Daengku: Journal of Humanities and Social Sciences Innovation *ISSN: 2775-6165 (online)*
Vol. 6 No. 5 (2026)
https://doi.org/10.35877/454RI.daengku5025

Trade Openness and Economic Growth: Short and Long Term Panel Data Analysis

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Abstract

This study examines the effect of trade openness on economic growth using an unbalanced panel dataset covering up to 217 countries/economies during 2011-2024. The study is motivated by the need to reassess the openness-growth nexus in a contemporary global economy characterized by post-crisis adjustment, trade-policy uncertainty, pandemic disruption, supply-chain reconfiguration, and rising concerns over trade fragmentation. Economic growth is measured by annual GDP growth, while trade openness is proxied by trade as a percentage of GDP. Population growth, life expectancy, gross capital formation, and foreign direct investment are included as control variables. The empirical strategy applies pooled least squares, random effects, fixed effects, and dynamic fixed-effects specifications with robust standard errors. The results indicate that trade openness has a positive and statistically significant effect on economic growth in both short-term and long-term estimations. This relationship is observed in the full sample as well as in high-income and lower-middle-income country groups, although the magnitude differs across income categories. These findings suggest that trade openness remains relevant as a source of growth, but its effectiveness depends on domestic productive capacity, investment quality, and the ability of countries to transform external integration into real economic performance. The study contributes by providing updated evidence from the 2011-2024 period and by positioning trade openness as a growth-enhancing mechanism whose impact is conditional on income-group heterogeneity and absorptive capacity.

Keywords: trade openness; economic growth; panel data; fixed effects

Received: 21 June 2026 Revised: 9 August 2026 Published: 31 October 2026

1. Introduction

Economic growth remains a central objective of macroeconomic and development policy because it reflects the ability of an economy to expand production, generate income, absorb labor, and improve welfare. In growth theory, long-run output expansion is closely related to capital accumulation, productivity improvement, and technological progress (Solow, 1956). However, the contemporary global economy has become increasingly unstable, making the search for reliable sources of growth more complex. Countries are now required not only to increase output, but also to strengthen resilience against global shocks, supply-chain disruption, and policy uncertainty.

One of the most debated sources of growth is trade openness. Classical and neoclassical trade theories argue that international trade enables countries to specialize according to comparative advantage, expand markets, and gain from exchange and specialization (Samuelson, 1948; Krugman et al., 2018). Through openness, countries may access larger markets, imported inputs, foreign technology, and competitive pressure that can raise efficiency and productivity. The export-led growth argument further suggests that trade can stimulate output through scale economies, market expansion, and industrial upgrading (Balassa, 1978).

Nevertheless, the relationship between trade openness and growth is not automatic. Greater openness may provide opportunities, but it can also expose domestic firms to stronger international competition. Countries with limited industrial capability, weak infrastructure, low institutional quality, and narrow export structures may not fully capture

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the potential gains from openness. Therefore, the growth effect of trade openness is likely to depend on domestic absorptive capacity and the ability of an economy to convert external integration into productive transformation (Rodriguez & Rodrik, 2000; Rodrik, 2018).

The period 2011-2024 provides an important setting for reassessing this relationship. Unlike earlier phases of globalization that were dominated by rapid trade expansion and deeper global value-chain integration this period was marked by post-global-financial-crisis adjustment, rising trade-policy uncertainty, the COVID-19 shock, supply-chain reconfiguration, and growing concerns over trade fragmentation. The World Trade Organization (2023) notes that the current trade debate has shifted from simple liberalization toward re-globalization, resilience, inclusiveness, and the risk of fragmentation. Beyond its economic dimensions, globalization also reshapes local knowledge transmission and educational practices. Manggau et al. (2025), for instance, document how globalization and digital transformation have challenged the intergenerational transmission of indigenous cultural knowledge through the Bugis Iyabelale tradition. This changing context raises a critical question: does trade openness still support economic growth in the contemporary global economy?

Descriptive evidence from the dataset confirms that the period under study was not a stable growth episode. As shown in Figure 1, the average GDP growth rate for all countries/economies declined from 4.30% in 2011 to -4.59% in 2020, before rebounding to 6.00% in 2021 and moderating to 2.95% in 2024. The contraction was visible across both high-income and lower-middle-income groups, although the depth of the decline differed. This pattern indicates that growth dynamics during 2011-2024 were shaped by both structural differences and common global shocks, making it necessary to examine the openness-growth relationship in both short-term and long-term settings.

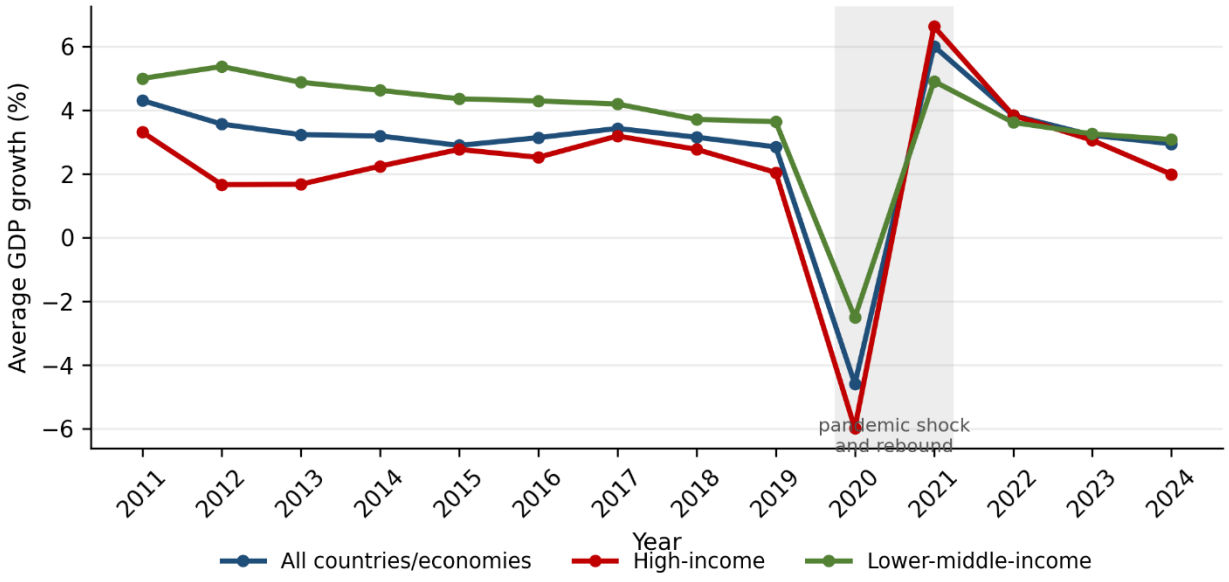


Figure 1. Average GDP growth dynamics, 2011-2024. Source: Authors' calculation based on the research dataset.

