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Characterizing Service Components of China's Manufacturing Exports

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Based on the World Input-Output Database, we decompose China's manufacturing exports into domestic content and foreign content using the framework proposed by Wang et al. (2013) to calculate and analyze the service components of manufacturing exports. The share of services in China's gross manufacturing exports presented a U-shape trend from 2000 to 2009, and decreased after 2009. Comparison with Japan and the United States in the same period reveals that this pattern is distinctive to China. The empirical study finds that labor cost in production and investment structure are two important factors that influence the service components of China's manufacturing exports.

Key Words: Service Components; Global Value Chains; China's Manufacturing Exports.

JEL Classification Numbers: F14, F15.

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1. INTRODUCTION

In recent decades, patterns of international trade have changed with the emergence of global value chains (GVCs). As different stages of production now regularly take place in different countries, and intermediate inputs cross borders multiple times, traditional statistics on trade value are becoming less reliable. A "value chain" refers to value added at various stages of production, running from the initial phase such as R&D and design to the delivery of the final product to consumers. This value chain can be national if all of the stages of production are confined to a single country, or global if different stages take place in different countries. Among the measures of GVCs presented in recent studies are production length (defined as the number of stages) upstreamness and downstreamness indexes (see Wang et al., 2017; Antràs et al., 2012). Measures of GVCs in sequential production are under development, and trade in value added can be calculated using certain frameworks at the aggregate country level (Koopman, Wang, and Wei, hereafter KWW, 2014), or at the country-sector level (Wang, Wei, and Zhu, hereafter WWZ, 2013).

Based on micro-level data obtained in Germany, Kelle (2013) finds that services are exported not only by service firms but also by manufacturing firms at different stages in the value chains. Services can have substantial economic effect, because they are vital inputs for the production of downstream goods (Heuser and Mattoo, 2017). In addition, improvements in services such as transportation, communication, and information technology enable GVCs to be divided between countries (Low, 2013). Value-added statistics accounting for the contribution of services to manufacturing exports aid evaluation of the true importance of service input to trade. According to OECD-WTO Trade in the Value-Added database (TiVA), services represent a larger share of world exports—almost 50%—when a value-added approach is adopted. The roles of services in GVCs have been emphasized in recent years and can be classified as follows: as links in the GVCs and inputs for manufacturing activities, as in-house inputs into manufacturing firms, as outsourced inputs in GVCs, and as value-creating activities (Heuser and Mattoo, 2017; Miroudot and Cadestin, 2017). Since the release of several sets of inter-country input-output tables and the emergence of a new literature on GVCs, some of these roles have been empirically illustrated and subjected to data analysis.

Based on the OECD-WTO TiVA database, Miroudot and Cadestin (2017) calculate the share of services in gross exports, finding that services account for a much larger share of exports when flows are considered in value-added terms. This is a source of widespread concern among academics. Many studies show that productive services have positive effects on manufacturing, such as improving productivity (Arnold, Javorcik, and Mattoo, 2011; Fernandes and Paunov, 2012; Arnold et al., 2016) and increasing the competitiveness of exports (Francois and Woerz, 2008; Lodefalk, 2014). Multiple studies on trade show that the share of services in trade in value added is both large and increasing (OECD, WTO, and World Bank Group, 2014). In contrast, however, the share of services in total world gross exports has remained around at 20% since the 1980s, increasing from below 30% to more than 40% in value-added terms (Heuser and Mattoo, 2017). Baldwin, Forslid, and Ito (2015) find that this pattern also holds across Asian countries with no major differences between developed or developing countries, high- or low-technology countries. In addition, the share of services value added in exports varies significantly across countries and industries (Miroudot and Cadestin, 2017). However, little research exists on the service components of China's manufacturing exports.[1] An examination of the structure of services in China's manufacturing exports in GVCs provides important insights for development policy makers seeking to upgrade manufacturing in China and other countries.

As long as services are inputs supplied by other firms in the production process, input-out tables can help identify their contribution to value added in manufacturing exports (Francois and Woerz, 2008). To measure value added in GVCs, we use the World Input-Output Database (WIOD), whose latest edition was released in 2016. The 2016 WIOD provides world input-output tables for each year from 2000 to 2014, and covers 43 economies, comprising all 27 countries in the European Union (as of January 1, 2015) and 16 other major economies. It provides data on 56 industries in the global economy, including 18 manufacturing industries, 29 service industries, and another 9 industries, such as agriculture, mining, and construction.

We adopt existing methods of decomposing GVCs to calculate the share of services in China's manufacturing exports. KWW (2014) provide a unified mathematical framework that fully decomposes a country's total gross exports into four parts: exports of domestic value added that are absorbed abroad (DVA), domestic value added that returns home (RDV), foreign value added (FVA), and other additional pure double counted terms (PDC). Although KWW's framework has many useful applications, such as re-computing revealed comparative advantages, it has an important limitation as pointed out by WWZ (2013): decomposition is carried out only at a country's aggregate trade level, and not at the sector level, bilateral level, or bilateral sector level. Alternative methods are needed to analyze the share of services at the sector level. WWZ (2013) generalize the KWW approach to the bilateral/sector level and provide a new and

[1] Dai (2016) analyzes the rate of service added value included in manufacturing exports from 1995 to 2011, in which the service values added value contains the service exports. Obviously, our study differs to that of Dai (2016).

