R | E | A | L

Regional Economics Applications Laboratory

The **Regional Economics Applications Laboratory** (REAL) is a unit in the University of Illinois focusing on the development and use of analytical models for urban and regional economic development. The purpose of the **Discussion Papers** is to circulate intermediate and final results of this research among readers within and outside REAL. The opinions and conclusions expressed in the papers are those of the authors and do not necessarily represent those of the University of Illinois. All requests and comments should be directed to Sandy Dall'erba, Director.

Will increasing tariffs on China really bring the manufacturing plants back to the U.S.?

Lei Wang

School of Economics

Wuhan University of Technology

Sandy Dall'Erba

ACE and REAL,

University of Illinois

Geoffrey J. D. Hewings

REAL,

University of Illinois

Long Wei

School of Economics

Wuhan University of Technology

REAL 19-T-3

August, 2019

ILLINOIS

Will increasing tariffs on China really bring the manufacturing plants back to the U.S.?

Abstract: This paper investigates whether the recent rise in tariffs on goods produced in China will lead processing trade manufacturing plants now located in China to delocate to the U.S. By using a hypothetical extraction method and examining the global value chains of income, we compare the factor payments in the Chinese and U.S. manufacturing sectors. Our estimates indicate that the average tariff rate necessary to move the processing trade firms is 48.15%, i.e. well above the current 25% rate. We also find a significant amount of variation across sectors. For instance, three manufacturing sectors could benefit from moving to the U.S. under the current tariff level.

1. Introduction

The accession of China to the WTO in 2001 not only accelerated the process of globalization but it also influenced the strategic allocation decisions of many multinational corporations. In order to capture economic rents and to enhance their competitive advantage, firms such as Ford and IBM became less vertically integrated within the U.S. by delocating the most labor-intensive links of their Global Value Chain (GVC) to China while maintaining their research and development (R&D) and marketing activities in the U.S. Since the value-added generated by each link along the GVC is not the same – for instance, assembly links and original equipment manufacturer (OEM) activities generate little of it – a large number of low-wage job opportunities and outsourcing tasks are now taking place in developing countries like China where production costs tend to be lower (Kogut, 1985; Gereffi, 1999; Gereffi et al., 2005).

The value of gross exports from China increased from $330 billion in 2001 to more than $2.2 trillion in 2017 (2017 constant price, China's National Bureau of Statistics, 2018). The United States is China's largest export market with a value of around $500 billion, while exports in the reverse direction were $130 billion in 2017. Furthermore, several Chinese products command a high share of the US market. Examples are toys and umbrellas (82%), footwear (63%), furniture (50%) and electronic equipment (41%) (UN Comtrade, 2015). Since his election, President Trump has regarded the expanding trade deficit with China as a major obstacle to domestic manufacturing and the blue-collar jobs associated to it. As a result, the first tranche of 25 percent tariff on $34 billion of imports began in July 2018, followed by a second tranche of 25 percent tariff on another $16 billion of Chinese imports in August. Finally, in September 2018, a 10% tariff was imposed on $200 billion of Chinese goods which was raised mid-May 2019 to a 25% tariff level since the two countries did not come to an agreement on technology transfer, intellectual property and agriculture. Meanwhile, China began levying on $50 billion of U.S. exports of steel, aluminum, food and agricultural products with 25% tariff duties in July and August 2018, followed by a 5-10% tariff on U.S. goods worth $60 billion in September 2018. The part of the $60 billion list of U.S. goods that have been subject to tariff increases were subject to a tariff increase rate of 25%, 20% or 10% on June 1, 2019. After the G20 summit in Japan on June 29, 2019, the U.S. trade negotiations with China carried on. The U.S. decided it would not impose further tariffs on China and the latter committed to importing again a large amount of agricultural products from the U.S.

In this paper, the aim is to determine whether the 25% tariff rate would actually be large enough to bring some or all of the manufacturing value chain links already established in China back to the U.S. Very little quantitative work has focused on this question. Based on a multi-country general equilibrium model, Guo *et al.* (2018) evaluate the impact of a 45% import tariff rate on Chinese exports to the U.S. and the impact of China charging a 45% import tariff on the U.S. exports also. Their findings indicate that China would be negatively affected (a 0.03% loss in real wages) but the U.S. would lose relatively much more (a 2.25% loss in real wages). The reason is China can rely on both its large domestic market and on the rest of the world to maintain its role of "factory of the world", while the U.S. would have to supply themselves or import relatively more expensive products, which would hurt the country's welfare. Furthermore, a study by Goldman Sachs (2017) evaluates the cost in capital and time necessary to delocate production in the face of higher tariffs. Their results indicate that the production costs could increase by 46% for apparel and 37% for smartphones if they were made in the U.S. It would lead to a price increase of about 15% for consumers in the U.S. Moreover, since the U.S. and China both import large number of intermediate inputs from each other, the value-added content of the U.S. and China is deeply embedded in the other country's final goods. When the content of domestic final goods in foreign intermediate goods is high, governments have less incentive to manipulate the terms-of-trade, which leads to lower import tariffs. On the other hand, when foreign final goods are high in domestic intermediate goods, some of the costs of protection are passed back up the value chain to foreign suppliers, hence making them less competitive (Blanchard *et al.,* 2016). For instance, computers and electronic products imported from China can be full of central processing units and operating systems designed in the U.S. If the U.S. increases tariffs on

such computers coming from China, U.S. companies such as Intel and Apple would suffer from it. This type of supply-chain ripple effects come from mature economies having delocated their unskilled labor-intensive production to lower-wage countries while keeping strategic and high value-added workers at home (Timmer *et al.* 2015). Such results are confirmed by a study by Los *et al.* (2016) that relies on a hypothetical extraction method to calculate job flows and industrial delocation among 43 economies. However, in that study the authors use the same value-added coefficient vector in both processing trade and general trade¯, hence generating potentially misleading results. Indeed, China specializes in processing trade which means that exporting firms are the last section of a long GVC as they only assemble foreign components into a final product before export (Koopman *et al.*, 2008). By not acknowledging that processing trade has a higher intensity of foreign inputs than general trade, their approach overestimates the domestic value-added and the jobs embedded in exports. On the other hand, Dedrick *et al.* (2010) and Gereffi and Lee (2012) analyze the product-level processing trade of smartphones and personal computers assembled in China and destined for export. They find that the proportion of local value-added is less than 5%, while this figure is almost 60% in the general trade of products made and consumed in China (Koopman *et al.,* 2010). These elements explain how the case study on smartphones conducted by Goldman Sachs concludes that display, memory, battery and even final assembly operations could be moved to the U.S. under the pressure of a 37% increase in tariffs, while high value-added Chinese activities such as the foundry of semiconductor production would be very unlikely to move.

Since previous empirical evidence indicates that higher tariffs have a heterogeneous impact on the location choice of various GVC linkages, we push this idea further by i) splitting China's gross exports into processed goods, general goods and services, ii) by computing the value-added in each type of export and iii) by providing a critical assessment of the delocation of processing trade firms that could take place with a 25% tariff once the cost of manufacturing in the U.S. is accounted for. Processing trade firms import the total or most of their intermediate inputs, use them in their production process and then export the final goods abroad.

