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Heterogeneous Effects of Global Value Chain Participation on Economic Growth: An Empirical Study of Fifteen Asian Countries

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Abstract

Based on panel data from 15 Asian countries from 2001 to 2022, this study examines the impact of global value chain (GVC) participation on economic growth from a value-added trade perspective. Using data from OECD-TiVA and the WDI, this paper constructs indicators of overall, forward, and backward GVC participation and estimates their effects with a two-way fixed effects model. The results show that overall GVC participation has a significant negative effect on economic growth. After further decomposition, forward participation exhibits a more significant and robust negative effect, while backward participation does not show stable significance in the baseline regression. Heterogeneity analysis indicates that the growth effect of GVC participation varies across stages: it shows some growth-promoting effects in the low-participation group, whereas negative effects are more pronounced in the high-participation and high-capital-formation groups. Mechanism tests suggest that trade openness and import openness have certain dynamic explanatory power, as their one-period lagged values both exert positive effects on economic growth. The findings suggest that deeper GVC participation does not necessarily lead to better growth outcomes; rather, its growth effect depends on the mode of integration, position in the division of labor, and domestic capacity for value creation.

Keywords

Global Value Chains (GVC), Forward Participation, Backward Participation, Economic Growth, Asian Countries

1. Introduction

With the deepening of economic globalization and the increasing fragmentation of international production, Global Value Chains (GVCs) have become an important form of international trade and

transnational production organization. Unlike traditional trade, which is mainly based on the cross-border exchange of final goods, GVCs emphasize the staged production of goods and services across multiple countries. According to the OECD, about 70% of international trade takes place within GVCs, as services, raw materials, parts, components, and intermediate goods often cross borders several times before reaching final consumers.

Asia is one of the regions with the most intensive GVC linkages and the most active production networks. World Bank data show that although economic growth in East Asia and the Pacific remains faster than in most other regions, it is slowing down, with growth projected at 4.5% in 2025, lower than 5.0% in 2024. This suggests that, amid weak global demand, accelerating supply chain restructuring, and rising external uncertainty, how Asian countries can obtain sustained growth momentum through GVC participation has become an important issue.

It should be noted that although Asian countries are widely involved in GVCs, they differ in their modes of participation, positions in the division of labor, and capacity for value capture. East Asia has become increasingly embedded in GVCs, yet the region as a whole remains in a relatively downstream position, while its internal dependence on core economies such as China and Japan continues to evolve (Ge, Y. Q., & Liu Q., 2020, pp. 5-16, p. 146). South Asian countries generally show a pattern in which backward participation exceeds forward participation.

Against this background, economic growth needs to be examined from a new perspective. On the one hand, GVC participation may promote productivity and growth through technology diffusion, knowledge spillovers, improved access to intermediate inputs, and economies of scale. On the other hand, it may weaken growth gains through processing-and-assembly lock-in, dependence on low-value-added activities, and unequal value distribution. Therefore, GVC participation does not automatically translate into economic growth; its economic effects are complex and conditional (Lee, K., Álvarez, I., & Valarezo, á, 2025, pp. 517-537; Autor, D. H., Dorn, D., & Hanson, G. H., n.d.). Moreover, GVC participation is not a homogeneous concept. From the perspective of value-added decomposition, it can be divided into forward participation and backward participation. Forward participation reflects a country's ability to supply domestic value added to production and final demand in other countries, while backward participation reflects the dependence of a country's export production on foreign intermediate inputs (Kimm, G. S., 2026, pp. 10-28).

Based on this, this paper uses panel data for 15 Asian countries to systematically examine the impact of GVC participation on economic growth from a value-added trade perspective, and further identifies the heterogeneous effects of forward and backward participation. The contribution of this paper is threefold. First, by focusing on Asian countries, it provides regional empirical evidence on the relationship between GVC participation and economic growth. Second, by distinguishing forward and backward participation based on value-added decomposition, it more precisely identifies the growth effects of different modes of GVC integration and helps avoid the interpretive bias that may arise from using a single aggregate participation indicator. Third, by considering the close supply chain linkages and

substantial cross-country differences in production roles within Asia, this paper analyzes the mechanisms underlying heterogeneous effects and provides policy implications for Asian countries seeking to enhance domestic value-added creation and optimize their modes of GVC participation (Chawla, I., & Kumar, N., 2023, p. 100071).