Trade openness also fluctuated substantially during the same period. Figure 2 shows that average trade openness for all countries/economies decreased from 92.57% of GDP in 2011 to 81.43% in 2020, increased to 100.15% in 2022, and then eased to 92.07% in 2024. The figure also reveals clear income-group heterogeneity: in 2024, average trade openness remained higher in high-income countries (117.39% of GDP) than in lower-middle-income countries (76.40% of GDP). These differences suggest that openness is not merely a global average phenomenon, but a structurally uneven process across income groups.

These descriptive patterns strengthen the need for a more focused empirical investigation. If trade openness and economic growth both move through periods of disruption and recovery, the relationship between them should not be assumed to be linear or uniform. Moreover, if high-income and lower-middle-income countries display different levels of openness and different growth responses, income-group heterogeneity must be considered explicitly. This is important because the same degree of openness may generate different outcomes depending on productive capacity, export composition, domestic investment, and institutional readiness.

Recent evidence also shows that the contemporary trade environment is shaped by policy uncertainty and supply-chain shocks. Trade-policy uncertainty can affect trade and investment decisions, while the COVID-19 shock demonstrated how global production linkages transmit disruptions across economies (Handley & Limão, 2017; Caldara et al., 2020; Bonadio et al., 2021).

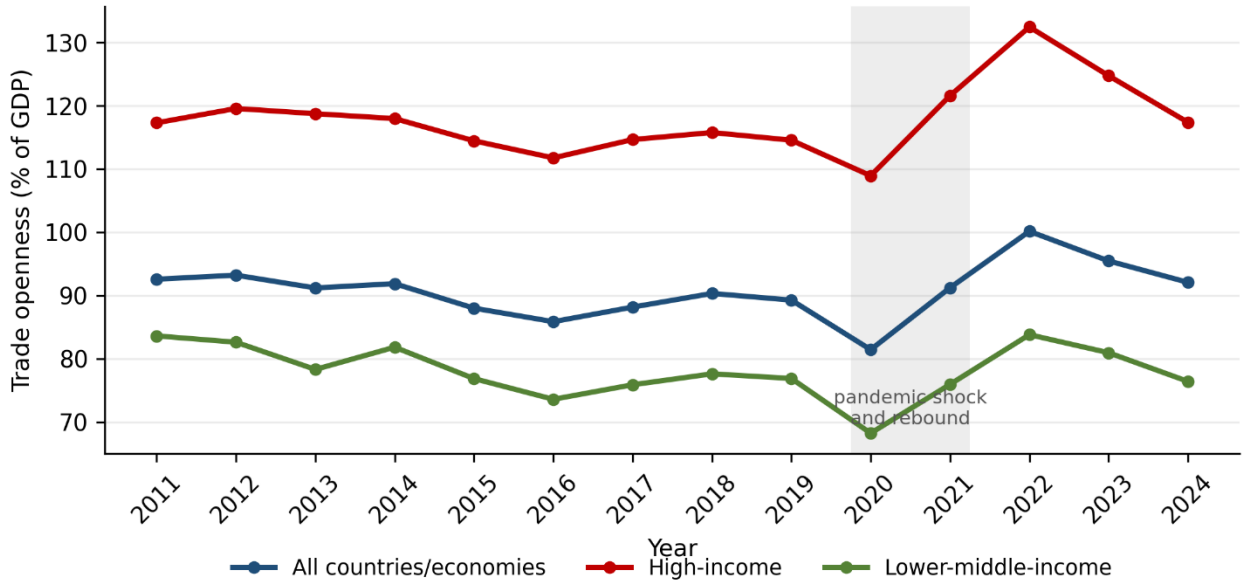


Figure 2. Average trade openness dynamics, 2011-2024. Source: Authors' calculation based on the research dataset.

Previous empirical studies provide mixed evidence. Some studies find that trade openness promotes income and growth by improving market access and productivity (Frankel & Romer, 1999; Tahir & Hayat, 2020). Other studies argue that the effect depends on openness measurement, growth distribution, institutional conditions, and country characteristics (Foster, 2008; Huchet-Bourdon et al., 2018). Rodriguez and Rodrik (2000) also warn that the positive link between trade policy and growth can be overstated when methodological and institutional differences are not adequately addressed. These debates show that the openness-growth nexus remains theoretically important and empirically unsettled.

More recent empirical work reinforces this lack of consensus. Results vary with the definition of openness, sample composition, development level, and econometric strategy, and recent studies report both linear and heterogeneous or asymmetric relationships between openness and growth (Fujii, 2019; Gries & Redlin, 2020; Jalil & Rauf, 2021; Bleaney, 2023; Nam & Ryu, 2024; Shan et al., 2024; Nosheen et al., 2025).

This study addresses the gap by using an updated unbalanced panel dataset covering up to 217 countries/economies from 2011 to 2024. The dependent variable is economic growth, measured by annual GDP growth, while the main explanatory variable is trade openness, measured by trade as a percentage of GDP. The analysis controls for population growth, life expectancy, gross capital formation, and foreign direct investment. In addition to the full-sample estimation, the study examines high-income and lower-middle-income country groups to identify whether the growth effect of trade openness differs across income categories.

The novelty of this study lies in three aspects. First, it updates the analysis using a contemporary period characterized by trade disruption, recovery, and fragmentation risk. Second, it distinguishes the full sample, high-income countries, and lower-middle-income countries, thereby avoiding the assumption that all economies benefit from openness in the same way. Third, it applies panel estimation with robust standard errors and a dynamic fixed-effects specification to examine both short-term and long-term relationships. Accordingly, the main objective of this study is to determine whether trade openness still drives economic growth in the contemporary global economy and whether the magnitude of this effect differs across income groups.

2. Literature Review

2.1. Trade Openness and the Theoretical Foundations of Growth

The theoretical foundation of the trade openness-growth relationship is rooted in the idea that international trade improves resource allocation and expands the production possibilities available to an economy. Classical and neoclassical trade theories emphasize that countries gain from specialization and exchange when they allocate resources according to comparative advantage (Samuelson, 1948; Krugman et al., 2018). In this framework, openness enables economies to reach larger markets, obtain intermediate goods, and exploit scale economies that would be more difficult to achieve under closed-market conditions.

From a growth perspective, trade openness can influence output through several mechanisms. First, it expands demand by allowing domestic producers to reach foreign markets. Second, it increases access to imported inputs and capital goods that may improve production efficiency. Third, it intensifies competition, encouraging firms to innovate and reduce inefficiency. Fourth, it can support productivity improvement by facilitating learning, technology diffusion, and participation in global production networks. These mechanisms are consistent with the export-led growth argument, which views external market access as a channel for output expansion and industrial upgrading (Balassa, 1978).

Recent studies extend these mechanisms by examining interactions with financial depth, innovation, sectoral structure, export composition, and productivity. This evidence suggests that openness can support growth through channels that depend on domestic financial conditions and the structure of production rather than through trade volume alone (Pradhan et al., 2017; Tahir et al., 2019; Belazreg & Mtar, 2020; Kacou et al., 2022; Mtar & Belazreg, 2023).

