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# Will falling domestic labor compensation share really be improved when global trade slowdown?

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The participation of Global Value Chains (GVCs) in the world's major economies has changed from rising to falling since 2010. Based on GVCs income, SDA method and multiple panel regression, this paper explores the cross-cycle effect, mechanism and persistence paths of GVCs participation on domestic labor compensation share in 51 economies from 2000 to 2018. The paper concludes that the overall effect of participating in GVCs on domestic labor compensation share is negative. However, forward participation in GVCs perform better than backward GVCs participation in stabilizing domestic labor compensation share. Capital-biased technological progress and availability of overseas labor are conditions under which the GVCs participation undermines domestic labor compensation share. This paper propose to seize the opportunity to increase the labor compensation share through measures and policies, such as promoting fair competition in domestic market, servitization of industrial structure and the establishment of relational value chains.

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## Introduction

Since the 1980s, information technology and trade liberalization have reduced trade costs and made vertical specialized production and task trade possible. This has led to the emergence of global value chains (GVCs). Participating in GVCs means a broader market, higher production efficiency, and faster growth of national wealth (Baldwin and Lopez-Gonzalez, 2015). Developed countries such as the U.S., Germany, and Japan, as well as developing economies like China, Vietnam and Ethiopia have experienced growth in per capita income, national welfare and better jobs after participating in GVCs (De Loecker et al., 2016; Antràs et al., 2017; Kangile et al., 2021). According to the World Development Report study, for every 1% increase in GVCs participation, per capita income increases by more than 1% (World Bank, 2020). However, whether the national wealth growth effect of participating in GVCs is equally distributed among individuals remains to be studied.

According to some scholars, GVCs are one of the most important features of 21st-century capitalism and have created crucial effects on the decline in domestic labor compensation share (Sell, 2019). This is because most of the revenue generated by GVCs is concentrated among a few large multinational companies, and only a small part of these gains is passed on to consumers and other suppliers. From a cross-country perspective, the higher the participation of GVCs in developing countries, the lower its markups. Over half (55%) of the value added in GVCs is concentrated in only 21 countries (Timmer et al., 2014). From the gender dimension, women are mostly placed in low-skilled positions and rarely in leadership and management positions (Velu et al., 2009; World Bank and IFC, 2014; Muñoz-Boudet et al., 2018).

Compared with the research on the cross-country perspective and gender dimension, this paper makes the following improvements in three aspects.

1. We exclude the interference of technology and consumption structure on the causal relationship between GVCs participation and domestic labor compensation share. First, this paper introduces the SDA method of Solow (1958) and Acemoglu and Guerrier (2008) to decompose domestic labor compensation share. The SDA method helps us fully identify multiple factors, such as intra-industry income distribution effect, intermediate product substitution effect, multiplier effect of industry linkage, and demand structure upgrading effect, affecting domestic labor compensation share. Intermediate product substitution effect and multiplier effect of industry linkage were determined by *GVCParticipation* and *GVCPar<sub>forwards</sub>*, and other effects are added to the benchmark regression model as control variables. The regression results in Table 4 show that GVCs participation is the sole determinant for falling labor compensation.
2. From the perspective of overseas labor availability, we explain why the SS theorem faces challenges under vertical specialization and fragmented value chain. In classical “cloth-for-wine” trade, it is difficult for foreign labor factor to participate in domestic intermediate production. According to the Stolper-Samuelson theorem (SS theorem), if an economy intensively employs domestic labor factors to participate in exports production, the price of domestic labor factors will rise. In a world of fragmentation, however, the theorem’s validity is undermined. Outsourcing and trade in intermediate goods prevailed, and foreign labor could be used for domestic production. Mechanism analysis results in Table 8 show that participation in GVCs will enhance availability of overseas labor. When competing for the same job, wages for the domestic labor force are suppressed by cheap labor abroad (Harrigan and Balaban, 1999; Antràs et al., 2006; Verhoogen,

2008). Hence, availability of overseas labor can explain the paradox that the intensive employment of labor leads to a decline in domestic labor compensation share. Conditions for causal relationship between GVCs participation and domestic labor compensation share are gradually being revealed.

3. Faced with the dilemma of efficiency and fairness, this paper proposed that forward participation in GVCs increased domestic trade benefits without reducing the labor compensation share. Economies participating in GVCs have higher economic growth and total factor productivity (TFP) than economies that do not. This paper proves that GVCs participation is the determinant for falling labor compensation share. However, forward participation in GVCs does not significantly reduce domestic labor compensation share. Backward participation in GVCs is the main cause of imbalances in labor and capital distribution. This implies that the participation of GVCs that occupy the upstream linkages and provide intermediate products for downstream linkages performs better than the GVCs participation mode of importing a large number of foreign intermediate products and occupying the downstream assembly and processing linkages in terms of increasing domestic labor compensation share.

The remainder of this paper is organized as follows: In “Literature review and hypothetical formulation”, we review relevant literature on the relationship between GVCs participation and domestic labor compensation share to formulate testable hypotheses. In “Methodology”, we describe the concept and measurement of GVCs participation, participation position, domestic labor compensation share, and econometric model. In “Empirical analysis”, we present the benchmark model, mechanism identification, and persistence paths of effects of GVCs participation on labor compensation. Finally, we conclude this paper in the last part.

## Literature review and hypothetical formulation

**The effect of GVCs participation on domestic labor compensation share.** The relationship between GVCs participation and domestic labor compensation was first studied by Timmer et al., (2014), which sparked heated discussions among scholars. With the emergence of corresponding measurement methods and indicators, such as GVCs value-added decomposition and GVCs income, the negative effects of participating in GVCs on domestic labor compensation share began to be recognized (Aguiar de Medeiros and Trebat, 2017; Barton, 2017).

Firms embedded in GVCs adopt more capital-intensive technologies than other domestic firms, which is considered to be an important reason for the decline in the labor compensation following the increase in GVCs participation share in developing economies (Bernard, et al., 2018). The increased participation of GVCs has exacerbated the asymmetry between labor and capital in the bargaining process (Becker et al., 2013; Shepherd and Stone, 2013). The case study of Vicol et al., (2018) pointed out that the trade gains obtained by the Indonesian coffee industry after embedding in GVCs were captured by key individuals with capital, which exacerbated imbalance in the distribution of labor and capital income.

Participation in GVCs not only reduces domestic labor compensation in developing countries but also has a negative impact on labor and capital distribution in developed countries. For instance, Hummels et al., (2014) matched Danish employee and employer data from 1995 to 2006 and found that Danish offshoring increased the income of high-skilled human capital and lowered the income of the domestic low-skilled labor force. Borghi and Crinò, (2013) further confirm that offshoring will widen the gap between capital and labor compensation within advanced economies using Italian income distribution data.

In summary, if an economy’s participation in GVCs increases, its labor compensation share would be negatively affected. Whether this economy is offshoring its own tasks or taking over GVCs linkages from other countries; whether this economy is a member of the G7 group or developing countries in Saharan Africa, the following hypothesis is formed:

H1. The domestic labor compensation share is negatively affected by participation in GVCs.