comprehensive methodological framework that decomposes bilateral level gross exports into various valued and double counted components. The task of this paper cannot be achieved simply by applying KWW's gross exports decomposition formula at the bilateral/sector level. Therefore, we use WWZ's approach to calculate service value added in DVA, RDV, FVA and PDC,[2] and to obtain the share of services in gross manufacturing exports, the share of services in domestic value-added content, and the share of services in foreign value-added content. It should be noted that PDC covers both domestic and foreign value added. Specifically, we define the domestic content of a country's gross manufacturing exports as the sum of DVA, RDV and the domestic component of PDC, and we define the foreign content of a country's gross manufacturing exports as the sum of FVA and overseas PDC. We calculate the following measures of the share of services in manufacturing exports:

$$\begin{aligned} ST &= \frac{ServT}{(DVA + RDV + FVA + PDC)}, \\ SD &= \frac{ServD}{(DVA + RDV + PDC_d)}, \\ SF &= \frac{ServF}{(FVA + PDC_f)} \end{aligned} \tag{1}$$

where ST, SD, and SF are measures of the share of services in China's manufacturing exports; $ServT$ is gross service value added; $ServD$ is domestic service value added; $ServF$ is foreign service value added; $ServT = ServD + ServF$; PDC_d denotes domestic pure double counted value added, and PDC_f denotes overseas pure double counted value added.

The paper makes three main contributions. First, we characterize various measures of the share of services in China's manufacturing exports at both aggregate and sector level from 2000 to 2014. The results show that ST and SD declined between 2000 and 2005, increased from 2006 to 2009 and declined again after 2009, while SF showed a rising trend with less fluctuation during the same period. Compared with equivalent figures for Japan and the United States, ST and SD in China were much more fluctuant, and SF exhibited no exceptional features in China. Second, we explore the causes of distinctive features of ST in China, and find that changes in ST over the sample period were driven by within-industry changes in ST rather than by a between-industry reallocation of exports. Third, labor cost in production and structure of investment were two important factors that influenced the service components of China's manufacturing exports.

[2]The details of the decomposition framework are provided in the appendix.

The remainder of this paper is organized as follows. Section 2 presents key features of the service components of China's manufacturing exports. A comparative analysis of China, Japan, and the United States is carried out in Section 3. Section 4 explores the determinants of changes in service components of China's manufacturing exports. Section 5 concludes.

2. FEATURES OF SERVICE COMPONENTS

2.1. General characteristics

WWZ (2013) use exports in the United States transportation equipment sector and Mexico's electronics exports to illustrate decomposition at the country-sector level between 1995 and 2011. The four components of exports in the United States transportation equipment sector showed different trends: the share of FVA increased over time, while that of RDV decreased. Similarly, we analyze trends in various components of China's manufacturing exports. Based on the WIOD, we use the method proposed by WWZ (2013) to calculate the four parts of value-added in China's manufacturing exports, namely, DVA, RDV, FVA, and PDC. It should be noted that the value added of domestic content is calculated by $DVA+RDV+PDC_d$, and that the value added of foreign content contains $FVA+PDC_f$. The decomposition of China's manufacturing exports from 2000 to 2014 is shown in Table 1. First, with the exception of little decrease in 2009, gross exports of manufacturing, domestic content, foreign content, DVA, RDV, FVA, and PDC increased over time with different degrees from 2000 to 2014, along with gross service value added and foreign service value added, while the domestic content decreased after 2012. Gross exports of manufacturing, domestic content and foreign content in 2014 were 8.9, 8.6 and 10.5 times those of 2000, while gross service, domestic service, and foreign service increased by 6.2, 4.9 and 11.8 times respectively in period 2000-2014. Second, the results show that the share of $DVA + RDV + PDC_d$ decreased over time, from 84.14% in 2000 to 81.35% in 2014, while that of $FVA + PDC_f$ increased from 15.86% to 18.65% in the same period. Third, the ratio of domestic service to total service value added decreased from 81.76% in 2000 to 65.08% in 2014 over time, which means that foreign service played an increasingly important role, rising from 18.24% in 2000 to 34.92% in 2014. This indicates that China's manufacturing exports became increasingly engaged in GVCs over the last decade.

Using equation (1), we calculate the three abovementioned service components — ST, SD, and SF — to explore the structure of China's manufacturing exports in depth. Two key observations are presented in Figure 1. First, the characteristics of ST differed across periods. Specifically, ST fell from 7.57% in 2001 to 5.03% in 2006, then increased to 6.19% in 2009, and fell again to 5.16% in 2014. SD showed a trend similar to that of ST,

TABLE 1.

Decomposition of China's Manufacturing Exports (Unit: Million \$)

Year	EXP	DVA	RDV	FVA	PDC	ServT	ServD	ServF	DC	FC
2000	132021.4	109632.8	1117.517	16275.64	4995.43	9851.149	8054.097	1797.053	111084.3	20937.07
2001	140674.7	116638	1369.895	17379.42	5287.454	10652.9	8779.251	1873.648	118395.4	22279.34
2002	169904.4	139589.5	2023.366	21553.15	6738.385	12342.67	10029.22	2313.449	142290.9	27613.46
2003	229994.8	187687	3138.232	29194.53	9975.091	13578	10608.8	2969.201	192121.2	37873.59
2004	313065.2	251806.9	4684.016	41189.34	15385.02	16485.58	12366.27	4119.307	258758.7	54306.52
2005	390891.1	316400	5539.932	49426.21	19524.91	19732.6	14517.97	5214.624	325123.2	65767.86
2006	504506.4	402988.4	7454.426	66018.14	28045.47	25389.78	18559.23	6830.553	415209	89297.4
2007	634836	509481.6	8533.059	81167.2	35654.11	34715.79	25483.2	9232.593	524236.4	110599.6
2008	752102.1	599163.9	10699.84	99850.87	42387.45	43810.12	31830.11	11980.01	616684.3	135417.7
2009	634931.2	517562.1	10237.93	77677.29	29453.88	39270.97	29713.14	9557.824	532419.6	102511.6
2010	836377.5	663884.5	16024.31	110043.3	46425.41	48527.95	35413.93	13114.02	687771.9	148605.6
2011	1001480	782586.3	21420.82	138281.4	59191.59	56028.09	40199.21	15828.88	813335.1	188145
2012	1053172	830416.6	23371.05	139864.4	59519.95	58467.36	41635.26	16832.09	863774.7	189397.3
2013	1112608	870407.9	25887.91	150656.8	65654.96	58895.82	39674.83	19220.99	907192.3	205415.3
2014	1179201	921419.7	27016.59	161483.7	69281.16	60870.02	39616.14	21253.88	959250.3	219950.9

