Research Article

Trade Openness and Current Account Adjustment in CIS Economies: Evidence from a Panel Threshold Model

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Abstract: This study investigates the relationship between trade openness and current account adjustment in the economies of the Commonwealth of Independent States (CIS). Using panel data for nine CIS economies over the period 1995–2024, the analysis employs the Hansen (1999) panel threshold model to examine whether the impact of trade openness on current account balances varies across different regimes of trade integration. The estimated threshold occurs at approximately 98.6 percent of GDP, indicating that the effect of trade openness on the current account balance becomes significantly stronger once trade integration exceeds this level. While trade openness has a limited effect below the threshold, higher levels of trade integration are associated with a deterioration in external balances. These findings highlight the importance of accounting for nonlinear adjustment mechanisms when analyzing external balance dynamics in transition economies and suggest that policies aimed at export diversification and strengthening domestic production capacity may contribute to improving external sustainability.

Keywords: Nonlinear Adjustment; Panel Threshold Model, CIS Economies
Jel Codes : F32, C23, C24

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BDT Ekonomilerinde Ticari Açıklık ve Cari İşlemler Dengesi: Panel Eşik Modeli Yaklaşımı

Öz: Bu çalışma, Bağımsız Devletler Topluluğu (BDT) ekonomilerinde ticari açıklık ile cari işlemler dengesi ayarlaması arasındaki ilişkiyi incelemektedir. 1995–2024 dönemini kapsayan dokuz BDT ekonomisine ait panel veri kullanılarak yapılan analizde, ticari açıklığın cari işlemler dengesi üzerindeki etkisinin ticari entegrasyonun farklı düzeylerine göre değişip değişmediğini incelemek amacıyla Hansen (1999) panel eşik modeli uygulanmıştır. Elde edilen sonuçlar, eşik değerinin GSYH'nin yaklaşık %98,6'sına karşılık geldiğini ve ticari entegrasyon bu düzeyi aştığında ticari açıklığın cari işlemler dengesi üzerindeki etkisinin belirgin biçimde güçlendiğini göstermektedir. Eşik değerin altında ticari açıklığın etkisi sınırlı kalırken, daha yüksek ticari entegrasyon düzeyleri dış dengelerde bozulma ile ilişkilidir. Bu bulgular, geçiş ekonomilerinde dış denge dinamiklerinin analizinde doğrusal olmayan ayarlama mekanizmalarının dikkate alınmasının önemini ortaya koymaktadır. Ayrıca, ihracatın çeşitlendirilmesine ve yerli üretim kapasitesinin güçlendirilmesine yönelik politikaların dış sürdürülebilirliğin iyileştirilmesine katkı sağlayabileceğini göstermektedir.

Anahtar Kelimeler: Doğrusal Olmayan Ayarlama, Panel Eşik Modeli, BDT Ekonomileri
Jel Kodları: F32, C23, C24

1. Introduction

Global current account imbalances remain one of the central concerns in international macroeconomics, particularly in an era of increasing globalization and financial integration. Among the various factors influencing external balances, trade openness has

attracted considerable attention in both theoretical and empirical studies. Previous empirical studies identify several macroeconomic determinants of current account balances, including trade openness, income levels, and financial development (Calderon et al., 2002; Chinn & Prasad, 2003; Gruber & Kamin, 2007). While greater trade integration may enhance export capacity and economic efficiency, it can also increase import demand and exposure to external shocks, thereby affecting current account dynamics.

This issue is particularly relevant for the economies of the Commonwealth of Independent States (CIS), which have undergone substantial structural transformation since the collapse of centrally planned economic systems in the early 1990s. During the transition to market-based economies, many CIS countries implemented extensive trade liberalization reforms and gradually integrated into global trade networks. At the same time, several economies in the region remain highly dependent on commodity exports, particularly energy resources. These structural characteristics make the relationship between trade openness and external balances especially important for understanding macroeconomic stability in the region.

In highly open economies, trade flows may approach or exceed the size of domestic production, potentially altering the transmission of external shocks and external balance dynamics. These characteristics make CIS economies particularly suitable for examining nonlinear external adjustment mechanisms. This relevance is further reflected in the substantial increase in external trade integration observed across CIS economies over the past three decades. According to World Bank statistics, trade openness in several CIS economies has risen markedly since the early years of economic transition, with the trade-to-GDP ratio exceeding 100 percent in a number of countries in recent years. At the same time, current account balances in the region have exhibited considerable volatility, reflecting the strong influence of commodity price fluctuations, particularly in energy-exporting economies. These developments highlight the importance of understanding how increasing trade integration shapes external balance dynamics in CIS economies.

Despite the growing body of literature examining the relationship between trade openness and current account dynamics, much of the existing empirical literature relies on linear econometric frameworks that assume a constant relationship between trade integration and external balances. However, in transition economies characterized by structural change, commodity dependence, and external vulnerability, the effects of trade openness may vary across different levels of trade integration. In such contexts, current account adjustment processes may exhibit nonlinear dynamics that cannot be adequately captured by conventional linear models.

