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Heterogeneity and Domestic Value Added of Chinese Exports

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Abstract

Chinese processing exports use imported intermediates more intensively than its ordinary exports. The share of processing exports in the Chinese exports to high income countries is much higher than that to low income ones. That heterogeneity suggests that the domestic value added of Chinese processing exports differs from that of ordinary exports, and the domestic value added of Chinese bilateral exports should vary across its trading partners. In this study I estimate the domestic value added of Chinese processing exports, ordinary exports, total exports and bilateral exports to 150 countries from 2004 to 2018, giving consideration to the heterogeneity. The estimates indicate that the domestic value added of processing exports was 30.1% in 2004, about 55 percentage points lower than that of ordinary exports. From 2004 to 2018, the domestic value added of total Chinese exports rose from 54.5% to 63.7%. However, the significant disparity in the domestic value added between processing and ordinary exports was persistent during the period. The domestic value added of Chinese exports also varied significantly across 150 trading partners. In 2004, it ranged from 39.5% to 84.1%. Generally, Chinese exports to developing countries were embedded with higher domestic value added than that to developed countries. Compared with the Chinese domestic value added reported by the OECD TiVA, the estimates of this study are 20 percentage lower on average.

Key Words: China, GVC, Domestic Value added
JEL: F1

1. Introduction

The exportation of goods to foreign countries, one of the most important economic activities in an open economy, is a critical source of income and employment. However, in recent times, most manufactured goods are produced and traded along global value chains (GVC), and commonly the exports of a country contain a substantial portion of imported intermediate goods from abroad and the total value added of gross exports consists of both domestic value added and foreign value added. This exaggerates export volumes as well as bilateral trade balances, especially for countries engaging in large scale processing exports, which involves the importing of a huge number of foreign parts and components for the manufacture of exports. To accurately assess the contribution of exports to an economy, an estimation of the domestic value added embedded in exports is essential, since only domestic value added contributes to the income and employment of the national economy.

Moreover, developing countries typically enter GVCs by specializing in labor intensive and low skilled tasks. At the early stage of their GVC participation, the domestic value added of manufactured exports from those countries would be relatively low. As the firms in those countries improve their technology capacity and substitute more and more domestically produced parts and components for the initially imported inputs for the manufacture of exports, the domestic value added of their exports would rise accordingly. Therefore, the evolution of domestic value added in exports can serve as a marker of upgrading along GVCs and as an indicator of the extent to which developing countries have improved their capacity to produce import substitutes.

At present, international input-output tables are the most popular approach for estimating domestic value added in exports, also known as trade in value added (TiVA). The Organization of Economic Cooperation and Development (OECD), the Asian Development Bank and the World Input-Output Database (WIOD) all employ international input-output tables in their estimations of domestic value added in gross exports of individual countries. The OECD's TiVA database is widely used by academics in value chain analyses. The GVC participation index, a parameter used in the quantification of a country's integration with GVCs, is calculated using estimated domestic value added of exports. Theoretically, international input-output tables are an ideal tool for tracing the country origins of intermediates used in the production of exports and identifying the destination markets of final goods. Wang, Wei and Koopman (2014) provide a theoretical framework for estimation of the domestic value added of exports using international input-output tables. On the other hand, not all the parameters required in the theoretical input-output models are readily available for calculation of domestic value added. In general, statisticians must make a lot of assumptions about unknown parameters, which overly simplifies the micro-features of GVCs and thus undermines the reliability of the estimates (Sturgeon et al., 2013). For instance, the assumption that imported inputs are proportional across all sectors tends to artificially raise the estimated domestic value added of exports.

Take for example China, the center of global manufacturing assembly: its exports use imported inputs more intensively than goods produced for the domestic market. There are two reasons for this. First, the imported intermediates for producing goods to be sold to domestic consumers are subject to tariffs and non-tariff barriers, which obviously discourages the usage of foreign-made inputs in the production of locally consumed goods. Those trade barriers were very high before China joined the WTO in 2001. Second, the Chinese government introduced the processing trade regime at the beginning of the economic reforms. The processing trade regime has granted free trade status to foreign intermediates if they are used for the manufacture of exports. That regime stimulated unprecedented growth of processing exports, mainly manufactured/assembled with foreign parts and components. In the early 1980s, processing exports accounted for less than one tenth of China's total exports. By 1995 the share of processing exports exceeded 50%; that dominance of processing exports persisted until the eruption of the global financial crisis in 2008 (Xing, 2021). Even today, processing exports comprise more than 30% of total Chinese exports. The extensive usage of imported intermediate inputs in the manufacture of processing exports implies that the domestic value added of Chinese exports should be lower than that of the Chinese goods serving China's domestic market. This heterogeneity should be considered in estimations of the domestic value added of Chinese exports; otherwise, it would be overestimated. Regarding bilateral trade, processing exports are not proportionally distributed among Chinese trading partners. The intensity of processing exports in Chinese exports to developed countries tends to be relatively high. A few studies (e.g, Ma & Assche, 2011; Xing, 2016a) have revealed that Chinese processing exports have been targeting mainly high-income countries. For example, in 2004, processing exports accounted for 67% of Chinese exports to the US, but only 23.8% of exports to Vietnam. The cross-country heterogeneity of processing exports suggests that the domestic value added of Chinese exports varies across trading partners, and that exports to high-income countries generally contain less domestic value added than those to low-income countries. To my knowledge, no study has analyzed the heterogeneity of domestic value added of exports across trading partners.

In this study, I estimate the domestic value added of Chinese exports by considering the heterogeneity within exports and across Chinese trading partners. I analyze detailed processing trade data compiled by the Chinese Customs and develop a direct estimation method, working from the definition of domestic value added of exports, rather than following the popular input-output table approach. Using this new method, I estimate the domestic value added of Chinese processing exports, ordinary exports, and total exports during 2004–2018. In addition, I calculate the domestic value added of Chinese exports to 150 countries, which cover most of Chinese trading partners. The results provide evidence of significant heterogeneity in the domestic value added across export types and trading partners.

Specifically, the domestic value added of processing exports is much lower than that of ordinary exports. In 2004, domestic value added comprised 30.1% of processing exports, but accounted for 84.7% of ordinary exports. The domestic value added of processing exports gradually increased to 37.6% by 2018, indicating that more and more domestically produced parts and components were used in the manufacture of processing exports. In contrast, the domestic value added of ordinary exports fell to 76%, which suggests that more imported intermediates were being used in the manufacture of ordinary exports. This phenomenon is consistent with China’s trade liberalization, which has substantially reduced tariff and non-tariff barriers and lowered the cost of imported intermediates. The use of high quality foreign parts and components is no longer the exclusive domain of processing exports.

