Manufacturing Localization, Technology Backfire, and Economic De-globalization

Qu Shenning*, and Yang Danhui
Institute of Industrial Economics (IIE), Chinese Academy of Social Sciences (CASS), Beijing, China

Abstract: *Since the global financial crisis, global value chain (GVC) have been contracting amid the trend toward economic de-globalization. With GVC participation rate in mind as the core indicator of economic de-globalization, in this paper we create a multi-country general equilibrium model to characterize the mechanism by which manufacturing localization affects GVC participation rate. Our theoretical derivation shows that changes in the local manufacturing status of final products in various countries directly influence the GVC participation rate of those countries. When the local proportion of a country's final products reaches a certain level, rising local proportion of intermediate inputs, economic growth below the world average level, and technology progress all cause the country's GVC participation rate to decline, giving rise to de-globalization at the manufacturing and trade levels. We further provide a comprehensive interpretation based on an empirical test of the deep-seated causes of economic de-globalization in relation to such economic phenomena as increasing trade concentration, the "technology backlash" effect of the new industrial revolution, and economic growth driven by the combined forces of trade protectionism and quantitative easing.*

Keywords: *Manufacturing localization, technology backfire, new industrial revolution, de-globalization, new development paradigm*
JEL Classification Code: E23, F41, L16
DOI: 10.19602/j.chinaeconomist.2023.01.04

1. Introduction

The global financial crisis that erupted in 2008 was followed by stagnation in the expansion of GVC that lasted for three decades (UNCTAD, 2018). By estimating changes in GVC participation rate, researchers have found that as the world's largest trading nations and the leading emerging and advanced economies, China and the United States saw their GVC participation rate decline since 2011 and 2010, respectively. In 2015, US GVC participation rate fell to 54.28%, down to the level of 2004, which is a decrease of 7.74 percentage points from the peak of 2010 (see Figure 1). Aside from China and the United States, other major trading nations led by Germany, Japan, and South Korea also experienced contractions in their GVC participation rate. Such a reverse evolution of economic globalization is often referred to as "de-globalization", which is defined in this paper as a trend of international economic cooperation disparate from the previous round of globalization driven by capital and labor costs.[1] As

* CONTACT: Qu Shenning, email: qushenning@163.com.
Acknowledgements: This paper is a result of the major project under the National Social Science Fund of China (NSSFC), "Advancing New-Type Industrialization and the Optimization and Upgrade of the Economic System" for interpreting the spirit of the Fifth Plenary Session of the 19th Communist Party of China (CPC) Central Committee (21ZDA021) and the Innovation Project of the Chinese Academy of Social Sciences (CASS), "Study on the High-Quality Development of Emerging Industries." This study is also supported by the Peak Strategy of the Chinese Academy of Social Sciences (CASS).

the primary vehicle of the international division of labor, GVC have been a hallmark of globalization over the years, and falling GVC participation rate suggests that economic de-globalization has become a reality as the global production structure based on traditional comparative advantages has been undergoing profound transformations (Carvalho, 2015).

Manufacturing localization has become the most salient feature of the evolution of the global production structure. Changes in the productivity of final products and intermediate inputs in various countries as a key manifestation of manufacturing localization largely reflect the direction and paradigm of the international division of labor (Johnson, 2014). From the 1980s to the early 2000s, outward and dispersive changes occurred in the global production structure, and this period coincided with an acceleration of economic globalization. After 2004, however, domestic final products as a share of the total consumption of final products ("local proportion of final products") and domestic intermediate inputs as a share of total intermediate inputs ("local proportion of intermediate inputs") ceased to decrease for major industrial economies such as China and the United States, whose manufacturing localization has reshaped the global production structure.

Amid a new round of technological and industrial revolutions, adjustments in the global production structure have begun to deepen, and the effects of manufacturing localization in advanced economies are becoming increasingly evident. Due to the adoption of emerging technologies and a "reindustrialization" strategy, the United States, for instance, saw a revival of industrial value-added goods after the global financial crisis, which exceeded their pre-crisis peak in 2015.

In this paper, we construct a theoretical model to unravel the intrinsic mechanism of interactions between the above factors and to get a handle on the profound and complex driving forces of de-globalization.

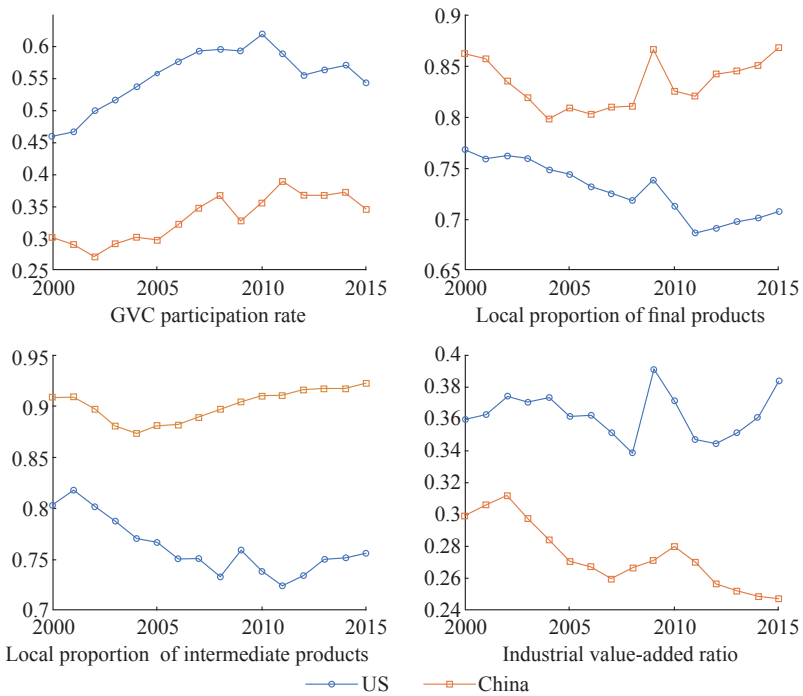

Figure 1: Changes in Indicators of China and the United States

[1] Notably, de-globalization is not equal to anti-globalization. De-globalization as discussed in this paper refers to the development or trend of international economic cooperation disparate from traditional globalization. It is an economic phenomenon and apolitical concept that underscores the reshaping of global production structures and changes in the division of labor.

Our research findings suggest that an increase in the level of manufacturing localization drives down GVC participation rate. We also observe that technological progress stemming from the new industrial revolution created a backfire against globalization, especially in the early stage of the new industrial revolution.

De-globalization is likely to be a short-lived phenomenon historically. In the long run, globalization tends to move ahead in waves, but the adverse effects of manufacturing localization and the "technology backfire" effect warrant consideration. Amid the China-US trade frictions and COVID-19, de-globalization presents grave challenges to the GVC-based division of labor paradigm and the stability and predictability of trade systems and limits China's participation in the global GVC division of labor and access to the dividends of globalization. In the face of turbulent changes unseen in a century, the CPC Central Committee called for the creation of a new development paradigm with "domestic circulation" as the most important feature and domestic and international "dual circulations" reinforcing each other. In light of this it is of great theoretical and practical significance to the CPC to reveal the underlying forces behind economic de-globalization. Such a revelation may serve to help explain the scientific implications of the new development paradigm of dual circulations and the theoretical rationale and historical background of this strategic decision adopted by the CPC Central Committee. Moreover, research on de-globalization can also help to shed light on the CPC's strategic orientation and policy approach toward a new and more "balanced and sustainable" globalization in the context of a tightening trade and investment environment.

2. Survey of Research Literature

De-globalization is often considered in Chinese and international academia as a response to globalization's adverse effects. Despite its historical contributions to world economic growth, wealth accumulation, and welfare improvement, globalization has also been blamed for negatively perceived outcomes such as growth divergence and unequal resource distribution. Scholars have also noted that as globalization moves ahead and factor markets becomes more liberalized, it becomes harder for countries to collect taxes from multinational companies and high-income individuals.

Egger et al. (2019) found that globalization raised labor income tax for the middle class in developed countries, but the top 1% of high-income individuals saw their tax burden decrease. In addition, multinational companies paid less corporate income tax through profit transfer due to globalization. Torlsov et al. (2018) identified EU member states that offer no tax preferences as the biggest victims of profit transfer between multinational companies. To make things worse, globalization increased unemployment in certain disadvantaged sectors. Since 2000, emerging economies led by China, Mexico, and Vietnam have become more competitive exporters, posing a challenge to developed countries. Autor et al. (2013) examined the impact of exports from emerging economies on US manufacturing employment and found that sectors heavily affected by emerging economies reported decreasing employment rates and wage levels in local labor markets. Compared to medium- and high-income groups, low-income groups suffered more income losses and faced greater job insecurity. Europe experienced a similar situation, which Utar (2018) attributed to trade integration between advanced economies rich in capital and emerging economies rich in labor. In this context, some countries and regions have blamed globalization for their loss of trade interests, prompting a shift in international trade policies, political attitudes, and financial activities (Gao et al., 2021).

Anti-globalization forces have also reinforced unilateralism. Since the eruption of the global financial crisis, nearly every country has experienced negative consequences from a worsening global trade policy environment. Major economies have imposed a litany of protectionist measures, threatening trade and investment liberalization under the multilateral system and global economic integration. Between 2009 and 2021, a total of 35,389 public policies on cross-border trade, investment, and labor migration have been implemented on a global scale, including 28,806 public policies with adverse

effects on international trade and investment, accounting for 81.4% of the total (Evenett and Fritz, 2021). Trade protectionism has dialed back GVC in the post-crisis era, diminishing the role of "external circulation" in China's economy compared to the first three decades after the economic reforms of 1978 (Jiang and Meng, 2021).