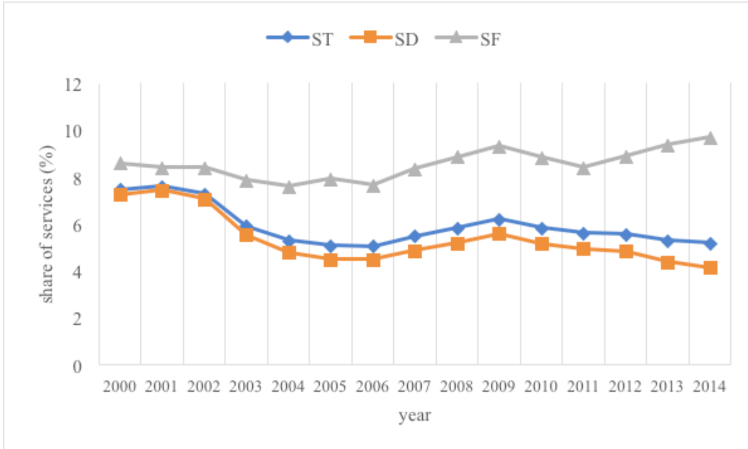
Source: Authors, based on WIOD.
Note: EXP, DC, and FC refer to gross exports, domestic content, and foreign content, respectively.

except that the "turning point" between the first stage (decline) and the second stage (increase) occurred in 2005, not 2006. Second, SF remained much higher than SD and ST for the entire period but with less fluctuation. China's manufacturing industry has been increasingly engaged in GVCs in recent years, and its manufacturing has moved upstream, creating demand for high-end services from abroad. Hence, SF increased in the last few years. SF refers to service components from abroad, including both developed and developing countries. Therefore, SF can be treated as a weighted share of services from various countries and is thus only minimally affected by factors at the country level or lower.

2.2. Sector-level features

The WIOD, published in 2016, covers 18 manufacturing and 29 service industries categorized according to the International Standard Industrial Classification. In each industry, DVA and FVA have specific features, as demonstrated by WWZ (2013). We can thus analyze each industry to study the sector-level characteristics of service components of China's manufacturing exports. However, similarities between industries should be noted. Following the China National Industry Classification (GB/T 4754-2011), we classify manufacturing industries in the WIOD into six sectors: daily consumer goods (WIOD sectors C10-16), paper and printing

FIG. 1. Service Components of China's Manufacturing Exports



Source: Authors, based on WIOD.

(C17-18), chemicals (C19-23), metals (C24-25), electronics (C26-28), and transportation equipment (C29-30) (see Table 3 in the appendix for further details).

As presented in Table 1 of the appendix, these sectors have different features. As ST and SD showed similar trends over the period under study, we discuss only ST in this section. First, ST was higher in sector C17-18 than in any other sector. It increased from 22.60% in 2000 to 23.99% in 2002, declined to 18.83% in 2005, rose to 23.28% in 2009, and fell again after 2009. Second, ST took its second highest values in sector C29-30. In contrast with its trend in C17-18, ST in C29-30 decreased continuously between 2001 and 2014 (from 19.75% to 10.49%), with the exception of a small increase in 2009. Third, ST was lowest in sector C26-28. It decreased continuously in this sector, dropping from 5.82% in 2000 to 3.32% in 2006, and then remained at around 3.61% (the mean) after 2006. Fourth, the trend in ST in each of the remaining three sectors was almost the same as that in gross exports, and the highest values of ST were found in sector C19-23. Fifth, SF showed similar trends across these six sectors. It was highest in C17-18, second highest in C29-32, and behaved similarly between C24-25 and C26-28, and between C10-16 and C19-23.

The sector-level data permit a decomposition of the aggregate trend into between- and within-industry changes. According to Kee and Tang (2016),

FIG. 2. Decomposing the changes of ST into within — and between — industry changes

Source: Authors, based on WIOD.

the change in ST can be decomposed according to the following identity:

$$\Delta ST_t = \underbrace{\sum_j \overline{w}_{jt}(\Delta ST_{jt})}_{within} + \underbrace{\sum_j \overline{ST}_{jt}(\Delta w_{jt})}_{between} \tag{2}$$

where $\overline{w}_{jt} = \frac{1}{2}\left(\frac{EXP_{jt}}{EXP_t} + \frac{EXP_{jt-1}}{EXP_{t-1}}\right)$ is the average share of industry j in gross exports of manufacturing over year $t-1$ and t, while $\overline{ST}_{jt} = \frac{1}{2}(ST_{jt}+ST_{jt-1})$ is the simple average of industry j's ST over year $t-1$ and t. The first part of the right side of equation (2) represents the within-industry changes, and the second part represents the between-industry changes.