Between 2004 and 2018, the domestic value added of all Chinese exports grew from 54.5% to 63.7%, implying that China was capturing more and more value added from its exports. It is worthy to emphasize that this study's estimates of China’s domestic value added are on average 20 percentage points lower than the estimates of the OECD TiVA 2018 during the period of 2004 to

2018. Given that processing exports accounted for a very large portion of Chinese exports, it is highly likely that the OECD TiVA substantially overestimates the domestic value added of Chinese exports, and that the estimates presented here are relatively reasonable and a more accurate reflection of the reality.

The heterogenous hypothesis is also supported by the domestic value added of Chinese exports to 150 foreign countries. In 2004, the domestic value added of Chinese exports ranged from 84.5% to 39.5% across the trading partners. A simple regression suggests that the domestic value added has a significantly negative correlation with the income of the trading partners. Generally, China's domestic value added of exports to low-income countries are significantly higher than that to high-income countries. For each dollar of export, China gained more value added from its exports to developing countries than that to developed countries. For instance, the domestic value added of the Chinese exports to the US was 48.1% in 2004 while that to Vietnam 71.7%. This disparity has an important economic implication: in terms of income generation, exporting a $3 good to the US is equivalent to exporting a $2 good to Vietnam. The domestic value added of 2018 Chinese exports to Germany is estimated at 63.2%; that to India, 70.4%. Despite the fact that China exported $77.5 billion to Germany that year, higher than China's $76.7 billion in exports to India, China captured more value added from its exports to India. This is the first study to estimate domestic value added in bilateral trade. The results promise to improve our understanding of the relative importance of trading partners in terms of actually gained income from exports.

2. Estimation of the Domestic Value Added of Exports under Heterogeneity

To derive the estimation method, I start from the original definition of the domestic value added embedded in Chinese exports. The share of the domestic value added in Chinese exports DV can be defined as

$$\mathrm{DV} = \frac{\mathrm{EX} - \mathrm{IM_{in}}}{\mathrm{EX}} \qquad (1),$$

where EX denotes China's total exports, and $\mathrm{IM_{in}}$ all imported intermediate inputs used for the manufacture of exports. Both EX and $\mathrm{IM_{in}}$ are measured in gross value. A typical concern expressed about this simple definition is whether $\mathrm{IM_{in}}$ contains domestic value added. Since $\mathrm{IM_{in}}$

represents the gross value of the imported intermediates used in the manufacture of export EX, it is highly likely that $\mathrm{IM_{in}}$ includes domestically made intermediates. It is a daunting task for statisticians following the input-output approach to remove the domestic value added embedded in imported intermediates so as to eliminate possible double counted value.

If any domestically produced X is included in $\mathrm{IM_{in}}$, it should be exported first before it can be imported back. Therefore, X must be counted twice in total exports EX if X is imported back only once, or counted N+1 times in EX if X is imported back N times as part of the intermediates for the production of exports. Therefore, the difference $(\mathrm{EX} - \mathrm{IM_{in}})$ only measures the domestic value added of exports. The domestic value is neither underestimated nor double counted in the difference, regardless how many times X is imported back for the production of exports. For a rigorous proof of the above statement, please see Xing (2016b).

The Chinese Customs classifies China's exports into two categories: processing exports and ordinary exports. The former is mainly produced with imported intermediates. Chinese imports are also divided into two groups: processing imports and ordinary ones. Processing imports are exclusively used for manufacturing processing exports.

Let

$\mathrm{EX} = \mathrm{PE} + \mathrm{OE}$

and

$\mathrm{IM_{in}} = \mathrm{IM_{in}^{p}} + \mathrm{IM_{in}^{o}}$,

where PE denotes processing exports, OE ordinary exports, $\mathrm{IM_{in}^{p}}$ imported intermediates for processing exports, and $\mathrm{IM_{in}^{o}}$ imported intermediates for ordinary exports. Using this notation, we can transform equation (1) as

$$\mathrm{DV} = \alpha \mathrm{DV_p} + (1 - \alpha)\mathrm{DV_o} \quad (2),$$

where

$\alpha = \frac{PE}{EX}$ is the ratio of processing exports to total exports;

$\mathrm{DV_p} = \frac{\mathrm{PE} - \mathrm{IM_{in}^{p}}}{\mathrm{PE}}$ is the share of domestic value added of processing exports; and

$\mathrm{DV_o} = \frac{\mathrm{OE} - \mathrm{IM_{in}^{o}}}{\mathrm{OE}}$ is the share of domestic value added of ordinary exports.

Equation (2) implies that the domestic value added of Chinese exports is equal to the weighted average of the domestic value added of processing exports and that of ordinary exports.

Now, to derive the formulas for estimating $\mathrm{DV_p}$ and $\mathrm{DV_o}$:

$\mathrm{DV_p}$ can be estimated as

$$\mathrm{DV_p} = \frac{\mathrm{PE} - \mathrm{IM_{in}^{p}}}{\mathrm{PE}} = \frac{\mathrm{PE} - \mathrm{PIM} - \mathrm{e_p}}{\mathrm{PE}} \quad (3),$$

where PIM is the reported processing imports by the Chinese Customs, i.e. imported intermediates exclusively used for manufacturing exports. All firms located in China and engaging in processing trade report their processing imports to the Chinese Customs in order to apply for tariff exemption. Energy is an essential input for the manufacture of processing exports. The firms manufacturing processing exports use electricity from the networks serving the whole country, and there are no power plants constructed exclusively for them. Therefore, the imported primary energy used in the production of processing exports is not included in the PIM. The imported primary energy used in the production of processing exports should add value to them and be part of foreign value added. That foreign value added due to the consumption of imported primary energy should be deducted from the gross value of processing exports. So, $\mathrm{e_p}$—total imported primary energy (mainly oil, gas and coal) utilized for producing processing exports—appears in equation (3) above.