2. Literature Review

2.1 Definition of GVC Participation

Existing studies on Global Value Chains (GVCs) mainly focus on their conceptual definition, modes of participation, positions in the international division of labor, and upgrading paths. Kimm G. S. defines GVCs as cross-border production chains jointly completed by at least two countries, and identifies forward and backward participation as key indicators for measuring how a country is embedded in GVCs (Kimm, G. S., 2026, pp. 10-28). Forward participation reflects the extent to which a country's domestic value added enters foreign production and final demand, while backward participation reflects the share of foreign value added embodied in a country's exports. Compared with traditional gross trade statistics, value-added decomposition provides a more accurate measure of a country's real position and value capture in global production networks.

In regional studies, Ge and Liu find that East Asia has become increasingly embedded in GVCs, but the region as a whole remains in a relatively downstream position. Although China has gradually become the center of the regional network, its role as an "upstream supplier" remains weaker than its role as a "downstream producer" (Ge, Y. Q., & Liu Q., 2020, pp. 5-16, p. 146). Bhusal points out that South Asian countries generally exhibit higher backward participation than forward participation, indicating greater reliance on foreign intermediate inputs in international production and relatively limited capacity to supply domestic value added to foreign final demand (Bhusal, L. B., 2025, p. 100110). In the literature on value chain upgrading, Stojčić and Matić argue that the shift from backward to forward integration is an important form of GVC upgrading, but this process is constrained by development level, innovation conditions, and the diversity of partner networks (Stojčić, N., & Matić, M., 2024, p. 102435). Chawla and Kumar, using India as an example, further show that a higher GVC participation rate does not necessarily imply stronger value-capture capacity (Chawla, I., & Kumar, N., 2023, p. 100071). Therefore, GVC participation is not only about whether a country participates, but also about how and in which segments it participates.

2.2 Studies on the Growth-Promoting Effects of GVC Participation

Some studies emphasize that GVC participation can promote economic growth through technology diffusion, capital accumulation, economies of scale, and improved resource allocation. Lee, Álvarez, and Valarezo argue that capital formation and structural change remain important sources of long-term growth, while integration into global production networks can further support growth by enhancing economic complexity and industrial linkages (Lee, K., Álvarez, I., & Valarezo, Á., 2025, pp. 517-537). From a spatial perspective, Su and Shao find that GVC participation not only promotes local economic

growth but also generates significant spatial spillover effects (Su, D. N., & Shao, C. D., 2017, pp. 48-59). Yang also suggests that improvements in GVC position and transaction efficiency contribute to higher-quality economic growth (Yang, J., 2022, pp. 114-117).

In terms of mechanisms, GVC participation enables developing countries to access higher-quality intermediate inputs, expand exports, and improve productivity. Kimm G. S. notes that participation in GVCs helps developing countries integrate more effectively into international markets, thereby generating growth momentum (Kimm, G. S., 2026, pp. 10-28). Son and Kim further show that forward participation is more likely to generate productivity spillovers when combined with high-tech FDI, while backward participation may improve production efficiency through low-cost intermediate inputs and technological imitation (Son, S. H., & Kim, Y. H., 2025, p. 107341). Overall, these studies support the view that GVC participation can promote economic growth.

2.3 Studies on the Growth-Inhibiting Effects and Heterogeneity of GVC Participation

In contrast, another strand of literature argues that GVC participation does not necessarily generate growth gains and may even constrain economic growth. Autor, Dorn, and Hanson's study of the "China shock" shows that openness and trade expansion may improve aggregate efficiency but can also lead to persistent local labor market adjustment costs and distributional consequences (Autor, D. H., Dorn, D., & Hanson, G. H., n.d.). Liu further finds that the impact of GVC participation on high-quality economic development is not unidirectionally positive; in particular, backward participation may lead to stronger external dependence and low-value-added lock-in (Liu, X. L., 2023). From the perspective of income distribution, Gao, Du, and Yang find that backward participation has a stronger negative effect on the labor income share than forward participation (Gao, Y. S., Du, X. Q., & Yang, C., 2024, pp. 107-125). Tan and Kam, in their study of Malaysian manufacturing, also find that backward linkages are an important driver of rising income inequality (Tan, K. K., & Kam, A. J. Y., 2026, p. 100675). These studies suggest that GVC participation may be accompanied by value leakage, unequal distribution of gains, and industrial lock-in, thereby weakening its growth effects.