**Analyzing the mechanism of GVCs participation affecting domestic labor compensation share.** The current literature not only focuses on the relationship between GVCs participation and labor compensation share, but also attempts to explore the mechanism by which GVCs participation expands uneven distribution of labor and capital. The mechanism of participating in GVCs to widen the inequality of labor and capital distribution is discussed from the following two aspects: capital-biased technology and availability of overseas labor.

Both firm-level and country-level analyses show that after embedding in GVCs, economies at all income levels have increased demand for human capital and capital-biased technology (Goldberg and Pavcnik, 2007; Shepherd and Stone, 2013). Capital-biased technology progresses faster than labor-biased technology and is considered to be one of the important reasons for the decline in domestic labor compensation share of OECD countries (Bentolina and Paul, 2003; Guscina, 2006). Compared with tasks undertaken by developed economies, although the tasks assigned by GVCs to developing economies are relatively low-tech, these tasks are still high-tech and capital-biased relative to other jobs in the country (Feenstra and Hanson, 1996; 1997). Thus, participation in GVCs also increases the demand for skilled workers and capital-biased technology in developing economies and puts upward pressure on the unequal distribution of labor and capital.

In a fragmented world, the restrictions that make it difficult for labor to move across borders are gradually being broken, and labor from developing countries has entered the world market (World Bank, 2020). The substantial increase in overseas labor supply has put upward pressure on the price elasticity and geographic elasticity of labor demand. This has become another mechanism for participating in GVCs to reduce domestic labor compensation share (Milberg, 2004; Zhang, 2015; Marjit and Kar, 2019). For example, Brazil’s Sinos Valley shoe industry was OEM for Nike and adidas, focusing on the manufacturing process. It was quite prosperous in the 1960s. But in the 1990s, it was quickly replaced by Chinese manufacturing with more price advantages (Schmitz, 1999; Bazan and Navas-Alemán, 2004; Schmidt et al., 2020). Similarly, the increased availability of overseas labor has also hit labor compensation in developed countries. The outsourcing of manufacturing tasks and the pressure of competition from foreign industries have led to a decline in the income of U.S. industrial workers and the emergence of a “rust belt” (Autor et al., 2016). Hence, this paper proposes the following mechanism hypothesis:

H2a. Capital-biased technological progress is one of the mechanisms by which increased participation in GVCs reduces domestic labor compensation share.

H2b. Increased availability of overseas labor is one of the mechanisms by which participation in GVCs reduces the share of domestic labor compensation share.

**Methodology**

This section first introduces the methods, such as KWW and GVCs income for measuring GVCs participation and domestic labor

compensation share. Next, to prove that the causality is really from GVCs participation to labor compensation share, the SDA methodology is used to fully identify GVCs participation and other variables that affect labor compensation share. Furthermore, we not only set these variables to the benchmark regression model, but also construct mechanism models to further identify conditions under which GVCs participation affects labor compensation share. Finally, this section presents data sources for empirical analysis with these methods and identification strategies.

**Measuring the GVCs participation with KWW method**

*Decomposing the value-added in export by employing KWW method.* This paper adopts the KWW method (Koopman et al., 2014) to decompose the value-added. As shown in Eq. (1), if the value-added decomposition matrix *VB* is multiplied by the export matrix *E*, the domestic and foreign distribution of the value-added in export will be measured as follow.

$$VBE = \begin{bmatrix} V_r B_{rr} \hat{E}_r & V_r B_{rs} \hat{E}_s & V_r B_{rt} \hat{E}_t \\ V_s B_{sr} \hat{E}_r & V_s B_{ss} \hat{E}_s & V_s B_{st} \hat{E}_t \\ V_t B_{tr} \hat{E}_r & V_t B_{ts} \hat{E}_s & V_t B_{tt} \hat{E}_t \end{bmatrix} \quad (1)$$

Each matrix on the diagonal of the block matrix *VBE* represents the domestic value-added in export for the exporting country. The sub-diagonal matrices in the off-diagonal matrix represent the value-added that foreign countries absorbed from export products. Taking country *r* as an example, the domestic value-added in export *DV* and foreign value-added in export *VS<sub>r</sub>* are shown in Eqs. (2) and (3):

$$E_r = DV_r + VS_r \quad (2)$$

$$DV_r = V_r B_{rr} \hat{E}_r \quad VS_r = V_s B_{sr} \hat{E}_r + V_t B_{tr} \hat{E}_r \quad (3)$$

Equation (4) presents the value-added *IV<sub>r</sub>* that country *r* absorbs from foreign exports. According to *VS<sub>r</sub>*, *IV<sub>r</sub>* and *E<sub>r</sub>*, the GVCs participation index in various economies would be measured in the following part.

$$IV_r = V_r B_{rs} \hat{E}_s + V_r B_{rt} \hat{E}_t \quad (4)$$

*Indicators for GVCs participation index.* There are three indicators that can reflect the change trajectory of GVCs participation in various economies, namely backward linkages, forward linkages and GVCs participation index. In Eq. (5), Koopman et al., (2010) call the value-added absorbed by other countries in domestic exports as backward linkages (*GVCP<sub>ar</sub>Backward*). At the same time, Koopman et al., (2010) defined the forward linkages (*GVCP<sub>ar</sub>Forward*) as the value-added absorbed by domestic firms from other countries’ exports. Both two indicators reflect the economic phenomenon of products or services that have crossed national boundaries for several times and cooperation in which companies from upstream to downstream create value-added. These are all regarded as signs of the increasing of GVCs participation (Wang et al., 2017). Koopman et al., (2010) sum the forward linkages and backward linkages to propose the *GVCP<sub>ar</sub>Participation* in Eq. (6).

$$GVCP_{ar}Backward = \frac{VS_r}{E_r} = \frac{V_s B_{sr} \hat{E}_r + V_t B_{tr} \hat{E}_r}{E_r} \quad (5)$$

$$GVCP_{ar}Forward = \frac{IV_r}{E_r} = \frac{V_r B_{rs} \hat{E}_s + V_r B_{rt} \hat{E}_t}{E_r}$$

$$GVCP_{ar}Participation = GVCP_{ar}forward + GVCP_{ar}backward = \frac{IV_r + VS_r}{E_r} \quad (6)$$

Wang et al., (2017) argue that if an economy or sector’s forward linkages are greater than the backward linkages, it is a symbol that

**Table 1 Average GVCs Participation index of major economies from 2000 to 2018.**

Economies	$GVCPar_{Forward}$	$GVCPar_{Backward}$	$GVCParticipation$	Labor compensation
Russia	34.99	8.80	43.79	51.06
Australia	26.15	12.42	38.57	58.08
Japan	26.85	13.04	39.89	55.31
the U.S.	23.92	10.50	34.42	59.50
Slovakia	18.73	43.94	62.67	47.57
China	16.71	20.06	36.77	49.48
Vietnam	13.40	41.23	54.63	43.42
Mexico	10.21	34.21	44.42	35.21