In order to investigate the potential impact of a new increase in tariffs on U.S.-China bilateral trade and delocation, the remainder of this paper is organized as follows: in section 2 we describe the concept and measurement of domestic value-added in export, GVC wages and the use of input-output models. Section 3 calculates the tariff rates that would be necessary to move the processing trade manufacturing plants from China to the U.S. Next, section 4 provides the detail of three retaliatory strategies that could keep the current manufacturing value chains in China. Finally, section 5 summarizes the main results of this paper and provides some concluding remarks.

2. Methodology

2.1 Domestic Value-Added in Export and Hypothetical Extraction Model.

In order to estimate the tariffs needed for the industrial delocation of the processing trade firms, we will compare the factor payments of the same production process completed in the U.S. and in China after tariff duties. Evaluating the factor compensation is essential to compute these payments. The simple

measurement of the value of gross exports does not provide this information directly. Instead, trade flows need to be measured in value-added terms. In that purpose, we rely on the social accounts of the world input-output database (WIOD) as they provide the value-added information necessary to measure, for each industry, the labor and capital compensation embedded in bilateral trade. This information is used to compare the factor payments of the same production process completed in the U.S. and in China after tariff duties. We follow Los and Timmer (2018) in the use of three components of the bilateral value-added in export (VAX): the value-added in direct export, noted VAXD (Los *et al.*, 2016; Wang *et al.*, 2013), the value-added consumed abroad, noted VAXC (Johnson and Noguera, 2012), and the value-added used abroad in the final stage of production, noted VAXP. These indicators make the estimation of the factor payments possible by transferring the trade flows data in input-output (IO) tables to value-added in export (VAX).

We assume that trading countries can be divided into three groups: (1) the countries that absorb the value-added from other countries in bilateral trade, a feature that is indicated by the left subscript of VAX-indicators; (2) countries that pay for the value-added generated by other countries as denoted by the right subscript of VAX-indicators; (3) countries excluded from bilateral trade. In the latter case, we will not add any subscript in the VAX-indicators. For instance, $VAXD_{12}$ represents the value-added that country 1 absorbs from the direct export to country 2. The meaning of the variables in equations (2.1) to (2.2) is as follows: V is a vector for which the elements indicate the factor payments (salary, rent, tax) per unit of output; the vector V_1 provides the share of domestic factor payments in total output of country 1; B is the well-known "Leontief inverse"; Y is the final demand vector; Y_1 stands for the total final production of country 1. We can obtain the factor payments in

4

gross output by multiplying these vectors. It will result in a value-added production matrix VBY as shown in equation (2.2).

$$V = [V_1 \quad V_2 \quad V_3] \quad A = \begin{bmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{bmatrix}$$

$$B = \begin{bmatrix} I - A_{11} & -A_{12} & -A_{13} \\ -A_{21} & I - A_{22} & -A_{23} \\ -A_{31} & -A_{32} & I - A_{33} \end{bmatrix} \quad (2.1)$$

$$VBY = \begin{bmatrix} V_1 B_{11} Y_1 & V_1 B_{12} Y_2 & V_1 B_{13} Y_3 \\ V_2 B_{21} Y_1 & V_2 B_{22} Y_2 & V_2 B_{23} Y_3 \\ V_3 B_{31} Y_1 & V_3 B_{32} Y_2 & V_3 B_{33} Y_3 \end{bmatrix} \quad (2.2)$$

Country 1's GDP can be computed by aggregating country 1's value-added or factor payments as in equation (2.3).

$$GDP_1 = (V_1 B_{11} Y_1 + V_1 B_{12} Y_2 + V_1 B_{13} Y_3) \quad (2.3)$$

In equation (2.4), Y_{12} is the export of final products from country 1 to country 2 and B' denotes the "Leontief inverse" matrix without the intermediate input from 1 to 2 in the direct consumption coefficient matrix A (hence A_{12}=0). Since the model presented in equation (2.4) omits the value-added embedded in intermediate export and final export in the calculation of the hypothetical GDP (noted GDP'), Los et $al.$ (2016) call it the hypothetical extraction method.

$$Y_1 = Y_{11} + Y_{12} + Y_{13}$$

$$GDP_1' = (V_1 B_{11}'(Y_1 - Y_{12}) + V_1 B_{12}' Y_2 + V_1 B_{13}' Y_3)$$

$$A = \begin{bmatrix} A_{11} & 0 & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{bmatrix} \quad (2.4)$$

$$B' = \begin{bmatrix} I - A_{11} & 0 & -A_{13} \\ -A_{21} & I - A_{22} & -A_{23} \\ -A_{31} & -A_{32} & I - A_{33} \end{bmatrix}^{-1}$$

$$VAXD_{12} = GDP_1 - GDP_1' \quad (2.5)$$

In equation (2.5) $VAXD_{12}$ represents the value-added that country 1 absorbs from the direct export to country 2. Since the trade flows for $VAXD_{12}$ between countries 1 and 2 belong to direct exports, this formulation only accounts for direct cross-border transactions between 1 and 2. The indirect export from 1 to 3 and 3 to 2 are not included. In other words, the value $VAXD_{12}$ corresponds to the GDP in country

1 (GDP_1) minus the hypothetical GDP without direct export from country 1 to country 2 (GDP_1').

If country 2's consumption of final products is zero, the hypothetical GDP in country 1 becomes ($GDP_1^{\#}$) as shown by equation (2.6). Since country 2 would not consume any final product, country 1 cannot absorb value-added with direct export and indirect export to country 2. The final consumption of country 2 consists of Y_{12}, Y_{22}, Y_{32}. Hence, $VAXC_{12}$ is the value-added country 1 absorbs from the final product consumption of country 2. There can be flows of value-added without direct bilateral trade between countries 1 and 2.

$$GDP_1^{\#} = V_1 B_{11}(Y_1 - Y_{12}) + V_1 B_{12}(Y_2 - Y_{22}) + V_1 B_{13}(Y_3 - Y_{32}) \quad (2.6)$$

$$VAXC_{12} = GDP_1 - GDP_1^{\#} \quad (2.7)$$

$$VAXC_{12} = V_1 B_{11} Y_{12} + V_1 B_{12} Y_{22} + V_1 B_{13} Y_{32} \quad (2.8)$$

When the final demand for output produced by country 2 is extracted, the hypothetical GDP is shown in equation 9. As for $VAXP_{12}$, it is the value-added of country 1 that is used as intermediate inputs in the final products of country 2. It means that the value-added flows of $VAXP_{12}$ are only in the intermediate exports of country 1.

$$GDP_1^{*} = V_1 B_{11} Y_1 + V_1 B_{13} Y_3 \quad (2.9)$$

$$VAXP_{12} = GDP_1 - GDP_1^{*} = V_1 B_{12} Y_2 \quad (2.10)$$

In this paper, $VAXD_{12}$ is used as the indicator of factor payments. This is because $VAXC_{12}$ includes the value-added absorbed from indirect exports. For instance, if the U.S. imposes high imported tariff on Chinese commodities, it would not influence the Chinese commodities that are first exported to Japan and then re-exported to the U.S. In the most extreme scenario, whereby country 2 stops importing products from country 1, the direct trade flows from 1 to 2 will become zero ($VAXD_{12} = 0$). However, country 1 can still absorb country 2's value-added indirectly through

the intermediate products traded via country 3 ($VAXD_{12} \neq 0$). Compared to $VAXD_{12}$, $VAXP_{12}$ captures only the intermediate exports of value-added that are used in final production abroad. The final products exported from country 1 to country 2 are not included in the $VAXP_{12}$. Since $VAXP_{12}$ cannot cover all the domestic value-added in the bilateral export, it is not appropriate to employ this indicator as the factor payments country 1 absorbs from country 2.