Figure 2 shows total, within-industry, and between-industry changes in ST from 2001 to 2014. Similar to findings concerning the firm level by Kee and Tang (2016), changes in ST over the sample period were driven by within-industry changes in ST rather than by a between-industry reallocation of exports. By the same method, it is shown that changes in SD were also caused by within-industry changes, as for SF. Based on equation (2), we define the sector-level contribution of each service component to ST fluctuations in China's manufacturing exports as follows,

$$CS_{jt} = \frac{\overline{w}_{jt}\Delta ST_{jt} + \overline{ST}_{jt}\Delta w_{jt}}{\sum_j \overline{w}_{jt}(\Delta ST_{jt}) + \sum_j \overline{ST}_{jt}(\Delta w_{jt})} \tag{3}$$

where CS_{jt} is the contribution rate of industry j in period t.

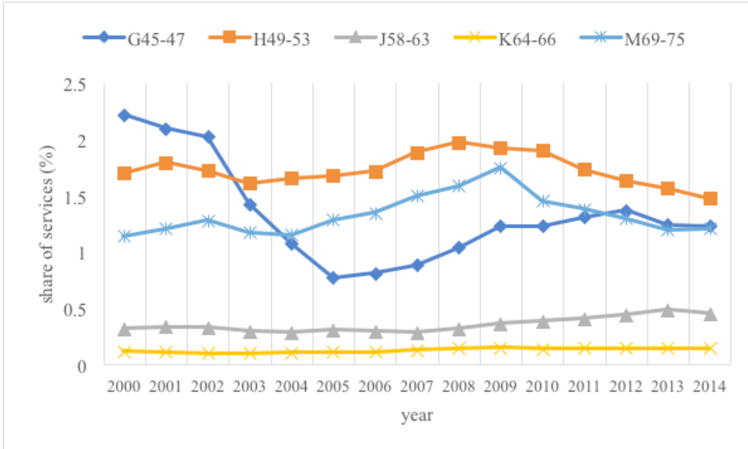
Table 2 of the appendix presents the contribution of each manufacturing industry to changes in ST from 2001 to 2014. The minus means that the share of service in the given industry changed in the opposite direction to the total changes in ST, while the plus refers that the share of service changed in the same direction. For instance, the share of service in sector C16 in 2008 decreased while ST increased. From Table 2 of the appendix, the contribution rates in 2006 were distinguished by the absolute values being greater than those of other years. Particularly, the contribution rates of C10-12, C20, C23, and C27 turned from negative to positive, while those of C13-15, C16, C25, C28, C29, and C30 changed from positive to negative. These features in 2006 corresponded to the turning point presented in Figure 1. Moreover, no industry was characterized by only positive or negative contributions from 2001 to 2014, suggesting that the share of service in each industry changed dynamically over time.

2.3. Structure of service components

The WIOD covers 29 service industries, such as wholesale and retail trade, transportation, telecommunications, finance, and education. As services play distinct roles in the production process, the effects of service sectors on service components of China's manufacturing exports vary over time. Based on the content of China's service industries, we categorize services into five sectors: wholesale and retail trade (G45-47), transportation, postal and courier activities (H49-53), information technology (J58-63), financial services (K64-66), and commercial services (M69-75).

Figure 3 presents trends in the service components of China's manufacturing exports from 2000 to 2014. First, the share of transportation, postal, and courier activities (H49-53) was higher than that of other service sectors in all of the years except 2000-2003, when the share of wholesale and retail trade (G45-47) was much higher. Overall, the share of financial services (K64-66) was the lowest. Second, the share of wholesale and retail trade (G45-47) in China's manufacturing exports showed the greatest fluctuation. It decreased from 2.22% in 2000 to 0.78% in 2005, increased continuously to reach 1.30% in 2012, and then fell to 1.21% in 2014. However, the share of financial services (K64-66) increased almost continuously in the same period. The share of commercial services (M69-75) increased almost continuously from 2000 to 2009 (interrupted only by small decline in 2003 and 2004), rising from 1.14% to 1.75%, before declining after 2009 to reach 1.21% in 2014. The share of the information technology sector (J58-63) decreased from 1.79% in 2001 to 1.61% in 2003, increased to 1.97% in 2008, and then fell continuously, reaching 1.48% in 2014. In short, the share in China's manufacturing exports of traditional service sectors, such as H49-53, M69-75, and G45-47 declined in recent years, while that of modern service sectors such as J58-63 and K64-66 increased.

FIG. 3. Structure of Service Components of China's Manufacturing Exports



Source: Authors, based on WIOD.

The share of value added of foreign content in China's manufacturing exports increased from 15.86% in 2000 to 18.65% in 2014, and the share of services in foreign content also increased continuously during this period. The decomposition formula proposed by WWZ (2013) allows us to trace the foreign content of China's manufacturing exports to countries of origin. As WWZ (2013) pointed out, Japan and Canada were the world's top suppliers of FVA in the 1990s and early 2000s but have since been overtaken by China. Therefore, we can trace the source countries of services to explore the economic relationships between China and other countries. Table 2 presents the source countries of service components in representative years.