OECD, Inter-Country Input-Output (ICIO), Database and International Labor Organization Statistics (ILOSTAT).

the economy is in the upstream of GVCs. In Table 1, countries such as Australia, Russia, and Japan have high forward linkages and low backward linkages. These countries are mainly engaged in the upstream linkages of GVCs, such as raw material supply, R&D (World Bank, 2020), which supply intermediate products to downstream linkages of GVCs. Countries like Vietnam, Mexico and Slovakia have high backward linkages and low forward linkages. They focus on the downstream linkages of GVCs such as manufacturing, assembly and processing. These countries have strong demand for intermediate from upstream countries, which participate in GVCs by introducing and processing intermediate products from upstream countries. From the perspective of the position of participating in GVCs, the last column of Table 1 shows that economies participating in GVCs from upstream have a higher share of labor compensation than those from downstream participating in GVCs. Therefore, the influence of GVCs participation position on labor compensation share could be presented by forward participation ( $GVCPar_{Forward}$ ) and backward participation ( $GVCPar_{Backward}$ ).

To fully reflect the degree of participation in GVCs, the sum of forward linkages backward linkages need to be employed. Adopting the GVCs participation index ( $GVCParticipation$ ) to describe the alternate process of globalization and de-globalization is helpful to explore whether globalization has widened the income gap, and whether de-globalization is the timing to adjust income distribution (Baldwin and Lopez-Gonzalez, 2015; Antràs, 2020). In Table 1, countries with low  $GVCParticipation$ , such as the U.S., Japan and Australia, show a higher share of labor compensation than those with high  $GVCParticipation$ . It also revealed clues that the degree of participation in GVCs affects the share of labor compensation.

Hence, this paper elaborates on the impact of participation in GVCs on the share of labor compensation from the two aspects of participation position and degree of participation, respectively. We would employ three GVCs participation indicators:  $GVCPar_{Forward}$ ,  $GVCPar_{Backward}$  and  $GVCParticipation$ .

**Measuring the availability of overseas labor with GVCs income method.** The trend of world manufacturing and fragmentation is becoming more obvious when GVCs participation is prevalent. A country could not only create jobs through its own production activities, but also obtain jobs by undertaking outsourcing tasks from foreign countries. The quantity of qualified labor that multinational corporations in developed countries obtain from overseas determines labor prices of outsourcing tasks.

GVCs income method (Timmer et al., 2013) could both decompose the domestic and foreign contributions of domestic employment, and measure how much offshore foreign labor the domestic country employs directly and indirectly. Based on the data of the domestic labor force engaged in domestic and foreign tasks, and the total labor compensation in various countries, the

per capita income of labor force would be measured. Hence, the labor price and wage level in each country would be reflected.

This paper defines  $L$  as the labor force coefficient vector. The element  $l_{ri}$  represents the amount of  $labor_{ri}$  input to produce a unit of gross output product  $x_{ri}$ . The quantitative relationship of workflow across borders could be expressed by Eq. (8). The number of jobs  $DL_s$  retained in country  $s$ , the number of jobs  $FL_s$  leaving country  $s$ , and the number of jobs  $IL_s$  flowing into country  $s$  from the outsourcing of other countries are shown in Eq. (9). After country  $s$  outsources tasks, the amount of labor it hires from overseas is the  $FL_s$ . We employ this indicator to measure the availability of overseas labor.

$$l_{ri} = labor_{ri}/x_{ri} \tag{7}$$

$$LBY = \begin{bmatrix} L_r B_{rr} \hat{Y}_r & L_r B_{rs} \hat{Y}_s & L_r B_{rt} \hat{Y}_t \\ L_s B_{sr} \hat{Y}_r & L_s B_{ss} \hat{Y}_s & L_s B_{st} \hat{Y}_t \\ L_t B_{tr} \hat{Y}_r & L_t B_{ts} \hat{Y}_s & L_t B_{tt} \hat{Y}_t \end{bmatrix} \tag{8}$$

$$DL_s = L_s B_{ss} \hat{Y}_s FL_s = L_r B_{rs} \hat{Y}_s + L_t B_{ts} \hat{Y}_s IL_s = L_s B_{sr} \hat{Y}_r + L_s B_{st} \hat{Y}_t \tag{9}$$

The GVCs income method would also create conditions for measuring labor prices. Equations (10) and (11) divide a country's gross value-added (GDP) into the labor compensation ( $GDP_{labor}$ ) and capital compensation ( $GDP_{capital}$ ) according to the proportion of factors contributing to GDP.

$$v = \frac{va}{x} = \frac{va_{labor} + va_{capital}}{x} = v_{labor} + v_{capital} \tag{10}$$

$$GDP = GDP_{labor} + GDP_{capital} = V_{labor}BY + V_{capital}BY \tag{11}$$

The average labor price shown in Eq. (12) is derived based on the total labor compensation and the number of domestic employment.

$$GVCs_{wage} = \frac{GDP_{labor}}{GVCs_{job}} = \frac{DV_{labor} + IV_{labor}}{DL + IL} \tag{12}$$

**Model design and variables selection**

*Benchmark model design.* This paper attempts to analyze whether a shift in GVCs participation from rising to falling would improve domestic labor compensation share. The benchmark regression model is as follows:

$$Laborshare_{rt} = \alpha_0 + \alpha_1 GVCParticipation_{rt} + \alpha_j \sum Control_{rt} + u_r + u_t + \epsilon_{rt} \tag{13}$$

Where  $r$  represents an economy and  $t$  stands for the year. The explained variable labor compensation as a share of GDP

$Laborshare_{it}$  and the core explanatory variables GVCs participation index  $GVCParticipation_{it}$ .

In order to prove that the causality really is from GVCs participation to labor compensation share, the following identification strategy is designed. First, this paper introduces the method of Solow, (1958) and Acemoglu and Guerrier, (2008) to decompose the  $Laborshare$ , which helps us fully identify the multiple factors affecting the  $Laborshare$ . Then, we test whether GVCs participation is the sole determinant for falling  $Laborshare$  after selecting the control variables for other influencing factors.

$$Laborshare = \frac{GVCs_{wage} \times labor}{GDP} = \frac{GDP_{labor}}{GDP} = 1^T \text{diag}(ml) \text{diag}(\theta) [I - \text{diag}(1 - \theta)A^T]^{-1} \gamma \tag{14}$$

