Impacts of global value chains' participation and domestic consumption on manufacturing employment in China

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Abstract

The literature on the employment impact of China's GVCs participation has focused on the Chinese imports substitution effects in developed countries, while few studies are made on the impact on domestic job creations. To complete this gap, this study proposes GVCs labor demand functions, which is augmented of domestic demand to control the impact of the Chinese reorientation development strategy to domestic consumption-led growth model (rarely studied). The functions are applied to panel data of 16 Chinese manufacturing industries over the 2005-2014 period using Arellano and Bond's GMM estimator for dynamic panel data model specifications. The obtained results show that China's backward linkages increased employment while forward linkages and GVCs position decreased it. The decline in processing and assembly activities of 3.4% per year on average diminished the employment of 0.9%. The increase of 0.95% per year on average of Chinese intermediate goods embodied in third countries' exports decreased the employment of 0.3%. The rise in final domestic demand of 20% per year on average increased the employment of 1.6% per year on average, which is higher than the negative effects of backward and forward linkages. These results provide a favor argument for China's "dual circulation" development strategy from the point of view of employment.

JEL Classifications: F14, F16, F66

Key words: GVCs, domestic consumption, manufacturing employment, China

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1. Introduction

The recent theoretical literature on the employment effects of global value chains (GVCs) focuses on the weak cost of inputs imported by developed countries. While the use of cheaper imported inputs in the production process boosts output, exports and thus employment (scale effects), it either substitutes or complements domestically produced goods, thus negatively or positively affects output, reduces or increases labor demand in production (import substitution or complementary effects) (Hasan et al., 2007; Rodrik, 1997; Davis and Mishra, 2007). The total employment effect of GVCs participation is theoretically uncertain.

The complementary effects may be more pronounced for developing countries which import from developed countries sophisticated, variety and higher quality and cost inputs to be processed and assembled with local low cost labor before re-exporting to the world market. These GVCs backward linkages activities located in the end of global value chains probably exert positive effects on labor demand. However along to the rise of labor cost and to stay competitive internationally, firms in developing countries tend to imitate advanced technologies to produce and to export more capital-intensive intermediate goods via forward linkages. The resulting structural change and moving up to higher value added industry favor productivity, and economic growth, but may need less labor, leading a kind of the 'mixed-blessing hypothesis' of GVC participation (Rodrik, 2018; Pahl and Timmer, 2020), contrary to the objective of economic development in long term. How to conciliate productivity improvement with job creation is thus a challenge especially for countries whose manufacturing industries are upgrading as China.

The empirical literature on the employment impact of GVCs is emerging. It uses backward linkages (i.e. share of foreign value added in exports), forward linkages (share of domestically produced intermediate inputs embodied in third countries' exports), GVCs participation (sum of backward and forward linkages), and/or GVCs position (i.e. log ratio of

supply of intermediates used in other countries' exports to the use of imported intermediates in its own production) proposed by Koopman et al. (2014) etc. to estimate GVCs employment impact.

The obtained results are ambiguous varying by studied countries/industries and estimated periods. If Banga (2016), Dine & Chalil (2021) and Szymczak & Wolszczak-Derlacz (2021) found negative impacts of backward linkages on employment respectively for India, Japan, and 43 countries/56 industries, Dine (2019), Long et al. (2019) and Pan (2020) obtained a positive impact for Turkey, Viet Nam and US respectively. Banga (2016) did not find a significant effect of forward linkages on Indian employment, while Long et al. (2019), Dine (2019) and Dine & Chalil (2021) showed negative effects in Viet Nam, Turkey and Japan; Szymczak and Wolszczak-Derlacz (2021) found a positive effect for panel data of 43 countries and 56 industries. Finally, Long et al. (2019) and Szymczak and Wolszczak-Derlacz (2021) obtained positive effects of GVCs position on employment in Viet Nam, and for 43 countries and 56 industries, while Long et al. (2019) found an insignificant effect of GVCs participation in Viet Nam.

It is surprising to observe that few studies, to our knowledges, analyzed the impact of China's GVCs participation on domestic employment, even that China is one of the major GVCs centers in the world, and unemployment is a serious challenge for the social stability. China's GVCs backward participation passes initially via labor intensive processing and assembly activities[2] profiting one of the lowest labor costs in the world at that time (1980s and 1990s) and allowing two hundred million rural workers to find employment in cities (Los et al. 2015). It recently passes via one step development strategy from importing core

[2] Besides ordinary trade regime, Chinese customs authorities established a processing trade regime in 1979 under which foreign inputs are imported duty-free for further processing, assembly and re-exporting.

technologies which are unable to be produced domestically to develop their own higher value added brands concentrating on producing noncore technology activities such as assembly and brand development[3] (ADB, 2021). China's GVCs forward participation passes via the strong development of intermediate input sectors and allowing the substitution of domestic for imported materials by individual processing exporters (Kee and Tang, 2016). China's successful GVCs participation provides an excellent example to study the impact of GVCs backward and forward participation on employment.

However, the existing studies focus on the impact of Chinese import substitutions on the employment in developed countries. Autor et al. (2013), Acemoglu et al. (2016), Pierce & Schott (2016) and Caliendo et al. (2019) have found negative effects of imports from China on the US employment in the industries exposed to Chinese competition, while Wang et al. (2018) have showed that trade with China has led net employment increase in US. While Dauth et al. (2014) and Branstetter et al. (2019) have found negative effect of imports from China on the employment in German and Portugal, Taniguchi (2019) and Choi and Xu (2020) have shown that increases in the imports of intermediate inputs from China had positive effects on Japanese and Korean employment respectively. Kiyota et al. (2021) have shown that the impact of Chinese imports is different for six advanced countries.

One objective of this study is to complete this gap to estimate the impact of China's GVCs participation on its manufacturing employment. If the Chinese manufacturing industry has been the main sector to create jobs along to the industrialization since the "open door"

[3] Inside GVCs, the complex intermediate goods are divided into small parts which are built in different countries all over the world but still function together when all parts are assembled as a whole. Chinese firms (Huawei, OPPO and Xiaomi for example) seize this unique opportunity of manufacturing modularization to import and assembly the small parts with core technologies which are unable to be produced domestically to develop their own brands (ADB, 2021).

policies launched in the end of 1978 which provided about two hundred million workers (Los et al., 2015), its employment absorption capacity has been decreasing. This decreasing job creation capacity is coincided with the moving out of the Chinese firms from low cost labor intensive processing and assembly activities via backward linkages and the development of higher technological content industries able to produce intermediate goods to be embodied in third countries' exports via forward linkages, but creates fewer jobs (Kee and Tang, 2016).