Moreover, an increasing number of studies have emphasized the heterogeneous effects of GVC participation. Razzaq et al. find that forward participation is generally more conducive to economic growth, whereas the effect of backward participation varies across income groups (Razzaq, A., Shahbaz, P., Haq, S. U. et al., 2024, p. e35348). Lee, Álvarez, and Valarezo also show that forward and backward participation do not have identical effects on growth (Lee, K., Álvarez, I., & Valarezo, Á., 2025, pp. 517-537). Jangam and Rath point out that forward and backward participation affect inflation dynamics in Asian economies through different mechanisms (Jangam, B. P., & Rath, B. N., 2026, p. 102129). Related studies have further expanded the explanatory boundaries of the economic effects of GVCs from the perspectives of services trade, demographic structure, exchange rate misalignment, environmental constraints, and firm innovation. Ma finds that services trade liberalization affects a country's GVC participation and position in the division of labor (Ma, Y. Y., 2019, pp. 113-127). Wu and Tang's study on population aging and service-sector development suggests that demographic

changes may influence participation in service segments through industrial restructuring (Wu, F. F., & Tang, B. Q., 2018, pp. 103-115, p. 128). Chen, Huang, and Lin show that the relationship between exchange rate misalignment and economic growth is moderated by the degree of GVC integration (Chen, S. S., Huang, Y. T., & Lin, T. Y., 2025, p. 103252). Zheng et al., using Chinese provincial data, find that changes in GVC participation affect the decoupling process between economic growth and carbon emissions (Zheng, J., Wu, S., Li, S. et al., 2025, pp. 193-208). Li and Jeon, as well as Xiaoli L., further show from the perspectives of firm innovation under carbon emissions trading schemes and high-quality economic development that the effects of GVC participation should be assessed in relation to institutional settings and development-quality objectives (Li, X., & Jeon, K., 2025; Xiaoli, L., n.d.). These studies indicate that the economic consequences of GVC participation are highly heterogeneous, and that their direction and magnitude depend not only on a country's development stage but also on its mode of GVC integration and position in the international division of labor.

2.4 Literature Review Summary

In summary, existing studies have systematically examined the definition of GVC participation, countries' positions in the division of labor, upgrading paths, and economic consequences. They have analyzed GVC participation from three main perspectives: growth promotion, growth inhibition, and heterogeneous growth effects. However, several gaps remain.

First, although existing studies commonly distinguish between forward and backward participation, research on their differentiated effects on economic growth still focuses mainly on single countries, regional cases, or specific outcome variables. Systematic comparative evidence at the level of Asian countries remains relatively limited. Second, existing studies place greater emphasis on the role of GVC participation in improving growth quality, productivity, or trade efficiency, while paying insufficient attention to its potential negative effects, especially the problem of "low-end lock-in" faced by developing economies in global production networks. Third, Asian economies have distinctive characteristics in GVCs: on the one hand, their degree of integration continues to increase; on the other hand, although many countries show rising levels of forward participation, this does not necessarily indicate stronger capacity to supply high-value-added products. Instead, it may reflect lock-in in resource-based, primary-processing, or low-end upstream segments. As a result, forward participation may fail to translate effectively into economic growth.

Based on these gaps, this paper uses panel data for Asian countries to systematically examine the effects of overall GVC participation, forward participation, and backward participation on economic growth from a value-added trade perspective, with particular attention to heterogeneous effects. In particular, by considering the possibility of low-end upstream lock-in among Asian economies in global production networks, this paper explains why forward participation may have strong theoretical growth potential but show negative empirical effects, thereby complementing the existing literature.

3. Methodology

3.1 Model Specification

Since the data used in this paper contain both country and time dimensions, and unobservable but relatively stable heterogeneity may exist across countries, this paper adopts a panel data model for estimation. In terms of model selection, an F-test is first used to examine whether individual fixed effects are significant. If the null hypothesis is rejected, the fixed effects model is preferred to the pooled regression model. The Hausman test is then used to compare the fixed effects model with the random effects model. If the test result is significant, the null hypothesis that the random effects model is consistent and efficient is rejected, indicating that the fixed effects model is more appropriate. Based on these tests, this paper finally adopts a two-way fixed effects model to identify the net effect of GVC participation on economic growth after controlling for country and year fixed effects.

The baseline model is specified as follows:

$$\text{Growth}_{it} = \alpha + \beta_1 \text{TGVC}_{it} + \beta_2 X_{it} + \mu_i + \lambda_t + \epsilon_{it} \quad (1)$$

where i denotes country and t denotes year. Growth_{it} represents the economic growth rate; TGVC_{it} denotes GVC participation; X_{it} is a vector of control variables, including inflation, gross capital formation as a share of GDP (GCF), population growth, and foreign direct investment net inflows as a share of GDP (FDI). μ_i represents country fixed effects, λ_t represents year fixed effects, and ϵ_{it} is the random error term.