De-globalization has also become increasingly prominent amid a new round of technological and industrial revolutions in tandem with the changing global production structure. However, existing studies have seldom paid much attention to the correlation among the three. While unilateralism behind the global financial crisis seems to have triggered de-globalization, the fundamental cause is the emergence of new developments and trends in the global production structure driven by the new industrial revolution, as well as the ebbing momentum of the previous round of globalization led by capital (Qu and Yang, 2018).

In their rapid industrialization processes, emerging economies like China have increasingly relied on import substitution for a growing array of products, enabling them to climb the ladder of GVC (Heathcote and Perri, 2013). In 1999, processing exports made up close to 60% of China's total exports (56.9%), much higher than the 24.6% of 2021. This reflects a change in China's position in GVC and the GVC layout of its export firms (including multinational companies in China). However, the United States and other advanced economies have implemented a "reindustrialization" strategy to re-shore manufacturing back to their home turf. Taking advantage of the opportunity afforded to them by the new industrial revolution, developed countries have boosted domestic productivity through industrial automation rekindling traditional industries such as textiles and apparel, mechanical processing, chemical engineering, and building materials (Qu and Yang, 2021). Changes in the global production structure manifested in manufacturing localization also have a lot to do with economic de-globalization, which can be supercharged by technological progress under the theme of digital and green transitions during the new industrial revolution.

Regretfully, existing studies have paid scant attention to these changes in international economics and their underlying theoretical rationale. While Chinese and international academics have focused on the technological progress effects of globalization for late-moving countries, relevant studies on the effects of technological and industrial revolutions on globalization have been confined to the inequality effect of the new industrial revolution. That is, the new industrial revolution has reduced demand for low-skilled technical positions, aggravated income inequality, and given rise to protectionism (Acemoglu and Restrepo, 2018).

The domestic and international research literature have shown some progress in the research on economic de-globalization but offer inadequate theoretical explanations of the evolving traits of globalization in its various stages. Existing studies have focused on the analysis and qualitative discussions of changes in GVC through the lens of political economics (Chen and Guo, 2017; Dong et al., 2017), and a few empirical studies have examined the effects of international trade on anti-globalization political forces. However, none have yet established a rigorous framework of theoretical interpretation.

Questions still abound. Why did the momentum of GVC expansion reverse after the global financial crisis? Why did de-globalization not occur only in the developed world while emerging economies like China also recorded a reduction in GVC participation rate? Is the overlap between the new round of technological and industrial revolutions and de-globalization coincidental or inevitable? How did critical innovations and technological progress contribute to de-globalization? Answers to these questions are hard to find in the existing research literature. The reason is that many studies are still confined to the traditional analytical paradigm of political economics or GVC measurement and few explore the underlying theoretical propositions from the perspective of open macroeconomics. Also absent from the scene are structural explanations based on theoretical models.

In this paper we attempt to make marginal innovations to the existing research approaches and methodologies in order to answer the above questions. From the perspective of manufacturing localization and technological change, we construct a theoretical model to explore the frontiers of

economic de-globalization in macroeconomics and open economies in an attempt to provide the theoretical rationale for China's new development paradigm of dual circulations. In light of the ongoing changes in the global production structure, ours is a multi-country general equilibrium model that encompasses trade in both intermediate inputs and final products and introduces GVC participation rate as the core indicator of economic globalization. We then put forth theoretical propositions regarding the underlying factors of de-globalization and offer structural explanations.

This paper's marginal contributions include the following. First, it establishes a macroeconomic framework for GVC analysis and derives an equation for GVC participation rate in a multi-country general equilibrium model, which allows for a theoretical clarification of the underlying factors and transmission mechanisms of de-globalization, thus broadening theoretical research on de-globalization with a novel paradigm. Second, this paper takes stock of the key variables of 21 countries and adopts the local proportions of final products and intermediate inputs as indicators that have received little attention in the existing Chinese research literature but are better able to track changes in the global production structure. Through systematic estimations, this paper also offers an empirical test of the de-globalization effects of factors identified in the theoretical model. Third, the theoretical rationale of this paper is used as a foundation from which to explore economic phenomena stemming from a combination of factors, to dissect the underlying factors of de-globalization, and to discuss China's countermeasures to cope with increasing uncertainties in the international environment under the new development paradigm of dual circulations.

The remainder of this paper is structured as follows: Part 3 specifies the basic model; Part 4 demonstrates the theoretical mechanism by which de-globalization occurs; Part 5 conducts an empirical test of the factors underpinning de-globalization; Part 6 further discusses the underlying driving forces of de-globalization; and the final section offers concluding remarks and policy implications.

3. Basic Model Specification

In this section, we create a multi-country general equilibrium model to depict how the changing global production structure will influence globalization. We include in the model such variables as trade in intermediate inputs, trade in final products, and import and export data, which is extended to the general circumstances of N countries. It is assumed that a total of N countries participate in global trade. In each period, the factors of production invested by manufacturers in each country include not only domestic capital and workforce, but intermediate inputs from domestic and international suppliers. By integrating final products from home and abroad, retailers meet the demand for domestic investment and consumption. Households provide labor, consume final products, and make equity investments.

3.1 Specification of Market Participants

3.1.1 Manufacturers

Manufacturers in country i employ capital $K_{i,t}$, labor $L_{i,t}$ and intermediate input $M_{i,j,t}$ from country j to manufacture products, and their manufacturing technology satisfies the Cobb-Douglas production function:

$$Y_{i,t} = \left[A_{i,t} K_{i,t-1}^{\alpha} L_{i,t}^{1-\alpha} \right]^{\upsilon} \left[M_{i,i,t}^{\mu} \left(\prod_{j \neq i} M_{i,j,t}^{\frac{1-\mu}{N-1}} \right) \right]^{1-\upsilon} \tag{1}$$

In equation (1), $Y_{i,t}$ is gross output, and $A_{i,t}$ is the level of technology for manufacturers in country i. It is assumed that the scholastic process concerning manufacturing technology is symmetric between countries. Parameter υ is the share of value-added in gross output, and parameter μ is the local proportion of intermediate inputs and reflects the openness of the intermediate input market. Manufacturers will

make choices on the factors, intermediate inputs, and investment $I_{i,t}$ to maximize their profit:

$$\text{Max}\sum_{t=0}^{\infty}\left(P_{i,i,t}Y_{i,t}-W_{i,t}L_{i,t}-\sum_{j=1}^{N}P_{i,j,t}M_{i,j,t}-I_{i,t}\right) \tag{2}$$

In equation (2), $P_{i,j,t}$ is the price of final products from country j relative to country i, $W_{i,t}$ is wage of labor force in country i, and investment $I_{i,t}$ satisfies the capital formation equation:

$$K_{i,t}=\left(1-\delta\right)K_{i,t-1}+I_{i,t} \tag{3}$$

3.1.2 Retailers

Final product $G_{i,t}$ consumed by country i consists of imported final products and domestic final products and satisfies the Cobb-Douglas aggregation function:

$$G_{i,t}=G_{i,i,t}^{\omega}\prod_{j\neq i}G_{i,j,t}^{\frac{1-\omega}{N-1}} \tag{4}$$

In equation (4), parameter ω is the local proportion of final products and denotes the openness of the final product market, which is perfectly competitive. The prices of local final products for various countries are standardized as χ_i, and retailers will choose corresponding products in each phase to maximize their profits: $\text{Max}\chi_i G_{i,t}-\sum_{j=1}^{N}\chi_i P_{i,j,t}G_{i,j,t}$

3.1.3 Households

For households in country i, their intertemporal utility is: $\sum_{t=0}^{\infty}\beta^t U\left(C_{i,t},L_{i,t}\right)$, where household utility preference satisfies the CRRA utility function: $U\left(C_{i,t},L_{i,t}\right)=\frac{C_{i,t}^{1-\gamma}}{1-\gamma}-\left(\frac{\theta_i}{1+\psi}\right)\left(\frac{L_{i,t}}{\Theta_i}\right)^{1+\psi}$. Parameters θ_i and Θ_i control for the negative effects of labor supply and labor endowment, which vary across countries. Parameter γ is the coefficient of risk aversion, and ψ is the Frisch elasticity coefficient. Households maximize their utility by choosing consumption, labor supply and share of equity investment in each country $S_{i,j,t}$ and satisfy the household constraint:

$$C_{i,t}+\sum_{j=1}^{N}E_{i,j,t}H_{j,t}\left(S_{i,j,t}-S_{i,j,t-1}\right)=W_{i,t}L_{i,t}+\sum_{j=1}^{N}S_{i,j,t-1}E_{i,j,t}\left(P_{j,j,t}Y_{j,t}-W_{j,t}L_{j,t}-\sum_{k=1}^{N}P_{j,k,t}M_{j,k,t}-I_{j,t}\right) \tag{5}$$

In equation (5), $H_{j,t}$ is share price, and $E_{i,j,t}$ is real exchange rate between country i and country j.

3.2 Market Equilibrium Conditions

The following conditions are satisfied when the market is in equilibrium:

$$Y_{i,t}=\sum_{j=1}^{N}\left(M_{j,i,t}+G_{j,i,t}\right) \tag{6}$$

$$G_{i,t}=C_{i,t}+I_{i,t} \tag{7}$$

$$\sum_{j=1}^{N}S_{i,j,t}=1 \tag{8}$$

Meanwhile, countries satisfy the law of one price: $E_{i,j,t}P_{j,j,t}=P_{i,j,t}$, where the equilibrium price and distribution are subject to the initial level of technology, capital accumulation and invested assets of

individual countries. For the society-wide planners, their optimal behavior is: $\text{Max}\frac{1}{N}\sum_{i=1}^{N}\sum_{t=0}^{\infty}\beta^{t}U\left(C_{i,t},L_{i,t}\right)$, which satisfies constraint equations (1), (3), (4), (6) and (7). By solving the optimal behaviors of households, manufacturers and retailers, we may obtain a first-order equation set.