To answer this objective, we follow the literature (Hamermesh's, 1996; Greenaway et al., 1998; Hasan et al., 2007 and Amiti and Wei, 2005 among others) to propose a GVCs augmented labor demand function which is derived from Cobb-Douglas production function by allowing GCVs impact efficiency of labor in production processes.

On the other hand, the decreasing foreign demand on Chinese manufactured goods since the 2007-2008 financial crises questioned the Chinese exports-led growth model, and pushed the Chinese government reorienting its development strategy to domestic consumption-led one (Los et al., 2015). This reorientation is reinforced by the recent US China trade conflict and the Covid-19 pandemic. In fact, the high Chinese economic growth during 40 years has allowed 853 million Chinese people out from the poverty, increasing their consumption demand capacity for manufactured goods. The domestic market is potentially very big. One interesting question is to know if the domestic market is able to mitigate or even exceed the decreasing manufacturing job creations caused by the industry upgrading and decreasing GVCs participation. The second objective of this study is to estimate the impact of final domestic demand on manufacturing employment by extending the production function.

The functions are estimated with OECD Trade in Value added (TiVA), World Input-Output Database (WIOD) and Socio Economic Accounts (SEA) for panel data of 16 manufacturing sectors over the 2005-2014 period. The obtained results show positive effects of backward linkages and final domestic demand on employment, but negative labor impact

of forward linkages and position, while the impact of GVCs participation is statistically insignificant, probably due to the opposite effects of backward and forward linkages. As the part of foreign value added in exports decreased of 3.36% per year on average, the decline in processing and assembly activities diminished the employment of 0.91% per year on average. As the part of Chinese intermediate goods embodied in third countries increase 0.95% per year on average, it decreased the employment of 0.3% per year on average. As final domestic demand increased of 20% per year on average, it contributed 1.6% of employment, which is higher than the sum of backward and forward linkages. The job creation of domestic market exceeding the job loss from GVCs participation provides a favor argument for the "dual circulation" development strategy adopted by the Chinese government from point of view of employment.

This study contributes to the literature in several ways. Few studies have been made on the domestic employment impact of China's GVCs participation; the literature focused on the impact of Chinese import substitution effects on the job creation in developed countries. This study completes this gap by estimating the impact of GVCs on sectoral manufacturing employment in China. The second originality is to add demand side factors into the GVCs augmented labor demand function which includes only supply side variables, and are commonly used in the GVCs literature. This study finally extended the literature on the effects of China's GVC participation, which focused on domestic value added in exports (Koopman et al., 2014, Kee and Tang, 2016; Meng et al., 2017; Yu and Luo, 2018; Taguchi and Li; 2018; Hua, 2022a etc.), or productivity (Lu et al., 2016; Ge et al. 2018; Chor et al., 2021; Hua, 2022b), but also on the impact of real exchange rate on employment in China (Hua, 1997, Chen and Dao, 2011).

The rest of the paper is structured as the following. The second section provides a rapid literature review. The third section gives theoretical analysis of employment effect of China's

GVCs participation and proposes GVCs labor demand functions augmented of final domestic consumption to be estimated in section 4. The economic and political implications are given in the conclusion in section 5.

2. Literature Review

The literature on employment effects of trade focuses on the cost of inputs imported by developed countries via scale and substitution effects. While the use of cheaper imported inputs in the production process boosts output, exports, and thus employment, it substitutes domestically produced goods, thus negatively affect output, reduces labor demand in production (Hasan, Mitra and Ramaswamy 2007, Rodrik 1997). Onaran (2008) and Feenstra and Hansan (1996) found that import penetration has decreased employment respectively for Austria and the United States (US). However, the employment effects of trade may not be negative when imported inputs are complementary to local intermediate goods (Davis and Mishra, 2007). This is especially true for developing countries which import sophisticated, variety and higher quality of imported inputs complementary to local low cost labor.

The empirical literature is emerging. Banga (2016), using fixed effects and generalized method of moments, found a negative impact of backward linkages on employment during 1995-2011 in India, but an insignificant effect of forward linkages, leading a net negative effect of global value chains participation on employment growth in Indian industries. Long et al. (2019), using the Viet Nam household living standard surveys and the OECD's TiVA database (2010, 2012 and 2014), showed that backward linkages exert a positive effect while forward linkages and GVCs position exert a negative one, and GVC participation has a statistically insignificant effect on the share of formal employment. Dine (2019), using fixed effects estimation and controlling for the spillovers effects of GVCs indicators, revealed that jobs creation depends not only on GVCs integration within the own sectors but also on

neighboring sectors, indicating significant spillovers effects across sectors in Turkey. Pan (2020), using panel data of 35 US industries over 1995-2011 period, and Arellano and Bond's GMM estimator for dynamic panel data model, found that GVC activities have significant positive impacts on the overall US employment, but only from the backward GVC linkages for the medium skilled labor force, while the forward GVCs have a minor significant negative impact on the low-skilled labor segment. Dine & Chalil (2021) examined how backward linkages impact industry-level employment in Japan by estimating a static and dynamic panel model. They found that both backward and forward linkages foster labor displacement. Szymczak and Wolszczak-Derlacz (2021), using panel data covering 43 countries and 56 sectors over the period from 2000 to 2014 from WIOD database and three-stage least squares regression, found that GVC backward linkage and position are negatively correlated with employment and that the GVC forward linkages have a positive impact on employment. Yu et al. (2021) used GLS regression analysis to study the impact of the ASEAN global value chain on its employment from 2005 to 2016. They found that the impact of GVC participation on employment is significantly negative, while GVCs position has no significant impact on male employment rate of ASEAN countries.

The literature analyzed Chinese import effects on employment in developed countries. Autor et al. (2013) and Pierce and Schott (2016) showed that employment decreases in the U.S. industries that are mostly exposed to Chinese competition. Branstetter et al. (2019) performed a firm-level analysis of how Chinese import competition affects labour market outcomes in Portugal, finding an economically significant fall in employment in export firms. Wang et al. (2018) showed that US imports of intermediated goods from China through the downstream channel and input cost savings benefit sectors that come later in the value chain (even if they are not importers themselves), which imply potential employment gains. They showed a net positive U.S. employment due to trade with China. Caliendo et al. (2019), using

a dynamic trade model with spatially distinct labor markets facing varying exposure to international trade, found that the rise in China trade shock resulted in a reduction of about 0.55 million U.S. manufacturing jobs, about 16% of the observed decline in manufacturing employment from 2000 to 2007.