Considering that GVC participation is not a single-dimensional concept but involves different modes of integration, this paper further decomposes GVC participation into forward and backward participation and constructs the following extended models:

$$\text{Growth}_{it} = \alpha + \beta_1 \text{ForGVC}_{it} + \beta_2 X_{it} + \mu_i + \lambda_t + \epsilon_{it} \quad (2)$$

$$\text{Growth}_{it} = \alpha + \beta_1 \text{BackGVC}_{it} + \beta_2 X_{it} + \mu_i + \lambda_t + \epsilon_{it} \quad (3)$$

In equations (2) and (3), ForGVC_{it} denotes forward participation, and BackGVC_{it} denotes backward participation. By estimating the effects of forward and backward participation separately, this paper compares different modes of GVC integration in terms of effect direction, magnitude, and statistical significance, thereby identifying the heterogeneous growth effects of GVC participation.

This paper further constructs the following mechanism-testing models:

$$M_{it} = \beta_0 + \beta_1 \text{TGVC}_{it} + \beta_2 X_{it} + \mu_i + \lambda_t + \epsilon_{it} \quad (4)$$

$$\text{growth}_{it} = \gamma_0 + \gamma_1 \text{TGVC}_{it} + \gamma_2 M_{it} + \gamma_3 X_{it} + \mu_i + \lambda_t + \epsilon_{it} \quad (5)$$

where M_{it} denotes the contemporaneous mechanism variable, and $M_{i,t-1}$ denotes its one-period lag. Given that GVC integration often affects economic growth through trade linkages and imported inputs with a time lag, this paper reports both the mechanism-variable equation and the lagged mechanism

growth equation. It should be noted that this section is interpreted only as a mechanism test, rather than as strict causal mediation identification. If the mechanism-variable equation is significant, the lagged mechanism variable is significant in the growth equation, and the coefficient of the core explanatory variable changes in a reasonable way, the relevant channel can be considered to have strong dynamic explanatory power. If only some links are significant, the channel is interpreted as having potential explanatory relevance.

3.2 Variable Selection and Description

3.2.1 Dependent Variable

The dependent variable is economic growth rate (Growth), measured by GDP growth (annual %), which reflects the annual growth performance of the sample countries.

3.2.2 Core Explanatory Variables

The core explanatory variables include total GVC-related value added (TGVC), forward GVC value added (ForGVC), and backward GVC value added (BackGVC). TGVC is defined as the sum of ForGVC and BackGVC, representing the overall scale of value added generated through GVC participation. Both ForGVC and BackGVC are constructed based on value-added decomposition indicators from the OECD-TiVA database and are measured in million US dollars at current prices.

Specifically, ForGVC measures the scale of domestic value added embodied in foreign final demand, reflecting a country's capacity to participate in GVCs as a supplier of value added. BackGVC measures the scale of foreign value added embodied in a country's exports, reflecting its dependence on foreign intermediate inputs. Compared with traditional gross trade indicators, these indicators more accurately identify a country's real position in global production networks and its mode of value capture.

3.2.3 Control Variables

To reduce potential omitted-variable bias, this paper includes the following control variables:

- (1) Inflation, measured by consumer prices (annual %), to control for the effect of macroeconomic price fluctuations on economic growth;
- (2) Gross capital formation as a share of GDP (GCF), used to measure the level of capital accumulation;
- (3) Population growth, used to control for the potential effect of demographic changes on economic growth;
- (4) Foreign direct investment net inflows as a share of GDP (FDI), used to control for the effect of international capital flows on economic growth.

3.2.4 Mechanism Variables

To further examine the potential channels through which GVC participation affects economic growth, this paper selects trade openness (ln_trade) and import openness (ln_import) as mechanism variables. Trade openness is measured as the logarithm of total trade in goods and services as a share of GDP, reflecting the overall intensity of a country's external trade linkages. Import openness is measured as the logarithm of imports as a share of GDP, capturing a country's ability to absorb external resources

through imports of intermediate goods, capital goods, and other productive inputs.

3.3 Data Sources and Sample Description

This paper selects 15 Asian countries as the research sample: China, Japan, South Korea, India, Pakistan, Bangladesh, Kazakhstan, Indonesia, Malaysia, Thailand, Vietnam, the Philippines, Singapore, Cambodia, and Laos. A country-year panel dataset is constructed for the period 2001-2022. These countries are selected for two reasons. First, the sample covers East Asia, Southeast Asia, Central Asia, and South Asia, giving it strong regional representativeness. Second, these countries differ substantially in economic development level, industrial structure, degree of openness, and mode of GVC integration, which helps identify the heterogeneous growth effects of GVC participation.