Solow, (1958) and Liu, (2022) use the structural decomposition analysis (SDA) to split the  $Laborshare$ . As shown in Eq. (14),  $1^T = (1, 1, \dots, 1)$  is the row vector with element 1. For any vector  $\Delta$ , define  $\text{diag}(\Delta)$  as a diagonal matrix with elements in vector  $\Delta$  as diagonal elements and non-diagonal elements as 0.  $ml = (ml_1, ml_2 \dots ml_n)^T$  is the labor marginal output vector of the industry  $i$ .  $\theta = (\theta_1, \theta_2, \dots, \theta_n)^T$  is the output elasticity vector of the production vector of the industry  $i$ .  $[I - \text{diag}(1 - \theta)A^T]^{-1}$  is equivalent to the famous Leontief inverse matrix.  $\gamma = (\gamma_1, \gamma_2, \dots, \gamma_n)^T$  is the household expenditure composition vector. The  $Laborshare$  is equal to the product of four parts as follows:

1. The income distribution relationship between labor and capital within the industry  $i$ . According to Solow's definition, the change in the country  $r$ 's  $Laborshare$  caused by the change of labor compensation share within the industry is called the intra-industry distribution effect. The level of industrial technology will affect the process of capital substituting labor within the industry (Feenstra and Hanson, 1996; 1997).
2.  $\theta$  reflects the proportion of production factor inputs in industrial output (value-added rate). The proportion of intermediate product inputs and production factor inputs show a trade-off relationship.  $GVCParticipation$  is a driving force in the substitution of inputs such as labor by intermediate product.
3.  $[I - \text{diag}(1 - \theta)A^T]^{-1}$  is equivalent to the famous Leontief inverse matrix, which represents the role of input-output structure and industrial linkages in GVCs. The larger the elements of the Leontief inverse matrix, the stronger the dependence of the associate industries on that industry. Wang et al., (2017) refers to the  $GVCParticipation$  that industry  $i$  provides intermediate products for industry  $j$  as forward GVCs participation ( $GVCPar_{forward}$ ). Forward participation has a multiplier effect that makes the industry's  $Laborshare$  amplified in the macro economy (Bigio and La'O, 2020).
4. The elements of vector  $\gamma$  represent the proportion of industry  $i$ 's final product in the final demand of all industries, which can be interpreted as the final product demand structure. High-end manufacturing uses capital intensively, and life service industries use labor intensively. Changes in consumption structure and industrial structure upgrading will change the  $Laborshare$ .

**Variable selection.** This paper identifies the factors affecting  $Laborshare$ , such as (1) product technology, (2) GVCs participation, (3) forward participation, and (4) consumption structure using the SDA method. GVCs participation ( $GVCParticipation$ ), forward participation ( $GVCPar_{forward}$ ), and backward

participation ( $GVCPar_{backward}$ ) are the core explanatory variables in the benchmark model (13). Other influencing factor are reflected in the control variables.

$\sum Control_{rt}$  is the set of control variables. This paper uses technological sophistication index ( $TSI$ ) to reflect the impact of product technology on the labor compensation share within the industry. Wang et al., (2021) employ technological sophistication index to characterize product technology when investigating the impact of technological progress on labor compensation shares in 44 major world economies such as China, the U.S. and Japan. This paper follows this practice with Eqs. (17) and (18).

$$TSI_{it} = \sum_r \frac{E_{rit}/E_{rt}}{\sum_r (E_{rit}/E_{rt})} M_{rt} \tag{15}$$

$$ES_{rt} = \sum_t \frac{E_{rit}}{E_{rt}} TSI_{it} \tag{16}$$

$$Tech_{rit} = \frac{DV_{rit}/DV_{rt}}{\sum_r DV_{rit}/\sum_r DV_{rt}} M_{rit} * IP_{rit} = RVCA_{rit} * M_{rit} * IP_{rit} \tag{17}$$

$$VTech_{rt} = \sum_i \frac{DV_{rit}}{DV_{rt}} Tech_{rit} \tag{18}$$

Based on the improved  $TSI$  of Wang et al., (2021), we characterize the technical level of each economy and industry in value chains. As shown in Eqs. (17) and (18): (1) the export value  $E$  in Eqs. (15) and (16) is replaced by the domestic value-added in export  $DV$  to adapt to the changes in the international trade from the industrial level to the value chain. (2) After adding the payments for the use of intellectual property  $IP_{ist}$ , the ability of the economy to absorb overseas technology using RVCs or GVCs will be reflected. The income per capita  $M_{ist}$  would be considered as the labor productivity of economy  $i$ , which reflects the ability of the economy to achieve endogenous technological upgrading by relying on the domestic market.  $RVCA_{ist}$  reveals the ability of an economy to connect domestic market, resources and international market, resources from the perspective of international competitiveness. Hence, the overall technological sophistication of economy  $r$  under the value-added and GVCs perspective is represented by  $VTech_{rt}$ .

Furthermore, considering the impact of changes in consumption structure on the  $Laborshare$ , this paper employs the proportion of final product consumption in the service industry to the whole final consumption to reflect the consumption structure ( $CS_r$ ) of the economy  $r$ . Finally, the control variables reflect the effect of capital accumulation ( $KL$ ) and high-skilled labor ( $Highskill$ ) on the  $Laborshare$ .

**Mechanism model design.** The conditions under which GVCs participation affects domestic labor compensation share are also an important issue in the model setting of this paper. Moderating effect analysis is used to investigate how the influence of GVCs participation on domestic labor compensation share varies with object characteristics and actual conditions. Identifying these conditions can help clarify robust paths by which participation in GVCs leads to a decline in domestic labor compensation share. The causal relationship between GVCs participation and labor compensation share will also be further examined.

Moderating effect 1: capital-biased technological progress

Equations (19) and (20) test whether capital-biased technological progress is one of the conditions under which GVCs

**Table 2 Descriptive statistics.**

Variable	Mean	Standard deviation	Minimum	Maximum	Observations
Laborshare	49.21%	9.2%	22.27%	68.83%	969
GVCParticipation	45.14%	10.07%	21.42%	80.16%	969
GVCPar <sub>Forward</sub>	18.35%	4.99%	7.26%	38.87%	969
GVCPar <sub>Backward</sub>	26.79%	11.53%	6.08%	68.29%	969
VTech	57.38	119.61	844.44	0.04	932
CS	51.10%	19.32%	10.18%	97.93%	969
Highskill	11.25%	13.57%	0.05%	56.94%	932
KL	0.16	0.12	0.03	0.54	947
TB	55.73%	26.84%	11.26%	90.05%	969
FL	6223.24	9370.79	50.35	52057.31	969

The author calculated the data based on the OECD input-output database, TiVA database, WIOD and World Bank database.

participation undermines domestic labor compensation share.

$$TB_{rt} = \beta_0 + \beta_1 GVCParticipation_{rt} + \beta_j \sum Control_{rt} + u_r + u_t + \varepsilon_{rt} \tag{19}$$

$$Laborshare_{rt} = \delta_0 + \delta_1 GVCParticipation_{rt} + \delta_2 TB_{rt} + \delta_3 GVCParticipation_{rt} * TB_{rt} + \delta_j \sum Control_{rt} + u_r + u_t + \varepsilon_{rt} \tag{20}$$

According to the criterion of ‘bias of technical change’ (Hicks, 1932), this paper adopts the factor output elasticity to construct the bias of technical change coefficient (TB). The larger the coefficient, the more capital-biased technological progress. If capital-biased technological process occurs, the marginal output of capital is greater than the marginal output of labor, enhancing the negative effect of GVCs participation on domestic labor compensation share.