The above rapid literature review shows that few studies have examined the impact of Chinese GVCs participation on its domestic employment. The next section tends to complete this gap.

3. Theoretical analysis of employment effects of China's GVCs participation

The Chinese economy is strongly integrated into the global value chains in particular since its adhesion into the WTO in the end of 2001 and becomes quickly one of the most important GVCs centers of manufactured goods in the world. This integration begins to decline since 2014 in favor of domestic consumption-led growth model, which is recently accentuated by US-China trade conflict and covid-19 Pandemic. It is therefore important to quantify to what extent the Chinese labor force is exposed to these changing external and internal market conditions.

Our analysis begins with a basic labor demand function, extended by taking into account the effects of GVCs as in the literature and finally by originally adding final domestic demand into labor demand functions. No studies, to our knowledge, have added demand side variable into the GVCs augmented labor demand function.

3.1. Labor demand function

Following Greenaway et al. (1999) who developed a model analyzing the employment effect of trade, we begin our analysis by writing a Cobb–Douglas production function in industrial level i in period t as following:

$$Q_{it} = A^{\gamma} K_{it}^{\alpha} L_{it}^{\beta} \qquad (1)$$

Where i and t denote industries and time respectively. Q is real output, K is capital stock, L is labor inputs used. α and β represent the factor share coefficients. The efficiency of the production is represented by A, which captures the impact of exports, imports, etc. and γ allows for factors changing efficiency growth in the use of labor in the production process.

We assume that economic agents are profit-maximizing, and decide labor and capital levels in such way that the marginal product of labor equals the wage (w) and the marginal product of capital equals its user cost c in order to minimize the total production cost as wL+rK. Solving this system simultaneously to eliminate capital from the output allows us to obtain the following equations:

$$Q_{it} = A_{it}^{\gamma} \left(\frac{\alpha L_{it}}{\beta} * \frac{w_{it}}{c}\right)^{\alpha} L_{it}^{\beta} \qquad (2)$$

Taking logarithms to derive the industry's labor demand function as following:

$$lnL_{it} = -\frac{\alpha lna - \alpha ln\beta}{\alpha+\beta} - \frac{\gamma}{\alpha+\beta} lnA_{it} - \frac{\alpha}{\alpha+\beta} \ln\left(\frac{w_i}{c}\right) + \frac{1}{\alpha+\beta} lnQ_{it} \qquad (3)$$

The substitution possibilities between capital and labor are quite considerable in China (Zhang, 2004, Hua, 2007). To measure the effect of capital/labor intensity on employment, the ratio between the capital user cost and wages in Eq. (3) is replaced by capital/labor intensity as follows:

$$lnL_{it} = -\frac{\alpha lna - \alpha ln\beta}{\alpha+\beta} - \frac{\gamma}{\alpha+\beta} lnA_{it} - \frac{\alpha}{\alpha+\beta} \ln CI_{it} + \frac{1}{\alpha+\beta} lnQ_{it} \qquad (4)$$

Where CI measures capital intensity.

Thus, labor demand is in function of productivity, capital intensity and real output whose coefficients are waited negative for the two first variables, and positive for last one.

3.2. Extended labor demand function: impacts of GVCs participation on employment

The participation of developing countries into global value chains (GVCs) may improve their productivity through backward and forward linkages (Criscuolo and Timmis, 2017). By access to qualified foreign intermediate goods and interacting with multinationals, developing countries adopt foreign technologies and management to match international standards, and thus benefit from learning externalities and technology spillovers (Kowalski et al., 2015; Pahl & Timmer, 2019). They invest in new processes, technologies and skills to survive from the higher competition from imports (Tajoli and Felice, 2018; Shu and Steinwender 2019). By access to larger export markets and the engagement in higher quality export activities, developing countries are incentivized to improve the production efficiency and the quality of their products and to diversify and upgrade towards new and higher value added activities (Bustos, 2011; Li and Liu, 2014; Ndubuisi and Owusu, 2021). The competitive pressure from GVCs participation optimizes resources reallocation to more productive firms, while the least productive ones are forced to exit the market (Leibenstein, 1966; Melitz, 2003; Melitz and Ottaviano 2008; Eslava et al. 2013).

We hypothesize that the parameter A in the production function varies with GVC participation such that:

$$A_{it} = e^{\delta_0} {GVC_{it}}^{\delta_1} \qquad (5)$$

Substituting for A_{it} in equation (4), we get GVC labor demand function as:

$$lnL_{it} = \frac{-\alpha lna + \alpha ln\beta + \delta_0}{\alpha+\beta} - \frac{\gamma\delta_1}{\alpha+\beta} lnGVC_{it} - \frac{\alpha}{\alpha+\beta} \ln CI_{it} + \frac{1}{\alpha+\beta} lnQ_{it} \qquad (6)$$

Thus, labor demand is in function of GVCs participation, capital intensity and real output. The coefficient of capital intensity is expected to be negative, while that of real output is waited to be positive. The sign of GVCs is uncertain since GVCs may exert a positive complementary effect and a negative productivity impact. In fact, developing countries import high qualified intermediate goods to be processed and assembled with local low cost labor before re-exporting. This complementary effect increases exports, and thus labor demand. On

contrary, international competitiveness from participating GVCs pushes firms to improve efficiency in labor uses by eliminating excess labor or by introducing labor saving techniques (automatization of production chains etc.). This may increase the productivity of surviving manufacturing firms as some of them are obligated to close the less performing factories or even disappear; This kind of Schumpeterian "creative destruction" benefits to the most performing enterprises (Guillaumont Jeanneney and Hua, 2001), but provides less job opportunities. However, it is possible that the productivity improvement increases operational efficiency and output, and thus tend to increase labor demand.

To capture the total effect of GVCs participation, we follow Amiti and Wei (2005) to incorporate GVC's scale effect on labor demand and rewrite the above equation in such way as:

$$lnL_{it} = \frac{-\alpha lna+\alpha ln\beta+\delta_0}{\alpha+\beta} + \frac{\delta_2-\gamma\delta_1}{\alpha+\beta} lnGVC_{it} - \frac{\alpha}{\alpha+\beta} \ln CI_{it} \qquad (7)$$

Where the coefficient of GVCs capture its net effect on labor demand; its sign depends on which impact is higher.