The data are mainly obtained from the OECD Trade in Value Added (TiVA) database and the World Bank World Development Indicators (WDI) database. GVC-related indicators are taken from the OECD-TiVA database, while macroeconomic variables are mainly obtained from the World Bank database. The OECD-TiVA database, based on value-added decomposition, can more accurately capture a country's mode of GVC integration and value-flow characteristics, and has strong international comparability. The World Bank database provides macroeconomic indicators with relatively consistent definitions, making it suitable for constructing cross-country panel data and conducting empirical analysis.

3.4 Descriptive Statistics

To present the distributional characteristics of the main variables more clearly, this paper reports descriptive statistics for economic growth, total GVC participation, forward participation, backward participation, and the control variables. The results are shown in Table 1. Overall, the variables show variation across both countries and years, indicating that the sample has sufficient cross-sectional and time-series variation for subsequent panel regression analysis. The mean of the economic growth rate reflects the overall growth performance of the sample countries, while the means and standard deviations of GVC-related variables indicate clear cross-country differences in both the degree and mode of GVC integration. This provides data support for further examining heterogeneous effects.

Table 1. Descriptive Statistics

Variable	obs	Mean	Std. dev.	Min	Max
growth	330	5.162762	3.254396	-9.518295	14.51975
TGVC	330	289.1202	462.3593	0.418886	3238.254
ForGVC	330	219.3715	378.0573	0.355848	2671.116
BackGVC	330	69.74866	94.12302	0.063038	567.138
Inflation	330	4.466245	4.07357	-1.61068	24.09685
GCF	330	28.0935	6.765779	13.54361	46.2703
popgrowth	330	1.161241	0.7981999	-4.170336	5.321517
FDI	330	4.112446	5.546962	-1.855686	33.30458

3.5 Research Hypotheses

Based on GVC theory, the value-added trade decomposition framework, and related empirical studies, this paper proposes the following hypotheses:

Hypothesis 1 (H1): GVC participation has a significant effect on economic growth.

GVC integration may affect economic growth by improving access to intermediate inputs, strengthening technology diffusion, optimizing resource allocation, and expanding international market linkages. Therefore, a significant relationship is expected between GVC participation and economic growth.

Hypothesis 2 (H2): Forward and backward participation have heterogeneous effects on economic growth.

Forward participation reflects a country's capacity to export domestic value added, while backward participation reflects its dependence on foreign intermediate inputs. Since these two forms of participation differ in their positions in the international division of labor, value-capture logic, and technology spillover mechanisms, their growth effects may differ significantly.

Hypothesis 3 (H3): Forward participation has a more significant effect on economic growth than backward participation.

Forward participation reflects the extent to which a country's domestic value added enters foreign final demand, and is more closely related to its position in the international division of labor, value-creation capacity, and income distribution structure. Therefore, its effect on economic growth may be more direct and significant. Backward participation mainly reflects dependence on foreign intermediate inputs, and its growth effect may be constrained by domestic value-added capacity, technological absorptive capacity, and industrial upgrading ability. As a result, its effect may be relatively weaker or less stable.

4. Results

4.1 Baseline Regression Results

Table 2 reports the baseline regression results for the effect of GVC participation on economic growth. Column (1) uses total GVC participation (TGVC) as the core explanatory variable. The coefficient of TGVC is -0.001 and is significant at the 5% level, indicating that overall GVC participation has a significant effect on economic growth. Therefore, Hypothesis 1, which states that GVC participation significantly affects economic growth, is preliminarily supported. However, the coefficient is negative, suggesting that, within the sample of this paper, deeper GVC integration does not generate the expected growth-promoting effect.

Table 2. Baseline Regression Results

Variable	(1)	(2)	(3)
	growth	growth	growth
TGVC	-0.001** (0.0004)		
ForGVC		-0.001** (0.0005)	
BackGVC			-0.005 (0.0035)
Inflation	-0.061 (0.0508)	-0.060 (0.0510)	-0.064 (0.0505)
GCF	0.060 (0.0496)	0.062 (0.0497)	0.054 (0.0489)
popgrowth	-0.652 (0.4550)	-0.647 (0.4553)	-0.661 (0.4478)
FDI	0.115* (0.0581)	0.112* (0.0579)	0.129** (0.0598)
Country FE	YES	YES	YES
Year FE	YES	YES	YES
N	330	330	330
Within R2	0.5719	0.5721	0.5693

Note. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 2 reports the baseline regression results for the effect of GVC participation on economic growth. Column (1) shows that the coefficient of total GVC participation (TGVC) is -0.001 and is significant at the 5% level. This indicates that GVC participation has a significant effect on economic growth, providing preliminary support for Hypothesis 1. However, the effect is negative.