First, the United States represents the largest source of service input into China's manufacturing exports, and the share of services from the United States in the foreign content of China's manufacturing exports increased from 6.86% in 2002 to 8.35% in 2014. Second, the Netherlands (NLD), the United Kingdom (GBR), Germany (DEU), and France (FRA) were the most important source countries in Europe during the same period; South Korea (KOR), and Japan (JPN) were the most important source countries in Asia. The Netherlands was not among the top 10 source countries in 2008, but took second place in 2014, reflecting its increased importance to China's manufacturing exports. As trade partners, China and South Korea developed closer economic relations during this period. South Korea held the ninth place in 2002, but ascended to sixth place in 2014. In contrast, Japan fell from second place in 2002 to tenth place in 2014. Third, with the exception of India (IND), all of these source countries were de-

TABLE 2.

Source Countries of Service Components (Unit: %)

	2002		2005		2008		2011		2014	
Rank	Country	Share	Country	Share	Country	Share	Country	Share	Country	Share
1	USA	6.86	USA	7.11	USA	7.12	USA	7.18	USA	8.35
2	JPN	5.00	JPN	5.81	JPN	4.90	GBR	5.36	NLD	6.81
3	CAN	3.64	CAN	4.92	RUS	4.18	NLD	4.75	GBR	4.53
4	GBR	3.61	DEU	4.22	DEU	4.00	DEU	4.63	DEU	3.82
5	DEU	2.99	GBR	3.90	CAN	3.87	FRA	4.27	FRA	3.68
6	FRA	2.80	LUX	3.40	GBR	3.42	RUS	3.75	KOR	3.61
7	NLD	2.77	FRA	3.23	KOR	3.29	CAN	3.67	CAN	3.43
8	AUS	2.28	KOR	2.52	IND	3.11	KOR	3.32	RUS	3.22
9	KOR	2.03	IND	2.52	FRA	2.92	JPN	3.28	BEL	2.12
10	TWN	1.81	RUS	2.47	ESP	2.59	IND	2.95	JPN	2.04

Source: Authors, based on WIOD.

veloped countries, reflecting the competitiveness of their services and not their proximity to China.

3. INTERNATIONAL COMPARISON ANALYSIS

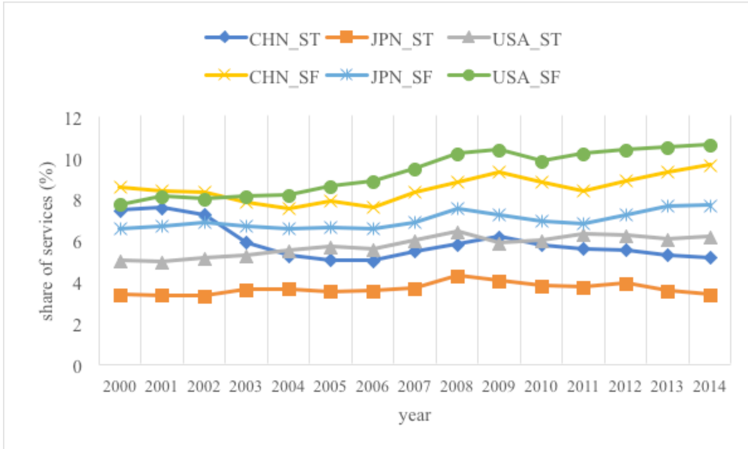
3.1. General characteristics

Japan and the United States rank among the world's most developed countries, and make an important economic contribution to China's manufacturing exports. They are thus taken as representative countries for international comparative analysis. Figure 4 presents trends in ST and SF in the manufacturing exports of China, Japan, and the United States. First, ST fluctuated much more in China's manufacturing exports than it did in the manufacturing exports of either Japan or the United States. In the United States, ST increased from 5.01% in 2000 to 6.38% in 2008, and remained around at 6% after 2008. ST in Japan was much more stable than in either China or the United States. Second, Japan showed the lowest values for ST, and ST in China was a little higher than that in the United States after 2004, with the exception of 2009. Third, SF was much higher than ST in all three countries for the entire period. The United States showed the highest SF values, and Japan the lowest. However, the SF trend increased in all three countries.

3.2. Sector-level features

In this section, we discuss and analyze the service components of China's manufacturing exports with reference to two sector-level dimensions: the structure of service components in gross exports, and the structure of ser-

FIG. 4. Comparative Analysis of ST and SF in China, Japan, and the United States



Source: Authors, based on WIOD.

vice components in each manufacturing sector. Because ST and SD showed similar trends in China, Japan, and the United States for the period under study, and because the trends in SF were similar overall, we restrict our analysis to the trends in ST.

(1) Structure of service components in gross exports

Before 2004, the share of wholesale and retail trade (G45-47) in gross manufacturing exports in China differed from that in Japan and the United States, decreasing from 2.22% in 2000 to 0.78% in 2004, and showing no distinguishing features after 2004. The share of transportation, postal and courier activities (H49-53) in gross manufacturing exports increased before 2008 in all three countries, and continued to decrease in Japan and China but increased slightly in the United States. The share of information technology (J58-63) in Japan and the United States was much more stable than that in China, which increased from 0.31% in 2000 to 0.45% in 2014. The share of J58-63 in the gross manufacturing exports of the United States was about three times larger than its share in China. The share of financial services (K64-66) in China was almost the same as that in Japan, but both were smaller than that in the United States, which also showed the greatest fluctuation. Unlike other service sectors, commercial services (M69-75) constituted a larger share of manufacturing exports in China than in Japan or the United States.

