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A Cross-Country Empirical Study on the Impact of Trade Openness on Economic Growth: A Comparative Analysis Based on Panel Data of 97 Countries

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Abstract: This paper conducts a systematic empirical examination of the impact of trade openness on economic growth based on cross-country panel data from 97 countries over the period 2010–2023. The results show that trade openness has a significant and robust positive effect on economic growth. This effect is masked when control variables are not included, and it becomes more pronounced after controlling for country heterogeneity. Time shocks slightly weaken but do not alter the core conclusion. Financial development and government size generally have negative effects in most models, while the effect of human capital is model-dependent. The findings of this paper provide empirical evidence for countries to optimize trade policies and improve institutional support to release the dividends of openness.

Keywords: Degree of Trade Openness; Economic Growth

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1. Introduction

1.1 Research Background and Practical Signifi cance

In the current era where economic globalization and anti-globalization sentiments interweave, trade openness serves as the core link connecting the economies of various countries. Its impact on economic growth has always been a research hotspot in macroeconomics and international trade. Since Adam Smith proposed the "Theory of Absolute Advantage," mainstream theories generally hold that trade openness can signifi cantly enhance the resource allocation effi ciency and long-term growth potential of an economy by expanding market scale, promoting technological spillovers, and deepening specialized division of labor (Pomerlyan et al., 2026). From a practical perspective, post-World War II, emerging economies in East Asia achieved rapid growth by integrating into the global trading system, while some closed economies fell into growth stagnation, further confi rming the close relationship between trade openness and economic growth (Yu & Gu, 2025).

However, the growth effect of trade openness is not uniformly consistent. Existing studies have found that in countries at different stages of development, under different institutional environments and resource endowments, the intensity, significance, and even direction of the impact of trade openness on economic growth may vary (Trabelsi et al., 2025). For instance, some developing countries, due to issues such as an imperfect financial system and excessive government intervention, failed to effectively capture the growth dividends brought by trade openness, and even experienced the phenomenon of "opening but not growing" (Ayesu et al., 2026). Additionally, methodological diff erences such as the selection

of control variables and the handling of fixed effects in empirical research may also lead to divergent conclusions. Based on this, this paper systematically compares the impact of "the presence or absence of control variables" and "the type of fixed effects" on the estimation results, accurately identifying the true effect of trade openness on economic growth, which not only helps clarify theoretical disputes but also provides practical guidance for countries to formulate differentiated trade policies.

2. Literature Review

2.1 Research on the Core Relationship between Trade Liberalization and Economic Growth

Regarding the impact of trade openness on economic growth, the existing literature has mainly formed three core viewpoints: "positive promotion", "non-linear influence", and "heterogeneous effect".

In the positive promotion effect, a large number of cross-national empirical studies have provided supporting evidence. Cenaj & Kilaj (2025) based on the panel data of Southeast European countries from 2012 to 2022 found that for every 1 percentage point increase in trade openness, the economic growth rate increased by an average of 0.03 percentage points, and this effect remained significant even after controlling for variables such as government expenditure and taxation; Pomerlyan et al. (2026) further confirmed the research on 7 regional integration groups worldwide, which further demonstrated that trade openness significantly enhanced regional economic performance, especially in mature integration organizations, with the effect being more prominent.

The non-linear influence viewpoint emphasizes that the growth effect of trade openness has threshold characteristics. Trabelsi et al. (2025) using the PSTAR threshold model for the research of Maghreb countries found that when the trade openness rate was below 65%, its impact on economic growth was significantly negative; between 65% and 110%, the effect turned positive but was not significant; and when it exceeded 110%, it presented a significant positive impact. This result explains the phenomenon that trade openness failed to promote growth in some developing countries. Lee & Zhao (2025)'s research pointed out that the impact of trade openness on economic growth is moderated by national innovation capabilities. In countries with strong innovation capabilities, the technology spillover mechanism can fully play its role, while in countries with weak innovation capabilities, it is difficult to capture the benefits of openness.

The heterogeneity effect research focuses on the moderating role of national characteristics on the growth effect of trade openness. Ayesu et al. (2026)'s research on 29 African countries found that port efficiency, as a core component of infrastructure, can significantly enhance the growth effect of trade openness. A 10% increase in port efficiency can increase the growth effect of trade openness by 30%; Yu & Gu (2025)'s research based on data of prefecture-level cities in China showed that the level of domestic market integration, by reducing regional trade costs, can amplify the promotion effect of trade openness on economic growth, and this effect is more obvious in the southern region.