Moderating effect 2: Availability of overseas labor

In the era of economic globalization, outsourcing and task trade are prevalent. When overseas labor availability is rich, a substantial increase in overseas labor supply inhibits the rise in wages of domestic labor for the same jobs. When the availability of overseas labor is poor, trade in value-added reverts to the classical ‘‘cloth-for-wine’’ trade. According to the SS theorem, an economy’s intensive use of its own labor factors will push up domestic labor prices (Stolper and Samuelson, 1941). Hence, Eqs. (21) and (22) test whether availability of overseas labor is one of the conditions under which GVCs participation undermines domestic labor compensation share.

$$FL_{rt} = \chi_0 + \chi_1 GVCParticipation_{rt} + \chi_j \sum Control_{rt} + u_r + u_t + \varepsilon_{rt} \tag{21}$$

$$Laborshare_{rt} = \phi_0 + \phi_1 GVCParticipation_{rt} + \phi_2 FL_{rt} + \phi_3 GVCParticipation_{rt} * FL_{rt} + \phi_j \sum Control_{rt} + u_r + u_t + \varepsilon_{rt} \tag{22}$$

FL<sub>rt</sub> represents the availability of overseas labor for the economy r in year t, expressed by the amount of offshore foreign labor employed directly or indirectly by economy r for producing domestic final product Y<sub>r</sub> as shown in Eq. (9). The H2b hypothesis proposes that increased labor availability will enhance the negative effect of GVCs participation on domestic labor compensation share.

**Data.** The labor compensation share (Laborshare), capital stock per capita (KL) and availability of overseas labor (FL) data are calculated based on the social economic accounts of the world input-output database (WIOD), the employment and GVCs accounts of

the OECD Trade in Value-Added (TiVA) database. The GVCs participation indexes GVCParticipation, GVCPar<sub>forward</sub>, GVCPar<sub>backward</sub> are calculated based on the 2000–2018 World Input-Output Table released by the OECD (IOTs-OECD). TSI is also obtained from OECD TiVA database (Domestic value-added content of gross exports & Gross exports accounts) and patent fee data in the World Bank database (Charges for the use of intellectual property). The International Labor Organization Statistics (ILOSTAT) provides data on the share of the high-skilled workforce (Highskill). There are a total of 66 economies in the OECD database. After excluding the economies with missing data, the data of 51 economies<sup>1</sup> are selected for empirical analysis. Table 2 provides some descriptive statistics of the mentioned variables. The unit of the capital stock per capita (KL) is million dollars. The unit of the availability of overseas labor (FL) is thousand people. Table 3 demonstrate the correlation analysis, which indicates that most of the variables have a correlation with labor compensation share. Correlation coefficient indicates a strong negative correlation between GVCs participation index and labor compensation share.

**Empirical analysis**

This section examines the cross-cycle effect, mechanism and persistence paths of GVCs participation on domestic labor compensation share. First, this section proves that GVCs participation is the solo determinant for falling domestic labor compensation share after controlling for multiple factors through benchmark regression analysis. Then, the robustness test proves that the causal relationship between the core explanatory variable and the explained variable is reliable. Endogenous analysis confirms that the direction of causality is from GVCs participation to labor compensation share. Furthermore, mechanism analysis reveals conditions under which GVCs participation reduces domestic labor compensation share. Finally, we exclude interference from the year period, economic development and embedding position on the causal relationship between GVCs participation and domestic labor compensation share using heterogeneity analysis.

**The impact of GVCs participation on domestic labor compensation share**

*Analysis of benchmark model results.* This part reports on the impact of GVCs participation on domestic labor compensation share to answer whether globalization would inevitably widen the domestic income gap and whether anti-globalization would help income equalization. GVCs participation and control variables fully represent the four types of influencing effects identified by the SDA method in Eq. (14). Furthermore, we discuss not only the overall effect of the degree of participation in GVCs but also

**Table 3 Correlation analysis.**

	Laborshare	GVCParticipation	GVCPar <sub>Forward</sub>	GVCPar <sub>Backward</sub>	VTech	CS	Highskill	KL	TB	FL
Laborshare	1									
GVCParticipation	-0.38***	1								
GVCPar <sub>Forward</sub>	0.17	0.10***	1							
GVCPar <sub>Backward</sub>	-0.45***	0.09***	0.51***	1						
Vtech	0.44***	0.13***	0.06*	0.09**	1					
CS	0.35**	-0.18	0.14**	0.39**	0.15*	1				
Highskill	0.22***	0.34***	0.21***	0.21***	0.19***	0.46***	1			
KL	0.47***	0.31***	0.24***	0.11***	0.24	0.23*	0.35**	1		
TB	-0.31**	0.27**	0.35	0.33***	0.56**	0.26	-0.42	0.59***	1	
FL	-0.35***	0.24***	0.06***	0.16***	0.43***	0.10	0.27*	0.47**	0.39	1

The author calculated the data based on the OECD input-output database, TIVA database, WIOD and World Bank database. \*\*\*, \*\*, \* represent the significance level of 10, 5, and 1% respectively.

the structural effects of the manner of participation in GVCs. As shown in Table 1, economies that focus on upstream participation in GVCs and downstream participation in GVCs show great differences in terms of GVCs participation and labor compensation share. The structural effects of participation in GVCs are divided into forward participation (*GVCPar<sub>Forward</sub>*) and backward participation (*GVCPar<sub>Backward</sub>*). By comparing the size and significance of the regression coefficients, we demonstrate the effective pathway to control domestic income inequity while participating in GVCs.

Table 4 reports the impact of GVCs participation on labor compensation share, which includes both overall and structural effects. Columns (1) and (2) report the regression results of the overall effect. As shown in column (2), GVCs participation become the solo determinant for the falling domestic labor compensation share. Among the four types of effects, such as product technology (Intra-industry income distribution effect), GVCs participation (intermediate product substitution effect), forward participation (multiplier effect of industry linkage) and consumption structure (demand structure upgrading effect), identified by the SDA method, only the GVCs participation significantly reduced domestic labor compensation share. These empirical results confirm our first hypothesis (H1). When global trade slowdown, the decline in GVCs participation leads to an increase in domestic labor compensation share. For every 1% decrease in GVCs participation, domestic labor compensation share will increase by 0.11%. This is why some scholars believe that GVCs are one of the most important features of “21st century capitalism” (Guscina, 2006; Jayadev, 2007). Hence, anti-globalization policies such as increasing tariffs and manufacturing delocation are used to increase domestic labor compensation share.