2.2. Empirical Debates on the Trade Openness-Growth Nexus

Although theory provides strong reasons to expect a positive relationship between openness and growth, empirical evidence remains mixed. Frankel and Romer (1999) show that trade has a positive effect on income, supporting the argument that external integration can raise economic performance. Similarly, Tahir and Hayat (2020) find that trade openness contributes to economic growth in Brunei Darussalam. These findings support the view that trade can operate as a growth-enhancing channel when countries are able to benefit from market access and external integration.

However, other studies show that the effect of openness is conditional rather than automatic. Foster (2008) finds that trade liberalization affects growth differently across the growth distribution, suggesting that the benefits of openness are uneven. Huchet-Bourdon et al. (2018) show that the openness-growth relationship depends on the measurement of openness, indicating that empirical conclusions may vary depending on how trade integration is proxied. Rodriguez and Rodrik (2000) further argue that many cross-country studies risk overstating the benefits of trade openness when institutional quality, geography, and methodological issues are not carefully addressed. Therefore, the empirical literature points to a positive but heterogeneous relationship between openness and growth.

Evidence from developing regions similarly points to substantial heterogeneity. Studies of Sub-Saharan Africa and BRICS economies show that the openness-growth relationship varies with foreign direct investment, institutional quality, and country-specific structural conditions, while regional evidence indicates that the gains associated with trade integration are not uniform across economies (Asamoah et al., 2019; Ikpesu et al., 2019; Banday et al., 2021; Oloyede et al., 2021; Yameogo & Omojolaibi, 2021).

2.3. Income-Group Heterogeneity and Absorptive Capacity

The growth effect of trade openness is likely to vary across income groups because countries differ in productive capacity, technological readiness, infrastructure quality, export structure, and institutional capability. High-income countries usually have stronger industrial bases, more diversified production systems, and better capacity to participate in higher-value segments of global trade. These conditions allow them to transform openness into productivity gains, innovation, and sustained output expansion more effectively than economies with weaker structural capacity.

Lower-middle-income countries may also benefit from openness, but the effect is more dependent on complementary domestic conditions. If openness is accompanied by investment, industrial upgrading, logistics improvement, and stronger domestic value added, it can support growth. If these conditions are weak, openness may instead increase import dependence or expose domestic firms to competition without sufficient productivity gains. Helpman et al. (2017) show that trade can generate uneven distributional and structural effects, while Rodrik (2018) emphasizes that

developing economies need domestic capability and productive transformation to benefit from global value chains. This implies that trade openness must be analyzed together with absorptive capacity and income-group differences.

Human capital development in resource-constrained environments may also benefit from affordable educational innovations. Swandi et al. (2025) demonstrate that integrating low-cost teaching aids into STEM-based science learning improved junior secondary school students' conceptual understanding, with a normalized gain of 0.58, alongside positive teacher perceptions. Although these findings do not establish a direct relationship with trade openness or economic growth, they illustrate how accessible educational resources can support foundational scientific learning. Ismail et al. (2026) demonstrated that deep learning, cognitive flexibility, and scientific argumentation contribute to innovation readiness through direct and indirect pathways. These findings provide complementary insights into human capability development as a potential foundation for technological adaptation and productive transformation.

Recent evidence also highlights governance as a conditioning factor in the openness-growth relationship. Nam et al. (2023) find that governance can strengthen the contribution of trade openness to economic development, reinforcing the relevance of absorptive-capacity arguments when economies differ in institutional and structural readiness.

2.4. Conceptual Framework and Research Positioning

Based on the theoretical and empirical literature, this study positions trade openness as an external integration variable that can affect economic growth through market expansion, competition, input access, efficiency gains, productivity improvement, and structural upgrading. However, the magnitude of this effect is expected to differ across income groups because the ability to transform openness into growth depends on domestic absorptive capacity. Therefore, the study does not treat openness as a uniform growth mechanism, but as a conditional driver of growth whose impact varies across economic structures.

The empirical model includes population growth, life expectancy, gross capital formation, and foreign direct investment as control variables. These variables represent demographic conditions, human development, domestic capital accumulation, and external capital inflows that may also influence growth. The study then compares the relationship across all countries/economies, high-income countries, and lower-middle-income countries. The conceptual framework is presented in Figure 3.

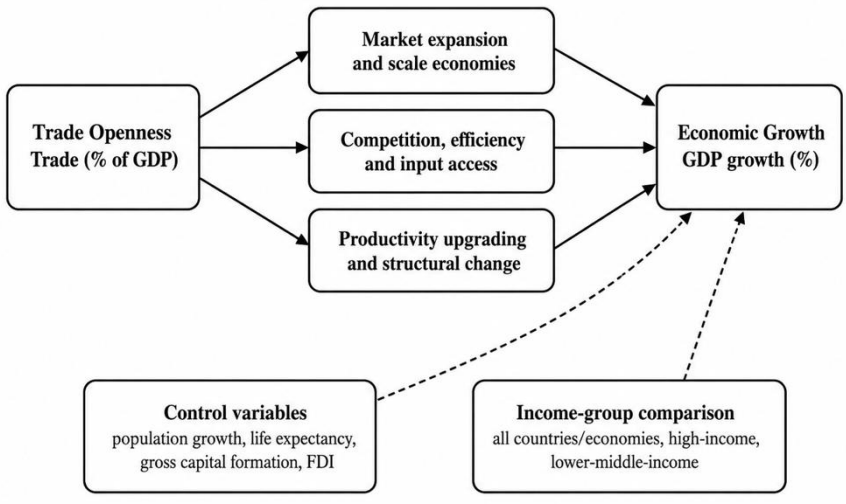


Figure 3. Conceptual framework of the trade openness-growth nexus. Source: Developed by the authors based on international trade theory and the empirical model.

Accordingly, the study develops the following research hypotheses:

H1: Trade openness has a positive effect on economic growth in the full sample of countries/economies.

H2: Trade openness has a positive effect on economic growth in high-income countries.

H3: Trade openness has a positive effect on economic growth in lower-middle-income countries.

H4: The magnitude of the trade openness effect differs between high-income and lower-middle-income countries.

3. Methods

This section explains the empirical design used to examine the relationship between trade openness and economic growth. The methodological structure is deliberately conservative: fixed-effects estimation with country-clustered robust standard errors is treated as the main model, while pooled least squares, random effects, and dynamic fixed-effects specifications are reported as comparison and robustness models. This choice is consistent with the panel diagnostics and avoids overstating the estimator as System GMM when the available output is based on fixed-effects regression with lagged dependent variables.

3.1. Research Design and Empirical Orientation

This study employs a quantitative explanatory research design using cross-country panel data. The purpose is not merely to describe changes in trade openness and economic growth, but to estimate whether variation in trade openness is systematically associated with variation in economic growth after controlling for demographic and capital-related factors. Panel data are appropriate because they combine cross-sectional variation across countries/economies with time-series variation across years, allowing the analysis to account for both structural differences between economies and changes within the same economy over time (Baltagi, 2021; Hsiao, 2014).

The empirical orientation of the study follows the trade openness-growth literature, which argues that external integration may influence growth through market expansion, efficiency gains, competitive pressure, and access to foreign inputs. However, because countries differ in institutional quality, productive capacity, demographic conditions, and investment structure, the estimation strategy controls for unobserved country-specific heterogeneity using the fixed-effects model. The main inference is therefore based on within-country changes over time rather than simple cross-country comparisons.