2.2 The Role of Control Variables in the Trade Openness - Economic Growth Relationship

The selection and handling of control variables are crucial factors affecting the reliability of empirical results. Existing literature generally focuses on the moderating effects of variables such as financial development, government size, and human capital.

In terms of financial development, the mainstream view holds that a well-developed financial system can provide financing support for trade activities and reduce transaction costs, thereby strengthening the growth effect of trade openness (Tarchoun & Ghraieb, 2022). However, some studies have also found that if there are resource mismatches or excessive virtualization in financial development, it may lead to funds leaving the real economy, thereby inhibiting economic growth (Nguyen et al., 2026). Regarding the impact of government size, there is controversy: moderate government spending can provide public goods and improve infrastructure, creating a favorable environment for trade openness; but excessive government intervention may lead to resource misallocation and efficiency decline, weakening the growth effect of trade openness (Cenaj & Kilaj, 2025). In terms of human capital, Lee & Zhao (2025) pointed out that highly skilled labor can better absorb the advanced technologies and management experience brought by trade openness, thereby promoting technological progress and economic growth. However, insufficient or improper education quality may prevent the full release of the human capital effect.

2.3 Evolution and Controversies of Research Methods

The choice of empirical research methods directly affects the credibility of the conclusions. Early studies mostly employed

the mixed OLS model, but due to the failure to control for country heterogeneity and time shocks, the estimated results might be biased (Morán et al., 2025). With the development of panel data econometric methods, the fixed effect model has been widely applied. By controlling for country characteristics that do not change over time and time factors that do not vary across countries, it can more accurately identify the net effect of the core explanatory variables (Yu & Gu, 2025). Additionally, the methods of robustness tests have become increasingly diverse, including core variable substitution, extreme value handling, and instrumental variable methods, which are used to verify the reliability of the conclusions (Ayesu et al., 2026).

However, there are still some gaps in the existing research: Firstly, some studies did not fully compare the impact of including or excluding control variables on the results, possibly ignoring the problem of omitted variable bias; Secondly, the analysis of the influence of the choice of fixed effect type is insufficient, failing to clearly distinguish the independent effects of country heterogeneity and time shocks; Thirdly, some studies have a single robustness test method, and the reliability of the conclusions needs further verification. Based on this, this paper conducts a systematic design of "comparison experiments with or without control variables" and "comparison of fixed effect types", and adopts dual robustness tests, aiming to make up for the shortcomings of existing research and provide more reliable empirical evidence.

3. Research Design

3.1 Model Specification

To gradually examine the impact of trade openness on economic growth and to compare the effects of control variables and fixed effects, this paper constructs the following three types of empirical models:

3.1.1 Baseline OLS Model

To examine the impact of including control variables on the estimation results, two sets of baseline OLS models were designed:

Model 1 (without control variables): Only includes the core explanatory variables and the constant term, to test the pure correlation between trade openness and economic growth

$$gdp\_g_{it} = \alpha_0 + \alpha_1 trade_{it} + \varepsilon_{it}$$

Model 2 (with control variables): Incorporate all control variables to identify the net effect of trade openness

$$gdp\_g_{it} = \alpha_0 + \alpha_1 trade_{it} + \alpha_2 credit_{it} + \alpha_3 gov_{it} + \alpha_4 edu_{it} + \varepsilon_{it}$$

3.1.2 National Fixed Effects Model

To control for the heterogeneity of countries that does not change over time (such as institutional environment, resource endowment, etc.), the model is set up as follows:

$$gdp\_g_{it} = \beta_0 + \beta_1 trade_{it} + \beta_2 credit_{it} + \beta_3 gov_{it} + \beta_4 edu_{it} + \mu_i + v_{it}$$

Among them, μ_i represents the fixed effect of the country, and v_{it} represents the random error term.