Columns (2) and (3) replace the aggregate indicator with forward participation (ForGVC) and backward participation (BackGVC), respectively. The results show that the coefficient of forward participation is -0.001 and significant at the 5% level, while the coefficient of backward participation is -0.005 but statistically insignificant. This indicates that forward and backward participation have different effects on economic growth, supporting Hypothesis 2. Moreover, the effect of forward participation is more statistically robust, whereas backward participation is not significant. This suggests that forward participation has a more significant effect on economic growth than backward participation, supporting Hypothesis 3. Overall, the baseline results indicate clear heterogeneity in the growth effects of GVC participation.

4.2 Robustness Tests

To examine the robustness of the baseline results, this paper conducts three additional tests: excluding the pandemic years, introducing one-period lagged core explanatory variables, and applying winsorization. The results are reported in Table 3.

Table 3. Robustness Tests

Variable	(1) growth Excluding pandemic years	(2) growth Excluding pandemic years	(3) growth Lagged	(4) growth Lagged	(5) growth Winsorized	(6) growth Winsorized
ForGVC	-0.002** (0.0006)					
BackGVC		-0.006 (0.0040)				
L.ForGVC			-0.002*** (0.0005)			
L.BackGVC				-0.008** (0.0035)		
ForGVC-winsor					-0.001** (0.0006)	
BackGVC-winsor						-0.004 (0.0037)
Inflation	-0.060 (0.0550)	-0.064 (0.0548)	-0.064 (0.0595)	-0.068 (0.0593)	-0.059 (0.0509)	-0.063 (0.0504)
GCF	0.068 (0.0423)	0.060 (0.0433)	0.080 (0.0519)	0.066 (0.0513)	0.055 (0.0469)	0.049 (0.0453)
popgrowth	-0.541 (0.6838)	-0.545 (0.6889)	-0.539 (0.3877)	-0.544 (0.3894)	-0.989 (0.7662)	-1.001 (0.7503)
FDI	0.121** (0.0488)	0.135** (0.0486)	0.079 (0.0613)	0.101 (0.0667)	0.126** (0.0562)	0.141** (0.0587)
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
N	285	285	315	315	330	330
Within R2	0.3887	0.3850	0.5958	0.5941	0.5741	0.5706

Note. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

First, after excluding observations from 2020 onward, the coefficient of forward participation remains negative and significant at the 5% level, while backward participation remains statistically insignificant. This suggests that the pandemic shock does not alter the main baseline conclusion. Second, after introducing one-period lagged core explanatory variables, forward participation still has a significant negative effect, and backward participation also shows a significant negative effect, indicating that the impact of GVC participation on economic growth may involve a time lag. Finally, after winsorizing the core variables, the coefficient of forward participation remains significantly negative, while backward participation still does not show robust significance. Overall, the robustness tests are broadly consistent with the baseline results. The negative effect of forward participation on economic growth is relatively robust, while the effect of backward participation is weaker. Therefore, the main conclusions of this paper are generally reliable.

4.3 Heterogeneity Analysis

4.3.1 Heterogeneity by Degree of GVC Participation

To further examine stage-specific differences in the effect of GVC participation on economic growth, this paper divides the sample into high-participation and low-participation groups based on the median level of GVC participation. Fixed effects regressions are then conducted separately for forward and backward participation. The results are reported in Table 4.

Table 4. Heterogeneity Test by Degree of GVC Participation

	(1)	(2)	(3)	(4)
Variable	growth High-participation group	growth High-participation group	growth Low-participation group	growth Low-participation group
ForGVC	-0.002*** (0.0004)		0.016* (0.0079)	
BackGVC		-0.012*** (0.0031)		0.019* (0.0088)
Inflation	0.089 (0.0542)	0.127** (0.0529)	-0.057 (0.0747)	-0.052 (0.0811)
GCF	0.034 (0.0549)	0.011 (0.0480)	0.138 (0.1010)	0.146 (0.0984)
popgrowth	-0.108 (0.1031)	-0.162 (0.1172)	-2.987** (1.0347)	-3.042** (1.0301)
FDI	-0.150* (0.0635)	0.183** (0.0546)	-0.040 (0.1085)	-0.013 (0.0981)
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	176	176	154	154
Within R2	0.6782	0.6890	0.6270	0.6313

Note. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The results show clear heterogeneity across countries with different levels of GVC participation. In the high-participation group, the coefficients of forward and backward participation are -0.002 and -0.012, respectively, and both are significant at the 1% level. This indicates that, among countries with a high degree of GVC integration, further increases in either forward or backward participation are significantly negatively associated with economic growth. By contrast, in the low-participation group, the coefficients of forward and backward participation are 0.016 and 0.019, respectively, and both are

significant at the 10% level. This suggests that, for countries with a lower degree of GVC integration, increases in both forward and backward participation generally help promote economic growth.