If γ is the imported primary energy needed for China to produce one dollar of domestic value added in processing exports, then

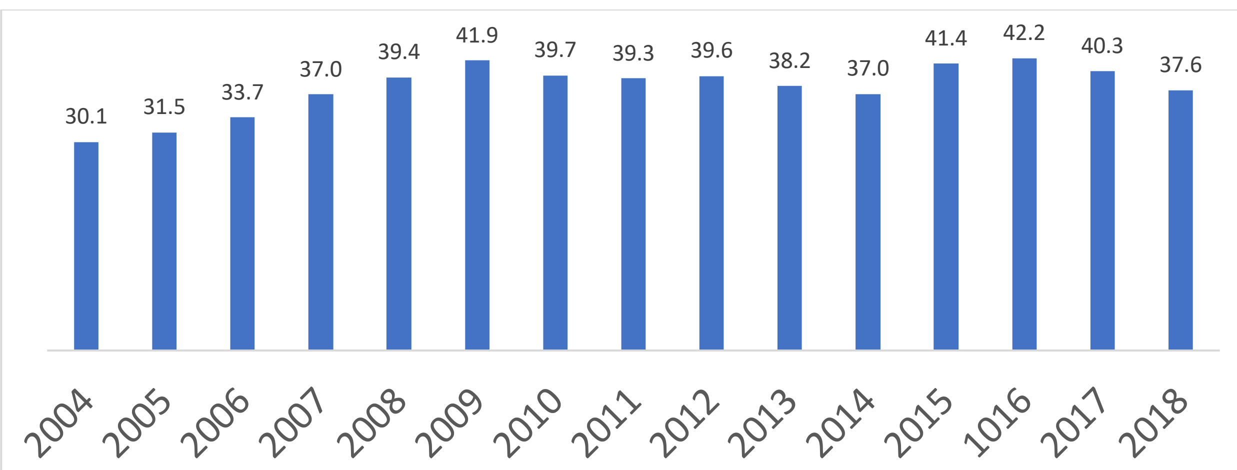
$$\mathrm{e_p} = \gamma * \mathrm{DV_p} * \mathrm{PE} \qquad (4).$$

Substituting (4) into (3) yields

$$DV_p = \frac{PE - PIM}{PE(1+\gamma)} \qquad (5)$$

In equation (5), parameters PE and PIM are readily available from the database maintained by the Chinese Customs, and γ is the only parameter which should be estimated. The γ used here is estimated by the research team of Prof. Ran Wang at the University of International Business and Economics, Beijing, China. Tables 2–4 in the appendix provide value for PE, PIM and γ used in that estimation. Figure 1 shows the estimates of annual DV_p from 2004 to 2018. In 2004, the domestic value added of processing exports was very low, about 30.1%, but consistent with the nature of processing exports—which are mainly produced with imported parts and components. Domestic value added of processing exports increased gradually to 37.6% in 2018, suggesting that China improved its capacity to produce import substitutes, and that more and more domestically produced inputs were used to produce processing exports. Despite that progress, the domestic value added of processing exports remained below 40%.

Figure 1. Domestic Value Added of China's Processing Exports (%)



Source: the author's calculations.

The estimation of DV_o is more complicated than that of DV_p, because the quantity of imported intermediate inputs exclusively used for ordinary exports IM_{in}^{o} is not available, hence it should be estimated with some assumptions. Below is the equation used to estimate IM_{in}^{o}:

$$IM_{in}^{o} = \beta * DV_o * OE + e_o \quad (6),$$

where β is the value of imported intermediate goods needed to produce one dollar of value added in ordinary exports, and e_o is the value of the imported primary energy needed for the production of ordinary imports. Similarly, using the parameter γ introduced above, we can calculate e_o as

$$e_0 = \gamma * DV_o * OE \quad (7).$$

Substituting equation (6) and (7) into equation (4), we derive

$$DV_o = \frac{1}{1+\beta+\gamma} \quad (8).$$

The β in equation (6) is an unknow parameter and can be estimated as

$$\beta = \frac{IM_{in}^{T} - PIM}{TMVA - DVPE} \qquad (9),$$

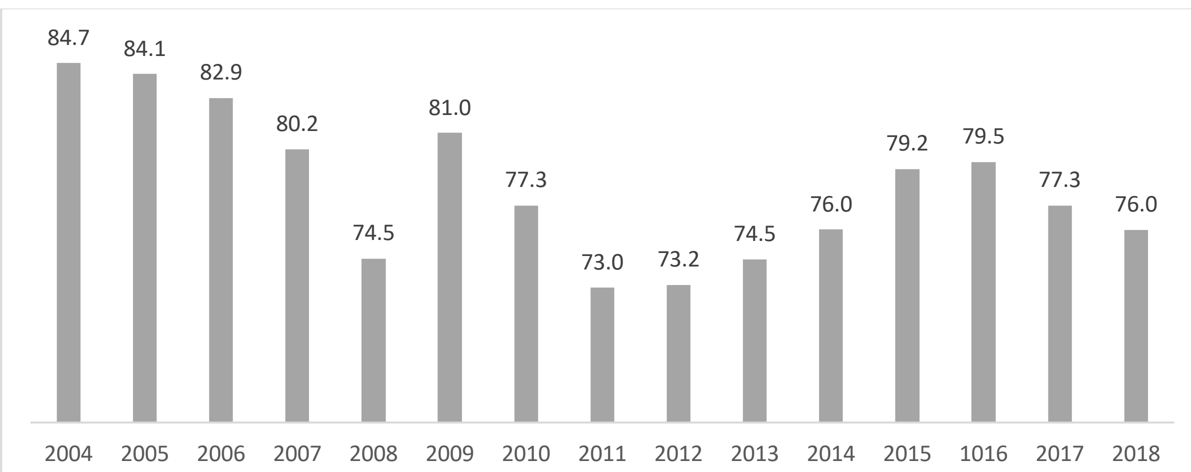
where IM_{in}^{T} is the total value of imported intermediate goods and extracted from the OECD's input-output table. $TMVA$ is the total manufacturing value added, and $DVPE$ is the total value added of processing exports. Because processing imports PIM, part of IM_{in}^{T}, is used exclusively for processing exports, the numerator $(IM_{in}^{T} - PIM)$ measures the quantity of imported intermediate goods only used in the manufacture of ordinary exports and goods consumed domestically. The denominator $(TMVA - DVPE)$ represents the total manufacturing value added accrued from ordinary exports and goods sold in the domestic market. Equation (9) assumes that imported intermediate goods are proportionally distributed between ordinary exports and goods sold in the domestic market. Due to the limitation of the data, it is necessary to make this assumption. However, it is much weaker than the assumption that imported intermediates are proportionally distributed among all goods produced in China, which is adopted by the input-output table approach for measuring the domestic value added of exports.

The value of $TMVA$ is extracted from the World Bank database, and $DVPE$ is estimated by

$$DVPE = DV_p * PE.$$

Figure 2 reports the estimated domestic value added of China's ordinary exports from 2004 to 2018. In 2004, the domestic value added was 84.7%. This implies that most intermediate inputs of ordinary exports were locally produced, so China captured most of the value added of ordinary exports. However, rather than increasing, the domestic value added of ordinary exports gradually decreased to 76% in 2018, 8.7 percentage points lower than in 2004.