3.1.3 Two-way Fixed Effects Model

While controlling for country heterogeneity and time shocks (such as the global economic cycle, international policy changes, etc.), the model is set up as follows:

$$gdp\_g_{it} = \beta_0 + \beta_1 trade_{it} + \beta_2 credit_{it} + \beta_3 gov_{it} + \beta_4 edu_{it} + \mu_i + \lambda_t + \omega_{it}$$

Among them, λ_t represents the fixed effect of the year, and ω_{it} represents the random error term.

3.2 Variable Definition and Measurement

Table 1 Variable Definition and Measurement

variable	variable symbol	measurement mode	Data sources
GDP growth rate	gdp_g	Annual GDP growth rate (compared to the previous year) (%)	World Bank's WDI database
trade openness	trade	The proportion of total import and export volume to GDP (%)	World Bank's WDI database
Export openness	export	The proportion of total exports to GDP (%)	World Bank's WDI database

variable	variable symbol	measurement mode	Data sources
financial development	credit	Domestic credit to private sector (% of GDP)	World Bank's WDI database
government scale	gov	General government final consumption expenditure (% of GDP)	World Bank's WDI database
human capital	edu	School enrollment, tertiary (% gross)	World Bank's WDI database

3.3 Data Sources and Processing

The panel data used in this study covers the period from 2010 to 2023, spanning 13 years. The cross-sectional individuals consist of 97 countries worldwide (including high-income, middle-income, and low-income countries, ensuring sample representativeness), with a total of 1,100 observations. The data mainly come from the World Bank's WDI database (World Development Indicators), which is widely adopted in cross-national empirical research (Cenaj & Kilaj, 2025; Nguyen et al., 2026).

During the data processing, the following main tasks were carried out: (1) Data cleaning: Remove observations with missing values for the core variables (gdp_g, trade, credit, gov, edu) to ensure the completeness of the regression sample; (2) Extreme value handling: In the robustness test, perform 1% two-way truncation on the dependent variable and the core explanatory variables, replace extreme outliers, and avoid their interference with the regression results; (3) Descriptive statistics: Test the distribution characteristics of the variables, and the results show that there are no serious abnormalities in each variable, which can be used for subsequent regression analysis.

4. Analysis of Empirical Results

4.1 Descriptive Statistics

Table 2 presents the descriptive statistics of all variables. From the distribution of the data, the mean of the explained variable gdp_g is 3.0686%, the standard deviation is 3.8162%, the minimum value is -17.8212%, and the maximum value is 24.624%, indicating that the economic growth of various countries in the sample varies significantly, including both emerging economies with rapid growth and countries facing recession; the mean of the core explanatory variable trade is 96.6172%, the standard deviation is 64.4280%, and the maximum value reaches 442.62%, while the minimum value is only 22.4862%, reflecting the significant differences in the degree of trade openness among various countries, which conforms to the actual characteristics of the global trade pattern; in terms of control variables, the means of credit, gov, and edu are 70.6070%, 16.9719%, and 54.3505% respectively, and the standard deviations are relatively large, indicating that there are obvious heterogeneities among different countries in terms of financial development, government intervention, and human capital levels, providing a data basis for testing the influence of control variables.

Table 2 Descriptive Statistics of Variables

variable	count	mean	std	min	Max
gdp_g	1100	3.0686	3.8162	-17.8212	24.6240
trade	1100	96.6172	64.4280	22.4862	442.6200
export	1100	47.3276	35.0398	5.1192	222.3085
credit	1100	70.6070	46.2217	9.3277	264.4421
gov	1100	16.9719	5.0477	5.0393	41.8557
edu	1100	54.3505	26.8980	2.1391	166.3896

4.2 Baseline OLS Regression: Comparison of Presence or Absence of Control Variables

Table 3 presents the comparative results of the baseline OLS regression, focusing on the impact of including or not including control variables on the coefficient of trade openness. Column (1) shows the regression result without including control variables, indicating that the coefficient of trade is 0.0015, with a standard error of 0.002. It fails to pass the significance

test at the 10% level, and the model R^2 is only 0.001, suggesting that when only considering trade openness, its explanatory power for economic growth is extremely weak. This might be due to the omission of key influencing factors such as financial development and government size, resulting in the concealment of the core effect.

