a negative relationship between CDS premiums and financial market performance in Türkiye. However, the Wald symmetry tests indicate that although the positive CDS component is individually significant, the long-run effect of CDS is statistically symmetric. In contrast, significant short-run lag asymmetry suggests that IPO activity reacts more rapidly to increases in sovereign risk than to improvements in risk conditions, implying that investor confidence recovers more gradually than it deteriorates.

The results regarding GPRTUR differ from a substantial part of the existing literature. The linear ARDL model reveals a positive long-run relationship between geopolitical risk and IPO activity, whereas the NARDL model provides only weak evidence of long-run asymmetry and no significant short-run effect. Previous studies generally argue that geopolitical risk increases uncertainty and weakens financial market performance (Caldara and Iacoviello, 2022; Zhang et al., 2023). Likewise, the PwC Global Investor Survey (2025) identifies geopolitical conflicts as one of the main sources of financial risk, while Nazlıoğlu (2025) and Ceyhan (2025) report that Turkish financial markets are sensitive to geopolitical developments. The positive coefficient obtained in the ARDL model therefore suggests that geopolitical developments during the sample period may have coincided with periods of increased IPO activity rather than directly stimulating IPO decisions.

The findings highlight the importance of domestic investor risk appetite. The ARDL model shows that higher RISKD promotes IPO activity in the long run, while the NARDL model demonstrates that this relationship is strongly asymmetric. Positive and negative changes in RISKD generate significantly different long-run responses, indicating that investor behavior cannot be adequately captured within a linear framework. These findings are consistent with studies emphasizing nonlinear and asymmetric relationships between investor sentiment and financial markets (Topaloğlu and Kurt Cihangir, 2022; Özdemir, 2025). Moreover, they support the view that domestic investors play an increasingly important role in Turkish financial markets (Çelik, 2025) and are broadly compatible with the argument that investor sentiment is shaped by market dynamics (Vergili, 2023; Avcı and Çınar, 2024).

Global financial volatility does not exert a significant linear long-run effect in the ARDL model. However, the NARDL model reveals that only negative VIX shocks significantly reduce IPO activity and that the long-run impact of VIX is asymmetric. This finding suggests that linear models may underestimate the influence of global uncertainty because they assume identical responses to positive and negative changes. The results are consistent with previous studies showing that heightened global uncertainty discourages IPO activity (Beaulieu and Bouden, 2015; Herley, 2026; Açıkgöz and Karataş, 2024) and with the broader literature indicating that increases in VIX strengthen risk aversion and negatively affect financial markets (Campbell and Viceira, 2002; Andersen et al., 2007).

RISKF does not have a statistically significant long-run effect in either the linear or nonlinear specifications. This finding suggests that, during the sample period, IPO activity in Türkiye was driven primarily by domestic market conditions rather than changes in foreign

investor sentiment. The result is also consistent with the evidence reported by Çelik (2025), who argues that domestic investors exert a stronger influence on Turkish financial markets than foreign investors.

Taken together, the results demonstrate that IPO activity in Türkiye is shaped by nonlinear interactions among country risk, global uncertainty, geopolitical developments, and domestic investor behavior. These findings have important implications for policymakers and market participants. Accordingly, the following policy recommendations are proposed: (i) Macroeconomic and institutional policies that enhance economic predictability, strengthen institutional confidence, and promote transparent policy communication should be prioritized to reduce the country risk premium and support the sustainable development of the IPO market. (ii) During periods of geopolitical uncertainty, policies aimed at strengthening market resilience and maintaining investor confidence may help reduce the adverse effects of uncertainty on IPO decisions. (iii) Considering the asymmetric effects of domestic investor risk sentiment, improving financial literacy and ensuring timely and transparent information disclosure can help mitigate behavioral biases and herd behavior in the IPO market. (iv) Companies planning an IPO should adopt flexible timing strategies by considering country risk, geopolitical developments, investor risk sentiment, and the nonlinear effects of risk indicators alongside macroeconomic conditions. (v) Policies should prioritize strengthening domestic investor confidence while maintaining an attractive investment environment for international investors.

Finally, the findings suggest that risk indicators and investor behavior should be evaluated jointly in both policy design and market monitoring. Developing early warning mechanisms based on indicators such as CDS, VIX, geopolitical risk, and investor risk sentiment would contribute to financial stability and support the sustainable development of the IPO market.

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

I am a single author of this paper. My contribution is 100%.

Declaration of Researcher's Conflict of Interest

There is no potential conflict of interest in this study.

Declaration of Artificial Intelligence Usage

In preparing this article, the Grammarly tool was used for grammar and spell checking. The processes performed have been reviewed, and the final version has been edited under the responsibility of the author.