The analysis is conducted for three samples: all countries/economies, high-income countries, and lower-middle-income countries. This structure is used to identify whether the estimated relationship is general across the global sample or differs across income categories. The subgroup analysis is important because the ability to transform openness into growth may depend on absorptive capacity, industrial depth, infrastructure readiness, and domestic capital formation.

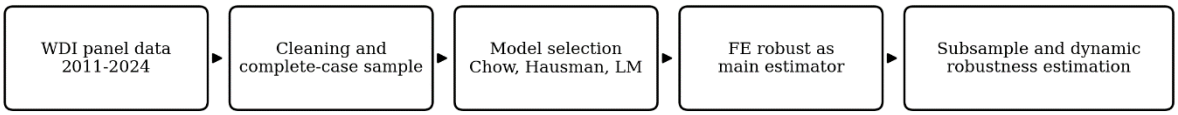


Figure 4. Empirical estimation procedure. Source: Developed by the authors.

3.2. Data Source, Period, and Sample Construction

The study uses annual panel data for the period 2011-2024. The dataset was constructed from World Development Indicators and converted into a long-panel format suitable for panel regression. The initial dataset covers 217 countries/economies over 14 years, generating 3,038 country-year records. The year 2025 was excluded because the six core variables were not available for that year in the prepared dataset.

The final dataset is an unbalanced panel because not every country/economy has complete observations for every variable and every year. This condition is common in cross-country macroeconomic datasets, particularly when the sample includes small economies, low-income countries, and territories with incomplete investment or FDI records. To maintain consistency across regression models, the core estimation relies on observations with available values for economic growth, trade openness, population growth, life expectancy, gross capital formation, and FDI.

The complete-case sample consists of 2,316 country-year observations from 175 countries/economies. Nevertheless, the effective number of observations differs across model specifications because lagged dependent variables reduce the usable sample in dynamic models. Therefore, the study reports the number of observations and countries/economies in each estimation table rather than claiming that all 217 countries/economies enter every regression specification.

3.3. Variable Measurement and Operational Definitions

The dependent variable is economic growth, measured by annual GDP growth. The main explanatory variable is trade openness, measured by trade as a percentage of GDP. Conceptually, the study discusses trade liberalization and openness; empirically, however, the variable is more precisely interpreted as trade openness because it captures the degree of trade integration through exports and imports relative to GDP, not direct policy instruments such as tariff rates or non-tariff barriers.

The model includes four control variables. Population growth captures demographic pressure and potential labor-supply expansion. Life expectancy represents a broad human-development condition that may influence growth through health, productivity, and demographic structure. Gross capital formation captures domestic investment and capital accumulation. FDI represents external capital inflows that may contribute to growth through financing, technology transfer, and integration into global production networks. These controls are included to reduce omitted-variable bias and to distinguish the effect of trade openness from other growth-related macroeconomic factors.

Table 1. Sample Construction and Panel Structure

Component	Value	Methodological implication
Initial countries/economies	217	Represents the broad global coverage of the dataset
Period	2011-2024	Captures the contemporary global trade and growth environment
Initial panel records	3,038 country-year observations	Reflects 217 countries/economies observed over 14 years
Complete-case sample	2,316 observations from 175 countries/economies	Used as the practical basis for the core regressions
High-income complete-case sample	838 observations from 62 countries/economies	Used for the high-income subgroup analysis
Lower-middle-income complete-case sample	603 observations from 45 countries/economies	Used for the lower-middle-income subgroup analysis
Panel status	Unbalanced panel	Effective observations vary across variables and lag specifications

Source: Authors' compilation based on the prepared panel dataset.

3.4. Empirical Model Specification

The baseline empirical model estimates the effect of trade openness on economic growth while controlling for demographic conditions, human-development conditions, domestic investment, and foreign capital inflows. The static panel specification is written as follows:

Equation (1): Static panel model

$$g_{it} = \alpha + \beta_1 TO_{it} + \beta_2 PG_{it} + \beta_3 LE_{it} + \beta_4 GCF_{it} + \beta_5 FDI_{it} + \mu_i + \varepsilon_{it}$$

Equation (2): Dynamic short-term specification

$$g_{it} = \alpha + \rho g_{i,t-1} + \beta_1 TO_{it} + \beta_2 PG_{it} + \beta_3 LE_{it} + \beta_4 GCF_{it} + \beta_5 FDI_{it} + \mu_i + \varepsilon_{it}$$

Equation (3): Dynamic long-term specification

$$g_{it} = \alpha + \rho g_{i,t-2} + \beta_1 TO_{it} + \beta_2 PG_{it} + \beta_3 LE_{it} + \beta_4 GCF_{it} + \beta_5 FDI_{it} + \mu_i + \varepsilon_{it}$$

In these equations, i denotes country/economy and t denotes year. The term μ_i captures unobserved country-specific characteristics that are time-invariant, such as geography, historical institutional features, long-run trade orientation, and structural economic characteristics. The term ε_{it} is the idiosyncratic error term. The coefficient of interest is β_1, which measures the association between trade openness and economic growth after controlling for other macroeconomic factors.

Equations (2) and (3) include lagged economic growth to account for growth persistence. The short-term dynamic specification includes the first lag of growth, while the long-term dynamic specification includes the second lag of growth. These dynamic specifications are used as robustness checks, not as System GMM estimators. The terminology

is important: because the available estimation is based on fixed-effects regression with lagged dependent variables and robust standard errors, the model is described as dynamic fixed effects rather than Dynamic Panel Data-System GMM.

3.5. Estimation Strategy and Model Selection

The empirical estimation proceeds from simpler to more restrictive panel estimators. First, pooled least squares (PLS) is estimated as a baseline comparison model. Second, random-effects (RE) and fixed-effects (FE) models are estimated to account for country-level panel structure. Third, model selection tests are used to determine the preferred estimator. Fourth, dynamic fixed-effects models are estimated to examine whether the trade openness-growth relationship remains consistent after accounting for growth persistence.

The Chow test indicates that country-specific effects are jointly significant, supporting the use of fixed effects over pooled least squares. The Hausman test produces a statistically significant result, indicating that the fixed-effects estimator is preferred over the random-effects estimator because the unobserved country-specific effects are systematically related to the regressors. The Breusch-Pagan Lagrange Multiplier test also confirms the relevance of panel structure. Based on these tests, the fixed-effects model with robust standard errors is treated as the main model, while PLS and RE are retained as comparison models.

Table 2. Estimation Strategy and Analytical Function

Model / test	Purpose	Role in the study
PLS	Provides a pooled baseline estimate without country effects	Comparison model
RE	Controls for random country-level variation under no-correlation assumption	Comparison model
FE	Controls for time-invariant country-specific heterogeneity	Main estimator
Dynamic FE	Adds lagged GDP growth to capture growth persistence	Robustness / dynamic specification
Chow test	Compares pooled model and fixed effects	Supports FE when country effects are significant
Hausman test	Compares RE and FE consistency	Supports FE when coefficients differ systematically
LM test	Tests the existence of panel effects	Confirms that panel structure matters

Source: Authors' methodological design.