Column (2) shows the regression result after including all control variables. It indicates that the coefficient of trade rises to 0.0054, with a standard error of 0.002, being significantly positive at the 1% level. The model R^2 also increases from 0.001 to 0.1220, and the F statistic is significant at the 1% level, indicating that the inclusion of control variables not only makes the growth effect of trade openness more apparent but also significantly enhances the overall explanatory power of the model. From the perspective of control variables, the coefficient of credit is -0.0109 (standard error = 0.003, $p < 0.01$), the coefficient of gov is -0.1677 (standard error = 0.024, $p < 0.01$), and the coefficient of edu is -0.0153 (standard error = 0.005, $p < 0.01$), all being significantly negative at the 1% level. This initially suggests that some countries within the sample period may have problems such as financial resource misallocation, excessive government intervention, and insufficient education quality.

Table 3 Baseline OLS Regression Results

variable	(1) Only includes the core explanatory variables	(2) Include all control variables
trade	0.0015	0.0054***
	(0.0020)	(0.0020)
credit	—	-0.0109***
		(0.0030)
gov	—	-0.1677***
		(0.0240)
edu	—	-0.0153***
		(0.0050)
const	2.9417***	7.0000***
	(0.1930)	(0.4110)
R^2	0.0010	0.1220
F-statistic	0.775	37.860***
No. Observations	1352	1100

Notes: *** , ** and * denote significance at 1%, 5%, and 10% levels, respectively.

4.3 Fixed Effect Regression: National FE vs Two-way FE

Table 4 compares the regression results of controlling only for national fixed effects and simultaneously controlling for both national and year-specific fixed effects. Both models include all control variables and focus on analyzing the impact of heterogeneity treatment on the estimation results. Column (1) shows the result of controlling only for national fixed effects, where the coefficient of trade significantly increases to 0.0642, with a standard error of 0.0094, being statistically significant at the 1% level, R^2 is 0.1751, and the F-statistic is also significant at the 1% level, indicating that after controlling for the heterogeneity of countries that do not change over time, the positive effect of trade openness on economic growth is fully released, and the model's explanatory power for the time fluctuations in economic growth is also further enhanced.

Column (2) shows the regression result of two-way fixed effects, where the coefficient of trade is 0.0386, with a standard error of 0.0076, still being statistically significantly positive at the 1% level, but the absolute value of the coefficient is lower than that of the national fixed effects model. R^2 is 0.1531, and the F-statistic is also significant at the 1% level. This result indicates that time shocks (such as the aftermath of the 2008 financial crisis, the 2020 COVID-19 pandemic, etc.) will slightly suppress the growth effect of trade openness, but it does not change its positive core conclusion, and the two-way fixed effect model, which simultaneously controls for country heterogeneity and time shocks, has more reliable estimation results.

From the control variables, credit is significantly negative in both models, and the absolute value of the coefficient is close (-0.0587 vs -0.0603), with standard errors of 0.0091 and 0.0069 respectively, indicating that the negative impact of financial development is stable; the coefficient of gov is -0.4027 (standard error = 0.0709, p<0.01) in the national fixed effects model and drops to -0.1604 (standard error = 0.0556, p<0.01) in the two-way fixed effects model, still being significantly negative but with a weakened intensity; the coefficient of edu is -0.0120 (standard error = 0.0146, p>0.1) in the national fixed effects model and turns positive (0.0073) in the two-way fixed effects model but is not statistically significant (standard error = 0.0133), indicating that the impact of human capital has model dependence.

Table 4 Regression Results of Fixed Effects

variable	(1) Only control for the fixed effects of the country	(2) Two-way fixed effect
trade	0.0642***	0.0386***
	(0.0094)	(0.0076)
credit	-0.0587***	-0.0603***
	(0.0091)	(0.0069)
gov	-0.4027***	-0.1604***
	(0.0709)	(0.0556)
edu	-0.0120	0.0073
	(0.0146)	(0.0133)
const	—	—
R^2	0.1751	0.1507
F-statistic	53.009***	43.734***
National fixed effect	controlled	controlled
Year fixed effect	Uncontrolled	controlled
No. Observations	1100	1100

Notes: *** , ** and * denote significance at 1%, 5%, and 10% levels, respectively.

4.4 Robustness Test

To verify the reliability of the core conclusion, this paper employs two robustness testing methods. The results are shown in Table 5. Both types of tests are based on the two-way fixed effects model framework, ensuring consistency with the baseline model setup.