4. Determinants of Economic De-globalization: Theoretical Derivation

Based on the first-order equilibrium conditions outlined in Section 3, we will continue to expand the theoretical model in this section to interpret the underlying factors of de-globalization at the theoretical level. The global input-output system is embedded into the benchmark model to examine the correlation of manufacturing localization and technology progress with de-globalization. To reflect de-globalization in the model framework, we need to select a variable that can measure the level of economic globalization. In earlier studies, some scholars employed imported inputs as a share of gross output and imported inputs as a share of the total input, among other indicators, to measure GVC participation rate (Sanyal and Jones, 1982; Feenstra, 1998). However, these indicators cannot reflect the real picture of imported intermediate inputs in China's output or export, nor can they effectively measure a country's actual level of participation in GVC (Haltmeier, 2015).

Hence, GVC participation rate provides a relatively comprehensive reflection of a country or region's level of participation in GVC. A country or region's ability to provide sophisticated or differentiated high-value products helps reveal its GVC position (Koopman et al., 2014; Wang et al., 2017). GVC participation rate has become one of the most important indicators for measuring a country's participation in global economic activities (UNCTAD, 2018). Change in GVC participation rate of various countries offers a glimpse into the trends of economic globalization.[2] Hence, this paper selects GVC participation rate as the critical variable for investigating de-globalization and extrapolates the transmission mechanism of change in the level of GVC participation rate to identify the underlying factors of de-globalization by proving the logical proposition of declining GVC participation rate.

At fixed time *t*, the following equation can be obtained by rewriting equation (6) into the global input-output matrix of exchange rates for various countries:

$$\begin{bmatrix} P_{1,1}Y_1 \\ P_{2,2}Y_2 \\ \vdots \\ P_{N,N}Y_N \end{bmatrix} = \begin{bmatrix} P_{1,1}M_{1,1}+E_{1,2}P_{2,1}M_{2,1}+\text{L}\ +E_{1,N}P_{N,1}M_{N,1} \\ E_{2,1}P_{1,2}M_{1,2}+P_{2,2}M_{2,2}+\text{L}\ +E_{2,N}P_{N,2}M_{N,2} \\ \vdots \\ E_{N,1}P_{1,N}M_{1,N}+E_{N,2}P_{2,N}M_{2,N}+\text{L}\ +P_{N,N}M_{N,N} \end{bmatrix} + \begin{bmatrix} P_{1,1}G_{1,1}+E_{1,2}P_{2,1}G_{2,1}+\text{L}\ +E_{1,N}P_{N,1}G_{N,1} \\ E_{2,1}P_{1,2}G_{1,2}+P_{2,2}G_{2,2}+\text{L}\ +E_{2,N}P_{N,2}G_{N,2} \\ \vdots \\ E_{N,1}P_{1,N}G_{1,N}+E_{N,2}P_{2,N}G_{2,N}+\text{L}\ +P_{N,N}G_{N,N} \end{bmatrix} \tag{9}$$

Using the Leontief inverse matrix, the above equation can be rewritten into the following:

$$\begin{bmatrix} P_{1,1}Y_1 \\ P_{2,2}Y_2 \\ \vdots \\ P_{N,N}Y_N \end{bmatrix} = \left(I-A\right)^{-1} \begin{bmatrix} P_{1,1}G_{1,1}+E_{1,2}P_{2,1}G_{2,1}+\text{L}\ +E_{1,N}P_{N,1}G_{N,1} \\ E_{2,1}P_{1,2}G_{1,2}+P_{2,2}G_{2,2}+\text{L}\ +E_{2,N}P_{N,2}G_{N,2} \\ \vdots \\ E_{N,1}P_{1,N}G_{1,N}+E_{N,2}P_{2,N}G_{2,N}+\text{L}\ +P_{N,N}G_{N,N} \end{bmatrix} \tag{10}$$

Based on the first-order optimization condition and the law of one price in the basic model, the Leontief inverse matrix can be derived:

---

[2] It should be noted that existing tools for GVC research also include value-added decomposition, average propagation length (APL), and number of production stages. Those instruments and methodologies are applicable for depicting the GVC positions of specific countries and industries. Given its wobbly theoretical basis, the general equilibrium model for international trade serves more as an accounting framework and cannot interpret the underlying factors of de-globalization and the theoretical level. Moreover, it cannot identify key variables to discuss causality in the economic sense. In measuring GVCs, most studies have employed such indicators as upstreamness, downstreamness, and production length. Compared with GVC participation, those indicators may reflect a country's GVC position at certain levels, but their economic implications are not clear. It is thus dubious that the estimated results may comprehensively and truthfully reflect a country's position in the global division of labor and specialization.

$$(I-A)^{-1}=\left[\upsilon\left(N-N\mu+N\mu\upsilon-\upsilon\right)\right]^{-1}\begin{bmatrix}1-\mu+\mu\upsilon+(N-2)\upsilon & (1-\upsilon)(1-\mu) & \cdots & (1-\upsilon)(1-\mu)\\ (1-\upsilon)(1-\mu) & 1-\mu+\mu\upsilon+(N-2)\upsilon & \cdots & (1-\upsilon)(1-\mu)\\ \vdots & \vdots & \ddots & \vdots\\ (1-\upsilon)(1-\mu) & (1-\upsilon)(1-\mu) & \cdots & 1-\mu+\mu\upsilon+(N-2)\upsilon\end{bmatrix} \tag{11}$$

We make $R=\frac{1-\mu+\mu\upsilon+(N-2)\upsilon}{N-N\mu+N\mu\upsilon-\upsilon}$, $T=\frac{(1-\upsilon)(1-\mu)}{N-N\mu+N\mu\upsilon-\upsilon}$. According to the Leontief inverse matrix, $R>0$, $T>0$, $R>T$. Hence, we may arrive at the value-added flow matrix F at the $N\times N$ order:

$$F=V\left(I-A\right)^{-1}Ex=\begin{pmatrix}REx_1 & TEx_2 & \cdots & TEx_N\\ TEx_1 & REx_2 & \cdots & TEx_N\\ \vdots & \vdots & \ddots & \vdots\\ TEx_1 & TEx_2 & \cdots & REx_N\end{pmatrix} \tag{12}$$

According to Koopman et al. (2014), country i's GVC participation rate $GVCP_{i,t}$ is:

$$GVCP_{i,t}=\frac{T\left(\sum_{j\neq i}Ex_{j,t}\right)+(N-1)TEx_{i,t}}{Ex_{i,t}}=T\frac{\left(\sum_{j\neq i}Ex_{j,t}\right)}{Ex_{i,t}}+(N-1)T \tag{13}$$

In equation (13), $Ex_{i,t}$ is country i's exports. Obviously, GVC participation rate is related to the ratio of exports from country T and country i to exports from other countries $\frac{\left(\sum_{j\neq i}Ex_{j,t}\right)}{Ex_{i,t}}$. For $Ex_{i,t}$, the following equation can be derived based on the first-order optimal condition in the basic model:

$$Ex_{i,t}=\sum_{j\neq i}M_{j,i,t}+\sum_{j\neq i}G_{j,i,t}=P_{i,i,t}Y_{i,t}-P_{i,i,t}M_{i,i,t}-P_{i,i,t}G_{i,i,t}=P_{i,i,t}Y_{i,t}\left[1-(1-\upsilon)\mu\right]-\omega G_{i,t} \tag{14}$$

The following can be derived from equation (10):

$$P_{i,i,t}Y_{i,t}=\upsilon^{-1}\left[R\omega+T(1-\omega)\right]G_{i,t}+\upsilon^{-1}\left[\frac{1-R\omega-T(1-\omega)}{N-1}\right]\sum_{j\neq i}E_{i,j,t}G_{j,t} \tag{15}$$

Let $\Delta Y_{i,j,t}=Y_{i,t}-E_{i,j,t}Y_{j,t}$, $\Delta G_{i,j,t}=G_{i,t}-E_{i,j,t}G_{j,t}$, and we have: $\Delta Y_{i,j,t}=\left[\frac{N\left(R\omega+T(1-\omega)\right)-1}{(N-1)\upsilon}\right]\Delta G_{i,j,t}$. Let $\Delta Ex_{i,j}=Ex_i-E_{i,j}Ex_j$, and we have: $\Delta Ex_{i,j,t}=\Delta Y_{i,j,t}\left[1-(1-\upsilon)\mu\right]-\omega\Delta G_{i,j,t}=\left(\frac{\mu-\mu\upsilon+\upsilon\omega-1}{N\omega-1}\right)\Delta Y_{i,j,t}$. Let function $f=\frac{\mu-\mu\upsilon+\upsilon\omega-1}{N\omega-1}$, and we have: $\frac{\left(\sum_{j\neq i}Ex_{j,t}\right)}{Ex_{i,t}}=(N-1)\frac{Ex_{k,t}+f\frac{\sum_{j\neq i}\Delta Y_{j,k,t}}{N-1}}{Ex_{k,t}+f\Delta Y_{i,k,t}}$. Except for the smallest economies, there is a country k, which makes $\Delta Y_{i,k,t}>0,\sum_{j\neq i}\Delta Y_{j,k,t}>0$. When $\Delta Y_{i,k,t}>\frac{\sum_{j\neq i}\Delta Y_{j,k,t}}{N-1}$, i.e. $Y_{i,t}>\frac{\sum_{j\neq i}Y_{j,t}}{N-1}$, $\frac{\left(\sum_{j\neq i}Ex_{j,t}\right)}{Ex_{i,t}}$ has an inverse relationship with f. This suggests that as long as country i's gross output exceeds the world average level, $\frac{\left(\sum_{j\neq i}Ex_{j,t}\right)}{Ex_{i,t}}$ is inversely related to f. This paper will identify the

factors that influence the GVC participation rate of major economies (with gross output above the world average level). Based on the above results, we may put forth the following proposition:

Proposition 1: With other variables constant, an increase in the local proportion of domestic final products ω will cause GVC participation rate to decline.