3.3. Extended labor demand function: impacts of domestic demand

Beside the employment effects of intermediate goods via GVCs participation, the final demand may exert the impact on employment (Los et al. 2015). To capture the employment effects of final domestic demand (FDD), we hypothesize that the parameter A in the production function varies with GVC participation and final domestic demand such as:

$$A_{it} = e^{\delta_0} GVC_{it}{}^{\delta_1} FDD_{it}^{\delta_2}$$

We get the following equations as

$$lnL_{it} = \frac{-\alpha lna+\alpha ln\beta+\delta_0}{\alpha+\beta} - \frac{\gamma\delta_1}{\alpha+\beta} lnGVC_{it} - \frac{\alpha}{\alpha+\beta} \ln CI_{it} + \frac{1}{\alpha+\beta} lnQ_{it} + \delta_3 lnFDD_{it} \qquad (8)$$

$$lnL_{it} = \frac{-\alpha lna+\alpha ln\beta+\delta_0}{\alpha+\beta} + \frac{\delta_2-\gamma\delta_1}{\alpha+\beta} lnGVC_{it} - \frac{\alpha}{\alpha+\beta} \ln CI_{it} + \delta_3 lnFDD_{it} \qquad (9)$$

4. Empirical functions and estimation

4.1. Empirical functions

In general, the current labor demand depends on the level in the previous periods to take into account the adjustment costs of hiring and firing. We add the dependent variable lagged one period on the right hand side of equations 6 to 9 to take account for costs related to the employment adjustment effect. We add industry-fixed and time fixed effects to capture specific factors for each industry and each period as well as error terms as

$$lnL_{it} = a_0 + a_1 lnL_{it-1} + a_2 lnGVC_{it} + a_3 \ln CI_{it} + a_4 lnQ_{it} + \mu_i + \pi_t + \varepsilon_{it} \quad (10)$$

$$lnL_{it} = b_0 + b_1 lnL_{it-1} + b_2 lnGVC_{it} + b_3 \ln CI_{it} + \mu_i + \pi_t + \varepsilon_{it} \quad (11)$$

$$lnL_{it} = c_0 + c_1 lnL_{it-1} + c_2 lnGVC_{it} + c_3 \ln CI_{it} + c_4 lnQ_{it} + c_5 lnFDD_{it} + \mu_i + \pi_t + \varepsilon_{it} \quad (12)$$

$$lnL_{it} = d_0 + d_1 lnL_{it-1} + d_2 lnGVC_{it} + d_3 \ln CI_{it} + d_5 lnFDD_{it} + \mu_i + \pi_t + \varepsilon_{it} \quad (13)$$

Where $a_0 = -\frac{\alpha lna - \alpha ln\beta}{\alpha+\beta}$, $a_2 = -\frac{\gamma\delta_1}{\alpha+\beta}$, $a_3 = -\frac{\alpha}{\alpha+\beta}$, $a_4 = \frac{1}{\alpha+\beta}$,

$b_0 = -\frac{\alpha lna - \alpha ln\beta}{\alpha+\beta}$, $b_2 = \frac{\delta_2 - \gamma\delta_1}{\alpha+\beta}$, $b_3 = -\frac{\alpha}{\alpha+\beta}$,

$c_0 = -\frac{\alpha lna - \alpha ln}{\alpha+\beta}$, $c_2 = -\frac{\gamma\delta_1}{\alpha+\beta}$, $c_3 = -\frac{\alpha}{\alpha+\beta}$, $c_4 = \frac{1}{\alpha+\beta}$,

$d_0 = -\frac{\alpha lna - \alpha ln\beta}{\alpha+\beta}$, $d_2 = \frac{\delta_2 - \gamma\delta_1}{\alpha+\beta}$, $d_3 = -\frac{\alpha}{\alpha+\beta}$,

4.2. Definitions and evolution of variables

Employment of manufacturing sectors comes from WIOD and SEA databases. The employment in all sectors increased (Fig. 1a). Labor-intensive textile & apparel sector created the most employment, which increased from 27.6 million persons in 2005 to 32.7 million persons in 2014, but only at an annual average growth rate of 2.2%, the lowest except for coke & petroleum sector (0.8%) and "other manufacturing" sector (0.4%). The employment in textile & apparel sector accounted for 23% of total manufacturing employment in 2005,

decreased to 19% in 2014. All labor-intensive sectors created more than a half employments in 2005 (53%), decreased to 48% in 2014. It suggests that labor-intensive sectors become more capital intensive because of the quick rise of labor costs. The employment in the machinery sector increased from 7.8 million to 15.2 million persons, thus created 7.3 million employment, the highest level of employment during 2005-2014 period. The employment in ICT & electronic and electronic equipment sectors also created 3.4 million and 4.9 million jobs respectively. The employment share in medium and high technology sectors increased from 30% in 2005 to 36% in 2014, while in medium sectors passed from 16% to 17% respectively.

Capital intensity (CI) is the ratio of nominal capital stocks deflated by the price of intermediate goods and divided by number of employees. Data on Capital stocks and number of employees of manufacturing sectors come from WIOD. The capital intensity of all manufacturing sectors increased quickly in 2014 relative to 2005. Only two sectors increased at annual average growth rates less than 10% (8.3% and 9.5% respectively for the coke & petroleum sector and food sector). Others increased from 11% per year at average for chemicals to 17% for fabricated metal sector (17.6%). The capital intensity increased 17% per year at average for ICT & electronic and 15% for textiles & apparel sector and 17.3% for other manufacturing sector. This suggests that the Chinese manufacturing industry becomes more capital-intensive, and thus needs less employment.

GVC backward linkage is measured as share of foreign value added embodied in sector i relative to gross exports of industry i. It captures the value of imported intermediate goods embodied in a domestic industry's exports from foreign industry upstream in the production chain. A large share indicates that the industry mainly engages in final assembly of imported inputs from other countries and thus strongly depends on the rest of the world.

GVC backward participation is considered as an easier gate for developing countries with low labor costs to enter into global value chains, because the countries need not having a whole production lines, but only fragmented lines for producing some "tasks" corresponding to their comparative advantages (Baldwin, 2016). China has used this gate in 1980s to access processing and assembly activities whose share in total exports attainted at the highest level in 1997-1998 period (57%) and stayed more than of 50% for the 1995-2007 period. China's processing and assembly exports profited GVCs' networks of multinationals to enter world markets. The ICT & electronics sector has the highest share of foreign value added relative to its exports, which decreased from 43% in 2005 to 32% in 2014. The share decreased 8 percentage points for four sectors (electrical equipment, other transport, rubber & plastics, paper & printing), followed by the machinery sector. The textiles and apparel sector's share decreased from 17% in 2005 to 11% in 2014.