As analyzed in Section 2.2, changes in shares of services had the greatest influence on trends in ST in China. Wholesale and retail trade (G45-47) was the main source of fluctuation in ST. From the perspective of the value chain, G45-47 is a downstream sector whose activity is almost entirely domestic. If *ST* in China retains its features when G45-47 is excluded, we can confirm that *ST* in China is distinct from that in Japan and the United States. When excluding wholesale and retail trade in the manufacturing exports of China, Japan, and the United States, the share of services in China did not differ significantly from that in Japan or the United States after 2004. With the exclusion of G45-47, *ST* fell from 5.47% in 2001 to 4.32% in 2004, but it moved in the opposite direction in Japan and the United States. As shown in Figure 3, the share of commercial services (M69-75) showed the second greatest degree of fluctuation. Next, we exclude commercial services (M69-75) along with G45-47 when calculating *ST*. No significant differences were found in the resulting *ST* trends. In the outside sectors of wholesale and retail trade (G45-47) and commercial services (M69-75), *ST* presented similar trends in China, Japan, and the United States, reflecting the increasing engagement of China's manufacturing sector in GVCs.

(2) Structure of service components in each sector

ST for daily consumer goods (C10-16) in Japan was about twice as high as that in China and the United States, but showed similar trends. In all three countries, *ST* was higher in the paper and printing sector (C17-18) than in any other manufacturing sector, and it took higher values in China than in Japan or the United States. In the chemicals sector (C19-23), trends in *ST* were almost identical across the three countries. In the metals sector (C24-25), *ST* was highest in the United States and fluctuated the most in China. In the electronics sector (C26-28), *ST* increased over time in the United States but decreased before 2006 in China and showed only a small increase after 2006. The decline in *ST* in the transportation equipment sector (C29-32) was much greater in China than that in Japan or the United States.

Table 3 presents a statistical summary of sector-level *ST* in China, Japan, and the United States. First, service sector share differed across manufacturing sectors. In the three countries, all shares held by transportation, postal and courier activities (H49-53) in C19-23, C24-25, C26-28, and C29-30 were higher than those of any other service sectors and wholesale and retail trade (G45-47) took the largest share in C10-16. In China, commercial services (M69-75) took the largest share of services in C17-18; in Japan, the largest service contributor to C17-18 was sector G45-47, and that in the United States was information technology (J58-63). Second, the sources of fluctuation in *ST* in each manufacturing sector varied across the three countries. In China, G45-47 was predominantly responsible for *ST* fluctuation in the manufacturing sectors C19-23, C24-25, C26-28, and C29-30; and H49-53 was the major source of *ST* fluctuation in the same sectors in Japan and the United States. In China, Japan, and the United

States, ST fluctuation in C10-16 arose mainly from H49-53, G45-47, and M69-75, respectively; and ST fluctuation in C17-18 was from M69-75, G45-47 and financial services (K64-66), respectively.

TABLE 3.

Summary of Statistics on Sectoral-level ST in China, Japan, and the United States

Services	Country	Statistics	C10-16	C17-18	C19-23	C24-25	C26-28	C29-30
G45-47	CHN	M	1.08	6.46	1.56	1.11	0.89	1.67
		S.D.	0.23	1.65	0.45	0.38	0.36	0.70
	JPN	M	3.72	6.06	1.40	0.70	0.53	0.47
		S.D.	0.84	1.11	0.23	0.08	0.10	0.08
	USA	M	1.19	3.83	1.26	1.20	0.84	0.81
		S.D.	0.10	0.40	0.08	0.10	0.09	0.08
H49-53	CHN	M	0.99	2.18	3.04	1.54	1.02	3.13
		S.D.	0.24	0.31	0.43	0.14	0.15	0.24
	JPN	M	2.99	3.45	3.00	0.95	0.55	1.12
		S.D.	0.33	0.46	0.43	0.09	0.05	0.11
	USA	M	0.97	2.04	3.11	2.00	0.73	2.17
		S.D.	0.07	0.12	0.55	0.22	0.09	0.19
J58-63	CHN	M	0.16	1.50	0.32	0.31	0.45	0.25
		S.D.	0.05	0.48	0.06	0.04	0.08	0.05
	JPN	M	0.35	0.91	0.23	0.18	0.34	0.09
		S.D.	0.04	0.07	0.01	0.01	0.04	0.01
	USA	M	0.65	4.65	0.63	0.92	0.91	0.37
		S.D.	0.05	0.57	0.04	0.08	0.18	0.03
K64-66	CHN	M	0.11	0.45	0.14	0.11	0.11	0.12
		S.D.	0.03	0.09	0.02	0.01	0.01	0.02
	JPN	M	0.35	0.94	0.14	0.09	0.10	0.07
		S.D.	0.04	0.17	0.01	0.01	0.01	0.01
	USA	M	0.43	2.36	0.40	0.36	0.38	0.28
		S.D.	0.10	0.62	0.07	0.07	0.11	0.06
M69-75	CHN	M	0.93	7.88	1.34	1.23	1.04	1.54
		S.D.	0.33	1.76	0.32	0.15	0.20	0.29
	JPN	M	0.54	1.39	0.34	0.24	0.33	0.15
		S.D.	0.09	0.23	0.05	0.04	0.06	0.03
	USA	M	0.48	2.08	0.63	0.60	0.56	0.39
		S.D.	0.11	0.31	0.13	0.13	0.14	0.08

Source: Authors, based on WIOD.
Note: M and S.D. denote the mean and standard deviation.