Hence, $VAXD_{12}$ will be the original factor payment before tariffs. The factor payments become c_1 after imposing high tariffs on exports from country 1 to country 2 as shown in equation (2.11).

$$c_1 = VAXD_{12} + tariff * E_{12} \qquad (2.11)$$

2.2 Measuring the Domestic Value-added Share in Direct Export When Processing Trade is Prevalent.

Now that we have established the framework of the factor payment input-output economic model under tariffs, note that this model uses the same value-added vector v_1. The share of domestic value-added embedded in general export and domestic consumption is much higher than the processing export that prevails in the trade flows from China to the U.S. For example, the wages paid for the final assembly of a smartphone in China only account for 5% of the final cost. However, the design of a smartphone is executed in the U.S. and it represents 15%-20% of the cost (Dedrick *et al.*, 2010; Gereffi and Lee, 2012). The significant difference in the intensity of domestic value-added between processing exports and general exports makes it necessary to account for the share of domestic value-added in processing trade.

[insert Figure 1 here]

The general structure of an international input-output table is shown in Figure 1. It will be assumed that processing exports account for a large proportion of the goods exported by country 1. Furthermore, the

domestic value-added share embedded in processing trade is observably lower than that embedded in general trade. Figure 2 exemplifies the difference of domestic value-added share between processing export and general export by assuming that firms in country 1 are split into four categories: manufacturing goods for domestic use (D), manufacturing goods for processing export (P), manufacturing goods for general export (N) and firms providing service products (S). Then, the value-added absorbed by country 1 (v_1) is also divided into four parts: value-added embedded in goods for domestic use (v_D^1), value-added absorbed from processing trade (v_P^1), value-added in general trade (v_N^1), and the contribution of service products (v_S^1).

[insert Figure 2 here]

As (v_1) is disaggregated into four parts, it is possible to estimate the contribution of each part in the value-added of the direct exports from country 1 to country 2. Equation (12) shows the direct domestic value-added that country 1 absorbs from country 2 via direct export and processing trade while $\sum VAXD_{i2}$ for i=D, P, N, S represents the sum of the value-added country 1 absorbs from country 2 in direct export via the four kinds of firms previously identified in country 1.

$$VAXD_{12} = GDP_1 - GDP_1' = v_1 - v_1'$$

$$VAXD_{P2} = GDP_P - GDP_P' = v_P^1 - v_P^{1'}$$

$$\sum VAXD_{i2} = \sum \left(GDP_i - GDP_i' \right)$$

$$= \sum \left(v_i^1 - v_i^{1'} \right), i = D,P,N,S \qquad (2.12)$$

Equations (2.13) and (2.14) verify that the actual GDP ($GDP_1 = \sum GDP_i$) or value-added of country 1 ($v_1 = \sum v_i$) is the same figure before and after the values for country 1 are split into four parts.

$$GDP_1 = V_1(B_{11}Y_1 + B_{12}Y_2 + B_{13}Y_3)$$

$$= V_1(X_{11} + X_{12} + X_{13}) = V_1X_1 = v_1 \qquad (2.13)$$

$$\sum GDP_i = \sum\sum V_i B_{ij} Y_j = \sum\sum V_i X_{ij}$$

$$= \sum V_i X_i = \sum v_i^1 = v_1 \ (i = D,P,N,S; j = D) \quad (2.14)$$

Equations (2.15) and (2.16) show that the hypothetical GDP values may change when comparing the hypothetical GDP before and after firms of country 1 are divided into four parts. The hypothetical GDP is determined by two variables: the gross output (X) and the share of value-added (V). As noted earlier, the hypothetical extraction method omits the value-added embedded in the intermediate and final exports when calculating the hypothetical GDP. If we note as X_{12}^E the output produced by country 1 that is due to the direct final exports (Y_{12}) and the direct intermediate export ($A_{12} X_2$) from country 1 to country 2, keeps its value before and after firms of country 1 are divided into four parts ($X_{12}^E = \sum X_{i2}^E$). On the other hand, since the share of value-added in processing trade is significantly smaller than that in general trade, in service products and in domestic use ($V_1 \neq V_P < V_i \ (i = D,N,S)$), we cannot ascertain that the hypothetical GDP will not change after the GDP of country 1 is disaggregated into four parts ($\sum GDP_i'$).

$$GDP_1' = GDP_1 - VAXD_{12}$$

$$= V_1(X_1 - X_{12}^E) - V_1 \sum (X_1 - X_{i2}^E) \ i = D,P,N,S$$

$$\sum GDP_i' = \sum (GDP_1 - VAXD_{i2})$$

$$= \sum V_i(X_i - X_{i2}^E) \ i = D,P,N,S \quad (2.15)$$

$$VAXD_{12} - \sum VAXD_{i2} = \sum GDP_i' - GDP_1'$$

$$= \sum V_i(X_i - X_{i2}^E) - V_1 \sum (X_i - X_{i2}^E)$$

$$= V_1 \sum X_{i2}^E - \sum V_i X_{i2}^E \ i = D,P,N,S \quad (2.16)$$

Next, the relationship of V_i and X_{i2}^E is simplified as shown in equation (17) based on the following constraints: (1) the share of value-added in processing trade is significantly lower than that in general trade, domestic use, and service products; and (2) the proportion of processing export products from country 1 to country 2 in the total processing exports of

country 1 is higher than the proportion of general products from country 1 to country 2 in the total general exports of country 1. The first part of equation (17) means that domestic use, general trade, and service products of country 1 share the same value-added vector; the second part indicates that most processing products in country 1 are exported to country 2, while a smaller proportion of general goods and service products flows to country 2.

$$V_D = V_N = V_S > V_P$$

$$\frac{X_{P2}^E}{X_P} > \frac{\sum X_{n2}^E}{\sum X_n} \rightarrow \frac{X_{P2}^E}{\sum X_{n2}^E} > \frac{X_P}{\sum X_n} \ (n = D,N,S) \quad (2.17)$$

Combining (2.16) and (2.17), the domestic value-added absorbed in bilateral trade will decrease after disaggregating country 1's firms into processing trade firms and other firms. The proof of concept is shown in equation (2.18). As a result and as shown in equation (2.19), the value-added in direct export from country 1 to country 2 ($VAXD_{12}$) would become minor after the value-added in direct export of country 1 is divided into 4 parts ($\sum VAXD_{i2}$).

$$\left(VAXD_{12} - \sum VAXD_{i2}\right)$$

$$= (V_1 - V_P)X_{P2}^E - \sum (V_N - V_1) X_{n2}^E$$

$$= \left(\frac{X_{P2}^E}{X_P} - \frac{\sum X_{n2}^E}{\sum X_n}\right) * \frac{\sum v_1 X_P - v_P \sum X_n}{(X_P + \sum X_n)} > 0$$

$$(n = D,N,S)$$

$$V_1 - V_P = \frac{v_1}{X_1} - \frac{v_P}{X_P} = \frac{(v_P + \sum v_n)X_P - v_P X_1}{X_P(X_P + \sum X_n)}$$

$$= \frac{\sum v_n X_P - v_P \sum X_n}{X_P(X_P + \sum X_n)}$$

$$V_N - V_1 = \frac{\sum v_i(X_P + \sum X_n) - (v_P + \sum v_i)\sum X_n}{\sum X_n(X_P + \sum X_n)}$$

$$= \frac{\sum v_i X_P - v_P \sum X_n}{\sum X_n(X_P + \sum X_n)} \quad (2.18)$$

$$VAXD_{12} > VAXD_{i2} \quad (2.19)$$

In order to quickly identify the change in $VAXD_{12}$ after disaggregation, we introduce the revealed processing trade index (RPA) in equation (2.20). The

structure of indicator RPA_{P2} is similar to the well-known revealed comparative advantage index (RCA index) (Balassa, 1965). Compared to the RCA index that is used for calculating the relative advantage or disadvantage that a country benefits from for a certain class of goods or services as evidenced by its trade flows, RCA captures the presence of processing export in bilateral trade flow compared to gross output. If $RPA > 1$, processing trade is more prevalent in bilateral trade than gross output and $VAXD$ will be overstated. If $RPA < 1$, there is less processing trade in bilateral trade and $VAXD$ is underestimated. Only when $RPA = 1$ does the figure stay the same before and after disaggregating $VAXD$.