GVC forward linkage is calculated as domestic value added embodied in intermediate exports that are further re-exported to third countries relative to gross exports of China's sector i. It measures exports of intermediate goods that are used as inputs for the production of exports of other countries. An increasing ratio suggests that the country is moving up in the GVCs to start producing intermediate goods for other countries (Wang et al. 2014). Fig 1c. shows that the highest share of intermediate goods exported to third country is motor vehicles whose shares increased from 67% in 2005 to 71% in 2014, followed by transport equipment from 31% to 35% and coke & petroleum from 28% to 33%, food from 13% in 2005 to 21% in 2014. The share is slightly increased for textile & apparel sectors, while that of ICT & electronic decreased slightly. The share decreased for paper & printing from 29% to 20%, followed by machinery equipment, and basic metals.

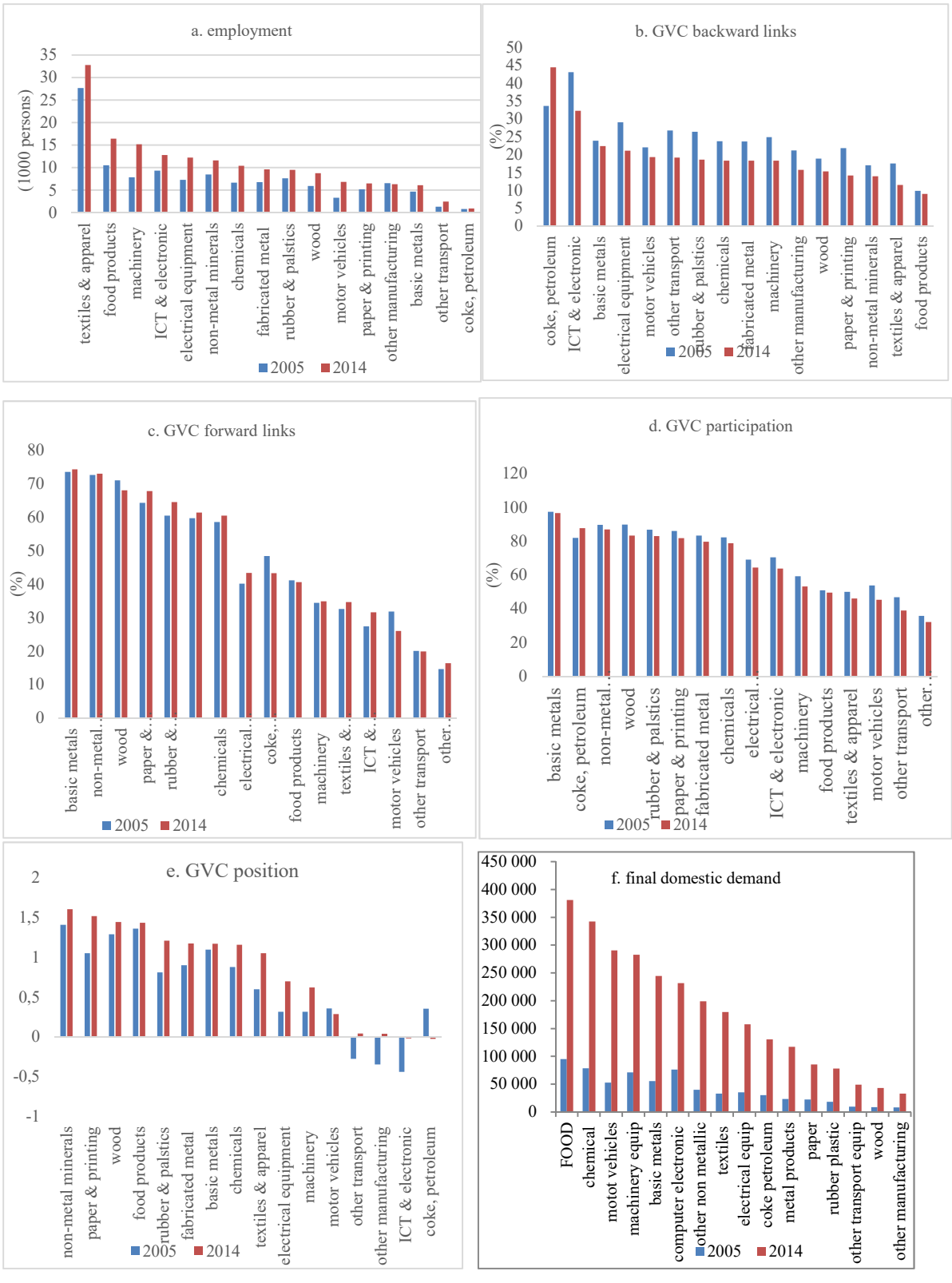
GVC participation is the sum of forward and backward linkages. It measures the extent to which a sector is involved in the global production chain. The larger the ratio, the

greater the intensity of involvement of a sector in a country in GVCs. GVC position is the log ratio of a country's supply of intermediates used in other countries' exports to the use of imported intermediates in its own production. This index characterizes the relative upstreamness of an industry. It gauges whether an industry is likely to be in the upstream or downstream of the global value chain (GVC) in a particular sector (Koopman et al., 2014). A positive position index means that countries are relatively upstream by producing inputs for others, thus contributing more value added to other countries' exports than other countries produce, and contribute to theirs. A negative position index suggests that sectors are relatively downstream by importing a large portion of intermediates from other countries to produce its final goods. It allows knowing if there is an effect of moving up.

All industries had positive position indices except for other transport, other manufacturing and ICT & electronic sectors in 2005. The sector position improved for all sectors in 2014 relative to 2005, except for motor vehicles and coke, petroleum sectors whose position indices become negative. The position of ICT & electronic sector was still negative in 2014, meaning that this sector imported more intermediate goods to produce final goods. Even still lightly negative, ICT & electronic sector improved its position among the best just after paper & printing, textiles & apparel.

Finally, China's finally domestic demand increased strongly in all sectors, increased at least at 20% per year on average (Fig 1h). The food sector met the highest growth rate, while the other manufacturing the lowest growth rate.