This study addresses this issue by examining the relationship between trade openness and current account adjustment in CIS economies within a nonlinear panel econometric framework. Specifically, the analysis employs the Hansen (1999) panel threshold model to investigate whether the impact of trade openness on current account balances changes across regimes defined by different levels of trade integration. By allowing the adjustment mechanism to vary across regimes, the threshold approach provides a flexible framework for identifying nonlinear dynamics in external balance adjustment.

Unlike conventional linear panel estimators that assume constant effects across different levels of trade integration, the Hansen (1999) panel threshold framework allows the relationship between trade openness and current account dynamics to vary endogenously across regimes. This is particularly relevant for CIS economies, where structural transformation and external vulnerability may generate heterogeneous adjustment mechanisms. By estimating threshold values directly from the data, the methodology enables the identification of critical levels at which the impact of trade openness on external balances changes significantly. Therefore, the contribution of this study lies not only in its regional focus but also in its methodological approach to capturing regime-dependent nonlinear adjustment dynamics.

The study contributes to the existing literature in several important ways. First, it provides new empirical evidence on the relationship between trade openness and current account dynamics in CIS economies, a region that has received relatively limited attention in the nonlinear adjustment literature. Second, the study explicitly investigates the presence of threshold-type nonlinearities in current account adjustment processes, thereby extending the empirical literature beyond conventional linear approaches. Third, the analysis incorporates robustness checks using alternative threshold variables based on the magnitude of external imbalances, allowing for a more comprehensive assessment of nonlinear adjustment mechanisms. The empirical findings provide evidence of threshold-type nonlinear adjustment in the relationship between trade openness and current account balances, suggesting that the impact of trade integration becomes more pronounced once trade openness exceeds a certain level.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature on trade openness and current account dynamics. Section 3 presents the empirical methodology and econometric framework. Section 4 reports the empirical results. Section 5 discusses the findings and their policy implications. The final section concludes the study.

2. Literature Review

2.1. Trade Openness and Current Account Balance

The relationship between trade openness and the current account balance has long been a central topic in open-economy macroeconomics. Since the current account balance is closely linked to the trade balance, the degree of trade integration can exert important effects on external balances.

Several studies emphasize the close connection between trade imbalances and current account dynamics. Osakwe and Verick (2007), for instance, examine current account deficits in Sub-Saharan African countries and show that these deficits largely originate from persistent trade imbalances. Similarly, Özdamar (2015) finds that the current account balance in the Turkish economy is closely related to the trade balance, with the terms of trade exerting a significant positive effect.

However, empirical evidence on the impact of trade openness on external balances remains mixed. Parikh and Stirbu (2004) show that trade liberalization may lead to faster import growth than export expansion, thereby worsening the trade balance in many countries. Likewise, Moussa (2016) finds that increasing trade openness in Sub-Saharan African economies has been associated with widening current account deficits, partly due to low value-added exports and income transfers related to foreign direct investment.

Other studies argue that the effects of trade openness depend on country-specific structural characteristics. Caivano and Coniglio (2016), analyzing European Union countries, show that trade openness influences the current account balance mainly through other macroeconomic variables. Similarly, Ibhagui (2018) finds that high levels of trade openness may contribute to widening current account deficits under certain structural conditions.

Overall, the empirical literature suggests that the relationship between trade openness and the current account balance is neither uniform nor unidirectional. Rather, it varies across countries depending on economic structure, institutional conditions, and macroeconomic policy frameworks.

2.2. Empirical Evidence for Developing and Transition Economies

Empirical studies focusing on developing and transition economies reveal heterogeneous relationships between trade openness and external balances. In these economies, external balance dynamics are influenced not only by trade integration but also by broader macroeconomic and institutional factors.

Abille and Meçik (2024), analyzing African countries using panel data methods, find that trade openness, income level, and financial development positively affect the current

account balance, while exchange rates and monetary expansion exert negative effects. Their findings also highlight the importance of institutional quality, suggesting that good governance can mitigate the potential adverse effects of trade openness on external balances. Similarly, Abille and Meçik (2023) show that the impact of trade openness on the trade balance varies across countries and depends on country-specific macroeconomic conditions.

Other studies emphasize the interaction between fiscal policy and external imbalances. Mehta and Mallikarjun (2023), for example, show that fiscal deficits, trade openness, and exchange rate movements contribute to current account deficits in India, providing support for the twin-deficit hypothesis. Likewise, Çetrez (2022) finds that trade openness tends to increase current account deficits in lower-income countries, although it simultaneously promotes economic growth.

Country-specific evidence further highlights the heterogeneous effects of trade openness. Oke and Adigun (2020) find that trade openness improves the current account balance in Nigeria through increased export revenues, although foreign direct investment may worsen the current account balance due to higher import dependence and profit repatriation.

Overall, the literature indicates that the direction and magnitude of the relationship between trade openness and external balances vary substantially across developing and transition economies. These findings suggest that external balance dynamics are shaped by complex interactions among structural characteristics, macroeconomic policies, and global economic conditions.