3.6. Diagnostic Tests and Robust Inference

Before interpreting the regression results, the study evaluates several diagnostic issues. Multicollinearity is assessed using the variance inflation factor (VIF). The VIF values are below the conventional threshold of 10, with a mean VIF of 2.16, indicating that multicollinearity is not a serious concern. Serial correlation is examined using the Wooldridge test for autocorrelation in panel data. The test does not reject the null hypothesis of no first-order autocorrelation, suggesting that first-order serial correlation is not detected in the model.

The Modified Wald test for groupwise heteroskedasticity in the fixed-effects model is statistically significant, indicating that the assumption of homoskedastic errors is violated. Because heteroskedasticity affects the validity of conventional standard errors, all main panel regressions are estimated using robust standard errors clustered at the country/economy level. This adjustment allows the statistical inference to remain reliable even when error variances differ across countries/economies (Wooldridge, 2010).

Table 3. Diagnostic Tests and Methodological Response

Diagnostic issue	Test / indicator	Decision rule	Response in this study
Multicollinearity	VIF; mean VIF = 2.16	Problem if VIF is high	No serious multicollinearity detected
Autocorrelation	Wooldridge test; $p = 0.8701$	Problem if $p < 0.05$	No first-order autocorrelation detected

Heteroskedasticity	Modified Wald test; p = 0.0000	Problem if p < 0.05	Use country-clustered robust standard errors
Model choice	Chow, Hausman, and LM tests	Estimator selected based on panel diagnostics	FE robust treated as main estimator

Source: Authors' summary based on the panel diagnostic results.

3.7. Short-Term, Long-Term, and Subsample Estimations

The short-term model uses annual observations to estimate the contemporaneous association between trade openness and economic growth. This specification is useful for identifying whether changes in openness are associated with annual growth performance during the 2011-2024 period. The dynamic short-term model includes the first lag of GDP growth to account for persistence in annual growth dynamics.

The long-term model is designed to capture a more persistent relationship by incorporating a longer lag structure in the dynamic specification. The second lag of economic growth is included to account for delayed adjustment in the growth process. This is theoretically relevant because the effect of trade openness may operate gradually through market expansion, input access, productivity upgrading, capital response, and structural transformation.

Subsample estimations are conducted for high-income countries and lower-middle-income countries. The high-income subgroup allows the study to examine whether economies with stronger institutions, higher technological readiness, and more advanced production systems gain more from openness. The lower-middle-income subgroup is used to examine whether trade openness contributes to growth in economies that are still undergoing structural transformation. The study avoids generalizing the lower-middle-income results to all developing countries because the effective regression sample corresponds specifically to lower-middle-income economies.

3.8. Interpretation of Coefficients and Methodological Boundaries

The coefficient of trade openness is interpreted as the change in GDP growth associated with a one percentage-point increase in trade openness as a share of GDP, holding other variables constant. For example, a coefficient of 0.0785 means that a 10 percentage-point increase in trade openness is associated with an increase in GDP growth of approximately 0.785 percentage points. This interpretation is applied consistently across the full sample, subgroup samples, static models, and dynamic specifications.

The methodological boundaries of the study are stated explicitly. First, the study uses trade as a percentage of GDP as a proxy for trade openness; therefore, the results should be interpreted as the growth effect of openness or trade integration, not as a direct estimate of tariff liberalization. Second, the main inference is based on fixed-effects estimation, which controls for time-invariant country heterogeneity but does not fully eliminate all potential sources of endogeneity. Third, the dynamic specification controls for growth persistence but is not claimed as System GMM. These boundaries make the empirical claims more transparent and reduce the risk of overstating the methodological contribution.

4. Result and Discussion

This section presents the empirical findings on the relationship between trade openness and economic growth using panel data for 2011-2024. The results are reported in a journal-style sequence: preliminary evidence, model selection and diagnostics, short-term estimates, longer-lag estimates, and a synthesis of the main empirical pattern. The presentation emphasizes the fixed-effects model with robust standard errors as the main specification, because the model selection tests support fixed effects and the diagnostic tests indicate heteroskedasticity. Pooled least squares, random effects, and dynamic fixed-effects estimates are retained as comparison and robustness specifications.

4.1 Preliminary Evidence and Panel Structure

The dataset has an unbalanced panel structure because not all countries/economies have complete observations for all variables over the entire period. This is common in cross-country macroeconomic datasets, especially when the sample covers a large number of countries/economies. The descriptive statistics show that economic growth has 2,901 observations, trade openness has 2,501 observations, population growth has 3,023 observations, life expectancy has

3,024 observations, gross capital formation has 2,398 observations, and foreign direct investment has 2,705 observations. The effective estimation sample therefore varies across specifications, particularly when lagged growth is included in the dynamic fixed-effects model.

The descriptive evidence indicates that the growth experience of countries/economies during 2011-2024 was highly heterogeneous. The standard deviation of GDP growth is larger than the mean, reflecting substantial cross-country and within-country fluctuations, including the pandemic shock and recovery period. Trade openness also varies widely, with some economies recording very high trade-to-GDP ratios due to their small domestic market size and strong external integration. This variation supports the use of panel estimation because the relationship between openness and growth is not expected to be identical across countries or over time.

Table 4. Descriptive Statistics of Main Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Economic growth (g)	2,901	2.759	6.316	-54.402	86.827
Trade openness (TO)	2,501	92.540	58.535	1.995	679.233
Population growth (PG)	3,023	1.147	1.570	-10.927	14.225
Life expectancy (LE)	3,024	72.487	7.991	18.818	86.497
Gross capital formation (GCF)	2,398	24.342	8.547	-15.678	76.782
Foreign direct investment (FDI)	2,705	8.149	66.878	-1303.108	1709.827

Source: Authors' calculation based on the estimation dataset.

4.2 Model Selection and Diagnostic Tests

The model selection tests support the use of fixed effects as the main empirical specification. The Chow test rejects the pooled model, indicating that country/economy-specific effects are statistically relevant. The Hausman test reports a chi-square statistic of 49.99 with a probability value of 0.0000, which implies that the fixed-effects estimator is preferred to random effects. The Breusch-Pagan Lagrange Multiplier test also confirms the presence of panel effects. These results justify the use of a fixed-effects framework to control for unobserved time-invariant characteristics such as geography, long-standing institutional differences, structural production patterns, and persistent trade orientation.

Table 5. Model Selection and Diagnostic Tests

Test	Statistic / Probability	Decision
Chow test / F-test for country effects	Prob > F = 0.0000	Fixed effects are preferred to pooled OLS
Hausman test	chi2(5) = 49.99; Prob > chi2 = 0.0000	Fixed effects are preferred to random effects
Breusch-Pagan LM test	Prob > chibar2 = 0.0000	Panel effects are present
Multicollinearity	Mean VIF = 2.16	No serious multicollinearity
Modified Wald test	Prob > chi2 = 0.0000	Heteroskedasticity is present
Wooldridge autocorrelation test	Prob > F = 0.8701	No first-order autocorrelation detected

Source: Authors' estimation output.