Columns (3) and (4) present the regression results of upstream GVCs participation (*GVCPar<sub>Forward</sub>*) in the structure effect. The empirical results illustrate that upstream participation in GVCs does not significantly change the labor compensation share. This result is consistent with the phenomenon in Table 1 that economies with upstream participation in GVCs, such as the U.S., Japan, and Australia, have a higher share of labor compensation. It also sheds light on the pathway of participating in GVCs while controlling the falling labor compensation share. That is to say, only when the accumulation of technology, human capital, service consumption, and physical capital is abundant enough to support the economy’s embedding in high value-added upstream linkages can domestic labor compensation share resist the negative impact of globalization.

Columns (5) and (6) report the results of regression analysis of downstream GVCs participation (*GVCPar<sub>Backward</sub>*) in the structure effect. Empirical results show that downstream participation in GVCs significantly reduces the labor compensation share. This is consistent with the rapid decline in the share of labor compensation after emerging economies such as China and Vietnam have successively participated in downstream linkages

like assembly and processing. Combining the results of structural effects and overall effect, it can be concluded that the increase in downstream participation in GVCs is the main source for the decline in labor compensation share.

*Robustness test results analysis.* The mainstream robustness test methods are divided into two categories: robustness test by changing the sample interval and robustness test by replacing indicators. Since the global financial crisis in 2008 had a major impact on GVCs, the participation of GVCs fluctuated wildly. To reduce the impact of violent fluctuations in the participation of GVCs in individual years on the regression results, this paper excludes the data of 2008 and 2009. The remaining 17 years’ data is employed for robustness testing. The regression results of the sample subintervals are shown in columns (1), (2) and (3) of Table 5. In column (1), the overall impact of GVCs participation on labor compensation share remains negative. In the structural effect presented by columns (2) and (3), upstream participation in GVCs still wouldn’t significantly change labor compensation share, while downstream participation in GVCs is the main source for the decrease in labor compensation share.

To avoid the regression bias of specific indicators on the regression results, an alternative indicator of the explained variable is adopted in this paper. The Gini coefficient is used to replace labor compensation share. The Gini coefficient is one of the commonly used indicators to measure domestic income gap. The larger the indicator, the more unequal an economy’s income is. Since the capital is occupied by a few people and labor is a factor that everyone owns, the decline in the labor compensation share is closely related to the domestic income inequality. If the regression results before and after the replacement variables are robust, it will further prove the causal relationship between GVCs participation and domestic labor compensation share. The regression results in column (4) of Table 5 show that the overall effect of participating in GVCs on the Gini coefficient is positive, meaning that globalization has widened domestic income inequality. After the robustness test replaced the indicator of the explanatory variables, GVCs participation still exacerbated the imbalance in labor and capital income distribution. The results of structural effects in columns (5) and (6) report that upstream participation in GVCs significantly reduces income gap, while downstream participation in GVCs will exacerbate income inequality. Because the results of the robustness test are consistent with the results of the benchmark model, it proves that the estimation results in this paper are reliable. The robustness test further confirms Hypothesis H1.

*Endogenous test.* The natural link between trade and national wealth makes it necessary to pay attention to endogeneity issues in international economics research. Severe endogeneity would make least squares estimation results biased and inconsistent. A common approach is to find instrumental variables that are closely related to participation in GVCs but independent of labor

**Table 4 The impact of GVCs participation on labor compensation share.**

	(1)	(2)	(3)	(4)	(5)	(6)
<i>GVCParticipation</i>	-0.10*** (-2.74)	-0.11*** (-2.77)				
<i>GVCPar<sub>Forward</sub></i>			0.07 (1.30)	0.08 (1.37)		
<i>GVCPar<sub>Backward</sub></i>					-0.09*** (-2.98)	-0.09*** (-3.01)
<i>VTech</i>		0.002 (0.69)		0.001 (0.88)		0.001 (0.90)
<i>CS</i>		0.01*** (4.28)		0.007*** (4.05)		-0.004 (-1.16)
<i>Highskill</i>		0.04*** (3.47)		0.04*** (3.46)		0.04*** (3.58)
<i>KL</i>		0.06 (1.15)		0.03 (0.83)		0.06 (0.73)
Constant term	0.53*** (38.82)	0.50*** (34.72)	0.48*** (51.23)	0.45*** (42.50)	0.51*** (68.91)	0.52*** (42.70)
Observations	920	920	920	920	920	920
R <sup>2</sup>	0.17	0.62	0.16	0.57	0.17	0.66

The t-statistic of the coefficient are in parentheses. \*\*\*, \*\*, \* represent the significance level of 10, 5, and 1% respectively.

**Table 5 Robustness test results.**

	(1)	(2)	(3)	(4)	(5)	(6)
<i>GVCParticipation</i>	-0.11*** (-2.83)			3.57** (2.40)		
<i>GVCPar<sub>Forward</sub></i>		0.06 (1.02)			-12.54*** (-4.71)	
<i>GVCPar<sub>Backward</sub></i>			-0.09*** (-2.99)			5.93*** (4.09)
$\sum Control_t$	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Constant term	0.55*** (32.50)	0.50*** (41.35)	0.50*** (63.01)	0.15** (2.49)	2.82*** (5.40)	0.63*** (3.37)
Observations	800	800	800	920	920	920
R <sup>2</sup>	0.29	0.32	0.33	0.66	0.72	0.75

The t-statistic of the coefficient are in parentheses. \*\*\*, \*\*, \* represent the significance level of 10, 5, and 1% respectively.

compensation share and perform two-stage least squares estimation.

This paper selects the trade flow measured by the “gravity model” and the foreign trade dependence in 1980 as instrumental variables, drawing on the practice of Frankel and Romer, (1999). Both the trade flow calculated by the “gravity model” and foreign trade dependence could be used as indicators to measure the degree of economic participation in the international division of labor, and are closely related to the participation of GVCs. At the same time, the “gravity model” obtains trade flows based on the geographical factor of bilateral distance, which is independent of the labor compensation share. The foreign trade dependence in 1980 is the earliest country-industry level historical data found in this paper, and it is also regarded as an exogenous variable.

Table 6 presents the regression results of the endogeneity test. Column (1) shows the regression result between labor compensation share and one period of lag in GVCs participation (*lag GVCParticipation*). The coefficients of variables are consistent and significant with the benchmark regression results. Column (2) lists the two-stage least square regression results of labor compensation share and GVCs participation as instrumental variables of trade flow and foreign trade dependence. The test results indicate that the selection of instrumental variables is appropriate. The above regression results confirm that the causal relationship really is from GVCs participation to domestic labor compensation share after the endogeneity test.

**Mechanism analysis**

*GVCs participation, bias of technical change and domestic labor compensation share.* Countries such as China and Vietnam have rapidly established modern industrial sectors by combining cheap domestic labor with foreign technology (Baldwin and Lopez-Gonzalez, 2015; World Bank, 2020). However, the technological progress produced by participating in GVCs is more inclined to capital, which directly affects the labor-capital distribution ratio

of the country (Acemoglu, 2003). Therefore, this section discusses whether more capital-intensive technological innovation is the mechanism by which GVCs participation inhibits the rising share of domestic labor compensation.