Figure 1: Evolution of employment, GVC indices and final domestic demand



4.3. Empirical estimations

Before performing the econometric regressions, we need to know if the variables are stationary at an absolute level to avoid spurious results. We apply Levin-Lin-Chu panel data unit root tests (Choi, 2001 and Im et al. 2003) in which time trend and panel-specific means (fixed effects) options were used; the variables are lagged by one period. We subtract the mean of the series across panels from the series to mitigate the impact of cross-sectional dependence (Levin et al. 2002). The results, reported in Table A2, allow us to reject the null hypothesis that all the panels contain unit roots, so we can accept the hypothesis that the variables are stationary at an absolute level. We then apply Hausman specification test and its results show that fixed effect estimations are preferred to random effect ones.

A potential econometric problem is the endogeneity of explanatory variables. This is a difficulty met in all the estimations on macroeconomic data, due to the possibility of a reverse causal relationship, i.e. an industry with low labor cost labor is more likely to be engaged in GVCs, due to measurement error, i.e. GVC indicators are estimated using Leontief decomposition and to the risk of omitted variables. The obtained results of Durbin-Wu-Hausman test do not allow us to accept the null hypothesis of exogeneity of GVCs. As the results of Pagan-Hall test do not allow us to accept the null hypothesis of homoscedasticity, the system estimator of the one-step Generalized Moment Model (GMM) of Blundel & Bond (1998) which is more efficient than IV/2SLS estimator is chosen.

The GMM system estimation approach combines an equation in levels in which lagged first-difference variables are used as instruments and a first-difference equation in which the instruments are lagged variables in levels[4]. We complete these lagged variables by

[4] Blundell and Bond (1998) showed that this estimator is more powerful than the first-differences estimators, derived from Arellano and Bond (1991), are, which give biased results in small samples with weak instruments.

adding a variable of world average industrial GVC indices to instrument China's GVC participation for the same industries, which is strongly correlated (Babh et al, 2020; Hua, 2022). We have used Arellano-Bond's standard autocorrelation test to ensure no autocorrelation at AR (2). We have tested the validity of the instruments by using the Sargan over-identification test. The results do not allow us to reject the hypothesis on their validity. The instruments are therefore independent of error terms.

The functions are estimated for 16 manufacturing industries over the period from 2005 to 2014 (see table A1 for the list of sectors). The analysis period and the sample size are determined by data availability from the OECD Trade in Value Added (TiVA) and World Input-Output Database (WIOD) databases. The OECD TiVA publishes data over the period from 2005 to 2015 for 16 manufacturing sectors (2018 edition). The WIOD published Socio Economic Accounts Release 2016 available February 2018 over the period from 2000 to 2014 for 18 manufacturing sector (Timmer et al., 2015). Both databases use an industry list based on the International Standard Industrial Classification (ISIC) Revision 4 and used 2008 System of National Accounts (SNA) concepts allowing for data compatibility. The sectors 17 (manufacture of paper and paper products) and 18 (printing and reproduction of recorded media) in WIOD are regrouped into a sector (paper products and printing) as in TiVA, as well as the sectors 20 (Manufacture of chemicals and chemical products) and 21 (Manufacture of basic pharmaceutical products and pharmaceutical preparations) into a sector (Chemicals and pharmaceutical products). The Socio-economic accounts of WIOD contain industry-level data on employment, capital stocks, gross output and value added at current and constant prices. The definitions the sources of data are the following and resumed in table A1.

Table 1 presents the results of baseline estimations for equations 10 to 13. As waited, the employment lagged one period is statistically significant and positive. The real output is statistically significant, and exerts a positive effect on employment, while the capital intensity

plays a negative effect (Column 1.1, part A table 1). We find that GVC backward linkages increase job creation with the estimated coefficient of 0.27 (column 1.2, part A table 1) while forward linkages decreases employment with the estimated coefficient of -0.36 (column 1.3, part A table 1). These contrasted GVCs effects lead a statistically insignificant effect on GVC participation, which is sum of backward and forward linkages while the impact of GVCs position is negative (-0.17) (column 1.4, part A table 1). The results reported in part B Table 1 show that the net impacts of backward, forward linkages and positions on employment are statistically significant, while the coefficient of GVCs participation is insignificant (column 1.6 to 1.10, table 1). Finally, the results reported in parts C and D table 1 show that final domestic demand exerts a positive effect on employment with the estimated coefficient of 0.08 (columns 1.11 to 1.20, table 1).

Table 2 calculated annual contributions of backward and forward linkages and final domestic demand to employment growth. The estimated coefficient of backward linkage is 0.27 (column 1.2, part A table 1). The part of foreign value added in exports decreased of 3.36% per year on average (column 2, table 2). The decline in processing and assembly activities diminished the employment of 0.91% (0.27*(-3.3%)) per year on average (column 3, table 2). The coefficient of forward linkages is estimated to -0.36 (column 1.3, table 1). As the part of Chinese intermediate goods embodied in third countries increase 0.95% per year on average (column 2, table 2), it decreased the employment of 0.3% (-0.36*0.95%) (column 3, table 2). The coefficient of final domestic demand is estimated to 0.08. As final domestic demand increase 20% per year on average (column 2, table 2), it increased the employment of 1.6% per year on average (0.08*20%) (column 3, table 2), which is higher than the negative effects of GVCs backward and forward linkages. These results suggest that China's final domestic demand created more jobs than its GVCs participation via backward and forward linkages.

Table 1. Impact of China's GVCs participation and domestic consumption on employment of 16 manufacturing industries over the 2005-2014 period, baseline GMM estimations