2.3. Nonlinear Adjustment in Macroeconomic Relationships

Recent research increasingly questions the assumption that relationships among macroeconomic variables are linear. Traditional econometric models generally assume symmetric responses to economic shocks, implying that positive and negative changes generate similar effects. However, growing empirical evidence suggests that economic relationships often exhibit asymmetric or regime-dependent dynamics.

To address these limitations, several nonlinear econometric approaches have been developed. One widely used framework is the nonlinear autoregressive distributed lag (NARDL) model proposed by Shin et al. (2014), which allows explanatory variables to be decomposed into positive and negative components and enables the analysis of asymmetric long-run relationships. Empirical studies provide substantial support for such asymmetric adjustment mechanisms. For instance, Abille and Kılıç (2023) show that increases and decreases in public debt affect economic growth differently in both the short and long run.

Similarly, studies examining exchange rate dynamics and trade balances highlight the importance of nonlinear approaches. Bahmani-Oskooee and Arize (2019) demonstrate that exchange rate appreciations and depreciations affect trade balances asymmetrically, suggesting that linear models may fail to capture the full dynamics of external adjustment processes. Related evidence is provided by Bahmani-Oskooee and Fariditavana (2015), who show that the J-curve effect becomes more pronounced when nonlinear models are employed. Mwito et al. (2021) further confirm that exchange rate movements exert asymmetric effects on trade balances in panel data analyses. In addition to asymmetric models, threshold-based approaches have been widely used to capture regime-dependent relationships in macroeconomic variables. The panel threshold model proposed by Hansen (1999) allows the relationship between variables to change once a threshold value of an explanatory variable is exceeded, thereby providing a flexible framework for identifying nonlinear adjustment processes across different regimes.

Beyond the Hansen (1999) threshold framework, several nonlinear approaches have been developed to capture regime-dependent dynamics in macroeconomic relationships. The Panel Smooth Transition Regression (PSTR) model (González et al., 2005) allows for gradual transitions between regimes, while Dynamic Panel Threshold Models (Seo &

Shin, 2016), Panel Quantile Regression (Koenker, 2004), and Markov-Switching models (Hamilton, 1989) capture alternative dimensions of nonlinearity, including dynamic persistence, distributional heterogeneity, and latent regime shifts. Despite their advantages, these methods address different aspects of nonlinear adjustment. Since the primary aim of this study is to identify observable threshold-type regime changes associated with trade integration levels, the Hansen (1999) panel threshold framework is considered the most suitable approach.

Despite the growing body of literature examining trade openness and external balances, several important gaps remain. In particular, very few studies investigate whether the relationship between trade openness and current account dynamics exhibits regime-dependent nonlinearities. Moreover, most empirical studies focus either on developed economies or broad cross-country samples, while relatively limited attention has been given to transition economies, particularly the CIS countries. In addition, much of the empirical literature still relies on linear econometric frameworks, implicitly assuming symmetric adjustment processes between trade openness and current account dynamics. However, given the structural transformations, external shocks, and commodity dependence that characterize many CIS economies, the adjustment of current account balances may exhibit nonlinear patterns. Therefore, analyzing this relationship within a nonlinear framework may provide deeper insights into external adjustment dynamics. In this context, the present study contributes to the literature by examining the nonlinear relationship between trade openness and current account adjustment in CIS economies.

Building on the limitations identified in the existing literature, this study further investigates whether the relationship between trade openness and current account dynamics in CIS economies exhibits nonlinear behavior. In particular, the analysis employs a panel threshold framework to examine whether the effects of trade openness on external balances differ across regimes defined by the degree of trade integration. By allowing the relationship between variables to change once a threshold level of trade openness is exceeded, this approach provides a flexible framework for capturing regime-dependent adjustment processes in transition economies.

3. Applied Methodology

3.1. Model Specification

The empirical specification of the current account is grounded in the intertemporal approach, which conceptualizes the current account balance as the outcome of optimal saving and investment decisions over time (Obstfeld & Rogoff, 1995). Within this framework, external imbalances arise from the interaction between domestic macroeconomic conditions and global economic factors.

Following this theoretical perspective, the current account balance can be modeled as a function of macroeconomic variables that influence saving–investment dynamics and external adjustment processes. In particular, trade openness, economic growth, and external shocks represent important channels through which global economic integration may affect external balances.

Accordingly, this study examines the relationship between trade openness and current account dynamics in CIS economies using a panel econometric framework that allows for potential nonlinear adjustment mechanisms. The baseline empirical model can be expressed as:

$$CA_{it} = \alpha_i + \beta_1 TRADE_{it} + \beta_2 GDPG_{it} + \beta_3 LOIL_t + \varepsilon_{it} \qquad (1)$$

where CA_{it} denotes the current account balance as a percentage of GDP for country i in year t. $TRADE_{it}$ represents trade openness measured as total trade relative to GDP, $GDPG_{it}$ denotes the annual real GDP growth rate, and $LOIL_t$ is the logarithm of the Brent

crude oil price. The term α_i captures country-specific effects, while ε_{it} represents the error term.