$$RPA_{P2} = \frac{\frac{X_{P2}^E}{\sum X_{n2}^E}}{\frac{X_P}{\sum X_n}} \quad (n = D,N,S)$$

$$RCA_{ij} = \frac{\frac{E_{ij}}{\sum_i E_{ij}}}{\frac{\sum_j E_{ij}}{\sum_i \sum_j E_{ij}}} \quad (2.20)$$

Finally, $\sum VAXD_{i2}$ is chosen as the indicator to measure the domestic value-added in bilateral trade since $VAXD_{12}$ exaggerates the contribution of processing trade to domestic value-added.

2.3 Measuring new factor payments for delocated GVC linkages.

In this part, the methodology is presented for estimating the cost of manufacturing if the GVC linkages in one country are moved to another. It is assumed that the cost of manufacturing consists of raw materials (Z_i) and factor payments (v_i). Traditionally, China specializes in the last section of a long GVC that focuses on assembling components from various countries into a final product before it is exported to the U.S. market (Koopman *et al*., 2008). If these GVC assembly linkages are relocated to the U.S., the U.S. still needs to input the same raw materials for manufacturing. Based on previous work by Goldman Sachs (2107), we assume that a relocation would have

a negligible impact on the cost of raw materials[二]. We also disregard any relocation costs (i.e. breaking land and building leases in China, building or refurbishing facilities in the U.S.). because the needed tariff rate is estimated sector by sector and the land price is not specific to an economic sector. Therefore, the large wage gap between the U.S. and China results in factor payments becoming the main component to determine the cost of relocating GVC linkages.

$$X_i = Z_i + v_i \quad (2.21)$$

$$v_i = GDP_i = CAP_i + LAB_i \quad (2.22)$$
$$= RC_i * K_i + wage_i * EMP_i \ (i = 1,2,3, D,P,N,S)$$

GDP_i or factor payments (v_i) are estimated as the sum of labor compensation (LAB_i) and capital compensation (CAP_i). The price of labor and capital are the wage ($wage_i$) and the rate of return on capital (RC_i) respectively. The quantity of required labor and capital are given by the number of employed (EMP_i) and the nominal capital stock (K_i).

Assuming that labor for the relocated job positions is available in the U.S. and not accounting for any automation, the quantity of required factors of production would remain the same while the factor price would change dramatically after relocating the GVC assembly linkages. The reason is that final assembly labor costs are worth \$15- \$25+ per hour in the U.S. vs. \$2- \$3 per hour in China. Therefore, $VAXD'_{i2}$ refers to the new factor payments for domestically manufacturing the same amount of products previously imported from country i.

$$VAXD_{i2} = RC_i * K_{i2} + wage_i * EMP_{i2}$$

$$VAXD'_{i2} = RC_2 * K_{i2} + wage_i * EMP_{i2}$$

$$(i = 1,3,D,P,N,S) \quad (2.23)$$

Compared with the costs of importing processing trade goods from country i, which requires paying for the original factors and imposing extra tariffs, domestic manufacturing leads to increasing factor prices only. If the factor payments of manufacturing domestically are lower than the original factor payments and extra tariffs, then the new tariff rate would be sufficient to cause the relocation of the GVC assembly linkages from China to the U.S. Otherwise, those GVC assembly linkages will not move to the U.S.

$$VAXD_{i2} + tariff * E_{i2} \geq VAXD'_{i2}$$

$(i=1,3,D,P,N,S)$ \hspace{2cm} (2.24)

The next section presents the empirical results. They show the difference of domestic value-added in bilateral trade before and after accounting for processing trade and they estimate the new factor payments after moving the GVC assembly linkages.

3. Estimation Results

After describing the data sources, the estimation results are discussed for domestic value-added in processing trade, general trade, domestic and service product, respectively.

3.1 Data Sources.

Inter-industry transactions and domestic value-added in bilateral trade data are from the 2011 Inter-Country Input-Output Tables (ICIO) published by the OECD (OECD, 2017). Unlike other international tables that only provide value-added and trade data country by country and industry by industry, ICIO presents detailed data on Chinese exports, imports, and value-added that identify the singular value of domestic sales, service products, processing and general trade in each sector. To compute the new factor payments, the social accounts of the WIOD are employed to describe labor compensation, capital compensation, employment and nominal capital stock (Timmer *et al.*, 2016). Information about tariffs imposed on China is aggregated from the United States International Trade Commission (USITC) website. All results are for the latest updated year (2011) and values are expressed in million U.S. $.

3.2 The empirical estimation of domestic value-added in US-China bilateral trade.

The first row of table 1 presents the two results of total domestic value-added in exports from China to the U.S. in 2011. One result ($303,646 million) is computed when the difference in domestic value-added ratio between processing trade and general trade are not distinguished. For comparison purposes, the figure from the disaggregated trade data ($269,781 million) that considers processing trade is also reported. The latter figure is smaller, which is consistent with our methodology ($c_1 = VAXD_{12} - \sum VAXD_{i2}$). Chen *et al.* (2018) also computes the bias in value-added in China's bilateral trade that is caused by using the same value-added coefficient vector in processing trade, general trade, domestic and service product. This mistake leads to a 12.4% overestimation of the value-added in trade with the U.S., which is very close to our results (12.6%). This bias mainly comes from the varying structure between the gross output of China (x_i) and the direct and indirect consumption for exporting to the U.S. (x_i^E). Compared with the gross output of China that includes more service products (38.24%) and less processing exports (3.57%), x_{i2}^E shows a relatively smaller percentage of goods with high value-added (24.15%) and a larger share of products with low value-added (20.38%). This structural divergence is also described by the RPA_{P2} index that was created. The direct and indirect processing trade products to the U.S. (x_{P2}^E) account for 22.91% of the total processing trade products made in China. However, the other three parts represent 3.32% of the total non-processing trade products. As a result,

9

$RPA_{P2} > 1$ and the total value-added in gross export to the U.S. becomes smaller when the value-added share of the various parts is considered.

[insert Table 1 here]

Table 1 also reports the detailed information for domestic value-added in processing trade, general trade, domestic use and service product respectively. Processing exporters account for 10.62% of the total domestic value-added in export to the U.S. but up to 43.39% of China's exports to the U.S. are processed in the country. This gap confirms our assumption that processing trade generates products with low value-added. As shown in the third row of Table 1, the intensity of domestic value added is 16.02% in processing trade. The rest of the value-added (83.98%) embedded in China's processing trade products comes from intermediate inputs imported from foreign countries. However, the service sector presents a high intensity of domestic value added with 135.35%. The reason is that the service sector absorbs not only the value-added from export services but also from the intermediate service inputs used in the domestic manufacturing of the final goods for export to the U.S. Hence, general trade only provides 20.20% of the total domestic value-added in export. The reason is general trade employs a high proportion of domestic intermediate inputs needed for the production of domestic firms.