Column (1) is the core variable robustness test. The export is used to replace the original core explanatory variable, trade openness (trade). The result shows that the coefficient of export is 0.0593, with a standard error of 0.0147, which is significantly positive at the 1% level and consistent with the positive effect of the original core variable; among the control variables, credit is significantly negative (-0.0606, standard error = 0.0070), gov is significantly negative (-0.1242, standard error = 0.0578), and edu is positive but not significant (standard error = 0.0134), which is consistent with the result characteristics of the two-way fixed effect baseline model, indicating that the core conclusion is not affected by the measurement method of the explanatory variables.

Column (2) is the 1% winsorization test. The dependent variable (gdp_g) and the core explanatory variable (trade) are winsorized at the 1% level on each tail, resulting in the processed variables gdp_g_wins and trade_wins. The regression results show that the coefficient of trade_wins is 0.0407, with a standard error of 0.0075, which is significantly positive at the 1% level and close to the coefficient of the original core variable in the two-way fixed effect model (0.0386); the coefficient symbols and significance of the control variables have not fundamentally changed, indicating that the core conclusion is not affected by extreme values.

Table 5 Results of Robustness Test

variable	(1) Core variable replacement	(2) Winsorized at the 1% level
export	0.0593***	—
	(0.0147)	
trade_wins	—	0.0407***
		(0.0075)
credit	-0.0606***	-0.0560***
	(0.0070)	(0.0064)
gov	-0.1242**	-0.1318**
	(0.0578)	(0.0512)
edu	0.0095	0.0007
	(0.0134)	(0.0123)
R^2	0.1429	0.1535
National fixed effect	controlled	controlled
Year fixed effect	controlled	controlled
No. Observations	1100	1100

Notes: *** , ** and * denote significance at 1%, 5%, and 10% levels, respectively.

5. Interpretation of Empirical Results

5.1 The Key Role of Including Control Variables: From "Effect Concealment" to "Real Manifestation"

The comparative results of the baseline OLS regression clearly show that the inclusion of control variables is crucial for identifying the true growth effect of trade openness. When control variables are not included, the trade coefficient is not significant and the model explanatory power is extremely weak. This might be because variables such as financial development and government size have interactions with trade openness. If not controlled, it will lead to omitted variable bias, thereby masking the true effect of trade openness. After including control variables, the trade coefficient is significantly positive and the model explanatory power improves, indicating that the positive impact of trade openness on economic growth is an independent net effect independent of financial development, government size, and human capital. This result is also consistent with the research conclusion of Cenaj & Kilaj (2025), that is, after fully controlling for interfering factors, the growth effect of trade openness can be accurately identified.

5.2 The Impact of Fixed Effect Types: The "Amplification Effect" of Country Heterogeneity and the "Slight Inhibition" of Time Shocks

The comparative results of the fixed effect regression reveal the differentiated impacts of country heterogeneity and time shocks on the growth effect of trade openness. When only controlling for country fixed effects, the trade coefficient is significantly higher than that of the baseline OLS and two-way fixed effect models, indicating that country heterogeneity (such as institutional environment, resource endowment, infrastructure level, etc.) is an important prerequisite for releasing the growth dividend of trade openness. In countries with improved institutions and good infrastructure, trade openness can more smoothly promote growth through channels such as technology spillovers and deepening of division of labor; while in countries with lagging institutions and weak infrastructure, the effect of trade openness may be counteracted (Ayesu et al., 2026). After controlling for time shocks, the trade coefficient slightly decreases but remains significantly positive, indicating that common short-term time factors such as the global economic cycle and the pandemic will have a short-term suppression on the growth effect of trade openness, but will not change its long-term positive trend. This finding also provides a perspective for understanding the fluctuations in the growth effect of trade openness during the period of anti-globalization.

5.3 Analysis of the Effects of Control Variables: The Negative Impact of Financial Development and Government Size

The regression results of the control variables show that financial development (credit) is significantly negative in most models, which is inconsistent with the expectations of traditional financial development theory. The possible reason is that during the sample period, some countries (especially developing countries) had problems of financial resource misallocation - the financial system tended to allocate credit resources to speculative fields such as real estate and stock markets rather than small and medium-sized enterprises and innovative enterprises in the real economy, resulting in financial development failing to effectively support trade openness and economic growth, and instead exacerbating economic fluctuations (Tarchoun & Ghraieb, 2022). The negative impact of government size (gov) indicates that in some countries in the sample, the government intervention was excessive, public expenditure efficiency was low, and there were problems such as corruption and rent-seeking, leading to resource misallocation and suppressing market vitality and the release of trade openness dividends (Cenaj & Kilaj, 2025).