Proof: By finding the partial derivative of function f with respect to ω, we have: $\frac{\partial f}{\partial \omega}=\frac{N-N\mu+N\mu\upsilon-\upsilon}{\left(-1+N\omega\right)^2}$. Since $T>0$, we have $N-N\mu+N\mu\upsilon-\upsilon>0$, and thus $\frac{\partial f}{\partial \omega}>0$, i.e. f is an increasing function of ω. At this moment, $\frac{\left(\sum_{j\neq i}Ex_{j,t}\right)}{Ex_{i,t}}$ is a decreasing function of ω. Since function T is unrelated to ω, with other variables constant, an increase in the local share of domestic final products ω will cause GVC participation rate to decline, thus proving the proposition.

As can be seen from Proposition 1, GVC participation rate is closely related to the local share of domestic final product ω, whose increase directly causes GVC participation rate to decrease.

Proposition 2: After ω exceeds a certain threshold, an increase in the local proportion μ of domestic intermediate inputs will cause GVC participation rate to decrease.

Proof: By finding the partial derivative of function T with respect to μ, we have: $\frac{\partial T}{\partial \mu}=\frac{\left(N-1\right)\left(-1+\upsilon\right)\upsilon}{\left(N+N\mu\left(-1+\upsilon\right)-\upsilon\right)^2}$. Since $N\geq 2$, $0<\upsilon<1$, we have $\frac{\partial T}{\partial u}<0$, i.e. T is a decreasing function of μ. Meanwhile, by finding the partial derivative of function f with respect to μ, we have: $\frac{\partial f}{\partial \mu}=\frac{1-\upsilon}{N\omega-1}$. Obviously, if and only if $\omega>\frac{1}{N}$, $\frac{\partial f}{\partial \mu}>0$, i.e. f is an increasing function of μ. At this moment, $\frac{\left(\sum_{j\neq i}Ex_{j,t}\right)}{Ex_{i,t}}$ is a decreasing function of μ. Thus, if $\omega>\frac{1}{N}$, i.e. when the local preference exists in the final product market, an increase in the local proportion μ of domestic intermediate inputs will drive down GVC participation rate. The proposition is thus proven.

For Proposition 2, if $\omega>\frac{1}{N}$, it can be considered that the local preference exists in the final product market. In this circumstance, an increase in the local proportion μ of domestic intermediate inputs driven by import substitution will cause GVC to decrease. Notably, for major economies with gross output above world average, the threshold denoted by $\frac{1}{N}$ varies due to differences in their resource endowment and policymaking. Hence, Proposition 2 essentially means that an increase in the local proportion of domestic intermediate inputs will cause GVC participation rate to decrease if there is a strong local preference in the final product market.

Proposition 3: When ω exceeds a certain threshold, a country's higher economic growth rate relative to other countries will cause its GVC participation rate to increase, and lower economic growth rate relative to other countries will cause its GVC participation rate to decrease.

Proof: When a country achieves economic growth by such means as technology innovation and monetary policy for its gross output to increase by ΔY, discussions can be made in the following two circumstances:

(i) When $\Delta Y_i>\frac{\sum_{j\neq i}\Delta Y_j}{N-1}$, i.e. country i's economic growth rate exceeds the world average, if $f>0$, ΔY_i will drive down $\frac{\left(\sum_{j\neq i}Ex_{j,t}\right)}{Ex_{i,t}}$, and if $f<0$, ΔY_i will cause $\frac{\left(\sum_{j\neq i}Ex_{j,t}\right)}{Ex_{i,t}}$ to rise. Since $f=\frac{\mu-\mu\upsilon+\upsilon\omega-1}{N\omega-1}$, where

the numerator $\mu-\mu\upsilon+\upsilon\omega-1<(\mu-1)(1-\upsilon)<0$, when $\omega>\frac{1}{N}$, $f<0$. Obviously, when ω exceeds a certain threshold, a country's higher economic growth rate relative to other countries will cause their GVC participation rate to increase.

(ii) When $\Delta Y_i<\frac{\sum_{j\neq i}\Delta Y_j}{N-1}$, i.e. country i's economic growth rate is below the world average level, if $f>0$, ΔY_i will drive up $\frac{\left(\sum_{j\neq i}Ex_{j,t}\right)}{Ex_{i,t}}$, and when $f<0$, ΔY_i will cause $\frac{\left(\sum_{j\neq i}Ex_{j,t}\right)}{Ex_{i,t}}$ to decline. When $\omega>\frac{1}{N}$, a country's lower economic growth rate relative to other countries will cause its GVC participation rate to decrease. Thus, the proposition is proven.

Proposition 3 reveals that when a strong local preference exists in the final product market, a country's economic growth relative to other countries will influence its GVC participation rate. Specifically, those with economic growth rates above the world average level will see their GVC participation rate increase and vice versa. Proposition 3 underscores the impact of economic growth on GVC participation rate, which is subject to the country's relative status in global economic growth. For emerging economies with growth rates generally above the world average level and advanced economies with growth rates generally below the world average level, economic growth has polar opposite effects on their GVC participation rate. Proposition 3 may well explain the reason for China's rising GVC participation rate between 2004 and 2011. Despite the steadily increasing local proportions of China's final products and intermediate inputs over this period, rapid economic growth offset the negative effect of those two variables on the country's GVC participation rate. However, as China's economic growth slowed in the new stage of medium-high growth since 2011, China's GVC participation rate naturally decreased.

Proposition 4: When ω exceeds a certain threshold, the rising value-added ratio υ due to technology progress will cause GVC participation rate to decrease.

Proof: An abundance of research literature has shown that technological progress is the single most important driver of the value-added ratio (Amiti and Konings, 2007; Antràs et al., 2012).[3] Here, we examine the effect of an increase in the value-added ratio υ on GVC participation rate. By finding the partial derivative of function T with respect to υ, we have: $\frac{\partial T}{\partial \upsilon}=\frac{(-1+N)(-1+\mu)}{\left(N+N\mu(-1+\upsilon)-\upsilon\right)^2}$. Since $N\geq 2$, $0<\mu<1$, we have $\frac{\partial T}{\partial \upsilon}<0$, i.e. T is a decreasing function of υ. Meanwhile, by finding the partial derivative of function f with respect to υ, we have: $\frac{\partial f}{\partial \upsilon}=\frac{-u+\omega}{-1+N\omega}$. That is to say, if and only if $\omega>\max\{u,1/N\}$ or $\omega<\min\{u,1/N\}$, $\frac{\partial f}{\partial \upsilon}>0$, i.e. f is an increasing function of υ. At this moment, $\frac{\left(\sum_{j\neq i}Ex_{j,t}\right)}{Ex_{i,t}}$ is a decreasing function of υ. When there is a large number N of countries, the possibility for $\omega<\frac{1}{N}$ is almost nil for a large economy with gross output above the world average level. Hence, when $\omega>\max\{u,1/N\}$, i.e. the local preference exists in the final product market and exceeds a certain threshold, an increase in

[3] It should be noted that the increase in value-added ratio is subject to various factors such as the intensive input of domestic factors. Yet for the manufacturing sector, technology progress is undoubtedly the single most important factor, which has been demonstrated in extensive theoretical and empirical research. In particular, manufacturing data analysis and empirical research based on international comparisons suggest that the level of industrial technology innovation is vital for the value-added ratio (Zhang and Xia, 2018).

value-added ratio υ due to technology progress will cause GVC participation rate to decline. Thus, the proposition is proven.

Proposition 4 suggests that when the local preference in the final product market further increases and exceeds the local proportion of intermediate inputs (i.e. $\omega>\mu$), an increase in the value-added ratio stemming from technology progress will drive down GVC participation rate, i.e. the "technology backfire" effect on GVC participation rate. This means that once trade protectionism reaches a certain level, technology innovation will reinforce the local preference instead of prompting GVC participation rate to increase, giving rise to a "technology backfire" effect. This proposition offers a reasonable explanation for the coexistence of the booming new industrial revolution, rampant trade protectionism, and falling GVC participation rate in the developed world since 2010. In the early stage of the new industrial revolution featuring the rapid iteration of generic technologies and dominant industries, both governments and enterprises in the developed world have an intrinsic motivation to prevent technology diffusion, strengthen their niche market positions, and take the high ground in emerging sectors, which makes the case for protectionist trade policies. With the combined effects of technological progress and trade protectionism, developed countries have continuously adjusted the global production structure, making it inevitable for GVC participation rate to fall.

Based on the conclusions of the above four propositions, the following logical rationale can be obtained: When the local proportion of final products rises to a certain level, for countries and regions (mainly major economies) whose economic growth is below the world average, an increase in the local proportion of their intermediate inputs will drive down their GVC participation rate. When the local preference for final products further increases, the negative effect of increasing the value-added ratio on GVC participation rate becomes evident. By the same token, it can also be found that the decreasing local proportions of final products and intermediate inputs, economic growth above the world average level, and increasing value-added ratio may all drive up GVC participation rate. In this sense, the local proportion of final products, the local proportion of intermediate inputs, economic growth rate and technology progress are all key factors of de-globalization. The overlapped effects of those factors jointly contribute to change in the GVC participation rate of various countries and steer the course of globalization.

5. Empirical Test of Driving Forces behind Economic De-globalization

In this section, we will provide empirical evidence for the four propositions under the theoretical framework and measure the effects of various econometric regressions on GVC participation rate. The economic structures of various countries are assumed to be symmetrical under the theoretical model specification in Section 3 without specifying country characteristics such as population and level of economic development, and the objects of research are major economies with gross output above the world average level. Hence, this paper takes the following two steps for improvement to reduce error in the empirical research: First, a total of 21 OECD member states[4] with similar levels of economic development to China are selected as the objects of empirical analysis. Those countries account for over 90% of the world trade volume with gross output all above the world average level to represent the evolving trend of global GVC participation rate.