The diagnostic tests further indicate that robust inference is necessary. The VIF values are far below the conventional threshold, suggesting that multicollinearity is not a major concern. The Wooldridge test does not detect first-order autocorrelation. However, the Modified Wald test shows groupwise heteroskedasticity across countries/economies. Consequently, the regression results are interpreted using robust standard errors, with the fixed-effects model serving as the main reference point.

4.3 Short-Term Estimation Results

Table 3 reports the short-term estimates of the effect of trade openness on economic growth. Across all samples, trade openness has a positive and statistically significant coefficient. In the full sample, the fixed-effects coefficient is 0.0785 and significant at the 1 percent level. This means that a 10 percentage-point increase in trade openness is associated with an increase in GDP growth of approximately 0.785 percentage points, holding the control variables constant. The dynamic fixed-effects estimate is slightly larger at 0.0889, showing that the positive association remains when lagged growth is included.

Table 6. Short-Term Effect of Trade Openness on Economic Growth

Sample	PLS	FE	RE	DFE	Obs. (static / DFE)	Countries (static / DFE)
All countries/economies	0.00844*** (0.00168)	0.0785*** (0.0155)	0.0178*** (0.00409)	0.0889*** (0.0177)	2,302 / 2,137	174 / 173
High-income countries	0.00755*** (0.00182)	0.101*** (0.0256)	0.00776** (0.00311)	0.115*** (0.0313)	838 / 777	62 / 62
Lower-middle-income countries	0.00911** (0.00454)	0.0644*** (0.0175)	0.0213*** (0.00683)	0.0561*** (0.0191)	603 / 560	45 / 45

Notes: The table reports coefficients of trade openness only. Robust standard errors are in parentheses. DFE denotes dynamic fixed-effects estimation with lagged GDP growth. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

The short-term effect is strongest among high-income countries. The fixed-effects coefficient reaches 0.101, implying that a 10 percentage-point increase in trade openness is associated with an increase in growth of about 1.01 percentage points. This result suggests that high-income economies are better able to convert trade exposure into growth gains, most likely because they possess stronger productive capacity, more advanced technology, better infrastructure, and deeper participation in global production networks.

For lower-middle-income countries, the short-term coefficient is also positive and statistically significant. The fixed-effects coefficient is 0.0644, indicating that a 10 percentage-point increase in trade openness is associated with an increase in growth of around 0.644 percentage points. Although the magnitude is smaller than that of high-income countries, the result is important because it shows that openness can support growth in lower-middle-income economies when country-specific heterogeneity is controlled. This finding also marks an improvement over the older empirical narrative, which was less able to identify a consistent positive effect for non-high-income countries.

4.4 Longer-Lag Estimation Results

Table 4 presents the longer-lag specification. The term longer-lag is used carefully here because the estimation relies on lagged growth within the 2011-2024 panel rather than a structural long-run equilibrium model. The results remain consistent with the short-term findings. In the full sample, the fixed-effects coefficient of trade openness is 0.0834 and significant at the 1 percent level, while the dynamic fixed-effects coefficient is 0.0955. This confirms that the positive association between trade openness and growth is not limited to contemporaneous adjustment.

Table 7. Longer-Lag Effect of Trade Openness on Economic Growth

Sample	PLS	FE	RE	DFE	Obs. (static / DFE)	Countries (static / DFE)
All countries/economies	0.00759*** (0.00195)	0.0834*** (0.0148)	0.0115*** (0.00322)	0.0955*** (0.0180)	1,171 / 1,002	175 / 173
High-income countries	0.00783*** (0.00212)	0.102*** (0.0252)	0.00783** (0.00305)	0.106*** (0.0273)	422 / 361	62 / 62
Lower-middle-income countries	0.00565 (0.00482)	0.0660*** (0.0243)	0.0181*** (n.a.)	0.0777** (0.0291)	293 / 251	45 / 44

Notes: The table reports coefficients of trade openness only. Robust standard errors are in parentheses where available in the estimation summary. DFE denotes dynamic fixed-effects estimation with the second lag of GDP growth. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

The longer-lag estimates again show the largest effect for high-income countries. The fixed-effects coefficient is 0.102 and the dynamic fixed-effects coefficient is 0.106, both significant at the 1 percent level. The similarity between the short-term and longer-lag coefficients suggests that openness contributes to growth in high-income countries in a relatively stable manner. In these economies, trade openness is more likely to operate through market expansion, productivity gains, innovation, and participation in higher-value production networks.

For lower-middle-income countries, the longer-lag results are more nuanced but still supportive of the main argument. The pooled coefficient is positive but statistically insignificant. However, once country-specific heterogeneity is controlled through fixed effects, trade openness becomes positive and significant. The fixed-effects coefficient is 0.0660, while the dynamic fixed-effects coefficient is 0.0777 and significant at the 5 percent level. This pattern indicates that the growth effect of openness in lower-middle-income countries becomes clearer after accounting for unobserved country characteristics.

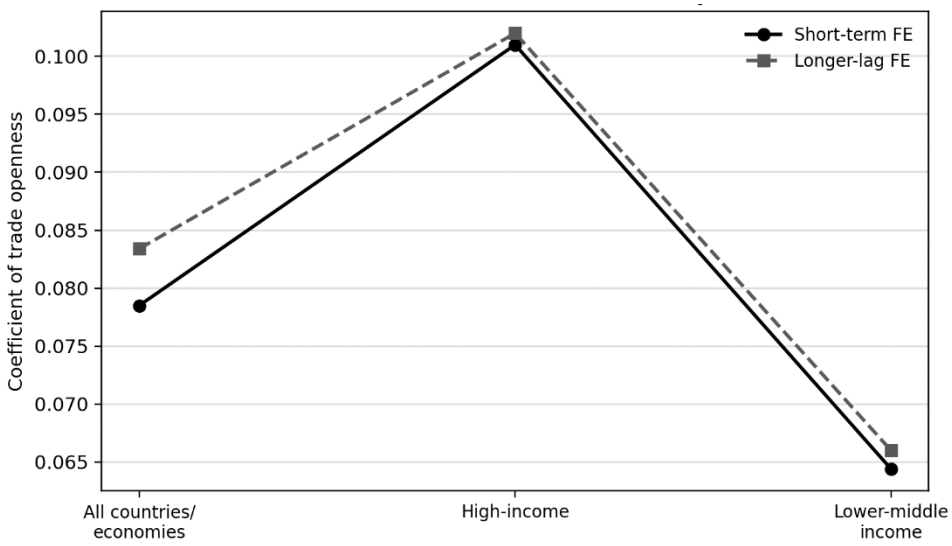


Figure 5. Comparison of Fixed-Effects Coefficients of Trade Openness. Source: Authors' estimation output.

Figure 5 summarizes the fixed-effects coefficients across the three samples. Two patterns stand out. First, the coefficient of trade openness is positive in all samples and in both specifications. Second, the magnitude is highest in high-income countries and lowest in lower-middle-income countries. This confirms that trade openness is growth-enhancing, but its effect is not homogeneous across income groups. The benefit of openness appears to depend on the ability of an economy to absorb trade opportunities and transform them into productive activity.