4. FURTHER DISCUSSION

As shown in Sections 2 and 3, the share of services in China's manufacturing exports varied across manufacturing sectors and over time. Why did the share of services exhibit such trends during the period under study? Many factors determine the influence of service components. For instance, improving the efficiency of services can increase the demand for such services from manufacturing sectors. Based on the OECD-WTO TiVA database, Heuser and Mattoo (2017) find that the share of services in value added exports is increasing, due to reclassification, a task-composition shift in the connection between services and final goods, and task-relative price shift. With reclassification, many of the activities traditionally sourced in-house by manufacturing firms become outsourced at arm's length and are thus classified as services. A task-composition shift means that outsourcing and offshoring tend to increase the share of services in a final good's value added with the emergence of GVCs. A task-relative price shift suggests that the motivation of cost reduction promotes the tendency to offshore, thus raising service value added in final manufactured goods.

It is necessary to explore the causes of distinctive features of the service components of China's manufacturing exports. Figure 2 shows that the changes of ST are mainly caused by within-industry changes. Although ST and SD did not show a continuously increasing trend from 2000 to 2014, the task-composition shift and the task-relative price shift may partially explain the trends in SF in China's manufacturing exports. In this section, therefore, we take labor cost and investment structure (the ratio of FDI to total investment) as explanatory variables to explore the determinants of service components during the sample period.

4.1. Data, Variables, and the Model

To explain industry-level changes in ST, we use China's industry data that are collected and maintained by China Statistical Yearbook, China Labor Statistical Yearbook, and China Industry Statistical Yearbook. Our sample period is between 2001 and 2014, excluding 2000 and 2004, because some key variables are missing for these two years. We follow Kee and Tang (2016) to analyze the time-series industry-level changes of ST through the reduced-form evidence. The estimating model at industry level is specified as follows:

$$ST_{it} = \alpha_i + \alpha_t + \alpha_X \mathbf{X}_{it} + \varepsilon_{it} \tag{4}$$

where i stands for industry, t represents year, X is a vector of control variables, and ε_{it} denotes the regression residual. The industry and year fixed effects are α_i and α_t respectively, with the year effect for 2001 dropped to avoid the dummy variable trap. Thus, the positive α_ts implies a within-industry increase in ST, while the negative α_ts refer to a within-industry decrease.

TABLE 4.

Summary Statistics of Key Variables (Unit: %)

Variable	Notation	Obs.	Mean	S.D	Min	Max
ST	ST	234	8.729	7.073	1.840	32.35
SF	SF	234	10.74	3.857	5.675	22.37
labor cost	LC	234	2.568	1.063	0.666	5.940
exports-to-sales ratio	ESR	234	16.68	14.25	0.974	66.06
FDI ratio	FR	234	18.07	8.588	2.170	47.42

Source: WIOD, China Statistical Yearbook, and China Industry Statistical Yearbook.

Arnold et al. (2011) analyze the importance of service liberalization on the performance of manufacturing sectors, and find that allowing foreign entry into services industries appears to be a key channel. Kee and Tang (2016) choose foreign direct investment (FDI) as a control variable when analyzing the determinants of domestic value added of China's exports. Dai (2016) also chooses FDI as a control variable. Following these studies, we take the investment structure, measured by the ratio of FDI to total investment, as an explanatory variable. If a firm relocates its relatively inefficient parts of the production process to another country, where they can be produced more cheaply, then it can expand its output in the production stages that it gains comparative advantage. Labor cost is one important reason for a firm to make decisions on whether to outsource or offshore. Therefore, we take labor cost (ratio of total wages to total sales) as another explanatory variable. Service inputs have been offshored and domestically outsourced, whereas material inputs have been either offshored or moved from domestic to foreign suppliers (Schwörer, 2013). There is a close link between service offshoring and firm productivity (Amiti and Wei, 2006), while exporters are found to be more productive than non-exporters, and the more productive firms self-select into export markets (Wagner, 2007). Hence, following Kee and Tang (2016), we take an industry's exports-to-sales ratio as the control variable. Kee and Tang (2016) use three-stage least squares to estimate the effect. Because changes of ST are at industry level in this study, we can adopt model (4) directly to explore the determinants. The summary statistics of labor cost, export-import price ratio, and FDI-to-total investment ratio are presented in Table 4.

4.2. Empirical Results

Table 5 presents the main results. Columns 1 to 3 show negative, significant, and decreasing year fixed effects, suggesting that industry ST is declining during the sample period. On average, industry ST decreased by 43.4% between 2001 and 2014. Columns 4 to 6 present positive, significant, and increasing year fixed effects after 2008, while showing negative effects before 2007, reflecting different trends between SF and ST.

In column 2, we add the FDI ratio as a control. The insignificant coefficient on LnLC shows that labor cost does not affect ST without controlling other variables. As service is one part of domestic value, therefore, the result is consistent with that in Kee and Tang (2016), where labor cost presents an insignificant effect on the ratio of domestic value add in exports to gross exports. When adding the exports-to-sales ratio (LnESR) in column 3, the coefficient on LnLC becomes significant, and the effect of LnESR on ST is negative and significant. The result — the more final goods traded, the lower the share of value-added service — coincides with China's trade structure in which the processing trade (inputs in processing firms are the main materials) plays the dominant role. The insignificant effect of the FDI ratio means that the investment structure does not change the production structure. No matter where the capital originates, firms are engaged in a similar production process that is constrained by given technology.