The second step is to assess the model's robustness. Such control variables as population size and level of economic development are included to test the robustness of the regression equation. Specifically, those countries include: Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN),

[4] Since this paper is mainly concerned with goods trade, China can be regarded as a comparable object of analysis given its manufacturing heft, great progress in its overall level, narrowing gaps with OECD countries, and certain output indicators surpassing those of some OECD countries.

Denmark (DNK), Finland (FIN), France (FRA), Germany (DEU), Italy (ITA), Japan (JPN), South Korea (KOR), the Netherlands (NLD), New Zealand (NZL), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), the UK (GBR), the US (USA), and China (CHN).

5.1 Specification of the Regression Equation

Based on the theoretical derivation in Section 4, this paper specifies the following regression model:

$$GVCP_{i,t} = c_0 + c_1\omega_{i,t} + c_2\mu_{i,t} + c_3\upsilon_{i,t} + c_4 gr_{i,t} + \gamma_i + \eta_t + \varepsilon_{i,t} \quad (16)$$

$$GVCP_{i,t} = c_0 + c_1\omega_{i,t} + c_2\mu_{i,t} + c_3\upsilon_{i,t} + c_4 gr_{i,t} + c_5 X + \gamma_i + \eta_t + \varepsilon_{i,t} \quad (17)$$

$$\Delta GVCP_{i,t} = c_0 + c_1\Delta\omega_{i,t} + c_2\Delta\mu_{i,t} + c_3\Delta\upsilon_{i,t} + c_4\Delta gr_{i,t} + \gamma_i + \eta_t + \varepsilon_{i,t} \quad (18)$$

$$GVCP_{i,t} = c_0 + c_1\omega_{i,t} + c_2\mu_{i,t}\left(\omega_{i,t} \le \phi_1\right) + c_3\mu_{i,t}\left(\omega_{i,t} > \phi_1\right) + c_4\upsilon_{i,t} + c_5 gr_{i,t} + \gamma_i + \eta_t + \varepsilon_{i,t} \quad (19)$$

$$GVCP_{i,t} = c_0 + c_1\omega_{i,t} + c_2\mu_{i,t} + c_3\upsilon_{i,t}\left(\omega_{i,t} \le \phi_2\right) + c_4\upsilon_{i,t}\left(\omega_{i,t} > \phi_2\right) + c_5 gr_{i,t} + \gamma_i + \eta_t + \varepsilon_{i,t} \quad (20)$$

where, $gr_{i,t}$ is the difference between country i's GDP growth rate and the world average growth rate in period t, and X is the control variable. All variables have been standardized. For the above regression equations, equation (16) is the benchmark regression model obtained from equation (13).

Equation (17) further includes control variables based on equations (17) and (16) to examine the robustness of the regression equations. Since the level of economic development and population size of various countries are not controlled for in this paper's model specification, control variable X mainly includes country i's logarithmic GDP per capita $gdpp_{i,t}$ in period t and country i's logarithmic total population $pop_{i,t}$ in period t.

Equation (18) examines whether the change in GVC participation rate over a certain period is related to changes in ω, μ, υ and gr. This paper specifies two-year and four-year periods to test whether such a correlation exists. Equation (18) is concerned with whether there is any regularity in the change of GVC participation rate after changes occur in ω, μ, υ and gr within a certain period.

Equations (19) and (20) are two threshold regression equations. Propositions 2 and 4 suggest that μ and υ will exert differentiated effects on GVC participation rate with change in ω. Hence, equations (19) and (20) will test the effects on μ and υ arising from the threshold effect of ω[5]. The regression equation controls for the individual fixed effect γ_i and the time fixed effect η_t to avoid the endogenous effect arising from the omission of variables, and $\varepsilon_{i,t}$ is error term.[6]

5.2 Data Treatment

This section puts together and standardizes the input-output tables and time-series data of 21 countries. With the limited availability of global input-output data, this paper adopts a research period in 2000-2015. The approach of Koopman et al. (2014) is adopted to measure the GVC participation rate of countries. Then, we have: $GVCP_{i,t} = \dfrac{DVX_{i,t} + FVA_{i,t}}{Ex_{i,t}}$, where, $DVX_{i,t}$ is the indirect value-added of country i in period t, and $FVA_{i,t}$ is foreign value-added of country i in period t.

$DVX_{i,t}$ and $FVA_{i,t}$ data of countries are calculated based on UNCTAD global value chain database, and the total export volume $Ex_{i,t}$ data of countries are from the World Bank database. Equation for the local proportion ω of final products from various countries is $\omega_{i,t} = 1 - \dfrac{\sum_{j \ne i} G_{i,j}}{\upsilon_{i,t} Y_{i,t} - \left(Ex_{i,t} - Im_{i,t}\right)}$, where

[5] In the interest of length, this paper only provides a single-threshold regression model.

[6] The endogeneity test is omitted in the interest of length and since our empirical analysis is based on the theoretical derivation in Sections 3 and 4 and provides an explicit causal relationship between independent and dependent variables with rigorous theoretical rationale.

numerator $\sum_{j\neq i} G_{i,j}$ is the import volume of country i's industrial final products during period t with data from the OECD. Denominator $v_{i,t}Y_{i,t}-(Ex_{i,t}-Im_{i,t})$ is the industrial final product demand of country i during period t, $v_{i,t}Y_{i,t}$ is industrial value-added in country i during period t, and $Ex_{i,t}-Im_{i,t}$ is country i's industrial net export volume during period t. Relevant data are from the OECD.

Equation for calculating the local proportion μ of intermediate inputs for various countries is $\mu_{i,t}=1-\frac{\sum_{j\neq i} M_{i,j,t}}{\sum M_{i,j,t}}$, where numerator $\sum_{j\neq i} M_{i,j,t}$ is the import volume of industrial intermediate inputs for country i during period t with data from the OECD. Denominator $\sum M_{i,j,t}$ is the total input of industrial intermediate inputs for country i during period t with data obtained from the input-output tables of various countries over the years. Value-added ratio $v_{i,t}$ is the ratio between country i's industrial value-added and gross industrial output during period t, which is also calculated with data from the OECD as is the case for the difference between country i's GDP growth rate and the world average GDP growth rate $gr_{i,t}$ during period t, logarithmic GDP per capita $gdpp_{i,t}$, and logarithmic total population $pop_{i,t}$.

Analysis of multi-country cross-section data further verifies the theoretical correlation of manufacturing localization indicators (local proportion of final products and local proportion of intermediate inputs) and technology progress indicator (value-added ratio) with GVC participation rate. As can be seen from Figure 2 (a), there is a significant difference in the GVC participation rate of various countries, whose values are between 10% and 130%. Meanwhile, the trendline in Figure 2 (a) suggests that when the local proportion of a country's final products is higher, the country's GVC participation rate becomes smaller. Deviations of key country nodes from the trendline are modest and display good regularity. This has verified the inverse relationship between the local proportion of final products and GVC participation rate as set forth in Proposition 1. Figure 2 (b) reveals a non-linear relationship between the local proportion of intermediate inputs and GVC participation rate: Below a certain threshold, there is a relatively flat linear relationship; beyond the threshold, there is a steep increase in the negative correlation between the local proportion of intermediate inputs and GVC participation rate, as reflected in an increasing slope of the curve in absolute terms. Compared with the manufacturing localization indicator, Figure 2 (c) shows the trend of technological progress to be more complex and irregular. On the whole, however, an increase in the value-added ratio above a certain threshold has still caused GVC participation rate to decline, which means that an empirical test needs to be performed.

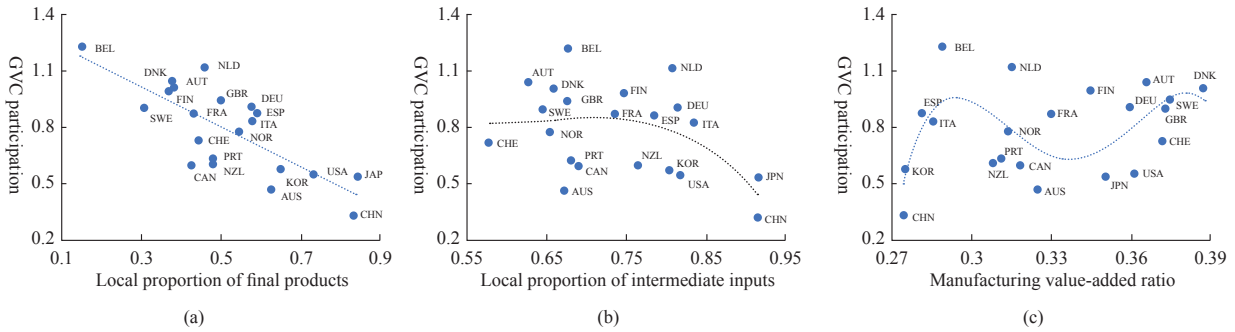

Figure 2: Distribution of the Local Content of Final Products, the Local Content of Intermediate Inputs, Industrial Value-Added Ratio and GVC Participation of Various Countries

Note: The horizontal coordinate of the nodes is the average value of industrial value-added ratios of various countries between 2000 and 2015, and the vertical coordinate is the average value of GVC participation rate.

5.3 Empirical Conclusions

Regression results of equations (16)-(18) are shown in Table 1. As can be seen from the regression results of equation (16), the local proportion of final products ω, the local proportion of intermediate inputs μ, value-added ratio υ and difference with world average economic growth rate *gr* had all been negatively correlated with GVC participation rate over the period between 2000 and 2015. This implies that the multi-country panel data have verified Propositions 1-4, demonstrating those indicators to be key factors of declining GVC participation rate. Among them, technology had the greatest effect. An increase in value-added ratio by each percentage point would drive down GVC participation rate by 0.7903 percentage points. An increase in the local proportion of intermediate inputs and the local proportion of final products by each percentage point would drive down GVC participation rate by 0.5025 and 0.5244 percentage points, respectively.