The empirical strategy proceeds in several stages to identify both linear and nonlinear adjustment mechanisms in the relationship between trade openness and current account balances.

3.2. Cross-Sectional Dependence

In macroeconomic panel datasets, cross-sectional units may be affected by common shocks such as global financial conditions, commodity price fluctuations, or regional economic developments. These common factors may generate cross-sectional dependence across countries and may bias conventional panel estimators if not properly addressed.

To examine this issue, cross-sectional dependence is tested using the Pesaran (2004) cross-sectional dependence (CD) test, which is widely applied in macro panel data analysis. The test statistic is based on the average pairwise correlations of the residuals across cross-sectional units. The null hypothesis assumes cross-sectional independence, while rejection of the null indicates the presence of cross-sectional dependence among countries.

3.3. Panel Unit Root Tests

Before estimating the panel model, the time-series properties of the variables are examined to determine their order of integration. Identifying the stationarity properties of the variables is essential to avoid spurious regression results and to determine the appropriate econometric methodology.

For this purpose, the Im–Pesaran–Shin (IPS) panel unit root test is employed. The IPS test allows for heterogeneity in the autoregressive coefficients across cross-sectional units and tests whether each individual series in the panel contains a unit root. The null hypothesis of the IPS test states that all series in the panel contain a unit root, whereas the alternative hypothesis allows at least some series to be stationary.

3.4. Linear Benchmark Panel Model

Following the stationarity analysis, a linear benchmark panel model is estimated to examine the baseline relationship between trade openness and the current account balance. The linear specification serves as a benchmark model against which potential nonlinear adjustment mechanisms can later be evaluated using the panel threshold framework.

Both fixed effects and random effects estimators are initially considered to account for unobserved heterogeneity across countries. The choice between these specifications is determined using the Hausman (1978) specification test, which evaluates whether the random effects estimator is consistent by testing for correlation between individual effects and the regressors.

The linear model provides a useful baseline specification that captures the average relationship between trade openness and current account dynamics before investigating potential nonlinear adjustment mechanisms.

3.5. Diagnostic Tests

To ensure the reliability of the regression results, diagnostic tests are conducted to detect potential econometric problems in the panel specification. Serial correlation is examined using the Wooldridge (2002) test for autocorrelation in panel data, while heteroscedasticity is tested using the Breusch–Pagan (1979) test.

Detecting these issues is important because violations of classical regression assumptions may lead to inefficient estimates and unreliable statistical inference.

3.6. Robust Estimation

To ensure reliable statistical inference in the presence of potential econometric problems commonly observed in macroeconomic panel datasets, the model is estimated

using Driscoll–Kraay robust standard errors. The Driscoll–Kraay estimator provides heteroskedasticity-consistent standard errors that are also robust to serial correlation and cross-sectional dependence in panel data.

In panels where cross-sectional units may be affected by common shocks—such as global financial conditions, commodity price fluctuations, or regional economic developments—conventional standard error estimators may produce biased statistical inference. The Driscoll–Kraay approach addresses this issue by allowing the covariance matrix of the error terms to exhibit general forms of temporal and cross-sectional dependence.

The Driscoll–Kraay covariance matrix estimator can be expressed as:

$$\hat{V}_{DK} = (X'X)^{-1}\left(\sum w(k,L)\hat{\Gamma}(k)\right)(X'X)^{-1} \quad (2)$$

Where $\hat{\Gamma}(k)$ denotes the estimated autocovariance of the cross-sectional averages of the residuals at k lag, $w(k,L)$ represents a kernel weighting function, and L denotes the maximum lag length used in the estimation.

This estimator is particularly suitable for macroeconomic panel datasets with relatively small cross-sectional dimensions and moderate time dimensions, where cross-country spillovers and common global shocks may induce cross-sectional dependence. Therefore, the use of Driscoll–Kraay robust standard errors provides more reliable statistical inference for the baseline panel model.

3.7. Testing for Nonlinear Adjustment

Given that the impact of trade openness on external balances may vary across different levels of trade integration, a nonlinear panel threshold framework provides an appropriate econometric approach for capturing regime-dependent adjustment dynamics.

Among alternative nonlinear approaches, the Hansen (1999) panel threshold model is particularly suitable for the purposes of this study because it allows threshold values to be estimated endogenously from the data rather than imposed ex ante. Unlike linear models that assume constant effects across different levels of trade integration, the Hansen framework enables the relationship between trade openness and current account dynamics to vary across distinct regimes. Alternative approaches, such as the Panel Smooth Transition Regression (PSTR) model (González et al., 2005), generally assume gradual transitions between regimes, whereas the present study seeks to identify discrete regime changes in external adjustment dynamics associated with different levels of trade openness. In addition, Dynamic Panel Threshold Models (Seo & Shin, 2016), Panel Quantile Regression (Koenker, 2004), and Markov-Switching models (Hamilton, 1989) address different dimensions of nonlinearity, including persistence, distributional heterogeneity, and latent regime shifts. However, given the relatively small cross-sectional dimension of the sample (N = 9) and the objective of identifying observable threshold-based regime changes, the Hansen (1999) framework provides a parsimonious and empirically suitable specification for CIS economies.