After computing the share of value-added in direct export of processing trade, general trade, domestic use and service product, we estimate the cost of moving each type of firm to the U.S. For example, the lowest domestic value-added share belongs to processing exporters (16.02%), which means that the latter uses the least amount of domestic labor and capital per unit of direct export if the average wage and rate of return on capital are employed. When we consider that the processing trade firms are low-skilled labor-intensive, it makes this low domestic value-added part easier to move to other cheap factor countries under the same

tariff rate (Fernández, 2015; Humphrey and Schmitz, 2002).

3.3 What tariff rate is needed to move the processing trade manufacturing plants from China to the U.S.?

Based on the domestic value-added in direct export of each part, we calculate the quantity of domestic labor and capital that enters into direct export. Then, we report the payments needed for the exact same quantity of factors in the U.S. Combining the export information, the necessary tariffs can be determined to evaluate whether the decision to delocate processing trade manufacturing plants from China to the U.S. is viable economically.

[insert Table 2 here]

Employment and capital are based on the wages and rate of return on capital data provided by the WIOD's social economic account. Employing the same quantity of factors but combined with the wages and rate of return on capital from the U.S., the factor payments increase sharply in all types of exporting firms. In order to cover the large difference between factor payments in China ($ 28,657 million) and in the U.S. ($ 216,222 million), the tariff rate should increase to 104.82%. However, when the factor payments in the U.S. were calculated, we used the average U.S. manufacturing wage as the labor payment. On average, China's processing trade factories hire mostly low-skilled workers (54.99%) while U.S. firms employ mostly high-skilled workers (32.42%) and medium-skilled workers (59.26%). As shown in Table 3, the average wage in China is driven by the wage of the low-skilled workers, while the U.S. average wage is higher than that of medium-skilled workers. Using the average U.S. wage as the level of payment for low-skilled jobs may inflate the U.S. factor payments. This point is consistent with Timmer (2013) who concludes that, with increased globalization and specialization, mature economies

10

will delocate their unskilled, labor-intensive production to lower-wage countries while keeping strategic and high value-added workers at home. As such, evaluating the factor payments and tariff rates needed to move the Chinese processing trade manufacturing plants to the U.S. requires knowing the characteristics and skill levels of the workers.

[insert Table 3 here]

The second and third columns of Table 2 present the U.S. factor payments when we take into account the skill level of the jobs that could move from China. The second column of Table 2 provides the factor payments resulting from hiring workers with the same skill level structure as in China. When we compare this tariff rate in the first and second columns of Table 2 (104.82% and 73.7% respectively), the tariff rates of the processing trade manufacturing exporters drop dramatically if more low-skilled workers and fewer high value-added workers are employed. We test the robustness of our findings by estimating the factors and tariff rates needed in a situation where the U.S. employers fill all the transferred positions with low-skilled laborers' wages. This figure is 48.15%. It represents the baseline tariff rate needed to move the exporting firms from China to the U.S.

The factor payments and tariff rates of processing trade manufacturing firms are shown by industry in Table 4. This table illustrates in detail the manufacturing industries that would move to the U.S. or remain in China under different factor payments.^三 Our simulation is based on the new 25% tariff rate and the assumption of hiring workers with the same skill level as Chinese firms. In that situation, the first two industries to delocate to the U.S. would be the manufacture of coke and refined petroleum products

_____

三 Columns 3 and 4 report the factor payments and tariff rates needed to support the delocation when employers hire workers with the same skill levels structure as in China. Columns 5 and 6 report similar figures but under the assumption that the employers pay their workers the lowest wage.

and the manufacture of fabricated metal products. They both display a calculated tariff rate for delocation that is just below this figure (20.42% and 18.49% respectively). The second group of processing trade firms would require tariffs to be between 37-45% for delocation to take place. It is composed of the sectors manufacturing food, beverages, and tobacco products, manufacturing chemicals and chemical products and manufacturing other transport equipment.

[insert Table 4 here]

If the tariff rate were to rise to 68.67%, even the sectors manufacturing computer, electronic and optical products, the largest processing trade sector in China, would move to the U.S. If the same labor productivity were to be maintained, it would create an estimated 983,120 U.S. jobs. Yet, the factor payments would be 5.69 times larger in the U.S. in that scenario. Finally, an even greater tariff (86.49%) would be needed to move the manufacturing of textile, apparel, and leather because it is an even more labor-intensive industry which has little chance of becoming profitable in the U.S. Furthermore, the upstream manufacturing of yarn and fabric has become increasingly automated, so it is only the final step (garment manufacturing) that is still heavily labor-intensive. In this scenario, the U.S. would create only about 250,000 jobs, which is about half the number of jobs that China has in this sector. Therefore, a lack of large-scale labor creation might be another obstacle to completing delocation of the textile industry.

Columns (4) and (5) report the factor payments and tariff rate that would be needed to support delocation if U.S. employers were to pay their workers the lowest wage of each industry. Since the lowest wages correspond to low-skilled workers and low value-added GVC assembly linkages, the foreign components account for a larger proportion in the total value of the final products. Processing trade firms import the totality or most of their intermediate inputs and then export to the U.S. As a result, the entirety or

most of the tariff would be imposed on firms from China, not on its foreign suppliers. When China's low value-added goods face the U.S.'s high tariff, it would be more viable economically to delocate the processing trade manufacturing plants from China to other low-skilled, cheap labor countries. However, our results show that 3 industries would move their manufacturing plants to the U.S. with a 25% tariff while the figure goes up to 9 industries with a 45% tariff.

4. Potential Strategies for Keeping Manufacturing Plants in China

4.1 Cutting trade cost in the service sectors.

When analyzing the industrial structure of China's exports, we find that the manufacturing industries account for 96% of the total exports to the U.S. On the other hand, 45.33% of the domestic value-added embedded in the exports from the U.S. to China is in the service sectors. Zeng (2002) stipulates that this phenomenon is derived from the complementary trade structure between the U.S. and China. As a result, identifying what U.S. sectors have a trade cost and competitiveness level that would help reduce the U.S. trade deficit with China could keep manufacturing plants in China.

[*insert Figure 3 & 4 here*]

As displayed on Figures 3 and 4, the value-added adjusted revealed comparative advantage (Koopman, 2010) index shows that most manufacturing industries in China have a comparative advantage over their U.S. counterparts, except for the manufacture of coke and refined petroleum products, of fabricated metal products, and of other transport equipment. All three industries could move with the 25% tariffs. The consistent relationship between RCA and tariffs is also present in the manufacture of computer,

electronic, and optical products as well as the manufacture of motor vehicles, trailers, and semi-trailers. Since the RCA of these industries is very close, only an even greater tariff rate would provide the necessary incentive for delocation to the U.S. When it comes to the service sectors (Fig. 4), the RCA of the U.S. is above the one of their Chinese peers. It is the reason why China's service sectors do not export to the U.S. Yet, the export of U.S. sectors that possess a high RCA index - insurance, reinsurance, and pension funding ($19.59 million), activities auxiliary to financial services ($4.27 million) and advertising and market research ($0.32 million) - is relatively low. The reason is the Chinese government protects its nascent industries by imposing many protectionist regulations on foreign firms (Harwit, 2001). For instance, China still does not count any exclusively foreign-owned insurance enterprise. Therefore, the different trade costs in various industries might be one of the critical factors leading to the imbalance in U.S.-China bilateral trade.