Columns (1) and (2) of Table 7 report the results in Eqs. (19) and (20). The regression results in column (1) show that an increase in GVCs participation leads to capital-biased technological progress. Specifically, for every 1% increase in GVCs participation, capital-biased technological progress increases by 0.37%. Column (2) reports the effect of the interaction term of capital-biased technical change and GVCs participation on the labor compensation share. The interaction term in Eq. (20) has a significant negative impact on domestic labor compensation share. This suggests that changing technical bias is one of the pathways through which GVCs participation affects labor compensation share, thus confirming our second hypothesis (H2a).

*GVCs participation, availability of overseas labor and domestic labor compensation share.* The deepening of vertical specialization of GVCs has led to an increase in the overseas labor force indirectly employed by countries importing intermediate products (Timmer et al., 2014). The availability of overseas labor is closely related to GVCs participation and labor compensation share. It is an important channel for multinational corporations to restrain the rising wages of emerging economies’ labor. This part explores whether the volatility of participation in GVCs would change the availability of overseas labor and then affect the labor compensation share. Recently, the U.S.-China trade friction and the Covid-19 pandemic have caused some GVCs linkages to be decoupled. It has become more difficult for multinational companies to obtain overseas labor (Stiglitz, 2021). This not only increases labor wages in developed countries but also coincides with the timing when some emerging economies, such as China, became middle-income countries (Baldwin and Freeman, 2020). The mechanism test model is shown in Eqs. (21) and (22).



Columns (3) and (4) of Table 7 report the results of the mechanism test regression analysis. As shown in column (3), the 51 economies studied in this paper have significantly improved their ability to acquire foreign labor by participating in GVCs. For every 1% increase of GVCs participation, the number of employed overseas labor would increase by 1.01%. This indicates that the assumption of SS theorem that labor only flows between sectors is changed. Economies with scarce labor factor can also use foreign labor at low prices to serve domestic production with the help of GVCs. Column (4) presents the interference of the quantity of labor force acquired overseas by the above-mentioned economies on the relationship between globalization and labor compensation share. Empirical results show that the intersection of overseas labor availability and GVCs participation in Eq. (22) has a negative impact on the labor compensation share. This implies that increased overseas labor availability is the mechanism by which an economy's labor compensation share decreases after participating in GVCs. Hence, empirical results confirm our final hypothesis (H2b).

**Further analysis.** In this part, heterogeneity analysis is adopted to further demonstrate that GVCs participation is the cause of the decline in domestic labor compensation share. Drawing on an analytical framework for new trade theory that economies without comparative advantages can also participate in international trade through economies of scale (Krugman, 1979), we design the following research framework to exclude interference from the year period, economic development, and embedding position on the causal relationship between GVCs participation and domestic labor compensation share.

*Period heterogeneity.* In 2008, the financial crisis swept the world. Indicators such as international trade volume and FDI fell off a cliff. The slowdown in the process of economic globalization is reflected in the fact that the GVCs participation in the world's major economies has turned from rising to declining. The impact of changes in the overall trend of GVCs participation on domestic labor compensation share is worth considering. To exclude the interference of period heterogeneity on causality, this paper employs 2008 as the cut-off point to design the dummy variable *crisis* of financial crisis. The period before the financial crisis is assigned a value of 0, and the period after the financial crisis is assigned a value of 1.

Column (1) of Table 8 reports the regression results for period heterogeneity. The regression coefficient for GVCs participation was significantly negative, suggesting that participation in GVCs prior to the 2008 financial crisis reduced domestic labor compensation share. Column (1) also shows that the regression coefficient of the interaction term *GVCParticipation* and *crisis* is significantly negative, indicating that the inhibitory effect of GVCs participation on domestic labor compensation share has been enhanced after the outbreak of the financial crisis.

*Development heterogeneity.* Economies vary in terms of economic growth rates, science and technology, national income and social welfare. These factors may affect an economy's labor compensation share. This paper analyzes the heterogeneity of economic development based on advanced economies. The degree of economic development is set as a dummy variable *Advanced*. Based on the International Monetary Fund's (IMF) definition of developed economies, this paper classified economies with a per capita GDP of more than \$30,000 in the sample as developed economies and assigns them a value of 1. Economies with a GDP per capita of less than \$30,000 are defined as developing economies and assigned a value of 0.

Column (2) of Table 8 shows that the effect of GVCs participation on domestic labor compensation share is significantly negative. In economies at similar levels of economic development, the domestic labor compensation share will also decline due to the increase in GVCs participation. The regression coefficient of the interaction term *GVCParticipation* and *Advanced* is not significant, indicating that there is no significant difference in the causality relationship of GVCs participation and labor compensation share in developed economies compared with emerging economies.

*Position heterogeneity.* Table 1 shows that there are differences in the GVCs position among countries. This part perform a group regression test on all country samples divided into manufacturing linkages and non-manufacturing linkages to test whether GVCs participation is a determinant of lower labor compensation share

**Table 6 Endogenous test.**

	(1) Lag	(2) IV
<i>GVCParticipation</i>		-0.16** (-2.51)
<i>lagGVCParticipation</i>	-0.18*** (-3.99)	
$\sum Control_t$	Controlled	Controlled
Kleibergen-Paap rk LM statistics		49.33***
Kleibergen-Paap Wald rk F statistics		36.56 [19.26]
Hansen statistics		0.00
Constant term	0.61*** (17.32)	0.28*** (3.04)
Observations	457	325
R <sup>2</sup>	0.41	0.35

The t-statistic of the coefficient are in parentheses. "\*\*\*", "\*\*", "\*" represent the significance level of 10, 5, and 1% respectively.

**Table 7 GVCs participation, the availability of overseas labor and labor compensation share.**

	Technological bias		Overseas labor	
	(1) TB	(2) Laborshare	(3) FL	(4) Laborshare
<i>GVCParticipation</i>	0.37** (1.97)	-0.10** (-2.59)	1.01** (2.51)	-0.11*** (-3.28)
<i>GVCParticipation*TB</i>		-0.01*** (-7.15)		
<i>GVCParticipation*FL</i>				-0.03** (-2.70)
$\sum Control_t$	Controlled	Controlled	Controlled	Controlled
Constant term	10.55*** (137.83)	0.51*** (36.41)	4.71*** (30.26)	0.67*** (37.15)
Observations	920	920	920	920
R <sup>2</sup>	0.59	0.29	0.45	0.37

The t-statistic of the coefficient are in parentheses. "\*\*\*", "\*\*", "\*" represent the significance level of 10, 5, and 1% respectively.