Figure 2: Domestic Value Added of China's Ordinary Exports: 2004–2018 (%)



Source: the author's calculation.

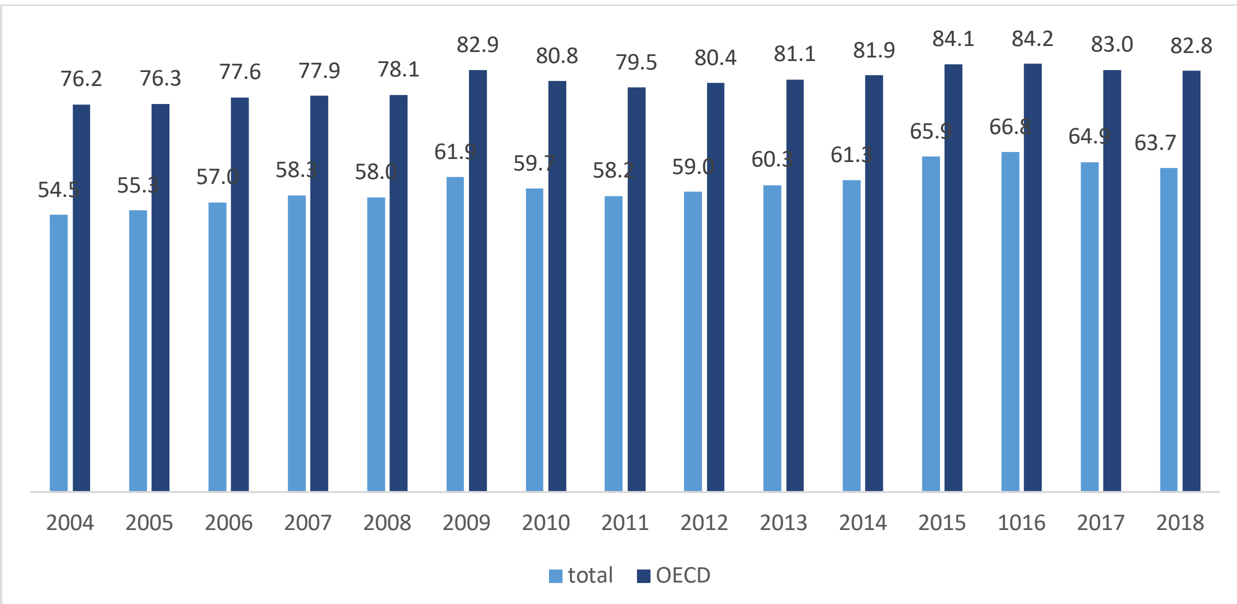
The progress of China's trade liberalization could offer a reasonable explanation for that decline. Since 1980, when the Chinese government introduced the processing trade regime, processing imports have been exempted from tariffs and quotas. However, during that period the imported intermediate inputs for the production of ordinary exports and goods consumed domestically were subject to relatively high tariffs and import quotas, which hindered the usage of imported inputs for producing non-processing exports. As the Chinese government gradually lowered tariffs and abolished import quotas, the cost of imported intermediates declined, which stimulated demand for foreign intermediates as inputs for the production of either ordinary exports, or goods sold in the Chinese market. As a result, the domestic value added of ordinary exports fell. Energy efficiency improvement, and the fluctuation in the price of oil also contributed to the dynamic changes in the domestic value added of ordinary exports.

Comparing the domestic value added of processing exports with that of ordinary exports, it is readily apparent that there is heterogeneity of domestic value added between processing exports and ordinary exports. Specifically, the domestic value added of ordinary exports was consistently higher than that of processing exports, with the difference ranging from 55 to 40 percentage points during the period 2004–2018. Unambiguously, for each dollar of goods sold abroad, China gained much more income from ordinary exports than from processing exports. To a certain extent, the disparity between the domestic value added of the two groups shrank substantially. On the one hand, more and more domestically made intermediates were being used in the production of processing exports; on the other hand, more and more imported intermediates were used in the manufacture of ordinary exports. This implies that import substitution is not a one-way street. While Chinese-made intermediate inputs were being substituted for imports in the production of processing exports, foreign intermediates expanded their presence in the production of ordinary exports, which accounted for more than two third of Chinese exports in 2020.

As shown in equation (2), the domestic value added of total Chinese exports DV is a weighted average of DV_p and DV_o. Using the results of figures 1 and 2, I estimate DV from 2004 to 2018. Figure 3 shows the results of the estimation and compares them with the domestic value added estimated by the 2018 version of the OECD's TiVA. The estimates demonstrate that the domestic value added of the Chinese exports accounted for 54.4% of gross exports in 2004, rising steadily to 63.7% in 2018, suggesting that China made substantial progress in upgrading along GVCs by raising its value added in exports.

The domestic value added estimated by the OECD's TiVA, however, is significantly higher than the estimate presented here. For instance, according to the TiVA, the domestic value added of Chinese exports in 2004 comprised 76.2% of the gross value of those exports, almost 22 percentage points higher than the 54.5% calculated in this study; in 2018 the domestic value added of the TiVA jumped to 82.8%, about 20 percentage points higher than the 63.7% estimate of this study. Rather than allocating processing imports proportionally between exports and goods produced for domestic consumption, in the estimation I allocate all processing imports as intermediate inputs of processing exports, which is the right approach in analyzing how much domestic value added is embedded in Chinese exports. This explains why the domestic value added presented here is significantly lower than that estimated by the OECD TiVA.