These findings indicate that the effect of GVC participation on economic growth is not linear or uniform, but has clear stage-specific characteristics. For countries with relatively low levels of integration, further participation in GVCs helps them access technology, markets, and intermediate inputs, thereby generating growth gains. However, for countries already deeply integrated into GVCs, further participation may not continuously generate additional benefits. Instead, it may constrain economic growth through stronger external dependence, value-added lock-in, or diminishing marginal returns.

4.3.2 Heterogeneity by GCF Level

Since capital accumulation may affect a country's ability to absorb GVC spillovers and achieve industrial upgrading, this paper further divides the sample into high-GCF and low-GCF groups based on the average level of gross capital formation as a share of GDP (GCF). Group regressions are then conducted separately, and the results are reported in Table 5.

Table 5. Heterogeneity Test by GCF Level

Variable	(1) growth High-GCF group	(2) growth High-GCF group	(3) growth Low-GCF group	(4) growth Low-GCF group
ForGVC	-0.002*** (0.0003)		0.001 (0.0052)	
BackGVC		-0.007** (0.0028)		-0.004 (0.0100)
Inflation	-0.087 (0.0464)	-0.100** (0.0390)	0.053 (0.0658)	0.048 (0.0648)
GCF	0.071 (0.0568)	0.052 (0.0591)	0.019 (0.0655)	0.010 (0.0697)
popgrowth	-3.879** (1.1246)	-3.772** (0.1172)	-0.332 (0.2306)	-0.350 (0.2240)
FDI	0.005 (0.1033)	0.033 (0.1160)	0.058 (0.0693)	0.074 (0.1011)
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	176	176	154	154
Within R2	0.6476	0.6313	0.6709	0.6718

Note. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The results show that, in the high-GCF group, the coefficients of forward and backward participation are -0.002 and -0.007, respectively, and are significant at the 1% and 5% levels. This indicates that, in countries with higher levels of capital accumulation, both forward and backward participation have significant negative effects on economic growth. By contrast, in the low-GCF group, the coefficients of forward and backward participation are 0.001 and -0.004, respectively, and neither is statistically significant. This suggests that, in countries with lower levels of capital accumulation, different modes of GVC integration do not have significant effects on economic growth.

These results indicate that capital accumulation affects the growth effects of GVC participation. For countries with higher levels of capital accumulation, although they have stronger investment capacity and a better industrial base, if their GVC integration remains concentrated in low-value-added segments, deeper forward or backward participation may reinforce external dependence and low-end lock-in, thereby constraining economic growth. For countries with lower levels of capital accumulation, insufficient capital accumulation limits their capacity to absorb technology spillovers and achieve industrial upgrading, making the growth effect of GVC participation difficult to realize. Overall, capital accumulation does not eliminate the complexity of the relationship between GVC participation and economic growth; rather, it further shows that this relationship is jointly constrained by domestic development foundations and absorptive capacity.

4.4 Mechanism Tests

4.4.1 Mechanism Variable Equation

To further identify the potential transmission channels through which GVC participation affects economic growth, this paper uses trade openness and import openness as the core mechanism variables and introduces their one-period lags into the growth equation to capture a more economically plausible dynamic transmission process. Since mechanism tests are more susceptible to over-control, Table 6 reports the mechanism variable equations under a relatively parsimonious control specification, retaining only GCF, population growth, and two-way fixed effects. The results show that BackGVC has a marginally significant positive effect on trade openness, while ForGVC has a significantly negative effect at the 5% level. In the import openness equation, BackGVC also has a positive effect at the 10% level, whereas ForGVC has a significantly negative effect at the 5% level. These findings suggest that backward participation is more conducive to expanding trade linkages and access to imported inputs, while within-country changes in forward participation are associated with lower openness. This provides a basis for the subsequent dynamic mechanism test.

Table 6. Estimation Results for Core Mechanism Variable Equations

Variable	(1) ln_trade	(2) ln_import
BackGVC	0.003* (2.130)	0.003* (2.030)
ForGVC	-0.001** (-2.670)	-0.001** (-2.390)
GCF	0.002 (0.390)	0.002 (0.230)
popgrowth	0.005 (0.180)	-0.022 (-0.550)
Country FE	Yes	Yes

Year FE	Yes	Yes
N	330	330
Within R2	0.3617	0.2756

Note. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. This table reports results from a parsimonious control specification, retaining only GCF, population growth, and two-way fixed effects to identify the core mechanism chain.