We estimate the trade costs at the country-industry level using Head and Reis (2001) index. Table 5 reports the results. We find that China displays a high level of competitiveness in the top five sectors with the lowest trade costs, while the competitiveness of the U.S. in these industries is even lower than the global average. As a result, $141,676 million in computer, electronic, and optical products, $44,641 million in electrical equipment, and $56,589 million in textiles, clothing, and leather products were exported from China to the U.S in 2014. These sectors are the main sources of the U.S. deficit and China's domestic value-added in export.

[*insert Table 5 here*]

When we identify the sectors with the highest trade costs, we find that they belong to the service industries and are concentrated in finance, insurance, and consultancy. As noted earlier, the U.S. shows a significant advantage in most service sectors

12

compared to China. However, protectionist regulations restrict the exports of these sectors to a relatively low level. If these sectors were to open their market to U.S. firms, the service sectors could partially compensate for the trade deficit in manufacturing. If China were to import more service products from the U.S. and if the trade deficit were to narrow, the need to impose tariffs on China's manufacturing industries would decrease. Over the most recent year, China has been launching a series of projects to open up part of the insurance business to foreign companies (State Council of the PRC, 2018, 2019). We believe that this action will contribute to reducing the U.S.-China trade imbalance.

4.2 Developing manufacturing industries with the One Belt and One Road initiative.

In 2013, China launched the OBOR initiative to strengthen the economic connections with its neighbors and expand its presence in the high value-added linkages of GVC. The OBOR initiative includes 65 countries, most of which are emerging economies. Since the OBOR initiative is based on large investments, we provide an analysis of the potential of these countries to become new markets for the Chinese manufacturing industries.

[*insert Figure 5 here*]

We present in Figure 5 the contribution of the emerging economies and the Group of Seven (G7) to China's value-added in export. In 2000, before China's accession to the WTO, the Group of Seven (G7) was the main market that accounted for more than half of China's value-added in export. Among the G7 members, the U.S. played a key role with 25% of the value-added in export devoted to it. In comparison, the OBOR countries in the emerging economies group provided a value-added in export of about 3% only. By 2008, the emerging economies and the G7 accounted for nearly the same proportion of China's value-added in export. Kaplinsky and Farooki

(2011) and Baldwin (2012, 2013) indicate that this catching-up reflects that the main GVC consumption markets have switched from northern to southern countries. The results obtained for this paper are consistent with their findings. Indeed, by 2014, the proportion of emerging economies is at 50% while the one of the G7 is around 35%. We also note that the role of OBOR has increased while the one of the U.S. has decreased. As a result, if the trend continues, it is likely that OBOR countries keep replacing the U.S. as a market for China's manufacturing industries.

5. Conclusion

This paper addresses whether the current trade war between China and the U.S. will bring the processing trade manufacturing plants located in China back to the U.S. Using the method of hypothetical extraction introduced by Los (2016) and the Global Value Chain income calculation proposed by Timmer (2013, 2015), we compare the payments that go to the factors of production in manufacturing in both countries. However, this exercise requires to separate the export of the processing trade firms from the other firms to avoid the mistake of ignoring the difference in the intensity of domestic value-added between processing exports, general exports, domestic consumption and service products. In addition, the processing trade firms are more sensitive to a tariff than other exporting firms. Our estimates indicate that an average 48.15% tariff rate would persuade China's processing trade firms to delocate to the US.

Yet, the current 25% tariff rate imposed on China is large enough to support delocation of the following three industries only: the manufacture of fabricated metal products except for machinery and equipment, the manufacture of coke and refined petroleum products and the manufacture of other transport equipment. Other industries may be affected by the

13

current tariff rate but not to the point of delocating to the U.S. because China has a clear competitive advantage over their U.S. counterparts in these industries. In addition, a high proportion of the job positions the delocation of processing trade firms would generate are low-skilled and low-wage. Furthermore, the current low unemployment rate (<4%) and high payroll growth (>3%) in the U.S. suggest the country has limited labor capacity. As a result, it is not evident that the new tariff rate or even a higher one will bring back manufacturing to the U.S. as the current White House administration too often proclaims.

At the same time, one strategy the Chinese government could use to ease current tensions is to reduce or eliminate the trade costs in the service sectors. Our empirical results show that the U.S. experiences a strong competitive advantage in insurance, finance, and computer programming. As a result, both the U.S. and China would gain value-added from greater bilateral trade in these sectors and the U.S. could see its trade deficit with China reduce by this action. Otherwise, China could also consider the market of the OBOR countries as a way to compensate for the lesser accessibility to the U.S. market. Their relative role in China's exports has kept increasing since China's accession to WTO to the point where they could overtake the role of the U.S. in a few years from now.

Reference

Balassa B., 1965. The liberalization and 'revealed' comparative advantage. The Manchester School. 33, 99-123.

Baldwin R., 2011. Trade and industrialization after globalization's 2nd unbundling: how building and joining a supply chain are different and why it matters. NBER Working Paper No.17716, https://doi.org/10.3386/w17716.

Baldwin R., Lopez- Gonzalez J., 2015. Supply- chain trade: a portrait of global patterns and several testable hypotheses. The World Economy 38, 1682-1721.

Blanchard E., Bown C., Johnson R., 2016. Global value chains and trade policy. NBER Working paper No. 21883, https://doi.org/10.3386/w21883.

Chen Q., *et al*, 2018. Distinguishing China's processing trade in the world input-output table and quantifying its effects. Economic Systems Research. https://doi.org/10.1080/09535314.2018.1534225.

Dedrick J., Kraemer L., Linden G., 2010. Who profits from innovation in global value chains?: a study of the iPod and notebook PCs. Industrial and Corporate Change. 19, 81-116.

Fernández, V. R., 2015. Global value chains in global political networks tool for development or neoliberal device? Review of Radical Political Economics. 47, 209-230.

Gereffi G., 1999. International trade and industrial upgrading in the apparel commodity chains. Journal of International Economics. 48, 37-70.

Gereffi G., Humphrey J., Sturgeon T., 2005. The governance of global value chains. Review of international political economy. 12, 78-104.

Gereffi G., Joonkoo L., 2012. Why the world suddenly cares about global supply chains. Journal of Supply Chain Management. 48, 24-32.

Goldman Sachs, 2017. Made in the USA or China? : 25 years of supply chain investment at a crossroads, Goldman Sachs Global Investment Research. Available at http://xqdoc.imedao.com/16251202b1c17a403fee8630.pdf..

Guo M., Lu L., Sheng L., Yu M., 2018. The day after tomorrow: evaluating the burden of Trump's trade war. Asian Economic Papers. 17, 101-120.

Harwit E., 2001. The impact of WTO membership on the automobile industry in China. The China Quarterly. 167, 655-670.

Head K., Ries J., 2001. Increasing returns versus national product differentiation as an explanation for the pattern of US-Canada trade. American Economic Review. 91, 858-876.

Humphrey J., Schmitz H., 2002. How does insertion in global value chains affect upgrading in industrial clusters? Regional Studies. 36, 1017-1027.