Figure 3. Domestic Value Added of Total Chinese Exports



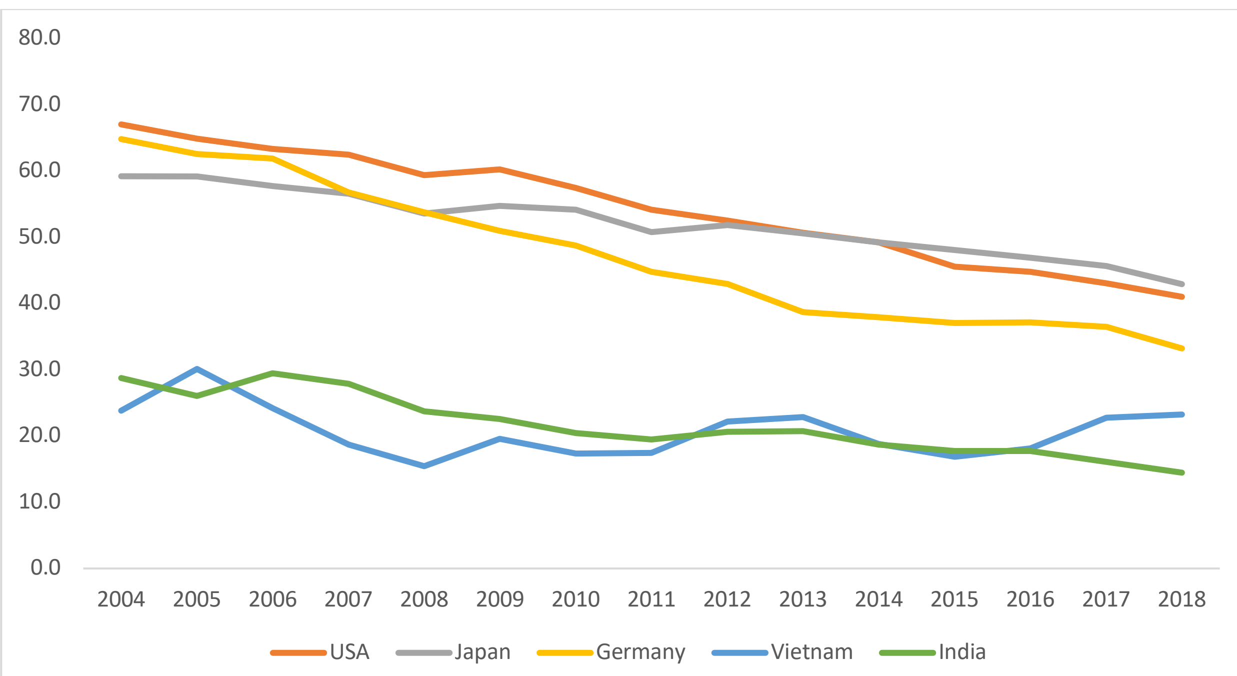
Sources: the author's calculation and the OECD TiVA.

3. Domestic Value Added in China's Bilateral Exports

For Chinese goods, the markets of developed countries are generally more competitive and difficult to enter than those of developing countries. Processing exports are a subset of GVC activities, and they can enjoy three spillover effects associated with the brands, technology and distribution networks of GVC lead firms (Xing, 2021), so it is relatively easy for them to enter the markets of high-income countries. For instance, it is easier to sell Nike shoes than Li-Ning shoes in the Japanese market; it is easier to export assembled iPhones than the Chinese brand OPPO phones to American consumers. Therefore, China's processing exports for the most of part end up in the markets of the US, Japan and Western European countries.

Figure 4 presents the share of processing exports in China's exports to the US, Japan, Germany, Vietnam and India during the period 2004 to 2018. In 2004, processing exports accounted for 67%, 59.2% and 64.8% of Chinese exports to the US, Japan and Germany respectively; they accounted for 23.8% and 28.7% of Chinese exports to Vietnam and India respectively. Even though the share of processing exports in Chinese exports to the US, Japan and Germany fell substantially, in 2018 processing exports still accounted for more than 40% of Chinese exports to the US and Japan, but for less than 15% of those to India. As demonstrated in section 2, the domestic value added of Chinese processing exports is much lower than that of ordinary exports. The disparity in the proportion of processing exports across Chinese trading partners implies that the domestic value added of Chinese bilateral exports should vary accordingly. To be specific, the domestic value added of the Chinese exports to the countries with higher proportion of processing exports should be lower.

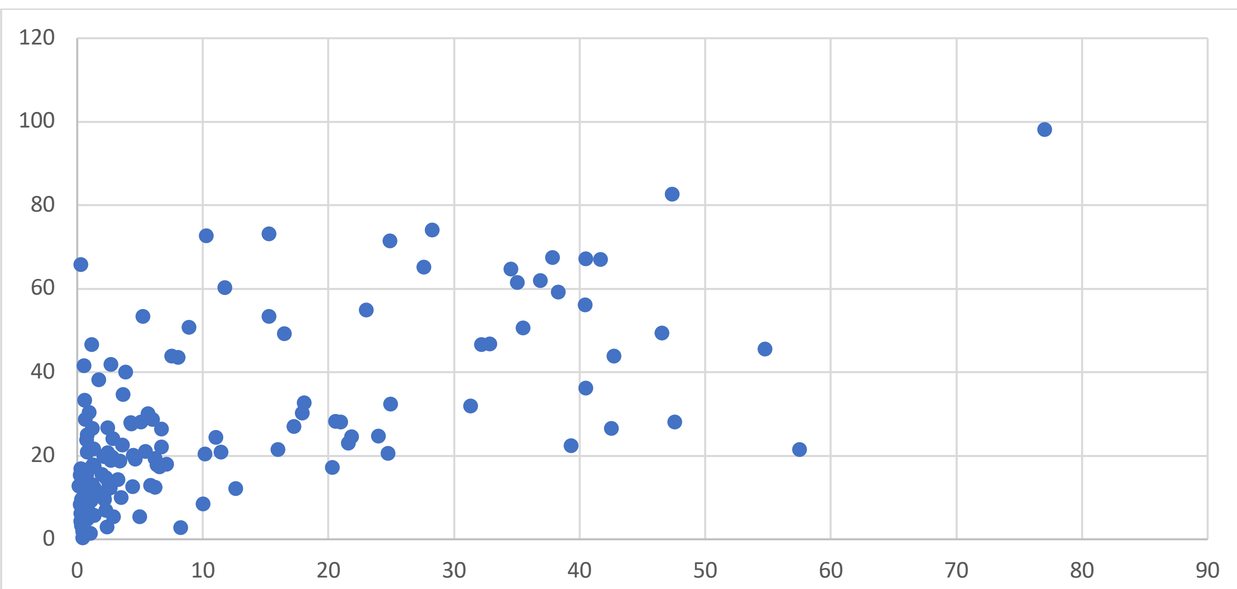
Figure 4. Share of Processing Exports in China's Exports to Selected Countries, 2004–2018 (%)



Source: the author's calculation based on the data provided by the Chinese Customs.