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APPENDIX

Table A1. ARDL Model Selection Criteria Table

Model	LogL	AIC*	BIC	HQ	Adj.R.Sq	Specification
11675	175.6807	-2.04629	-1.7953	-1.9444	0.9977	ARDL(1,1,1,3,0,0)
11050	176.6052	-2.04534	-1.7751	-1.9356	0.9978	ARDL(1,2,1,3,0,0)
11800	174.3538	-2.04218	-1.8105	-1.9481	0.9977	ARDL(1,1,0,3,0,0)
10425	177.2403	-2.04075	-1.7512	-1.9231	0.9978	ARDL(1,3,1,3,0,0)
11175	175.102	-2.0390	-1.7881	-1.9371	0.9977	ARDL(1,2,0,3,0,0)
10550	176.079	-2.0387	-1.7685	-1.9289	0.9977	ARDL(1,3,0,3,0,0)
11045	176.950	-2.0371	-1.7475	-1.9195	0.9978	ARDL(1,2,1,3,1,0)
11674	175.878	-2.0362	-1.7659	-1.9264	0.9977	ARDL(1,1,1,3,0,1)
11425	176.844	-2.0357	-1.7462	-1.9182	0.9977	ARDL(1,1,3,3,0,0)
11670	175.787	-2.0350	-1.7648	-1.9253	0.9978	ARDL(1,1,1,3,1,0)
11049	176.763	-2.0347	-1.7452	-1.9171	0.9978	ARDL(1,2,1,3,0,1)
10800	177.722	-2.0342	-1.7254	-1.9088	0.9977	ARDL(1,2,3,3,0,1)
11550	175.715	-2.0341	-1.7639	-1.9244	0.9977	ARDL(1,1,2,3,0,0)
11650	175.700	-2.0339	-1.7637	-1.9242	0.9977	ARDL(1,1,1,4,0,0)
8550	175.686	-2.0337	-1.7635	-1.9240	0.9977	ARDL(2,1,1,3,0,0)
7925	176.676.	-2.0336	-1.7441	-1.9160	0.9979	ARDL(2,2,1,3,0,0)
11170	175.667	-2.0335	-1.7633	-1.9154	0.9977	ARDL(1,2,0,3,1,0)
11025	176.624	-2.0330	-1.7434	-1.9154	0.9977	ARDL(1,2,1,4,0,0)
10925	176.607	-2.0327	-1.7432	-1.9152	0.9977	ARDL(1,2,2,3,0,0)

Table A2. NARDL Model Selection Criteria Table

Model	LogL	AIC*	BIC	HQ	Adj.R.Sq	Specification
10625	184.176	-2.0908	-1.7225	-1.9412	0.2948	ARDL(1,3,0,0,0,0)
10500	186.754	-2.0854	-1.6784	-1.9201	0.2986	ARDL(1,3,1,0,0,0)
10624	186.619	-2.0837	-1.6767	-1.9184	0.2974	ARDL(1,3,0,0,0,1)
7500	184.271	-2.0793	-1.6917	-1.9219	0.2905	ARDL(2,3,0,0,0,0)
10600	185.210	-2.0786	-1.6715	-1.9132	0.2938	ARDL(1,3,0,0,1,0)
10475	187.149	-2.0778	-1.6320	-1.8967	0.3007	ARDL(1,3,1,1,0,0)
7375	185.798	-2.0734	-1.6469	-1.9002	0.2938	ARDL(2,3,1,0,0,0)
7499	185.640	-2.0713	-1.6449	-1.8982	0.2925	ARDL(2,3,0,0,0,1)
10499	186.634	-2.0713	-1.6255	-1.8902	0.2961	ARDL(1,3,1,0,0,1)
12300	184.364	-2.0679	-1.6608	-1.9025	0.2862	ARDL(1,0,1,3,0,0)
7475	185.361	-2.0678	-1.6414	-1.8946	0.2900	ARDL(2,3,0,1,0,0)
10599	186.312	-2.0672	-1.6214	-1.8861	0.2933	ARDL(1,3,0,1,0,1)
10623	186.310	-2.0672	-1.6214	-1.8861	0.2932	ARDL(1,3,0,0,0,2)
4375	184.271	-2.0667	-1.6596	-1.9014	0.2854	ARDL(3,3,0,0,0,0)
10000	184.220	-2.0660	-1.6590	-1.9007	0.2849	ARDL(1,4,0,0,0,0)
7350	187.218	-2.0660	-1.6008	-1.8771	0.2848	ARDL(2,3,1,1,0,0)
10620	184.209	-2.0659	-1.6588	-1.9006	0.2848	ARDL(1,3,0,0,1,0)
10575	186.173	-2.0654	-1.6196	-1.8844	0.2920	ARDL(1,3,0,2,0,0)
12425	181.972	-2.0629	-1.6946	-1.9133	0.2748	ARDL(1,0,0,3,0,0)

Note: EViews 14 reports the NARDL order in compact form based on the original explanatory variables. Because each regressor is decomposed into positive and negative partial sums, NARDL(1,3,0,0,0,0) corresponds to the expanded asymmetric representation NARDL(1,3,3,0,0,0,0,0,0,0).