For most OECD countries in the panel data during the calculation period, the differences between their economic growth rates and the world average level were negative values (with the only exception of China and South Korea whose differences were positive for most of the time). Such relatively low economic growth rates were negatively correlated with the GVC participation rate of those countries. If a country was below the world average economic growth rate, an increase in its economic growth rate by one percentage point would drive down its GVC participation rate by 0.6836 percentage points. As shown in the regression results of equation (17), when the control variable is included, there is little change in the parametric values of key variables, which are simultaneously significant.

Moreover, R^2 value in equation (17) increases by a smaller margin compared with equation (16), reflecting relatively good robustness in the specification of the regression equation in this paper. Equation (18) performs a regression estimation from the two dimensions of two-year change and four-year change. The result indicates that for the two-year period and four-year period, the regression parameters of ω, μ and *gr* are relatively significant, and the regression parameter of υ is insignificant with the four-year change offering a better goodness of fit than the two-year change. The implication is that change in GVC participation rate is negatively correlated with the local proportion of final products, the local proportion of intermediate inputs, and difference with world average economic growth rate, and the longer the duration of change, the better the goodness of fit becomes. For the four-year period, the more the local proportion of final products, the local proportion of intermediate inputs and the difference in economic growth rate increased, the more GVC participation rate would decrease. Specifically, an increase of one percentage point in those indicators would each cause GVC participation rate to fall by

Table 1: Regression Results of Equations

Variable	Equation (16)	Equation (17)	Equation (18) (2-year change)	Equation (18) (4-year change)
ω	-0.5244*** (-5.8965)	-0.4242*** (-4.8864)	-0.3522*** (-4.3508)	-0.4005*** (-4.0974)
μ	-0.5025*** (-3.1737)	-0.4566*** (-2.9761)	-0.7346*** (-4.6728)	-0.5110*** (-3.0708)
υ	-0.7903** (-2.4970)	-0.5745* (-1.8673)	-0.0191 (-0.0713)	-0.1457 (-0.4704)
gr	-0.6836** (-2.3412)	-0. 6949** (-2.4767)	-0.4477*** (-2.6204)	-0.4142* (-1.8292)
Control variable	No	Yes	No	No
R^2	0. 7516	0.7761	0.4699	0.5783

Notes: Values in parentheses are T test values; *** p<0.01, ** p<0.05, * p<0.1.

0.4005, 0.5110, and 0.4142 percentage points, respectively.

Before performing a regression estimation of the threshold effect equation, it is necessary to determine the number of thresholds and threshold values for the key variable. This paper performs a test of the assumption that a varying number of thresholds exist for the threshold variable and simulates the likelihood statistic with the bootstrapping method 500 times for the single-threshold, dual-threshold and triple-threshold scenarios to estimate the threshold value, relevant intervals, and statistical test values (see Table 2). The test result of the threshold effect reveals that the single-threshold P value of the independent variable μ is significant at the 5% confidence level while its dual-threshold and triple-threshold P values are both insignificant. In addition, the single-threshold P value of the independent variable υ is significant at the 10% confidence level, and its dual-threshold and triple-threshold P values are also both insignificant. That is to say, the threshold effect indeed exists in equations (19) and (20), and the single-threshold specification should be selected.

According to their different threshold values μ and υ, the single threshold can be divided into two intervals to investigate the effects of μ and υ on GVC participation rate within different intervals. As can be seen from the regression results of Table 3, the regression parameters of the threshold equation are all relatively significant with decent goodness of fit. For μ, when $\omega \leq 0.3454$, its regression parameter value is -0.5041, but when $\omega > 0.3454$, the regression parameter value further decreases to -0.7116. For υ, when $\omega \leq 0.3785$, its regression parameter value is -1.4910, and when $\omega > 0.3454$, its regression parameter value further decreases to -1.7364. This has verified the conclusions of Propositions 2 and 4, i.e. after ω exceeds

Table 2: Test of Threshold Effect

Variable	Number of thresholds	Threshold value	Interval	P value
μ	Single threshold	0.3454	[0.3386, 0.3462]	0.0340**
	Dual thresholds	0.6688	[0.6537, 0.6753]	0.2180
	Triple thresholds	0.1761	[0.1421, 0.1771]	0.6880
υ	Single threshold	0.3785	[0.3707, 0.3806]	0.0700*
	Dual thresholds	0.2750	[0.2723, 0.2848]	0.5280
	Triple thresholds	0.5484	[0.5374, 0.5492]	0.4660

Table 3: Regression Result of the Threshold Equation

Variable	Equation (19)	Variable	Equation (20)
ω	-0.8019*** (-8.0347)	ω	-0.7886*** (-7.6640)
$\mu(\omega \leq 0.3454)$	-0.5041*** (-2.9995)	μ	-0.7731*** (-4.7997)
$\mu(\omega > 0.3454)$	-0.7116*** (-4.4573)	$\upsilon(\omega \leq 0.3785)$	-1.4910*** (-5.2523)
υ	-1.7366*** (-6.4440)	$\upsilon(\omega > 0.3785)$	-1.7364*** (-6.3457)
gr	-0. 8318** (-2.5308)	gr	-0.8063** (-2.4190)
R^2	0.6269	R^2	0.6165

a certain threshold, increases in μ and υ will more significantly drive down GVC participation rate.[7]

Further analysis of real-world data uncovers that in 2000-2015, the local proportion of final products for most countries in the multi-country panel data initially decreased but later increased. Beyond a certain level, a further increase in the local proportion of intermediate inputs and the value-added ratio will drive down GVC participation rate at an accelerated pace. Judging by specific threshold values, the threshold value of ω to which μ corresponds is 0.3454, which is below the threshold value of ω to which υ corresponds. This finding chimes with the theoretical derivation in Section 4, i.e. the threshold for Proposition 4 should be higher than the threshold in Proposition 2.

6. Further Discussions: Interpretation of the Causes of De-globalization Based on a Combination of Influence Factors

There is a two-way causality between expansion in the international division of labor and the increasing GVC participation rate of countries if globalization marches forward in the traditional sense. As the global production structure becomes reshaped, de-globalization appears to be inevitable. Among various underlying factors of de-globalization, the local proportion of final products reflects the market preference for local products. This indicator is subject to the competitiveness of local products and says a lot about trade policy orientation. This paper has identified and demonstrated the rising local proportion of final products as the most immediate factor of de-globalization. An increasing preference for local products is naturally followed by a swerve in the trade policy orientation of countries.

It should also be noted that developing and developed countries are subject to differentiated effects of changes in the local proportion of final products, the local proportion of intermediate inputs, the industrial value-added ratio, economic growth rate, and other factors. The reasons for the declining GVC participation rate of various countries are heterogeneous. Analysis of those issues reveals a clearer mechanism by which manufacturing localization contributes to de-globalization. Yet the abstract factors behind those phenomena are often overlooked, and existing research is more focused on specific economic phenomena.

Based on the theoretical and empirical proof of the underlying factors of economic de-globalization, this section extends discussions on the headwind against globalization to a broader level. In this section, the underlying factors of de-globalization will be interpreted through the lens of such economic phenomena as the increasing trade concentration due to a combination of factors, the "technology backfire" effect of the new industrial revolution, and economic growth under the combined effects of trade protectionism and quantitative easing (QE). Further verification of the applicability of this paper's analytical framework will strengthen the theoretical basis for China's new development paradigm of dual circulations.

6.1 Import Substitution of Emerging Economies and Increasing International Trade Concentration Ratio

Over the past two decades, emerging economies such as China, India, Mexico and Vietnam have experienced robust industrial development. Rapid industrial development in those countries largely owes to an expansion of the trade sector amid economic openness. With their increasing export of finished products and rising international market share, emerging economies have transformed the landscape of international trade. With increasing domestic supply chain abilities, however, China and other emerging economies participate in the international division of labor not just by serving as destinations for industrial relocation but by accelerating import substitution with an improving industrial

[7] It should be noted that Propositions 2 and 4 suggest that after ω exceeds a certain threshold, an increase in the local share of intermediate inputs μ and value-added ratio υ will drive down GVC participation. However, when ω is below this threshold value, the increases in μ and υ have an uncertain effect on GVC participation, whose direction needs to be assessed through the empirical analysis. If the influence coefficients of μ and υ on GVC participation are positive, the turning point will occur after the threshold value is exceeded, and if the influence coefficients are negative, both factors will drive down GVC participation at an accelerated pace after exceeding the threshold.

system and increasingly vibrant innovations. As a result, enterprises in those countries, including local manufacturing subsidiaries of multinational companies, become less dependent on imported intermediate inputs, causing the local proportion ω of final products and the local proportion μ of intermediate inputs to increase. According to the conclusions of Propositions 1 and 2, this will slow and reverse the growth of GVC participation rate in emerging economies like China. Meanwhile, import substitution has led to the increasing export market shares of emerging economies for both intermediate inputs and industrial finished goods, causing the Herfindahl-Hirschman Index (HHI) to rise steadily for the global markets of intermediate inputs and industrial finished goods, i.e. higher levels of trade concentration in intermediate input and final product markets (see Table 4). After 2004, in particular, the global markets of intermediate inputs and industrial finished goods saw rising HHI indices. In 2004-2015, the local proportion of China's intermediate inputs increased from 87.6% to 94.1%, and the local proportion of finished goods hiked from 79.7% to 84.6%. During the same period, the HHI indices of the global markets of intermediate inputs and industrial finished goods rose from 8.27% and 8.94% to 9.62 % and 11.08%, respectively.