To show that processing exports mainly target the markets of developed countries is a common phenomenon, I expand the sample from the four countries to 150 Chinese trading partners. Figure 5 is a scatter chart between the GDP per capita of Chinese trading partners (the horizontal axis) and the share of processing exports in the Chinese exports to those countries in 2004. Unambiguously the scatter chart suggests a positive correlation between the two variables. A simple regression shows that the two variables have a positive correlation at 5% significant level.[1] In order to examine the persistence of the positive correlation, I generate a similar scatter chart for 2018, which is showed in Figure 6. The chart also reveals a positive correlation between the income of the trading partners and the corresponding share of processing exports. A simple linear regression is also run for the sample of 2018, and the result indicates a significantly positive correlation between the two underlying variables.[2]

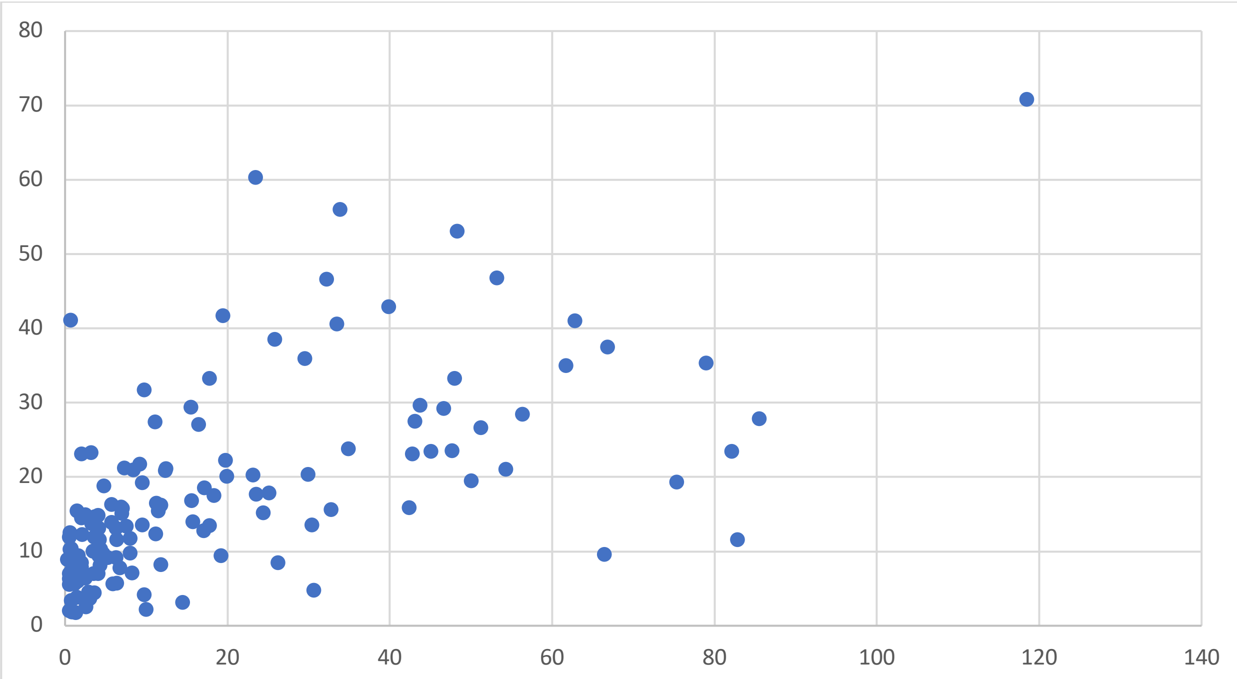
Figure 5: Correlation between the Income of the Chinese Trading Partners and the Share of Processing Exports to Those Countries in 2004



Source: the author's calculation and the IMF

[1] $Y_i = 16.13 + 0.89 \times X_i$, where X_i denotes the GDP per capita of country in i in 2004 and $Y_i$the share of processing exports in China's exports to the country. The coefficient of X_i is significant at 5%.
[2] $Y_i = 10.47 + 0.36 \times X_i$, where X_i denotes the GDP per capita of country in i in 2018 and $Y_i$the share of processing exports in China's exports to the country. The coefficient of X_i is significant at 5%.

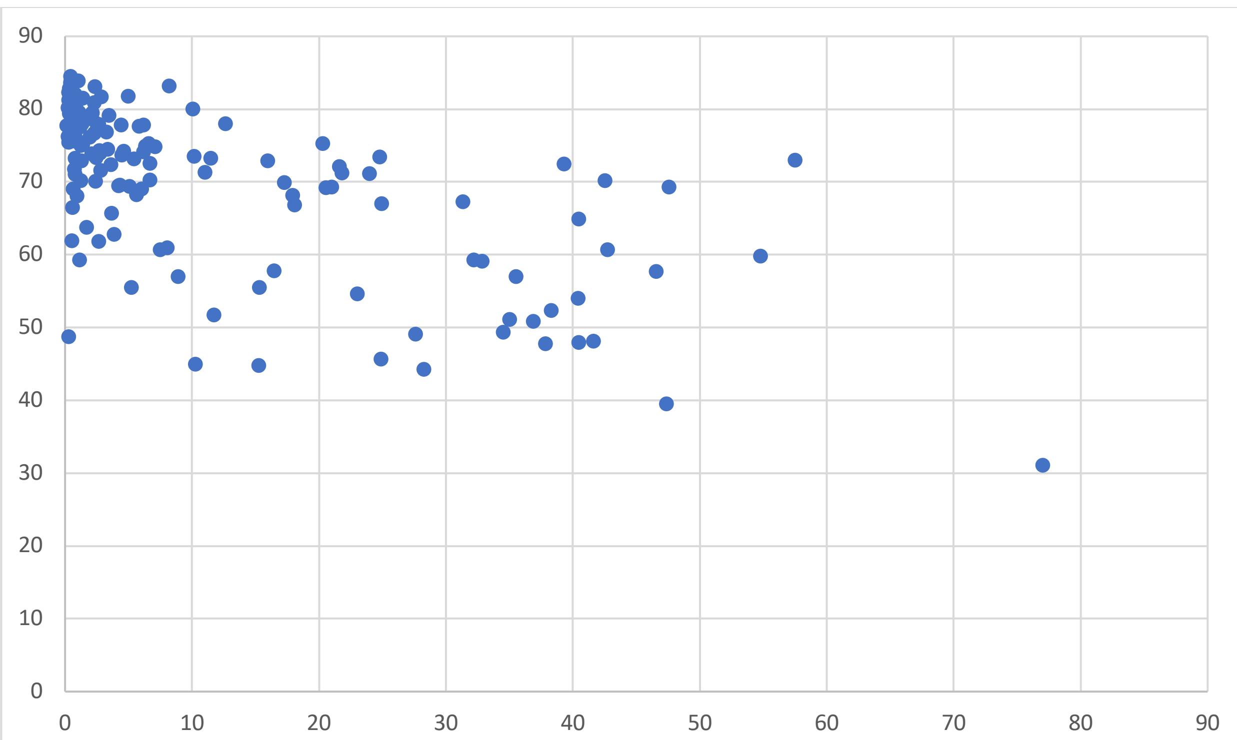
Figure 6: Correlation between the Income of Chinese Trading Partners and the Share of Processing Exports to Those Countries in 2018