Accordingly, this study employs the panel threshold methodology developed by Hansen (1999), which allows the relationship between the dependent and explanatory variables to vary across regimes defined by an endogenous threshold variable.

In the panel threshold framework, the sample is divided into different regimes depending on whether the threshold variable exceeds a certain threshold value. The general specification of the panel threshold model can be written as:

$$CA_{it} = \mu_i + \beta_1 X_{it} I(q_{it} \leq \tau) + \beta_2 X_{it} I(q_{it} > \tau) + \varepsilon_{it} \quad (3)$$

where CA_{it} denotes the current account balance for country i at time t, X_{it} represents the vector of explanatory variables, q_{it} denotes the threshold variable, and τ is the unknown threshold parameter to be estimated. The indicator function I(·) takes the value of 1 when the condition is satisfied and 0 otherwise. This specification allows the

coefficients of the explanatory variables to differ depending on whether the threshold variable lies below or above the estimated threshold value.

The threshold parameter is determined endogenously by minimizing the sum of squared residuals over all possible values of the threshold variable. Following Hansen (1999), the presence of threshold effects is tested using the likelihood ratio (LR) statistic defined as:

$$LR(\tau) = \frac{S(\tau) - S(\hat{\tau})}{\sigma^2}$$

where S(τ) denotes the residual sum of squares for a given threshold value and $S(\hat{\tau})$ represents the minimum residual sum of squares obtained at the estimated threshold value $(\hat{\tau})$. Since the threshold parameter is not identified under the null hypothesis of linearity, the asymptotic distribution of the test statistic is non-standard. Therefore, statistical inference is obtained using bootstrap procedures.

The null hypothesis of the Hansen threshold test corresponds to a linear specification with no threshold effects, while the alternative hypothesis allows for threshold-type nonlinear adjustment. Rejection of the null hypothesis indicates that the relationship between trade openness and the current account balance differs across regimes defined by the estimated threshold value.

3.8. Panel Threshold Regression Model

If the null hypothesis of linearity is rejected, the relationship between trade openness and the current account balance is estimated using a panel threshold regression model. This framework allows the coefficients of the explanatory variables to differ across regimes defined by the estimated threshold value.

The panel threshold regression model can be specified as follows:

$$CA_{it} = \mu_i + \beta_1 TRADE_{it} I(TRADE_{it} \leq \tau) + \beta_2 TRADE_{it} I(TRADE_{it} > \tau) + \gamma_1 GDPG_{it} + \gamma_2 LOIL_t + \varepsilon_{it} \quad (4)$$

where CA_{it} denotes the current account balance for country *i* in year *t*, and $TRADE_{it}$ represents trade openness measured as total trade relative to GDP. The threshold parameter τ divides the sample into two regimes depending on whether the level of trade openness lies below or above the estimated threshold value.

The indicator function I(·) determines the regime classification. When $TRADE_{it} \leq \tau$ the coefficient β_1 captures the effect of trade openness on the current account balance. When $TRADE_{it} > \tau$, the effect is captured by β_2. This specification allows the relationship between trade openness and the current account balance to vary across different levels of trade integration.

Such a framework provides a flexible approach for identifying regime-dependent nonlinear adjustment mechanisms in the relationship between trade openness and external balances.

3.9. Robustness Check: Alternative Threshold Variable

To examine the robustness of the nonlinear adjustment mechanism, the threshold estimation is repeated using an alternative threshold variable based on the magnitude of external imbalances. Specifically, the absolute value of the current account balance is used as the threshold variable.

The alternative panel threshold specification can be written as:

$$CA_{it} = \mu_i + \beta_1 TRADE_{it} I(|CA_{it}| \leq \tau) + \beta_2 TRADE_{it} I(|CA_{it}| > \tau) + \gamma_1 GDPG_{it} + \gamma_2 LOIL_t + \varepsilon_{it} \quad (5)$$

Where $|CA_{it}|$ represents the absolute value of the current account balance and τ denotes the estimated threshold parameter.

This specification allows the analysis to assess whether nonlinear adjustment dynamics depend on the magnitude of external imbalances rather than solely on the degree of trade openness. If the threshold effect remains significant under this alternative specification, it provides additional evidence supporting the robustness of the nonlinear adjustment mechanism.