The effect of human capital (edu) is model-dependent. This result is consistent with the research of Lee & Zhao (2025), that is, the impact of human capital on economic growth not only depends on the number of education , but also on the quality and allocation efficiency of education. Although some countries in the sample have a high school enrollment rate, the educational content is disconnected from industrial demands, and highly educated workers engage in low-skilled jobs, resulting in a low marginal output of human capital and an inability to fully manifest the effect.

5.4 The Significance of Robustness Tests: Verification of the Reliability of Core Conclusions

The results of the dual robustness tests further confirm the reliability of the core conclusion of this paper. The core variable substitution test shows that regardless of whether the openness is measured by the proportion of import and export or the proportion of export, its positive effect on economic growth is significant and is not affected by the measurement method of the variable; the 1% winsorization test excludes the distortion of the regression results caused by extreme values, indicating that the growth effect of trade openness is universal and not driven by individual abnormal samples.

6. Conclusion and Policy Recommendations

6.1 Conclusion

The degree of trade openness has a significant and stable positive impact on economic growth. This conclusion holds true under various model settings, including the inclusion of control variables, controlling for national heterogeneity and time shocks, replacing core variables, and handling extreme values. It confirms the long-term growth dividend of trade openness.

The inclusion of control variables and the handling of fixed effects are crucial for the estimation results: Failure to include control variables would mask the true effect of trade openness. After controlling for national heterogeneity, the effect intensity significantly increases. Time shocks slightly weaken but do not change the core conclusion.

Financial development and government size have a negative impact in most models, reflecting that some countries have problems such as financial resource misallocation and excessive government intervention. The effect of human capital has model dependence, and the release of its growth dividend depends on the improvement of education quality and allocation efficiency.

6.2 Policy Recommendations

Maintain a trade liberalization orientation and unleash the benefits of openness. All countries should abandon trade protectionism, actively reduce trade barriers, expand the scale of imports and exports, especially developing countries should actively integrate into the global trading system, absorb advanced technologies and management experience through trade openness, and improve the efficiency of resource allocation. At the same time, attention should be paid to optimizing the trade structure, avoiding excessive reliance on low value-added product exports, and enhancing the sustainability of trade openness.

Optimize the financial system structure and enhance the ability to serve the real economy. In response to the negative impacts of financial development, all countries should strengthen financial supervision, guide credit resources to the real economy, especially small and medium-sized enterprises and innovative enterprises; improve the financial market system, enhance the accessibility and efficiency of financial services, develop inclusive finance, and avoid excessive concentration of financial

resources in speculative fields; developing countries should gradually promote financial marketization reforms, reduce financial fragility.

Reasonably control the size of the government and enhance public governance efficiency. All countries should optimize the structure of government expenditures, reduce unnecessary administrative intervention, and focus on increasing investment in infrastructure, education, and healthcare public products; enhance government governance capabilities, strengthen anti-corruption and integrity building, and improve the efficiency of public expenditure; through streamlining administration and delegating powers, optimizing the business environment, fully stimulate market vitality, and create conditions for the release of trade openness benefits.

Strengthen the quality of human capital and promote effective transformation. All countries should increase investment in education, not only focus on improving the coverage rate of basic education, but also pay attention to the matching of education quality and industrial demands; strengthen the connection between vocational education and higher education, cultivate skilled talents that meet market demands; improve the mechanism for allocating human capital, reduce talent mismatches, and fully utilize the ability of human capital in absorbing the spillover effects of trade openness.

Take into account the heterogeneity characteristics of one's own country and formulate differentiated policies. Developing countries should focus on improving the institutional environment and infrastructure to lay a foundation for the release of trade openness benefits; developed countries should pay attention to the synergy between trade openness and innovation, high-end manufacturing, and further strengthen the spillover effect of technology; all countries need to pay attention to the impact of global time shocks, flexibly adjust trade policies and macro-control measures, and cope with external environmental fluctuations.

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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