Source: the author's calculation and the IMF

The empirical evidence above implies that the heterogeneity of Chinese bilateral exports is too significant to be ignored in the estimation of the domestic value added of bilateral exports. Using equation (2) and the estimates of Figure 1&2, I calculate the domestic value added of Chinese exports to its 150 trading partners from 2004 to 2018. The estimated domestic value added for individual countries varies substantially. In 2004, the domestic value added ranged from 39.5% of the exports to Ireland to 84.1% to Laos; in 2018 China's exports to Tajikistan contained 75.3% domestic value added, the highest among the 150 countries, while that to Luxembourg 48.8%, the lowest. Generally, the estimates reveal that Chinese exports to higher countries are embedded with lower domestic value added. This pattern is consistent with the fact that Chinese processing exports, assembled with imported parts and components and sold under brands owned by foreign multinational corporations, mainly target industrialized countries, while Chinese ordinary exports, manufactured with domestically made intermediate inputs and sold under indigenous Chinese brands, largely cater the markets of developing countries. The consumers of developed countries prefer internationally recognized brand goods and new technological products. They can afford those goods with their high income. In contrast, duo to the income constraint, consumers of developing countries are less brand oriented and tend to accept products with less advanced technological functions. The differences in the preferences of consumers determine the marketing strategy of Chinese exporters in international markets and give rise to the heterogeneity of the domestic value added across the trading partners. Figure 7 is a scatter chart between the income of 150 Chinese trading partners and the domestic value added of its exports to those countries in 2004. Clearly, it implies a negative correlation. A regression analysis indicates that the negative correlation is significant at 5%.[3]

Figure 7. Correlation between the Income of Chinese Trading Partners and the Domestic Value Added of Chinese Exports to Those Countries in 2004.



Source: the author's calculation and the IMF.

[3] $Y_i = 75.89 - 0.49 \times X_i$, where X_i denotes the GDP per capita of country in i in 2004 and $Y_i$the share of processing exports in China's total exports to the country. The coefficient of X_i is significant at 5%.

Table 1 in the appendix summarizes the results of 20 countries, which comprise ten largest trading partners from developed economies and ten largest trading partners from emerging and developing economies. In 2004, the domestic value of Chinese exports to the ten trading partners from developed economies averaged 51.9%, about 15.9 percentage points lower than the domestic value added of its exports to the ten trading partners from emerging and developing economies. In 2018, even though the disparity in the domestic value added of the Chinese exports to the two groups shrank to 7.7 percentage points, the Chinese exports to the emerging and developing economies remained relatively high, about 68.7%[4]. Take individual countries as an example, in 2004, the domestic value added of Chinese exports to the US, Japan and Germany was 48.1%, 52.4% and 49.3% respectively. Foreign intermediate inputs contributed about half of the gross value of Chinese exports to the three high-income countries. In the same year, the domestic value added of Chinese exports to Vietnam and India was 71.7% and 69.0% respectively, implying that for each dollar of exports, China gained much more income from its exports to those two developing countries than from the three high-income countries. The heterogeneity of domestic value added across trading partners suggests that gross export value may not reflect the relative importance of foreign markets. Taking Germany and Vietnam as an example, in 2015 China exported $69.2 billion in goods to Germany, more than the $66.0 billion to Vietnam. However, the domestic value added of the exports to Germany was 65.2%, less than the 72.8% to Vietnam. Hence China gained more income from its exports to Vietnam. The exports to Vietnam contributed more to the Chinese economy than that to Germany, even though the gross exports to Germany was relatively high.

4. Concluding Remarks

In the age of GVCs, domestic value added of exports is an important indicator for assessment of the importance of trade to national economies and for evaluation of the progress of an economy's upgrading along GVCs. It is not a trade indicator readily available in the databases of customs offices but there is a need for estimating it. The international input-output table approach is often used to estimate the domestic value added of exports for individual countries, but popular though the approach may be, it fails to recognize heterogeneity in the use of imported intermediates either

[4] Upon the request, I will be happy to provide the estimated value added of Chinese exports to other trading partners from 2004 to 2018.

between different categories of exports or across trading partners, and thus tends to overestimate the domestic value added.

In this paper, I consider that heterogeneity and estimate the domestic value added of Chinese processing exports, ordinary exports and the bilateral exports to its 150 trading partners. The estimates demonstrate clearly that the domestic value added of ordinary exports is much higher than that of processing exports, on average 40 percentage point higher during the period 2004–2018. It is noteworthy that, while the domestic value added of processing exports rose steadily during the period examined here, that of ordinary exports declined, which indicates that import substitution is not a one-way street: as fewer and fewer foreign intermediates were used in the production of processing exports, more and more were used in the manufacture of ordinary exports.

In addition, the study shows that the domestic value added of Chinese exports varies across its trading partners. Generally, more domestic value added is imbedded in the exports to low-income countries. This finding implies that the importance of developing and emerging markets for the Chinese economy should be assessed in terms of value add rather than gross value in exports.

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Appendix

Table 1. Domestic Value Added of Chinese Exports to Selected Countries (%)

Advanced Economies	2004	2006	2008	2010	2012	2014	2016	2018
Australia	59.1	61.5	60.5	62.5	61.2	63.2	68.1	65.1
Germany	49.3	52.5	55.6	59.0	58.8	61.2	65.7	63.2
Hong Kong	45.6	46.8	48.4	49.6	51.6	52.7	61.2	55.6
Japan	52.4	54.5	55.7	56.9	55.8	56.8	62.0	59.5
Korea	57.7	60.6	59.3	58.2	55.5	57.4	62.9	60.4
Netherland	48.0	49.2	52.7	53.7	52.7	54.9	59.3	58.1
Singapore	49.1	50.8	54.0	52.9	55.3	58.2	61.6	61.6
Taiwan	55.5	56.3	57.3	58.3	58.4	60.6	65.7	61.2
U.K.	54.0	57.0	57.2	60.5	60.7	63.0	68.7	64.6
U.S	48.1	51.8	53.6	55.7	55.6	56.8	62.8	60.3
average	51.9	54.1	55.4	56.7	56.6	58.5	63.8	61.0
Developing and Emerging Economies								
Bangladesh	76.2	72.5	69.0	71.7	68.5	70.6	74.6	72.7
Brazil	65.7	63.0	62.7	65.9	63.8	65.8	71.1	67.7
India	69.0	68.4	66.2	69.6	66.3	68.7	72.9	70.4
Malaysia	55.5	55.5	58.9	63.5	64.0	66.5	70.9	65.5
Philippines	59.2	62.7	62.5	67.4	66.1	68.1	74.0	70.7
Russia	77.8	74.1	67.2	69.2	66.3	69.7	72.1	69.7
Thailand	61.8	62.3	61.7	63.8	62.3	66.7	71.0	67.9
Turkey	69.0	70.6	62.8	65.5	63.3	66.4	70.4	68.6
UAE	72.4	71.0	66.1	66.7	64.6	67.4	71.0	67.0
Vietnam	71.7	71.0	69.1	70.8	65.7	68.7	72.8	67.1
Average	67.8	67.1	64.6	67.4	65.1	67.9	72.1	68.7