4. Data and Empirical Results

4.1. Data

This study employs annual panel data for nine economies of the Commonwealth of Independent States (CIS) over the period 1995–2024. The sample includes Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan. The sample countries were selected based on data availability and consistency over the sample period (1995–2024). Turkmenistan and countries with changing CIS membership status were excluded due to limited or inconsistent data coverage, which could affect the comparability of panel estimations. Data on current account balance (as a percentage of GDP), trade openness (total trade as a percentage of GDP), and real GDP growth are obtained from the World Bank's World Development Indicators (WDI) database. Trade openness is measured as the sum of exports and imports relative to GDP, reflecting the degree of integration of national economies into international trade. In addition, global oil prices are included to capture the influence of external commodity price shocks, which are particularly relevant for several energy-exporting CIS economies. The oil price variable is measured as the logarithm of Brent crude oil prices. The selected variables capture key macroeconomic channels through which trade integration and external shocks may influence current account dynamics in transition economies. The resulting panel dataset provides a consistent framework for examining both linear and nonlinear adjustment mechanisms in the relationship between trade openness and external balances across CIS countries.

4.2. Cross-sectional Dependence

Before conducting the panel estimations, it is necessary to examine whether cross-sectional dependence exists across the countries in the sample. Since CIS economies are exposed to common external shocks such as oil price fluctuations, regional economic crises, and changes in global financial conditions, cross-sectional dependence may arise in the panel structure. To account for this possibility, the Pesaran (2004) cross-sectional dependence (CD) test is employed.

Table 1. Pesaran CD Test for Cross-Sectional Dependence

Variables	Test Statistic	p-value
CA, TRADE, GDPG and LOIL	1.6696	0.0950

Notes: The table reports the Pesaran (2004) cross-sectional dependence (CD) test. The null hypothesis is cross-sectional independence across panel units.

The results provide weak evidence of cross-sectional dependence at the 10 percent significance level, suggesting that CIS economies may be affected by common external shocks such as oil price fluctuations and regional economic disturbances.

4.3. Panel Unit Root Tests

After examining cross-sectional dependence, the stationarity properties of the variables are investigated using panel unit root tests. Identifying the order of integration is essential for determining the appropriate econometric methodology and avoiding spurious regression results. For this purpose, the Im–Pesaran–Shin (IPS) panel unit root test is applied under both intercept and intercept–trend specifications.

Table 2. IPS Panel Unit Root Test Results

Variable	Intercept Wtbar	p-value	Trend Wtbar	p-value
CA	-3.1846	0.0007	-2.9597	0.0015
TRADE	-1.8470	0.0324	-2.2468	0.0123
GDPG	-5.9612	0.0000	-5.5447	0.0000
LOIL	-1.6194	0.0527	-0.4974	0.3094

Notes: The table reports the Im–Pesaran–Shin (IPS) panel unit root test. The null hypothesis is that all panels contain a unit root, while the alternative hypothesis allows some panels to be stationary.

The IPS test results indicate that current account balance, trade openness, and GDP growth are stationary in levels under both intercept and intercept–trend specifications. The oil price variable exhibits mixed evidence regarding stationarity depending on the specification, appearing stationary under the intercept specification but non-stationary when a deterministic trend is included. Overall, the results suggest that the majority of variables are stationary in levels.

Although the IPS results for the oil price variable provide mixed evidence across specifications, the level form of LOIL is retained in the baseline analysis for several reasons. First, the oil price variable represents a common global external factor affecting all CIS economies rather than a country-specific process, making its level specification economically meaningful in the context of external balance dynamics. Second, the evidence of non-stationarity is not conclusive, given that LOIL appears stationary under the intercept specification. Finally, the subsequent panel estimations rely on robust standard errors, and the main nonlinear findings are primarily driven by the regime-dependent effect of trade openness rather than by the oil price coefficient itself.

Despite weak evidence of cross-sectional dependence at the 10 percent significance level based on the Pesaran CD test, the IPS test is retained as the baseline panel unit root test. Given the relatively small cross-sectional dimension of the sample (N = 9) and the mildly unbalanced structure of the panel, first-generation panel unit root tests remain commonly employed in similar empirical settings. In addition, the subsequent regression analysis employs Driscoll–Kraay robust standard errors, which are robust to cross-sectional dependence, serial correlation, and heteroscedasticity. Therefore, while the possibility of weak cross-sectional dependence is acknowledged, statistical inference is conducted using robust estimation procedures.

4.4. Linear Benchmark Panel Model

Given that most variables appear to be stationary in levels, the empirical relationship between trade openness and the current account balance can be analyzed using a level-based panel specification. Accordingly, a linear benchmark panel model is estimated to examine the baseline relationship between trade openness and current account dynamics in CIS economies.

Both fixed effects and random effects estimators are initially considered to account for unobserved heterogeneity across countries. The choice between these specifications is determined using the Hausman (1978) test, which evaluates whether the random effects estimator is consistent by testing for correlation between individual effects and the regressors.

The test results indicate that the null hypothesis cannot be rejected ($\chi^2 = 0.706$, $p = 0.872$), suggesting that the random effects model is consistent and efficient. Therefore, the random effects estimator is preferred for the benchmark specification.

Table 3. Linear Benchmark Panel Model (Random Effects Estimator)

Variable	Coefficient	Driscoll–Kraay Std. Error	t- Statistic	p-Value
TRADE	-0.080	0.035	-2.282	0.023
GDPG	0.230	0.146	1.573	0.117
LOIL	3.639	1.292	2.817	0.005
Observations = 250 Countries = 9 $R^2 = 0.107$				

Notes: The dependent variable is the current account balance (% of GDP). The model is estimated using the random effects estimator. Driscoll–Kraay robust standard errors are reported to account for heteroscedasticity, serial correlation, and cross-sectional dependence.