Johnson R. C., Noguera G., 2012. Accounting for Intermediates: Production Sharing and Trade in Value Added. Journal of International Economics. 86, 224-236.

Kaplinsky R., Farooki M., 2011. What are the implications for global value chains when the market shifts from the north to the south? International Journal of Technological Learning, Innovation and Development. 4, 13–38 .

Kogut B., 1985. Designing global strategies: comparative and competitive value-added chains. Sloan Management Review. 26, 15-28.

Koopman R., Wang Z., Wei S., 2008. How much of Chinese export is really made in China? Assessing domestic value-added when processing trade is pervasive. NBER Working paper No.14109, https://doi.org/10.3386/w14109 .

Koopman R., Powers W., Wang Z., Wei S., 2010. Give credit where credit is due: tracing value added in global production chains. NBER Working paper No.16426, https://doi.org/10.3386/w16426.

Los B., Timmer M. P., De Vries G. J., 2016. Tracing value-added and double counting in gross exports: comment. American Economic Review. 106, 1958-1966.

Los B., Timmer M. P., 2018. Measuring Bilateral Exports of Value Added: a Unified Framework. NBER Working Paper No. 24896 https://doi.org/10.3386/w24896.

Ning J. et al., 2018. Data from "China Statistical Yearbook 2018." Available at http://www.stats.gov.cn/tjsj/ndsj/2018/indexeh.htm..

OECD, 2018. Data from "STAN Input-Output: Input Output Database (Edition 2018)." Available at http://www.oecd.org/sti/ind/input-outputtables.htm.

State Council of the PRC, 2019. Decision of the Banking Regulatory Commission on Amending the Regulations for the Implementation of the Regulations on the Administration of Foreign Banks of the People's Republic of China (Draft for Comment). Available at http://www.cbrc.gov.cn/chinese/newShouDoc/9CDBB24B331344EE91 A47154B4340B2C.html.

Timmer M. P., Dietzenbacher E., Los B., Stehrer R., De Vries G. J., 2015. An illustrated user guide to the world input–output database: the case of global automotive production. Review of International Economics. 23, 575-605.

United Nations Statistics Division, 2016. Data from "UN Comtrade Database." Available at https://comtrade.un.org/data/.

Wang Z., Wei S., Zhu K., 2013 Quantifying International Production Sharing at the Bilateral and Sector Levels. NBER Working paper No. 19677 https://doi.org/10.3386/w19677.

Zeng K., 2002. Complementary trade structure and US-China negotiations over intellectual property rights. East Asia. 20, 54-80.

Table 1. Domestic value-added in the export from China to the U.S. in 2011 (in million U.S. $)

	Total (1)=(2)+(3)+(4)+(5)		Processing Exporter (2)	General Exporter (3)	Domestic firm (4)	Service (5)
Value added in Export	303,646	269,781	28,657	54,488	71,475	115,159
			10.62%	20.20%	26.49%	42.69%
Export to the U.S.	412,390		178,933	148,372.80	0	85,084
			43.39%	35.98%		20.63%
Intensity of Domestic Value added	65.42%		16.02%	36.72%	NA	135.35%
x_{i2}^E	911,800		185,781	212,642	293,139	220,237
	100%		20.38%	23.32%	32.15%	24.15%
x_i	22,701,880		810,863	2,791,459	10,417,679	8,681,878
	100%		3.57%	12.30%	45.89%	38.24%
x_{i2}^E / x_i	$RPA_{P2} = 6.91$		22.91%		3.32%	

Note: x_{i2}^E refers to the output for the direct and indirect export from China to the U.S.; x_i refers to the gross output of China.

Source: Author's calculation based on ICIO data published by the OECD, 2017 release.

Table 2. Factors payments if China's processing trade firms relocate to the U.S. (in million U.S. $)

	Keeping the former employment structure	Using the same employment structure as China	The U.S. using low-skilled labor only
Factor payments in China	28,657	28,657	28,657
Factor payments in USA	216,222	160,525	114,814
Factor payments changes	187,564	131,867	86,157
Tariff	104.82%	73.70%	48.15%

Source: Author's calculation based on ICIO data published by the OECD, 2017 release, and WIOD, 2016 Release.

Table 3. Comparing the structure of employment in the U.S. and in China

		Total	Low-skilled labor	Medium skilled labor	High skilled labor
Chin a	Employment	840,443	462,165	304,365	73,911
	(in thousands)		54.99%	36.21%	8.79%
	Average Wage (in thousands U.S. $)	4.64	3.76	5.27	7.53
US	Employment	147,898	12,302	87,651	47,944
	(in thousands)		8.32%	59.26%	32.42%
	Average Wage (in thousands U.S. $)	59.10	29.73	47.96	86.99

Note: EMP refers to "number of people engaged".

Source: Author's calculation based on WIOD data, 2016 Release

Table 4. Factor payments and tariff rates at the industry level (in million U.S. $)

Industry description	In China	In the US (1)	Tariffs (1)	In the US (2)	Tariffs (2)	Employment (in thousands)
Manufacture of fabricated metal products, except machinery and equipment	968	1,794	18.49%	1,065	11.83%	103
Manufacture of coke and refined petroleum products	40	148	20.42%	133	17.55%	0.41
Manufacture of other transport equipment	247	238	37.66%	192	21.21%	3
Manufacture of food products, beverages and tobacco products	267	895	36.22%	777	29.39%	13
Manufacture of chemicals and chemical products	669	3,005	44.35%	2,394	32.75%	29
Manufacture of other non-metallic mineral products	193	619	56.69%	534	45.41%	12
Manufacture of motor vehicles, trailers and semi-trailers	1,945	4,467	60.70%	3,248	37.10%	46
Manufacture of computer, electronic and optical products	15,362	87,514	68.67%	57,430	40.04%	983
Manufacture of electrical equipment	2,533	15,661	75.28%	10,228	44.12%	246
Manufacture of machinery and equipment n.e.c.	1,665	8,283	81.16%	6,249	56.22%	118
Manufacture of paper and paper products	330	2,085	82.74%	1,718.94	65.46%	34.86
Manufacture of textiles, wearing apparel and leather products	2,421	16,141	86.49%	13,918.49	72.48%	454.4
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	660.52	3,495.3	103.77%	2,945.88	83.66%	93.83

	in China	in the US (1)	Tariffs (1)	in the US (2)	Tariffs (2)	
Manufacture of basic metals	68.79	529.96	111.83%	453.13	83.34%	1.82
Manufacture of furniture; other manufacturing	454.75	3,678.46	112.04%	3,113.92	92.42%	66.69
Manufacture of rubber and plastic products	1,185.98	8,804	130.33%	7,437.76	106.96%	166.53

Note: "in China" refers to the factor payments of manufacturing these products in China; "in the US (1)" and "Tariffs (2)" present the factor payments and tariff rates needed to support the delocation when employers hire workers with the same skill level structure as in China; "in the US (2)" and "Tariffs (2)" report the factor payments and tariff rates needed to support the delocation under the assumption that the U.S. employers would pay their workers at the lowest wage.

Source: Author's calculation based on ICIO data published by the OECD, 2017 release, and WIOD data, 2016 Release.