Part A Equation 10	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**
Employment$_{-1}$	0.44*** (5.99)	0.45*** (6.60)	0.45*** (6.25)	0.44*** (6.31)	0.45*** (6.39)
Real output	0.14*** (4.59)	0.19*** (6.08)	0.15*** (4.89)	0.16*** (4.67)	0.17*** (5.47)
Capital intensity	-0.21*** (-3.27)	-0.15** (-2.41)	-0.17*** (-2.82)	-0.19** (-2.94)	-0.17*** (-2.79)
GVCs backward linkages		0.27*** (3.76)			
GVCs forward linkages			-0.36*** (-2.66)		
GVCs participation				0.24 (0.82)	
GVCs position					-0.17*** (-3.21)
AR(2)	0.71	0.25	0.76	0.57	0.39
Sargan test	0.10	0.12	0.27	0.05	0.23
Part B Equation 11	**1.6**	**1.7**	**1.8**	**1.9**	**1.10**
Employment$_{-1}$	0.75*** (17.39)	0.81*** (15.71)	0.75*** (18.36)	0.68*** (12.48)	0.78*** (16.16)
Capital intensity	-0.34*** (-4.55)	-0.29*** (-4.33)	-0.31*** (-4.72)	-0.33*** (-4.85)	-0.29*** (-4.51)
GVCs backward linkages		0.15* (1.84)			
GVCs forward linkages			-0.38** (-2.34)		
GVCs participation				-0.52 (-1.61)	
GVCs position					-0.11* (-1.75)
AR(2)	0.69	0.36	0.67	0.94	0.44
Sargan test	0.10	0.18	0.30	0.19	0.34
Part C Equation 12	**1.11**	**1.12**	**1.12**	**1.14**	**1.15**
Employment$_{-1}$	0.34*** (4.22)	0.36*** (5.21)	0.34*** (4.79)	0.37*** (5.08)	0.34*** (4.59)
Real output	0.10*** (2.89)	0.14*** (4.57)	0.12*** (3.65)	0.12*** (3.39)	0.12*** (3.74)
Capital intensity	-0.25*** (-3.95)	-0.18*** (-3.19)	-0.21*** (-3.78)	-0.20*** (-3.36)	-0.21*** (-3.71)
GVCs backward		0.31***			

linkages		(4.60)			
GVCs forward linkages			-0.36*** (-2.77)		
GVCs participation				0.15 (0.56)	
GVCs position					-0.20*** (-3.96)
Real domestic demand	0.08*** (2.75)	0.09*** (3.11)	0.07*** (2.51)	0.06** (2.12)	0.09*** (3.30)
AR(2)	0.92	0.34	0.96	0.77	0.54
Sargan test	0.05	0.19	0.05	0.05	0.11
Part D Equation 12	**1.16**	**1.17**	**1.18**	**1.19**	**1.20**
$Employment_{-1}$	0.45*** (5.83)	0.48*** (7.21)	0.48*** (6.93)	0.47*** (6.61)	0.45*** (6.86)
Capital intensity	-0.29*** (-5.31)	-0.30*** (-5.73)	-0.31*** (-5.74)	-0.31*** (-5.54)	-0.30*** (-6.00)
GVCs backward linkages		0.25*** (3.65)			-0.18*** (-3.50)
GVCs forward linkages			-0.39** (-2.92)		
GVCs participation				-0.32 (-1.20)	
GVCs position					-0.18*** (-3.50)
Real domestic demand	0.12*** (4.39)	0.15*** (5.59)	0.12*** (4.72)	0.10*** (3.74)	0.15*** (5.61)
AR(2)	0.90	0.30	0.88	0.90	0.46
Sargan test	0.05	0.05	0.05	0.06	0.06

Notes: t-statistics in parentheses. * p<0.1, ** p<0.05, *** p<0.01

Table 2. Annual average contribution of GVCs backward and forward linkages and final domestic demand to employment

	Estimated coefficients	Annual average growth rates	Annual average contributions
	1	2	3=1*2
Sector backward linkages	0.27	-3.36	-0.91
Sector forward linkages	-0.36	0.95	-0.3
Final domestic demand	0.08	20	1.6
Total			**0.39**

Source: Authors' calculation

5. Robustness tests

We make several robustness tests to check the stability of the obtained baseline estimations. We successively added labor productivity and foreign final demand into the estimations. Tables 3 and 4 report the results when labor productivity and foreign final demand are respectively added. The coefficient of labor productivity is negative and statistically significant (Table 3, column 3.1 to 3.10), while that of foreign final demand is not statistically significant (Table 4, column 3.1 to 3.5). Table 5 presents the results by excluding coke & and petrol sector which suffers special movement. The addition of labor productivity and foreign final demand, and the exclusion of coke & and petrol sector do not modify significantly the coefficients of basic equations.

Table 3. Impact of labor productivity on employment of 15 manufacturing industries over the 2005-2014 period

	3.1	**3.2**	**3.3**	**3.4**	**3.5**
$Employment_{-1}$	0.28*** (3.83)	0.28*** (3.83)	0.25*** (3.37)	0.26*** (3.46)	0.28*** (3.81)
Real output	0.34*** (8.28)	0.34*** (8.28)	0.31*** (7.34)	0.34*** (7.66)	0.32*** (7.80)
Capital intensity	0.01 (0.16)	0.01 (0.16)	-0.05 (-0.73)	-0.04 (-0.54)	-0.02 (-0.26)
GVCs backward linkages		0.26*** (3.84)			
GVCs forward linkages			-0.22* (-1.65)		
GVCs participation				0.34 (1.33)	
GVCs position					-0.18*** (-3.36)
Labor productivity	-0.11*** (-4.17)	-0.11*** (‘4.17)	-0.12*** (-4.09)	-0.14*** (-5.21)	-0.10*** (-3.69)
	3.6	**3.7**	**3.8**	**3.9**	**3.10**
$Employment_{-1}$	0.35*** (4.69)	0.39*** (5.87)	0.38*** (5.53)	0.38*** (5.33)	0.36*** (5.06)
Real output	0.12** (2.45)	0.16*** (3.54)	0.11** (2.37)	0.15*** (2.98)	0.14*** (3.12)
Capital intensity	-0.24***	-0.17***	-0.22***	-0.18***	-0.21***

	(-3.79)	(-2.88)	(-3.56)	(-2.92)	(-3.41)
Backward linkages		0.29*** (4.28)			
Forward linkages			-0.35** (-2.66)		
GVCs participation				0.20 (0.76)	
GVCs position					-0.20*** (-3.94)
domestic final demand	0.07** (2.43)	0.08*** (2.77)	0.06** (2.14)	0.06** (2.13)	0.09*** (2.81)
foreign final demand	-0.02 (-0.50)	-0.02 (-0.66)	-0.002 (-0.04)	-0.03 (-0.96)	-0.01 (-0.24)

Notes: t-statistics in parentheses. * $p<0.1$, ** $p<0.05$, *** $p<0.01$

Table 4. Impact of Chinese participation on employment of 15 manufacturing industries excluding coke & and petrol sector over the 2005 2014 period