4.4.2 Growth Equation with Mechanism Variables

Table 7 further incorporates the core mechanism variables into the growth equation. The results show that L1.ln_trade has a positive effect on economic growth at the 10% significance level, indicating that improvements in overall trade openness promote growth in the following period. More importantly, L1.ln_import has a positive effect on economic growth at the 5% significance level, with stronger statistical significance than L1.ln_trade. This suggests that, in the sample of Asian countries, external factor absorption through imports of intermediate goods, capital goods, and key productive inputs may be a more direct channel through which GVC participation affects growth. Compared with the previous finding that contemporaneous mechanism variables are insignificant, the lagged specification better accords with the economic logic that the effect of GVC participation on growth involves a transmission lag, and it provides more complete mechanism evidence. Additional tests show that industrial structure and high-tech export capacity do not form stable transmission chains. Therefore, the subsequent analysis mainly focuses on the two dynamic mechanisms of trade openness and import openness.

Table 7. Growth Equation with Mechanism Variables

Variable	(1) Dynamic trade channel	(2) Dynamic import channel
BackGVC	-0.004 (-0.850)	-0.005 (-0.970)
ForGVC	-0.001 (-0.810)	-0.001 (-0.750)
L1.ln_trade	2.234* (1.780)	
L1.ln_import		2.574** (2.610)
GCF	0.095* (1.900)	0.096* (2.030)
popgrowth	-0.660** (-2.200)	-0.604** (-2.350)
Country FE	Yes	Yes
Year FE	Yes	Yes
N	315	315
Within R2	0.5958	0.6074

Note. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. This table reports dynamic mechanism tests using forward and backward participation variables together with one-period lagged core mechanism variables.

5. Discussion

The results of this paper show that the effect of GVC participation on economic growth is highly heterogeneous. In the baseline regression, both overall participation and forward participation have significant negative effects on economic growth, while the effect of backward participation is unstable. This suggests that, in the sample of Asian countries, deeper GVC integration does not necessarily translate into growth gains.

This result may be related to Asian countries' positions in global production networks. Although some countries have increased their level of forward participation, their value-added exports may still be concentrated in resource-based products, primary processed goods, or low-value-added intermediate goods, rather than in high-tech and high-value-added segments. Therefore, higher forward participation does not necessarily imply value chain upgrading; instead, it may reflect lock-in in low-end upstream supply activities.

The heterogeneity tests further show that the effect of GVC participation is stage-specific. For low-participation countries, deeper integration helps them access markets, technologies, and intermediate inputs, thereby generating certain growth-promoting effects. However, for high-participation countries, further integration may face diminishing marginal returns, stronger external dependence, and insufficient value capture. The negative effects observed in the high-capital-formation group also suggest that capital accumulation alone does not guarantee gains from GVC participation. The key issue is whether capital can support industrial upgrading.

The mechanism tests show that trade openness and import openness have certain dynamic transmission effects. The one-period lagged values of trade openness and import openness both promote economic growth, indicating that the growth effect of GVC participation does not occur immediately, but gradually materializes through trade linkages and the absorption of imported inputs. Overall, GVC participation itself is not a sufficient condition for growth. Improving the quality of integration and strengthening domestic value-creation capacity are more important.

6. Conclusion

Based on panel data from 15 Asian countries from 2001 to 2022, this paper examines the heterogeneous effects of GVC participation on economic growth. The results show that overall GVC participation has a significant negative effect on economic growth. After decomposition, forward participation has a more stable negative effect, while backward participation is insignificant in the baseline regression. The robustness tests generally support these findings.

Further heterogeneity analysis shows that the growth effects of GVC participation differ across stages. In the low-participation group, both forward and backward participation show certain growth-promoting effects. By contrast, in the high-participation group and the high-capital-formation group, both types of participation have significant negative effects. The mechanism tests indicate that trade openness and import openness have certain dynamic explanatory power, as their one-period

lagged values both have positive effects on economic growth.

This paper argues that deeper GVC participation is not always better. For Asian countries, whether GVC participation promotes growth depends on the mode of integration, position in the value chain, and domestic absorptive capacity. Policy should therefore shift from expanding the scale of participation to improving the quality of participation. By strengthening technological absorptive capacity, domestic value-added creation, and the efficiency of converting imported inputs into productive capacity, Asian countries can better transform GVC integration into long-term growth momentum.

This paper still has some limitations. Due to constraints in sample coverage and data level, the analysis is mainly conducted at the country level and does not further identify transmission mechanisms at the industry or firm level. Future studies may use more disaggregated data to examine the specific channels through which GVC participation affects economic growth.

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