4.5 Additional Evidence from Control Variables

The control variables provide useful supporting evidence. Gross capital formation generally has a positive association with growth, particularly in the full sample and lower-middle-income countries. This suggests that domestic investment capacity remains a key condition for transforming trade openness into growth. In other words, openness is more effective when countries are able to expand productive assets, infrastructure, and capital formation.

Foreign direct investment shows a positive and significant effect in the full sample and high-income countries in the short-term specification, but it is not consistently significant for lower-middle-income countries. This indicates that FDI does not automatically generate growth unless it is connected to productive sectors, technology transfer, employment creation, and domestic value-added formation. Population growth is positive in several specifications, especially for lower-middle-income countries, while life expectancy produces mixed coefficients. The mixed result for life expectancy should be interpreted cautiously because it may reflect demographic composition, aging structure, and differences in development stages rather than a direct negative effect of human development.

4.6 Synthesis of Empirical Findings

Overall, the results show that trade openness has a positive and statistically significant relationship with economic growth during the 2011-2024 period. This finding is consistent across the full sample, high-income countries, and lower-middle-income countries. The fixed-effects results are particularly important because they control for unobserved country-specific characteristics, making the estimated relationship more reliable than the pooled model.

The evidence also shows that the effect of trade openness differs by income group. High-income countries obtain the largest growth effect from openness, suggesting stronger absorptive capacity. Lower-middle-income countries also benefit, but the magnitude is smaller and appears more dependent on domestic investment and structural readiness. Therefore, the results support the view that trade openness remains a relevant growth channel, but its effectiveness depends on the domestic capacity to convert external integration into real economic performance.

Compared with the older version of the article, the updated 2011-2024 results provide a stronger and more contemporary empirical message. The previous study used a longer historical period and concluded that trade liberalization had a weaker or insignificant effect for middle- and low-income countries in some specifications. The updated evidence, with a more focused recent period and a more precise lower-middle-income subsample, indicates that trade openness is positively associated with growth even in lower-middle-income economies after controlling for country heterogeneity. This strengthens the contribution of the revised article and makes the findings more relevant to recent debates on trade openness, post-pandemic recovery, and growth resilience.

Table 8. Operational Definition of Variables

Variable	Symbol	Measurement	Role in model	Expected sign
Economic growth	g	GDP growth, annual percentage	Dependent variable	-
Trade openness	TO	Trade in goods and services as percentage of GDP	Main explanatory variable	+
Population growth	PG	Annual population growth rate	Control variable	+/-
Life expectancy	LE	Life expectancy at birth, total years	Control variable	+/-
Gross capital formation	GCF	Gross capital formation as percentage of GDP	Control variable	+
Foreign direct investment	FDI	Net FDI inflows as percentage of GDP	Control variable	+

Source: Authors' operationalization based on the prepared WDI panel dataset.

4.7. Trade Openness and Growth in the Contemporary Global Economy

The empirical results indicate that trade openness has a positive and statistically significant relationship with economic growth in the full sample. This finding confirms that external trade integration remains a relevant source of growth during 2011-2024, a period marked by post-crisis adjustment, pandemic disruption, supply-chain restructuring, and renewed debates about globalization. The positive coefficient suggests that countries/economies with greater trade exposure tend to record stronger growth after controlling for demographic conditions, life expectancy, gross capital formation, and foreign direct investment.

Theoretically, this result is consistent with the logic of comparative advantage and export-led growth. Trade openness can support growth through several channels. It expands market access, increases demand opportunities, improves access to intermediate inputs, intensifies competition, and encourages efficiency gains. These mechanisms are aligned with the argument that trade can raise productivity and income when economies are able to reallocate resources toward more productive activities (Balassa, 1978; Frankel & Romer, 1999; Krugman et al., 2018).

The updated evidence is important because the 2011-2024 period does not represent a smooth phase of globalization. The world economy experienced trade disruptions and uncertainty, especially during the COVID-19 shock and the subsequent recovery. Nevertheless, the positive relationship between openness and growth remains visible. This suggests that trade openness has not lost its relevance as a growth channel, even though the nature of globalization has become more uncertain and contested. The finding is also consistent with the view that the current policy challenge is

not simply whether countries should be open or closed, but how openness can be managed to support secure, inclusive, and productive growth (WTO, 2023).

Compared with the previous article, the updated findings provide a sharper interpretation. The earlier version emphasized that trade liberalization could be used as a source of economic growth, but the discussion was still largely descriptive and did not sufficiently explain the mechanisms through which openness operates. The current evidence allows a more analytical claim: trade openness supports growth because it strengthens the interaction between external market access and domestic production capacity. In other words, openness matters not only as a trade ratio, but as an economic channel that links countries to markets, inputs, technologies, and competitive pressure.

4.8. Income-Group Heterogeneity and Absorptive Capacity

The results also show that the effect of trade openness differs across income groups. High-income countries record the strongest coefficients in both short-term and longer-lag specifications. This pattern indicates that advanced economies are more capable of converting openness into economic growth. The reason is not simply that they trade more, but that they possess stronger absorptive capacity. They generally have better infrastructure, more efficient institutions, more diversified production structures, higher technological capability, and deeper participation in complex global production networks.

In high-income countries, trade openness is more likely to generate productivity gains because firms can use imported inputs, advanced technologies, and international competition to improve efficiency. These countries are also more likely to participate in higher value-added segments of global value chains. As a result, trade openness does not only increase the quantity of exports and imports, but also reinforces innovation, specialization, scale economies, and productivity upgrading. This explanation is consistent with the broader literature emphasizing that the gains from trade depend on country characteristics and production capabilities (Foster, 2008; Huchet-Bourdon et al., 2018).

The findings for lower-middle-income countries are especially important because they refine the conclusion of the previous article. The earlier study suggested that the effect of trade liberalization was not consistently significant for middle- and low-income countries, particularly in the long run. In the updated estimation, however, trade openness is positive and significant for lower-middle-income countries when country-specific heterogeneity is controlled using fixed effects. This means that lower-middle-income economies can benefit from openness, but the benefit is more conditional than in high-income countries.

This result should be interpreted carefully. It does not mean that all developing economies automatically gain from openness. The subgroup in this study refers specifically to lower-middle-income countries based on the effective estimation sample. The positive coefficient indicates that, within this group, greater trade openness is associated with stronger growth, but the magnitude is smaller than in high-income countries. This difference implies that openness is beneficial when supported by domestic readiness, but the strength of the effect depends on the ability to transform trade exposure into productive activity.

The lower-middle-income result also supports the absorptive-capacity argument. Trade openness provides access to markets and inputs, but countries need domestic capabilities to take advantage of those opportunities. Without sufficient capital formation, infrastructure, logistics, industrial upgrading, human capability, and institutional support, openness may lead to import dependence rather than growth-enhancing transformation. This interpretation is consistent with Rodrik (2018), who emphasizes that integration into the global economy must be supported by domestic productive capabilities and structural transformation.