**Table 8 Group and time varying test regression results.**

	Time (1)	Development (2)	Position (3)
<i>GVCParticipation</i>	-0.18*** (-3.05)	-0.15*** (-3.17)	-0.12*** (-4.59)
<i>GVCParticipation</i> × <i>crisis</i>	-0.07** (-2.42)		
<i>GVCParticipation</i> × <i>Advanced</i>		0.05 (1.05)	
<i>GVCParticipation</i> × <i>Manufacturing</i>			-0.09** (-2.14)
$\Sigma Control_t$	Controlled	Controlled	Controlled
Constant term	1.32*** (6.02)	0.74*** (4.83)	1.19*** (5.37)
Observations	920	920	920
R <sup>2</sup>	0.72	0.69	0.71

The t-statistic of the coefficient are in parentheses. \*\*\*, \*\*, \* represent the significance level of 10, 5, and 1% respectively.

in economies embedded in similar position of GVCs. This paper analyzes heterogeneity of GVCs position based on manufacturing linkages. The position of embedding in GVCs is set as a dummy variable *Manufacturing*. This paper adopts the World Bank's, (2020) classification methodology, which defines economies with backward participation in manufacturing greater than 15% and service & manufacturing accounting for more than 80% of domestic value-added in export as GVCs manufacturing linkages and assigns them a value of 1. Economies that do not meet the above criteria are defined as non-manufacturing linkages and assigned a value of 0.

Column (3) of Table 8 reports the regression results for position heterogeneity. The regression coefficient for GVCs participation was significantly negative, indicating that GVCs participation is a determinant of lower labor compensation share in economies embedded in similar position of GVCs. Column (3) also shows that the regression coefficient of the interaction term *GVCParticipation* and *Manufacturing* is significantly negative, suggesting that the decline in labor compensation share affected by GVCs participation is more serious in GVCs manufacturing linkages.

### Conclusion

This paper empirically analyzes the relationship between GVCs participation and domestic labor compensation share using data from 51 economies in the OECD Input-Output Database from 2000 to 2018. The analysis is conducted from four aspects: effects identification, benchmark regression, mechanism analysis, and persistence paths. Based on the results obtained from this analysis, the following conclusions are drawn:

**The domestic labor compensation share is negatively affected by participation in GVCs.** The regression results of this paper show that for every 1% decrease in GVCs participation in 51 economies, the domestic labor compensation share will increase by 0.11%. Therefore, although reduced participation in GVCs has brought losses to participants' production efficiency and trade gains, it is also an opportunity to release the potential of domestic demand and optimize the distribution structure of labor and capital. As global trade slows down, export-oriented economies face a shift from being deeply embedded in GVCs to building National Value Chains (NVCs). This paper proposes promoting fair competition in the domestic market through the Anti-Monopoly Law and correcting the problem of some large enterprises obtaining monopoly profits through capital expansion.

**Capital-biased technological progress and availability of overseas labor are conditions under which GVCs participation undermines domestic labor compensation share.** The results of mechanism analysis show that every 1% increase in capital-biased technological progress and availability of overseas labor will further

reduce the already low labor compensation share by 0.01 and 0.03%, respectively. Under intermediate products trade and vertical specialization, there are paradoxes where intensive use of labor forces reduces domestic labor wages for the same job (the SS theorem fails), and an increase in production efficiency like artificial intelligence (AI) reduces employment. To reverse the trend of low labor compensation share and even continued decline after participating in GVCs, this paper suggests: (1) absorbing more domestic employment and changing the situation of excessive capital bias in technology by promoting the development of the tertiary industry and export of service products; (2) setting increasing minimum wages and reasonable economic growth targets to correct capital-biased technological progress from aspects of development goals and factor price constraints, promoting technological progress in accordance with domestic resource endowments; (3) implementing redistributive policies such as taxes and transfers, as well as human capital improvement measures such as skill training and continuing education to ensure the welfare and employment of the domestic labor force that has been hit by cheap overseas labor from GVCs participation.

**Forward participation in GVCs is a path to balance efficiency and equity.** This paper compares the effects of forward participation in GVCs and backward participation in GVCs on domestic labor compensation share. Forward participation in GVCs performs better than backward GVCs participation in stabilizing domestic labor compensation share. This also explains the international strategic adjustment of both emerging and developed countries to adopt policies and measures, such as "manufacturing returning to the USA", "Endless Frontier Act", and "the new development paradigm", to increase forward participation and reduce backward participation (Khandelwal and Fajgelbaum, 2022; Chor and Li, 2021). When the world's major economies aim to increase the export of intermediate goods and import substitution, competition for upstream linkages of GVCs will be extremely fierce. At present, as China continues to upgrade in GVCs, the GVCs position between China and established powers is approaching, leading to frequent trade frictions and decoupling actions. To transform competition and conflict into synergy and cooperation, this paper proposes establishing a series of regional trade agreements (RTAs), such as the North American Free Trade Agreement (NAFTA) and Regional Comprehensive Economic Partnership (RCEP), setting aside disputes, and promoting relational value chains that are both imported and exported (Gereffi and Korzeniewicz, 1994). At the same time, this paper calls on economies to take into account the interests of other countries when paying attention to domestic labor compensation share. Only when emerging economies and advanced economies re-establish a consensus on the value of GVCs will the choices and policies made by economies around GVCs participation be effective.

Our research suffers from some limitations. First, variables related to GVCs participation and embedded position are all accounted for through value-added decomposition, thus there is a risk of multicollinearity in our regression model. Second, we preliminarily reveal that change in GVCs participation is an important condition for the validity of the SS theorem. To demonstrate this finding more rigorously, it is necessary to explore and compare theoretical models before and after relaxing the assumption of free labor mobility. This facilitates proving our inferences about revalidation of the SS theorem as participation declines. In follow-up studies, we will focus on key industries that participate in GVCs and their effects on domestic labor compensation share from an industrial perspective. Finally, our future research direction will also include whether technology spillover from developed countries to developing countries is capital-biased or labor-biased.

### Data availability

The datasets analyzed during the current study are available in the Dataverse repository: <https://doi.org/10.7910/DVN/PTQI8U>. The author calculated the data based on the OECD input-output database, TiVA database, WIOD, International Labor Organization Statistics (ILOSTAT) and World Bank database. The URLs for each database are as follows. OECD IO database: <https://www.oecd.org/sti/ind/input-outputtables.htm>. Tiva: [https://stats.oecd.org/Index.aspx?DataSetCode=TIVA\\_2021\\_C1](https://stats.oecd.org/Index.aspx?DataSetCode=TIVA_2021_C1). WIOD IO database: <https://www.rug.nl/ggdc/valuechain/wiod/?lang=en>. ILO-STAT database: <https://ilostat.ilo.org/>. World Bank database: <https://data.worldbank.org/>

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### Note

1 The 51 economies selected in this paper include all 38 OECD member countries and 13 non-membership economies. These 51 economies specially involve Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica Czech-Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Israel, Italy, Japan, South Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherland, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, Argentina, Brazil, Bulgaria, China, Croatia, Cyprus, India, Indonesia, Malta, Romania, Russia, Saudi Arabia, and South Africa.

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LW designed the study, performed the research, and wrote the paper. TSR was responsible for the revision of the paper.

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### Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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### Additional information

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