It warrants attention that an increase in trade concentration has further restrained the GVC participation rate of countries. In the theoretical model, change in the number of trading countries N only represents change in trade concentration. The higher the value of N, the more trade is scattered. In the analysis of the impact on GVC participation rate in Section 4, the number of trading countries N is assumed to be constant. In this section, this condition is relaxed to discuss the influence of change in trade concentration on GVC participation rate. From the theoretical derivation in Section 4, we have:

$$GVCP_{i,t}=\frac{T\left(\sum_{j\neq i}Ex_{j,t}\right)+(N-1)TEx_{i,t}}{Ex_{i,t}}=T(N-1)\left[\frac{Ex_{k,t}+f\frac{\sum\Delta Y_{j,k,t}}{N-1}}{Ex_{k,t}+f\Delta Y_{i,k,t}}+1\right]$$

. Since $\frac{Ex_{k,t}+f\frac{\sum_{j\neq i}\Delta Y_{j,k,t}}{N-1}}{Ex_{k,t}+f\Delta Y_{i,k,t}}+1$ is directly proportional to N, we may have: $GVCP_{i,t}\propto T(N-1)$. Here, the value of N should be 7, 20 and 50, i.e. assuming that global trade is concentrated in seven, 20 and 50 countries, i.e. G7, G20 and G50. Based on statistics in Table 1, υ is assigned a value of 0.33 to simulate the scope of change in GVC participation rate. As shown in Figure 3, the scope of change in GVC participation rate will increase with N's value. When the local

Table 4: Market Trends of Global Intermediate Inputs and Industrial Finished Goods

Year	1993	1997	2001	2005	2009	2013	2018
Share in the intermediate input market							
Global HHI	8.13%	7.86%	7.89%	8.25%	8.94%	9.29%	9.64%
China	3.10%	3.46%	4.20%	6.33%	7.42%	8.81%	9.41%
India	1.24%	1.34%	1.42%	2.01%	1.96%	2.56%	2.58%
Mexico	0.79%	1.00%	1.00%	0.97%	0.95%	1.05%	1.08%
Vietnam	0.05%	0.05%	0.07%	0.09%	0.20%	0.37%	0.73%
Other emerging economies combined	19.14%	18.56%	19.52%	21.27%	22.90%	23.82%	24.64%
Share in the industrial finished goods market							
Global HHI	9.12%	8.94%	8.78%	9.02%	9.93%	10.76%	11.06%
China	5.02%	6.20%	8.34%	13.17%	16.94%	19.08%	19.74%
India	0.65%	0.71%	0.77%	1.04%	1.34%	1.53%	1.60%
Mexico	1.37%	2.06%	2.80%	2.16%	2.07%	2.49%	2.91%
Vietnam	0.04%	0.12%	0.17%	0.26%	0.48%	0.98%	1.90%
Other emerging economies combined	15.90%	17.06%	17.69%	18.33%	19.19%	20.18%	20.92%

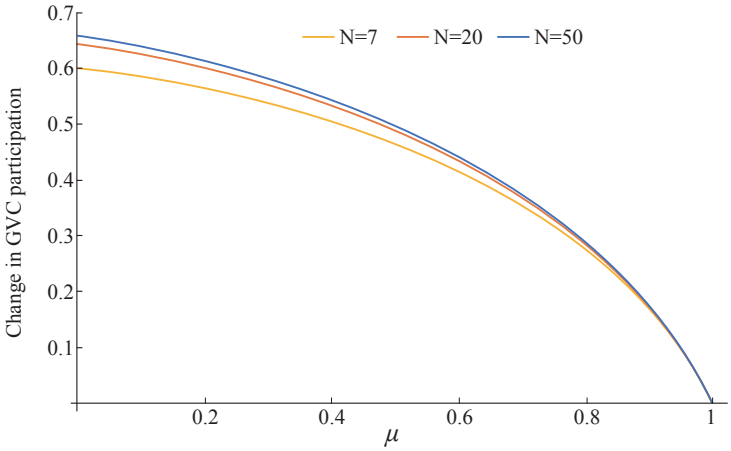

Figure 3: Effects of Changes in Trade Concentration on GVC Participation

proportion μ of intermediate inputs is constant, a higher value of N corresponds to a higher level of GVC participation rate. This suggests that an increase in trade concentration will cause GVC participation rate to shrink further. Rapid industrialization and import substitution of emerging economies will not only cause their GVC participation rate to decline but impede the GVC participation rate of other countries.

6.2 New Industrial Revolution, Unilateralism and the "Technology Backfire" Effect for Advanced Economies

Since 2010, the new industrial revolution has been on the surge. New technologies led by artificial intelligence (AI), industrial internet and advanced robotics have empowered smart, green and service-based manufacturing, giving rise to new industrial clusters that help raise total factor productivity (TFP). With their dominant position in frontier technologies and emerging industries, advanced economies have bolstered their industrial competitiveness. In general, advanced economies have suffered heavily from the global financial crisis with more protracted repercussions. Consequently, their post-crisis economic performance has been eclipsed by the world average level. Rising trade protectionism and populism have reinforced the preference for local proportion, as manifested in the increase in the local proportion ω of final products.

According to the conclusions of Propositions 3 and 4, economic growth and rising value-added ratio driven by the new industrial revolution are likely to bring down GVC participation rate. On the surface, trade protectionism and de-globalization are the key steps for the developed world to re-industrialize and shore up the real economy. At a deeper level, however, change in the global trade order is a result of the shifting dynamism of globalization amid the new industrial revolution. Under the new technology revolution, TFP in the US began to spike after 2011, causing US value-added ratio and share in global GDP to increase for the first time since the dawn of the 21st century. Compared with overseas investments and markets, localization became more appealing to firms, which is a key reason for the decline in US GVC participation rate.

During the course of the new industrial revolution, the advantages of advanced economies over emerging economies are changing. Take the relative industrial competitiveness between China and the US for instance, the traditional comparative advantage theory argues that US manufacturing advantages over China are concentrated in capital-intensive and high-value-added sectors. The US is supposed to boast significant capital strengths in capital-intensive sectors like transportation equipment manufacturing, petroleum processing and coking, mechanical processing, chemical raw materials, and chemical product manufacturing. In technology-intensive sectors such as communication equipment,

computers and other electronic devices, and electrical machinery and apparatuses, the US should have greater technological and intellectual factor advantages over China.

Under the new industrial revolution, however, the US with its highly automated production processes has turned what are still labor-intensive sectors for China such as food manufacturing, printing and reproduction of recording media, furniture manufacturing, and textiles, apparels, footwear and hat manufacturing into capital-intensive sectors less dependent on labor force to outcompete China in those traditional sectors (see Table 5). Increasing productivity makes it more likely for the US to re-shore and revive certain processes of traditional industries like textiles and apparels, mechanical processing, chemical engineering, and building materials. To some extent, a manufacturing resurgence helps the US reduce its dependence on China's supply chains and global value chains.

Since 2010, advanced economies led by the US, the UK, Germany and Switzerland have seen an increasing local proportion of intermediate inputs. Specifically, the local proportion of intermediate inputs rose from 72.39% in 2011 to 75.53% in 2015 for the US and from 62.09% in 2011 to 69.19% in 2015 for the UK. The COVID-19 pandemic has further justified this trend in terms of supply chain security for governments and enterprises, allowing local preference to steer the course of global production structure adjustment.

6.3 Overlapped Effects of Trade Protectionism and QE in Advanced Economies

After the global financial crisis, major advanced economies including the US, the EU and Japan implemented a QE policy for considerably a long time. By locking up long-term low-interest rates, the US, the EU and Japan continuously injected liquidity into the banking system and showered a flood of cash into the market to stimulate domestic industrial investment and economic growth. In this period, the monetary policy environment of QE coexisted with trade protectionism. The question that warrants discussion is whether such a policy overlap has contributed to the rise of de-globalization? Our theoretical framework proves that the combined effects of trade protectionism and an easy monetary policy to induce industrial investment could precipitate the fall of GVC participation rate.

According to the theoretical structure of Section 3, when household asset distribution is in a steady state, we have: $S_{i,j,t}-S_{i,j,t-1}=0$, and the following equation can be derived from equation (5):

$$C_{i,t}=W_{i,t}L_{i,t}+S\left(P_{i,j,t}Y_{i,t}-W_{i,t}L_{i,t}-\sum_{j=1}^{N}P_{i,j,t}M_{i,j,t}-I_{i,t}\right)+\frac{1-S}{N-1}\sum_{j\neq i}E_{i,j,t}\left(P_{i,j,t}Y_{i,t}-W_{i,t}L_{i,t}-\sum_{j=1}^{N}P_{i,j,t}M_{i,j,t}-I_{i,t}\right).$$ With the first-order optimal condition of the benchmark model, we have: $\Delta C_{i,j,t}=\upsilon\left[1-\alpha\frac{N-NS}{N-1}\right]\Delta Y_{i,j,t}+\frac{1-NS}{N-1}\Delta I_{i,j,t}$.

Table 5: China and US's Competitiveness for Representative "Labor-Intensive" Sectors

Representative sectors	Labor input-output ratio		Energy input-output ratio		Tax burden ratio	
	US	China	US	China	US	China
Food production	3.21	2.27	27.55	16.98	0.0707	0.1128
Printing and reproduction of recording media	1.79	1.51	31.40	16.64	0.0421	0.0643
Furniture manufacturing	1.71	1.60	60.85	20.93	0.0212	0.0149
Textiles, apparels, footwear and hat manufacturing	1.52	1.22	104.87	26.70	0.0179	0.0098

Notes: This table is based on data of 2014 from China and the US. Labor input-output ratio is the ratio between sectoral value-added and labor cost, energy input-output ratio is the ratio between industrial value-added and the cost of energy consumption, and tax burden ratio is the ratio between tax payment and sectoral value-added. China's tax burden ratio calculation has included the impact of export tax rebates. Higher labor and energy input-output ratio and a lower tax burden help increase sectoral competitiveness.