Table 3 reports the results of the linear benchmark panel model estimated using the random effects estimator with Driscoll–Kraay robust standard errors. The findings indicate that trade openness has a negative and statistically significant effect on the current account balance. Oil prices also display a positive and statistically significant

impact, reflecting the importance of energy exports in several CIS economies. In contrast, the effect of economic growth becomes statistically insignificant once cross-sectional dependence and serial correlation are taken into account.

Additional diagnostic tests were conducted to examine potential econometric issues in the panel specification. The Breusch–Godfrey/Wooldridge test indicates the presence of serial correlation in the idiosyncratic errors ($\chi^2 = 119.1$, $p < 0.001$), while the Breusch–Pagan test does not provide strong evidence of heteroscedasticity (BP = 6.47, $p = 0.091$). To address these potential econometric issues, the model is estimated using Driscoll–Kraay robust standard errors, which are robust to heteroscedasticity, serial correlation, and cross-sectional dependence.

4.5. Testing for Nonlinear Adjustment

To investigate whether the adjustment dynamics of the current account balance exhibit nonlinear behavior, the Hansen (1999) panel threshold test is applied. The test evaluates whether the relationship between trade openness and current account dynamics differs across regimes defined by a threshold value of trade openness.

The bootstrap results reject the null hypothesis of linearity at conventional significance levels. The estimated bootstrap p-value is 0.003, indicating statistically significant threshold nonlinearity in the panel. This finding suggests that the effect of trade openness on current account adjustment differs across regimes, implying that the adjustment process may depend on the level of trade integration.

Table 4. Hansen Panel Threshold Test

Test	Bootstrap p-value	Result
Hansen Threshold Test	0.0033	Nonlinearity detected

Notes: Bootstrap replications = 300. The null hypothesis is linearity.

Since the null hypothesis of linearity is rejected, a panel threshold regression model is estimated to examine how the impact of trade openness on current account dynamics differs across regimes. The threshold estimation allows the effect of trade openness to vary depending on whether the level of trade openness lies below or above the estimated threshold value. The results of the panel threshold model are reported in Table 5.

Table 5. Panel Threshold Model Results

Variable	Regime 1 (TRADE ≤ 98.62)	Regime 2 (TRADE > 98.62)
TRADE	0.015 (0.042)	-0.067* (0.034)
GDPG	0.281** (0.110)	0.281*** (0.110)
LOIL	0.009 (1.487)	0.009 (1.487)
Threshold value: τ=98.62 Bootstrap replications=300 Countries=9		

Notes: The table reports the results of the Hansen (1999) panel threshold model where the threshold variable is trade openness. Robust standard errors are reported in parentheses (White heteroscedasticity-consistent). The estimated threshold value divides the sample into two regimes based on the degree of trade openness. The threshold value is determined using a bootstrap procedure with 300 replications. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

The threshold estimate suggests that the impact of trade openness on the current account balance becomes more pronounced once trade openness exceeds approximately 100 percent of GDP. The Hansen panel threshold estimation identifies a trade openness threshold at approximately 98.6 percent of GDP, dividing the sample into two distinct regimes. In the first regime, where trade openness remains below the threshold, the effect

of trade openness on the current account balance is statistically insignificant. However, in the second regime, where trade openness exceeds the threshold level, the coefficient becomes negative, indicating that higher levels of trade openness are associated with a deterioration in the current account balance.

The estimated threshold is close to 100 percent of GDP, corresponding to a high level of trade integration. At this stage, external trade flows become comparable to the size of the domestic economy, potentially increasing the sensitivity of the current account balance to changes in trade openness. These findings suggest that the impact of trade integration on external balances becomes stronger once economies reach a sufficiently high level of openness.

Overall, these results highlight the limitations of a purely linear specification in capturing the dynamics of current account adjustment.

The loss of statistical significance of the oil price variable within the threshold specification may reflect the redistribution of explanatory power across trade integration regimes. In the nonlinear framework, part of the variation previously captured by oil prices in the linear benchmark model may instead be absorbed by regime-specific effects associated with trade openness. Given the close relationship between trade integration and commodity exports in many CIS economies, this result may also reflect overlapping variation between oil price fluctuations and trade-related external adjustment mechanisms.

While the linear benchmark model provides useful baseline evidence, the threshold estimation reveals that the relationship between trade openness and the current account balance varies across different levels of trade integration. Therefore, the nonlinear panel threshold framework provides a more appropriate representation of external adjustment dynamics in CIS economies.