	4.1	**4.2**	**4.3**	**4.4**	**4.5**
Employment$_{-1}$	0.35*** (4.01)	0.36*** (4.58)	0.33*** (4.02)	0.37*** (4.56)	0.34*** (4.21)
Real output	0.18*** (4.87)	0.24*** (6.45)	0.20*** (5.56)	0.19*** (4.03)	0.23*** (6.33)
Capital intensity	-0.20*** (-2.72)	-0.11 (-1.56)	-0.12* (-1.71)	-0.19*** (-2.56)	-0.11 (-1.66)
Backward linkages		0.30*** (4.16)			
Forward linkages			-0.45*** (-3.09)		
GVC participation				0.18 (0.61)	
GVC position					-0.22*** (-3.85)
	4.6	**4.7**	**4.8**	**4.9**	**4.10**
Employment$_{-1}$	0.34*** (3.99)	0.38*** (5.48)	0.39*** (5.46)	0.44*** (5.98)	0.39*** (5.96)
Capital intensity	-0.41*** (-5.82)	-0.34*** (-6.14)	-0.35*** (-6.12)	-0.34*** (-5.78)	-0.34*** (-6.40)
GVCs backward linkages		0.43** (5.64)			
GVCs forward linkages			-0.55*** (-3.63)		
GVCs participation				-0.05 (-0.16)	
GVCs position					-0.30*** (-5.27)
Final domestic demand	0.16*** (5.17)	0.23*** (7.38)	0.16*** (5.79)	0.13*** (4.14)	0.20*** (7.16)
	4.11	**4.12**	**4.13**	**4.14**	**4.15**
Employment$_{-1}$		0.38*** (5.37)	0.34*** (4.79)	0.36*** (4.65)	0.34*** (4.41)
Real output		0.11** (2.06)	0.12*** (3.65)	0.15** (2.44)	0.09 (1.50)
Capital intensity		-0.21*** (-2.76)	-0.21*** (-3.78)	-0.18** (-2.10)	-0.25*** (-2.97)
Backward linkages		0.36*** (4.91)			
Forward linkages			-0.36*** (-2.77)		
GVC participation				0.15 (0.53)	
GVC position					-0.28*** (-4.72)
Final domestic demand		0.12** (2.47)	0.07** (2.51)	0.07** (2.63)	0.14** (2.60)

Notes: t-statistics in parentheses. * p<0.1, ** p<0.05, *** p<0.01

5. Conclusion: economic and political implications

How to provide jobs to almost 11 million students who graduated from universities in 2022 in addition of 10 million unemployed is a great challenge for the Chinese government to keep social stability. If the Chinese manufacturing industry has been the main sector to create jobs along to the industrialization since "open door" policies launched in the end of 1978, its employment absorption capacity has been decreasing recently. This decrease is coincided with the moving out of the Chinese firms from low cost labor intensive processing and assembly activities via backward linkages and the development of higher technological content industries able to produce intermediate goods to be embodied in third countries' exports via forward linkages but need less labor, in particular non-qualified one. An alternative solution of the Chinese government face to the decreasing manufacturing job creation capacity is to reorient its exports-led growth model to domestic demand-led one. In fact, the Chinese high economic growth since its open door policies has increased strongly domestic consumption demand.

Using panel data of 16 Chinese manufacturing industries over the 2005-2014 period and OECD TiVA and WIOD databases, we estimated GVCs labor demand functions augmented of final domestic demand. The obtained results show that China's backward linkages and final domestic demand increased its domestic employment, while forward linkages improvement decreased employment. The part of foreign value added in exports decreased of 3.36% per year on average contributed diminishing the employment of 0.91% per year on average. The part of Chinese intermediate goods embodied in third countries increase 0.95% per year on average contributes decreasing the employment demand of 0.3% per year on average. The annual average growth rate of 20% of China's final domestic

demand per year on average contributed to increase the employment demand of 1.6% per year on average, which exceeded the job less caused by GVCs participation. These results suggest that domestic demand becomes the main motor of job creation. They provide an argument in favor of the "double circulation" which mainly focuses domestic market as development strategy adopted by the Chinese government in 2020 from the point of view of job creation.

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Table A1: 16 Manufacturing Industry Classifications

Labels	Manufacturing sectors	TiVA_Code	WIOD code	ISTC Rev. 4 codes
Food	Foods products, beverages & tobacco	D10T12	C10-C12	10-12
Textiles & apparel	Textiles, textile products, leather & footwear	D13T15	C13-C15	13-15
Wood	Wood and products of wood and cork	D16	C16	16
Paper & printing	Paper products and printing	D17T18	C17 C18	17, 18
coke & and petrol	coke & and petrol	D19	C19	19
Chemicals	Chemicals and chemical products	D20T21	C20 C21	20, 21
Rubber & plastics	Rubber and plastics products	D22	C22	22
Non-metal minerals	Other non-metallic mineral products	D23	C23	23
Basic metals	Basic metals	D24	C24	24
Fabricated metals	Fabricated metal products except machinery and equipment	D25	C25	25
ICT & electronics	Computer, electronic and optical products	D26	C26	26
Electrical equipment	Electrical machinery & apparatus n.e.c.	D27	C27	27
Machinery	Machinery and equipment n.e.c.	D28	C28	28
Motor vehicles	Motor vehicles, trailers & semi-trailers	D29	C29	29
Other transport	Other transport equipment	D30	C30	30
Other manufacturing	Other manufacturing	D31T32	C31C32	31, 32

Table A2. Names, calculation methods, sources and unit root tests of variables

Names of variables	Calculation methods	Sources	Levin-Lin-Chu unit-root test*
Employment	Number of employment	World Input-Output Database	-7.8438
GVC backward linkage	share of foreign value added relative to gross exports	OECD TiVA	-6.6287
GVC forward linkage	Share of domestic value added embodied in intermediate inputs re-exported to third countries relative to gross exports	OECD TiVA	-7.6478
GVC participation	sum of forward and backward linkages	OECD TiVA	-5.8732
GVC position	log ratio of supply of intermediates used in other countries' exports to the use of imported intermediates in its own production	OECD TiVA	-7.0031
Capital intensity	ratio of nominal capital stocks deflated by the price of intermediate goods and divided by number of employees	WIOD	-5.6254
Labor productivity	Nominal domestic value added in exports deflated by value-added price (2010=100) and divided by numbers of employees	OECD TiVA; WIOD Database	-7.8764
Real final domestic demand	Domestic value added embodied in domestic demand deflated by the price of value added (2012=100)	OECD TiVA	-5.4007

Note: * Levin-Lin-Chu unit-root test (Ho: Panels contain unit roots) is made with time trend and panel-specific means (fixed effects) and subtracted cross sectional means options. The variables are lagged by one period. The results of adjusted t are reported in table corresponding p-value=0.0000 for all variables.