Since $\Delta Y_{i,j,t}=\left[\frac{N\left(R\omega+T\left(1-\omega\right)\right)-1}{\left(N-1\right)\upsilon}\right]\Delta G_{i,j,t}=\left[\frac{N\left(R\omega+T\left(1-\omega\right)\right)-1}{\left(N-1\right)\upsilon}\right]\left(\Delta C_{i,j,t}+\Delta I_{i,j,t}\right)$, it is substituted into the above equation: $\Delta Y_{i,j,t}=\frac{\left(S-1\right)\left(N\omega-1\right)}{1+\mu\left(-1+\upsilon\right)+\alpha\upsilon-\alpha\upsilon S-\upsilon\omega+N\left(-1+\mu-\mu\upsilon+\left(1-\alpha+\alpha S\right)\upsilon\omega\right)}\Delta I_{i,j,t}$, and let $z=\frac{\left(S-1\right)\left(N\omega-1\right)}{1+\mu\left(-1+\upsilon\right)+\alpha\upsilon-\alpha\upsilon S-\upsilon\omega+N\left(-1+\mu-\mu\upsilon+\left(1-\alpha+\alpha S\right)\upsilon\omega\right)}$. It can be derived that when $R\omega+T(1-\omega)>\frac{1}{N}$, $z>0$. Since R and T in the Leontief inverse matrix denote the output conversion coefficients of domestic and imported products, $R\omega+T(1-\omega)$ may denote the composite trade openness index. Meanwhile, since $R\omega+T(1-\omega)$ is an increasing function of ω, after ω exceeds a certain threshold, an increase in investment $\Delta I_{i,j,t}$ may drive up gross output $\Delta Y_{i,j,t}$. Hence, the partial derivative of z can be found: $\frac{\partial z}{\partial\omega}=\frac{N^2\left(1-S\right)\upsilon\left(R-T\right)}{\left(NT\left(1-\omega\right)+NR\omega-1\right)^2\left[\left(\frac{\alpha\left(N-NS\right)}{N-1}-1\right)\upsilon+\frac{\left(N-1\right)\upsilon}{NT\left(1-\omega\right)+NR\omega-1}\right]^2}$. Since $0<S<1$ and $R>T$, we have: $\frac{\partial z}{\partial\omega}>0$. This means that an increase in ω will not only crank up gross output through investment but magnify the multiplier effect of investment on economic growth. However, as mentioned in Proposition 3, when ω crosses a certain threshold, such economic growth under the combined effect of QE and trade protectionism will drive down GVC participation rate. The higher level of trade protection, the more significant the combined effect becomes, i.e. trade protectionism magnifies QE's effect on de-globalization. This offers a good explanation of the coexistence between QE and de-globalization after the global financial crisis. The interpretation of de-globalization in this paper is also broadened from the firm level to sectoral and macroeconomic levels.

7. Concluding Remarks and Policy Implications

Using GVC participation rate as a core indicator of globalization's evolving trend, we put forth four propositions regarding the factors that influence GVC participation rate for major economies with gross output above the world average level. As shown in the proofs of the propositions, the local proportion of domestic final products as a key reflection of manufacturing localization exerts a direct influence on GVC participation rate: An increase in the local proportion of final products drives down GVC participation rate. When there is a strong local preference for final products, the combined effect of an increase in the local proportion of intermediate inputs and weaker economic growth compared to other countries drives down the GVC participation rate of such a "major" economy. When the local preference for final products becomes reinforced, an increase in the value-added ratio restrains GVC participation rate; this is the "technology backfire" phenomenon.

Next, we employed data from 21 countries, including OECD member states and China, for an empirical analysis, and the results are consistent with the above four propositions. As our analysis shows, the phenomenon of de-globalization that has occurred in recent years cannot be interpreted simply as a string of coincidental political incidents or the result of populist fervor. At a deeper level, the global economy is on the cusp of change. The spread of unilateralism and slowing globalization are thus likely to permeate more sectors on a broader scale.

As the new industrial revolution unfolds, traditional comparative advantages with labor cost at the forefront have become a less potent force for globalization. In this context, China-US trade frictions and COVID-19 pandemic have created a greater impetus for decreasing GVC participation rate and

de-globalization. Specifically, China-US trade frictions have heightened the barriers of US trade protectionism, giving rise to preferences for local final products. Furthermore, COVID-19 has upended global supply chains and forced countries to enhance their own industrial resilience in response to these preferences for local products. Strategic interest has also replaced efficiency as the top priority for multinational companies in managing their production layout and supply chains. The Russian-Ukraine conflict that broke out in February 2022 has further ruptured the global production system, making the case for supply chain regionalization. An upturn in GVC participation rate seems elusive in the post-pandemic area, and de-globalization and its consequences are likely to deepen.

To some extent, many twists and turns in the process of globalization process are a result of the trend toward manufacturing localization in various countries. Changes in the international balance of power are manifested in increasing trade concentration as a result of import substitution and a new round of internalization in the developed world driven by the new industrial revolution. It is against this backdrop that China adopted the "dual circulations" strategy. With its industrial sophistication and supply chain modernization, China's import substitution is expected to expand. The increasing local proportion of final products and intermediate inputs is conducive to forming a domestic circulation and creating conditions for regional value chains with closer intranational cooperation.

With advanced economies less involved in GVC, we believe that it is imperative for China to boost supply chain security and independence. While its economy at a higher level, we also contend that China should reinforce domestic and international dual circulations and give full play to the strengths of its complete domestic industrial system and market heft. By making its industrial and supply chains more independent and modernized, China can take the opportunity of global production restructuring and forge new competitive strengths in a complex and volatile international environment. Moreover, the "technology backfire" against globalization could be but a blip in the early stage of the new industrial revolution. Indeed technological innovation is likely to reignite global resource allocation as has been the case throughout history.

References:

[1] Acemoglu, D., and P. Restrepo. 2018. "The Race between Man and Machine: Implications of Technology for Growth, Factor Shares, and Employment." *American Economic Review*, 108(6):1488-1542.

[2] Amiti, M., and J. Konings. 2007. "Trade Liberalization, Intermediate Inputs and Productivity: Evidence from Indonesia." *American Economic Review*, 97(5):1611-1638.

[3] Antràs, P., D. Chor, T. Fally, and R. Hillberry. 2012. "Measuring the Upstreamness of Production and Trade Flows." *American Economic Review*, 102(3): 412-416.

[4] Autor, D., D. Dorn, and G. Hanson. 2013. "The China Syndrome: Local Labor Market Effects of Import Competition in the United States." *American Economic Review*, 103(6): 2121-2168.

[5] Carvalho, V. 2015. "From Micro to Macro via Production Networks." *Journal of Economic Perspectives*, 28(4): 23-48.

[6] Chen, W.G., and Q. Guo. 2017. "Analysis of the Mechanism of Anti-globalization and the Reconstruction of New Globalization and Its Governance." *Nankai Journal* (Philosophy, Literature and Social Science Edition), 5:58-70.

[7] Egger, P., S. Nigai, and N. Strecker. 2019. "The Taxing Deed of Globalization." *American Economic Review*, 109(2):353-390.

[8] Evenett, S., and J. Fritz. 2021. "The 28th Global Trade Alert Report." Centre for Economic Policy Research.

[9] Feenstra, R. 1998. "Integration of Trade and Disintegration of Production in the Global Economy." *Journal of Economic Perspectives*, 12(4):31-50.

[10] Gao, Y. S., Z. X. Li, and J. C. Zhu. 2021. "The Trade Imbalance Caused Anti-globalization—Based on the Perspective of Trade in Value Added." *Journal of International Trade*, 9:1-16.

[11] Haltmeier, J. 2015. "Have Global Value Chains Contributed to Global Imbalances?" *International Finance Discussion Papers,* No. 1154.

[12] Heathcote, J., and F. Perri. 2013. "The International Diversification Puzzle Is Not as Bad as You Think." *Journal of Political Economy*,

121(6):1108-1159.

[13] Jiang, X. J., and L. J. Meng. 2021. "Mainly Inner Circulation, Outer Circulation Empowerment and Higher Level Double Circulation: International Experience and Chinese Practice." *Journal of Management World*, 1:1-19.

[14] Johnson, R. 2014. "Five Facts About Value-Added Exports and Implications for Macroeconomics and Trade Research." *Journal of Economic Perspectives,* 28(2):119-142.

[15] Koopman, R., Z. Wang, and S. J. Wei. 2014. "Tracing Value-Added and Double Counting in Gross Exports." *American Economic Review*, 104(2):459-494.

[16] Qu, S. N., and D. H. Yang. 2018. "US Tariff Sanctions on China and Its Impact on US Investment Enterprises in China." *Intertrade*, 11:37-44.

[17] Qu, S. N., and D. H. Yang. 2021. "Areas and Policy Suggestions for Risk of Economic Decoupling Between China and US Under De-Globalization." *Research on Financial and Economic Issues*, 7:102-109.

[18] Sanyal, K., and R. Jones. 1982. "The Theory of Trade in Middle Products." *American Economic Review*, 72(1): 16-31.

[19] Tong, J. D., D. Y. Xie, Q. Bao, Q. H. Huang, X. Y. Li, Z. B. Liu, B. Jin, M. J. Yu, and X. S. Wang. 2017. "The Talks on Paper of the Deglobalization and Transformation and Upgrading of Real Economy." *China Industrial Economics*, 6:5-59.

[20] Torslov, T., L. Wier, and G. Zucman. 2018. "The Missing Profits of Nations." *NBER Working Paper*, No. 24701.

[21] UNCTAD. 2018. *World Investment Report 2018: Investment and New Industrial Policies*. New York and Geneva: United Nations.

[22] Utar, H. 2018. "Workers Beneath the Floodgates: Low-Wage Import Competition and Workers' Adjustment." *Review of Economics and Statistics*, 100(4):631-47.

[23] Wang, Z., S. J. Wei, X. Yu, and K. Zhu. 2017. "Measures of Participation in Global Value Chains and Global Business Cycles." *NBER Working Paper*, No. 23222.

[24] Zhang, H. X., and M. Xia. 2018. "The Effects of Division of Labor and Technology Progress on Value Added Rates—An Analysis Based on Input-Output Model." *Management Review*, 5:29-38.