Source: the author's calculations

Table 2. China's Exports: 2004-2018 (billion US$)

Year	Exports*	Processing Exports**	Ordinary Exports**	Share of Processing exports (%)***
2004	593.3	328	265.3	55.3
2005	762.0	416.5	345.5	54.7
2006	969.0	510.4	458.6	52.7
2007	1220.5	617.6	602.9	50.6
2008	1430.7	675.1	755.6	47.2
2009	1201.6	586.9	614.7	48.8
2010	1577.8	740.3	837.5	46.9
2011	1898.4	835.3	1063.1	44.0
2012	2048.7	862.7	1186.0	42.1
2013	2209.0	860.4	1348.6	38.9
2014	2342.3	884.2	1458.1	37.7
2015	2273.5	797.5	1476.0	35.1
1016	2097.6	715.3	1382.3	34.1
2017	2263.3	758.8	1504.5	33.5
2018	2486.7	797.1	1689.6	32.1

Source: *China Statistics Bureau; **China Customs Office; *** the author's calculation

Table 3. China's Imports (billion US$)

Year	Imports*	Imports of intermediate goods**	Processing imports***	Share of processing imports (%)****
2004	561.2	276.7	221.7	39.5
2005	660.0	335.5	274.0	41.5
2006	791.5	399.0	321.5	40.6
2007	956.1	512.2	368.5	38.5
2008	1132.6	653.8	378.4	33.4
2009	1005.9	537.0	322.3	32.0
2010	1396.2	737.3	417.4	29.9
2011	1743.5	1,005.7	469.8	26.9
2012	1818.4	1,070.4	481.3	26.5
2013	1950.0	1,110.6	496.7	25.5
2014	1959.2	1,140.9	524.1	26.8
2015	1679.6	1,023.8	446.6	26.6
1016	1587.9	970.8	396.4	25.0
2017	1843.8	1,133.3	431.2	23.4
2018	2135.7	1,274.4	470.4	22.0

Source: *China Statistics Bureau; **OECD; ***China Customs Office; **** the author's calculation

Table 4: Key Parameters Used in the Estimation

Year	Value added in manufacturing* (billion US$)	Imported primary energy for $1,000 value added in manufacturing ($)** (γ)	Imported Intermediate goods needed for $1 value added in ordinary exports *** (β)
2004	625.2	76.5	0.10
2005	733.7	86.8	0.10
2006	893.1	99.3	0.11
2007	1149.7	91.0	0.16
2008	1475.7	114.4	0.23
2009	1611.9	76.7	0.16
2010	1924.3	97.9	0.20
2011	2421.4	113.7	0.26
2012	2690.1	116.1	0.25
2013	2935.3	107.1	0.24
2014	3184.2	99.4	0.22
2015	3202.5	62	0.20
1016	3153.1	55.8	0.20
2017	3460.3	71.5	0.22
2018	3868.5	90.2	0.23

Source: *the World Bank; ** the author's calculation; *** provided by the research team of Prof. Ran Wang at the University of International Business and Economics.

Table 5. China's Exports to US, Japan, Germany, Vietnam and India (billion $)

Year	USA	Japan	Germany	Vietnam	India
2004	124.9	73.5	23.8	4.3	5.9
2005	162.9	84.0	32.5	5.6	8.9
2006	203.4	91.6	40.3	7.5	14.6
2007	232.7	102.0	48.7	11.9	24.0
2008	252.4	116.1	59.2	15.1	31.6
2009	220.8	97.9	49.9	16.3	29.7
2010	283.3	121.0	68.0	23.1	40.9
2011	324.5	148.3	76.4	29.1	50.5
2012	351.8	151.6	69.2	34.2	47.7
2013	368.4	150.1	67.3	48.6	48.4
2014	396.1	149.4	72.7	63.7	54.2
2015	409.2	135.6	69.2	66.0	58.2
1016	385.3	129.4	65.3	61.1	58.4
2017	429.7	137.3	71.1	71.6	68.0
2018	478.4	147.0	77.5	83.9	76.7

Source: China Statistics Bureau.

Table 6. China's Processing Exports to US, Japan, Germany, Vietnam and India (billion $)

Year	USA	Japan	Germany	Vietnam	India
2004	83.7	43.5	15.4	1.0	1.7
2005	105.7	49.7	20.3	1.7	2.3
2006	128.8	52.8	24.9	1.8	4.3
2007	145.4	57.7	27.6	2.2	6.7
2008	149.9	62.3	31.8	2.3	7.5
2009	133.1	53.6	25.4	3.2	6.7
2010	162.6	65.5	33.2	4.0	8.4
2011	175.6	75.2	34.2	5.1	9.8
2012	184.5	78.5	29.7	7.6	9.9
2013	186.7	75.9	26.0	11.1	10.0
2014	194.8	73.5	27.6	12.0	10.1
2015	186.2	65.1	25.7	11.2	10.3
1016	172.4	60.7	24.2	11.0	10.4
2017	185.0	62.6	25.9	16.3	11.0
2018	196.2	63.1	25.7	19.5	11.1

Source: China Customs Office

Table 7. Share of Processing Exports in China's Exports to Five Countries (%)

Year	USA	Japan	Germany	Vietnam	India
2004	67.0	59.2	64.8	23.8	28.7
2005	64.9	59.2	62.5	30.1	26.0
2006	63.3	57.7	61.9	24.2	29.5
2007	62.5	56.6	56.7	18.7	27.8
2008	59.4	53.6	53.7	15.4	23.7
2009	60.3	54.8	50.9	19.6	22.6
2010	57.4	54.1	48.8	17.3	20.4
2011	54.1	50.7	44.7	17.5	19.4
2012	52.5	51.8	42.9	22.2	20.7
2013	50.7	50.5	38.6	22.8	20.7
2014	49.2	49.2	37.9	18.8	18.7
2015	45.5	48.0	37.1	16.9	17.7
2016	44.7	46.9	37.1	18.1	17.7
2017	43.0	45.6	36.5	22.7	16.1
2018	41.0	42.9	33.2	23.2	14.5

Source: the author's calculation.