Table 6. Panel Threshold Model with Alternative Threshold Variable (|CA|)

Variable	Regime 1 (|CA| ≤ 11.38)	Regime 2 (|CA| > 11.38)
TRADE	-0.080** (0.035)	-0.120** (0.035)
GDPG	0.246 * (0.133)	0.246* (0.133)
LOIL	1.438 (1.504)	1.438 (1.504)
Threshold value: τ = 11.38 Bootstrap replications=300 Observations=250 Countries=9		

Notes: This table reports robustness results from the Hansen (1999) panel threshold model using the absolute value of the current account balance as the threshold variable. Robust standard errors are reported in parentheses (White heteroscedasticity-consistent). The threshold value is estimated using a bootstrap procedure with 300 replications. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

As a robustness check, the panel threshold model is re-estimated using the absolute value of the current account balance as an alternative threshold variable. The estimation identifies a threshold level of approximately 11.4 percent of GDP, indicating that the magnitude of external imbalances plays an important role in shaping the impact of trade openness on current account dynamics. When current account imbalances remain below this threshold, the negative effect of trade openness on the current account balance is relatively moderate. However, when the magnitude of external imbalances exceeds the threshold, the negative impact of trade openness becomes stronger. These results support the presence of nonlinear adjustment dynamics associated with the size of current account imbalances.

5. Discussion of Estimation Results and Policy Implications

The empirical findings provide important insights into the relationship between trade openness and current account dynamics in CIS economies. The linear benchmark model indicates that trade openness is negatively associated with the current account balance, suggesting that deeper trade integration may contribute to widening external imbalances in the region. This pattern may reflect the structural transformation of CIS economies during the transition from centrally planned systems to market-based economies, where trade liberalization has often been accompanied by rising import demand for capital goods and intermediate inputs.

Oil prices also play a crucial role in shaping external balances across CIS economies. The positive relationship between oil prices and the current account balance reflects the strong dependence of several CIS economies—particularly Russia, Kazakhstan, and Azerbaijan—on energy exports. Consequently, fluctuations in global oil prices tend to have a direct impact on export revenues and external balances. The magnitude of the oil price coefficient differs between the linear and threshold specifications. This difference reflects the fact that the threshold framework allows regime-dependent effects of trade openness, which may reallocate part of the variation previously captured by the oil price variable in the linear model.

More importantly, the threshold estimation reveals that the relationship between trade openness and current account dynamics is characterized by nonlinear adjustment. The Hansen panel threshold model identifies a trade openness threshold at approximately 98.6 percent of GDP, a level close to 100 percent of GDP where external trade flows become comparable to the size of domestic production. Below this threshold, the effect of trade openness on the current account balance appears relatively weak and statistically insignificant, whereas beyond this level the coefficient becomes negative and statistically significant, indicating that higher levels of trade integration may contribute to the deterioration of external balances. This nonlinear pattern suggests that once trade flows approach the size of domestic economic activity, external trade dynamics become more influential in shaping current account outcomes.

The robustness analysis using the absolute value of the current account balance as an alternative threshold variable (Table 6) further supports the presence of nonlinear adjustment dynamics. The results indicate that larger external imbalances amplify the negative impact of trade openness on the current account balance, suggesting that economies experiencing substantial external imbalances may become more vulnerable to the effects of deeper trade integration.

From a policy perspective, these findings imply that increasing trade openness alone may not lead to improvements in external balances in CIS economies. As trade integration deepens, policies aimed at export diversification, strengthening domestic production capacity, and reducing dependence on commodity exports become increasingly important. In particular, promoting the development of non-resource sectors and improving export competitiveness may help enhance external sustainability and reduce vulnerability to external shocks.

6. Conclusion

This study examined the relationship between trade openness and current account adjustment in the economies of the Commonwealth of Independent States (CIS) using a nonlinear panel econometric framework. Using annual data for nine CIS economies over the period 1995–2024, the study investigates whether the impact of trade openness on external balances varies across different levels of trade integration.

The empirical findings provide clear evidence of threshold-type nonlinearities in the relationship between trade openness and current account balances. In particular, the results indicate that the impact of trade openness becomes significantly stronger once

trade integration exceeds a critical level of approximately 100 percent of GDP. Beyond this threshold, deeper trade integration is associated with a deterioration in external balances.

These findings highlight the importance of considering nonlinear adjustment mechanisms when analyzing external balance dynamics in highly open transition economies. In the case of CIS countries, where export structures remain strongly linked to commodity markets, deeper trade integration may amplify external imbalances through stronger transmission of global shocks.

From a policy perspective, the results suggest that trade liberalization alone may not be sufficient to ensure sustainable external balances. Policies aimed at export diversification and strengthening domestic production capacity may therefore play an important role in improving external sustainability.

Methodologically, this study highlights the usefulness of the Hansen (1999) panel threshold framework in identifying regime-dependent current account dynamics in transition economies. By allowing threshold values to emerge endogenously from the data, the approach provides additional insights beyond conventional linear estimators and underscores the importance of accounting for nonlinear adjustment mechanisms in external balance analysis.

Overall, this study contributes to the literature by providing new empirical evidence that the relationship between trade openness and current account dynamics in CIS economies is characterized by regime-dependent nonlinear adjustment, thereby offering deeper insights into external balance dynamics in transition economies.

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