Table 5. Top 5 and bottom 5 sectors in trade costs list

Industry description	Trade costs	RCA-US	RCA-CHINA
Manufacture of furniture; other manufacturing	1.78	0.84	1.22
Manufacture of computer, electronic and optical products	1.79	1.10	1.51
Manufacture of machinery and equipment n.e.c.	1.89	0.86	1.18
Manufacture of electrical equipment	2.11	0.66	1.65
Manufacture of textiles, wearing apparel and leather products	2.11	0.27	2.41
Average number of manufacturing industries	2.54	0.97	1.29
Financial service activities, except insurance and pension funding	9.47	1.25	0.96
Insurance, reinsurance and pension funding, except compulsory social security	8.30	1.77	0.41
Telecommunications	6.32	1.28	0.75
Computer programming, consultancy and related activities; information service activities	5.12	1.26	0.23
Advertising and market research	4.25	2.52	0.00
Average number of service industries	3.76	1.27	0.53

Source: Author's calculation based on ICIO data published by the OECD, 2017 release, and WIOD data, 2016 Release.

		Intermediate use			Final use			
		Country 1	Country 2	ROW	Country 1	Country 2	ROW	Total use
Intermediate input	Country 1	Z_{11}	Z_{12}	Z_{13}	Y_{11}	Y_{12}	Y_{13}	X_1
	Country 2	Z_{21}	Z_{22}	Z_{23}	Y_{21}	Y_{22}	Y_{23}	X_2
	ROW	Z_{31}	Z_{32}	Z_{33}	Y_{31}	Y_{32}	Y_{33}	X_3
Value added		v_1	v_2	v_3				
Gross output		X_1	X_2	X_3				

Figure 1: The structure of an international input-output table

Notes: ROW refers to "Rest of the World"

		Intermediate use						Final use			Total use
		Part D	Part P	Part N	Part S	Country 2	ROW	Country 1	Country 2	ROW	
Intermediate input	Part D	Z_{DD}	Z_{DP}	Z_{DN}	Z_{DS}	Z_{D2}	Z_{D3}	Y_{D1}	Y_{D2}	Y_{D3}	X^1_D
	Part P	Z_{PD}	Z_{PP}	Z_{PN}	Z_{PS}	Z_{P2}	Z_{P3}	Y_{P1}	Y_{P2}	Y_{P3}	X^1_P
	Part N	Z_{ND}	Z_{NP}	Z_{NN}	Z_{NS}	Z_{N2}	Z_{N3}	Y_{N1}	Y_{N2}	Y_{N3}	X^1_N
	Part S	Z_{SD}	Z_{SP}	Z_{SN}	Z_{SS}	Z_{S2}	Z_{S3}	Y_{S1}	Y_{S2}	Y_{S3}	X^1_S
	Country 2	Z_{2D}	Z_{2P}	Z_{2N}	Z_{2S}	Z_{22}	Z_{23}	Y_{21}	Y_{22}	Y_{23}	X_2
	ROW	Z_{3D}	Z_{3P}	Z_{3N}	Z_{3S}	Z_{32}	Z_{33}	Y_{31}	Y_{32}	Y_{33}	X_3
Value added		v^1_D	v^1_P	v^1_N	v^1_S	v_2	v_3				
Gross output		X^1_D	X^1_P	X^1_N	X^1_S	X_2	X_3				

Figure 2: International input-output table with separate production for processing export and normal export

Notes: Part D refers to goods for domestic consumption, Part P refers to goods for processing export, Part N refers to goods for general export, Part S refers to production for service and ROW refers to "Rest of the World".
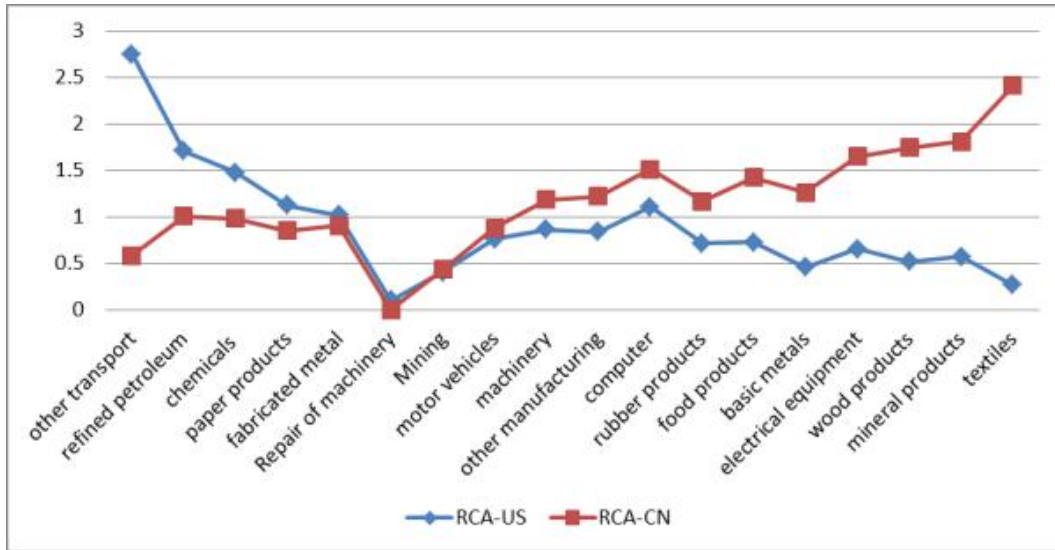
Figure 3: Value-added-adjusted RCA Index of Manufacturing Industries

Source: Author's calculation based on ICIO published by OECD, 2017 release, and WIOD, 2016 Release.
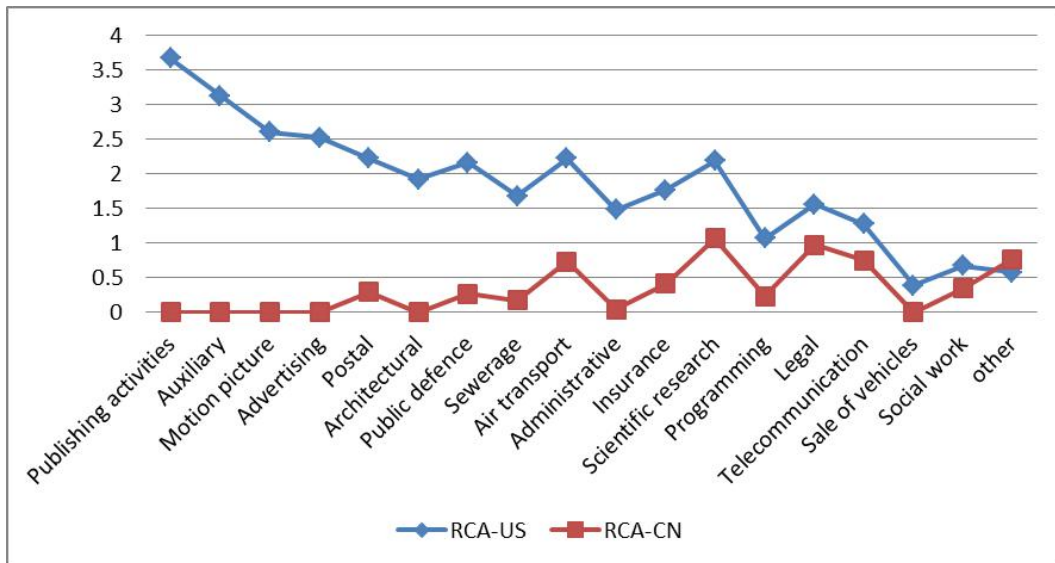

Figure 4: Value-added-adjusted RCA Index of Service Sectors

Source: Author's calculation based on ICIO published by OECD, 2017 release, and WIOD, 2016 Release.