4.9. Domestic Capacity, Investment, and Structural Transformation

The role of the control variables strengthens the interpretation that trade openness is not a stand-alone growth strategy. Gross capital formation generally shows a positive relationship with economic growth, particularly in the full sample and lower-middle-income specifications. This result indicates that domestic investment capacity is crucial for transforming trade openness into real output expansion. Openness may provide market opportunities, but firms and economies need productive assets, infrastructure, machinery, and capital accumulation to respond to those opportunities.

This point is important for policy interpretation. If openness increases access to foreign markets but domestic production capacity remains weak, the growth effect may be limited. Conversely, when openness is supported by capital formation, countries can expand production, improve competitiveness, and increase participation in trade-related activities. This is

why the positive effect of trade openness should be interpreted together with the role of investment. The empirical evidence suggests that open economies grow more effectively when openness is accompanied by productive capacity.

Foreign direct investment produces a less uniform pattern across specifications. It is positive and significant in several full-sample and high-income models, but less consistent in lower-middle-income countries. This does not necessarily mean that FDI is unimportant. Rather, it suggests that the growth contribution of FDI depends on the type and quality of investment. FDI is more growth-enhancing when it enters productive sectors, supports technology transfer, creates employment, strengthens domestic linkages, and increases local value added. If FDI is concentrated in extractive activities, short-term financial flows, or weakly connected enclaves, its contribution to growth may be smaller.

The demographic control variables also require careful interpretation. Population growth shows positive coefficients in several specifications, suggesting that demographic expansion may support growth when it increases labor supply and domestic demand. However, its effect is not always uniform because population growth can also create pressure on employment, infrastructure, and public services. Life expectancy shows mixed and sometimes negative signs. This should not be interpreted as evidence that longer life expectancy reduces growth. More plausibly, the coefficient captures broader demographic and structural differences, including ageing pressure in high-income countries, transition costs, or differences in the age composition of the population.

Overall, the control variables support a more nuanced conclusion: the growth effect of trade openness is mediated by domestic capacity. Openness can create opportunities, but investment, productive structure, and institutional readiness determine whether those opportunities are converted into sustained economic growth. This strengthens the central argument of the study that trade openness is growth-enhancing, but not automatically or equally across all countries.

4.10. Short-Term and Longer-Lag Effects of Trade Openness

The results are consistent in both short-term and longer-lag specifications. In the short-term models, trade openness can affect growth through contemporaneous channels such as export demand, import of intermediate inputs, trade-related production, and post-shock recovery in international transactions. These channels are particularly relevant in the 2011-2024 period because the world economy experienced both disruptions and rebounds. When trade flows recover, production, demand, and income can respond relatively quickly.

The longer-lag specification provides additional insight. Although the period covered by this study is not long enough to represent a very long historical horizon, the inclusion of lagged growth captures delayed adjustment in the openness-growth relationship. The positive and significant results in the longer-lag models suggest that trade openness may also operate through mechanisms that take time to materialize, such as productivity upgrading, firm learning, scale economies, technology diffusion, and structural change.

For this reason, the term long-term in this article should be understood in a cautious empirical sense. It refers to longer-lag or long-term-oriented specifications within the 2011-2024 panel, not to a multi-decade historical analysis. This methodological caution makes the interpretation more credible. The findings show that openness is not only associated with immediate growth performance, but also remains relevant after accounting for delayed growth dynamics.

4.11. Refining the Previous Evidence and Strengthening the Policy Message

The updated evidence improves the previous article in three main ways. First, it focuses on the contemporary period 2011-2024, which better captures the recent global trade environment, including pandemic disruption, trade-policy uncertainty, and supply-chain reconfiguration. Second, it uses a more careful income-group structure by distinguishing all countries/economies, high-income countries, and lower-middle-income countries. Third, it adopts a more conservative methodological position by relying on fixed effects with robust standard errors and dynamic fixed-effects specifications, instead of overstating the method as System GMM when the estimation output does not support such a claim.

The main policy message is that trade openness remains important, but openness alone is not sufficient. For high-income countries, the policy priority is to maintain competitive integration in global markets while strengthening innovation, digital trade capability, advanced manufacturing, and value-chain leadership. For lower-middle-income countries, the policy challenge is different. They need to ensure that openness is accompanied by industrial upgrading, logistics improvement, export diversification, productive investment, technology absorption, and stronger domestic value added.

The evidence also suggests that extreme protectionism is not a sustainable growth strategy, but unprepared openness can also produce limited benefits. The appropriate policy position is not simply to open markets, but to build the domestic capacity needed to benefit from openness. This includes improving infrastructure, human capital, institutional quality, investment climate, and firm-level productivity. In this sense, the key policy lesson can be summarized as follows: open markets need productive capacity.

Therefore, the contribution of this study is not only empirical but also conceptual. It shows that trade openness continues to matter for growth in the contemporary global economy, but its effect is shaped by domestic economic readiness. The updated results move beyond the simple debate between openness and protectionism by showing that openness produces stronger growth when it is embedded in a broader development strategy that strengthens productive transformation

5. Conclusion

This study concludes that trade openness remains an important driver of economic growth in the contemporary global economy. Using an unbalanced panel dataset covering up to 217 countries/economies during 2011-2024, the empirical findings show that trade openness has a positive and statistically significant effect on economic growth in both short-term and longer-lag specifications. The consistency of the results across pooled, random-effects, fixed-effects, and dynamic fixed-effects estimations indicates that the relationship is not merely a statistical coincidence, but reflects the continuing relevance of external trade integration as a channel for market expansion, efficiency improvement, and productivity-oriented growth.

The findings also confirm that the growth effect of trade openness is heterogeneous across income groups. High-income countries obtain a stronger effect because they generally possess better infrastructure, stronger institutions, higher technological capability, and deeper participation in complex global production networks. Lower-middle-income countries also experience positive gains from trade openness, but the magnitude is relatively smaller and more conditional. This means that openness can support growth in lower-middle-income economies when it is accompanied by domestic productive capacity, capital formation, investment readiness, and the ability to transform market access into higher domestic value added.

From a policy perspective, the results suggest that trade openness should not be interpreted as a stand-alone growth strategy. Opening the economy to international trade may create opportunities, but these opportunities can only be converted into sustained growth when supported by complementary domestic policies. Countries need to strengthen industrial upgrading, logistics performance, human capital, investment quality, export diversification, and technology adoption. For lower-middle-income countries in particular, the main policy challenge is not simply to increase trade exposure, but to ensure that trade openness contributes to structural transformation, productive employment, and stronger domestic production linkages.

This updated study refines the previous article by focusing on a more recent global period, improving the classification of income-group analysis, and adopting a more methodologically consistent estimation strategy. Instead of broadly assuming that trade liberalization benefits all economies in the same way, this study shows that the effect of trade openness depends on the capacity of each economy to absorb and use external integration productively. Future studies may extend this analysis by incorporating tariff measures, non-tariff barriers, global value chain participation, institutional quality, digital trade, or more advanced dynamic panel estimators with complete diagnostic tests.

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