In column 4, the labor cost presents a significant positive effect on SF. The high labor cost at home promotes firms to search for "cheap labors" by offshoring or outsourcing. This is a common practice considering the production system's technological capacity. Hence, the labor cost plays a significant role, even when adding controls, FDI ratio, and exports-to-sales ratio. Different from that in columns 2 and 3, the effect of the FDI ratio is significant and positive on SF in column 6. The firms with FDI have advantages in offshoring, and are willing to engage into global value chains. We also study the determinants of trend in SD, and the results are almost the same as those in columns $1 \sim 3$ of Table 5 because ST and SD displayed the similar trends over the period under study. Therefore, we do not report those results here.

We use the GMM method to conduct robustness check. Model (4) is modified as follows:

$$ST_{it} = \alpha_i + \alpha_t + \beta_t ST_{it-1} + \alpha_X \mathbf{X}_{it} + \varepsilon_{it} \tag{5}$$

where ST_{it-1} denotes the ST of industry i in period $t-1$.

Table 6 shows the results of robustness check. In columns 1 and 2, labor cost and FDI ratio show similar effects on ST as those in columns 1 and 2 of Table 5. In columns 3, exports-to-sales ratio presents significant and negative effect on ST as that in Table 5; the FDI ratio is also negative but insignificant; and labor cost is positive but insignificant, which is different from that in Table 5. It should be noted that the effects of labor cost in

TABLE 5.

Determinants of Industry-level Changes of ST and SF

	(1)	(2)	(3)	(4)	(5)	(6)
variables		$\ln ST$			$\ln SF$	
year_{2002}	-0.065^{*}	-0.062^{*}	-0.059^{*}	-0.002	-0.004	-0.003
	(0.036)	(0.036)	(0.036)	(0.019)	(0.019)	(0.019)
year_{2003}	-0.260^{***}	-0.255^{***}	-0.246^{***}	-0.039^{**}	-0.042^{**}	-0.036^{*}
	(0.037)	(0.037)	(0.037)	(0.019)	(0.019)	(0.019)
year_{2005}	-0.415^{***}	-0.403^{***}	-0.384^{***}	-0.020	-0.027	-0.016
	(0.040)	(0.041)	(0.042)	(0.021)	(0.022)	(0.022)
year_{2006}	-0.411^{***}	-0.398^{***}	-0.378^{***}	-0.054^{**}	-0.061^{***}	-0.049^{**}
	(0.041)	(0.043)	(0.044)	(0.022)	(0.022)	(0.023)
year_{2007}	-0.346^{***}	-0.331^{***}	-0.313^{***}	0.019	0.010	0.021
	(0.043)	(0.045)	(0.045)	(0.022)	(0.023)	(0.024)
year_{2008}	-0.301^{***}	-0.285^{***}	-0.271^{***}	0.079^{***}	0.070^{***}	0.079^{***}
	(0.044)	(0.046)	(0.047)	(0.023)	(0.024)	(0.024)
year_{2009}	-0.251^{***}	-0.236^{***}	-0.238^{***}	0.112^{***}	0.104^{***}	0.103^{***}
	(0.044)	(0.046)	(0.046)	(0.023)	(0.024)	(0.024)
year_{2010}	-0.338^{***}	-0.323^{***}	-0.323^{***}	0.074^{***}	0.066^{***}	0.067^{***}
	(0.046)	(0.048)	(0.047)	(0.024)	(0.025)	(0.025)
year_{2011}	-0.358^{***}	-0.351^{***}	-0.357^{***}	0.019	0.015	0.012
	(0.043)	(0.043)	(0.043)	(0.023)	(0.023)	(0.023)
year_{2012}	-0.366^{***}	-0.362^{***}	-0.370^{***}	0.066^{***}	0.064^{***}	0.059^{***}
	(0.043)	(0.043)	(0.043)	(0.022)	(0.022)	(0.022)
year_{2013}	-0.413^{***}	-0.413^{***}	-0.433^{***}	0.087^{***}	0.088^{***}	0.076^{***}
	(0.038)	(0.038)	(0.039)	(0.020)	(0.020)	(0.020)
year_{2014}	-0.434^{***}	-0.436^{***}	-0.456^{***}	0.114^{***}	0.115^{***}	0.103^{***}
	(0.038)	(0.038)	(0.039)	(0.020)	(0.020)	(0.020)
$\ln LC$	0.032	0.040	0.081^{*}	0.070^{***}	0.065^{***}	0.090^{***}
	(0.042)	(0.043)	(0.047)	(0.022)	(0.022)	(0.025)
$\ln FR$		-0.036	-0.015		0.020	0.033^{*}
		(0.032)	(0.034)		(0.017)	(0.018)
$\ln ESR$			-0.065^{**}			-0.039^{**}
			(0.033)			(0.017)
Observations	234	234	234	234	234	234
R-squared	0.639	0.642	0.649	0.498	0.501	0.514
Number of id	18	18	18	18	18	18

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5 and Table 6 are both positive, and it is only significant at the 10% level in Table 5. Therefore, the insignificant effect of labor cost on ST in Table 6 cannot reject the result in column 3 of Table 5. It does not show first-order correlation in columns 4-5, so we cannot use the GMM method to conduct robustness check for the determinants of trends in SF. That is to say, the fixed effect model is appropriate for analyzing the factors that influence the trends in SF. Therefore, we can accept the results in Table 5.

There may be many other factors affecting the trends in ST and SF. In this paper, we select and take labor cost, exports-to-sales ratio, and investment structure as the representative factors to explore the economic mechanism of the variations in the service components of China's manufacturing exports. The results are consistent with the characteristics analyzed above in Section 2 and the related studies, such as Kee and Tang (2016).

TABLE 6.

Robustness Check

	(1)	(2)	(3)
		LnST	
L_LnST	1.116***	0.885***	0.183
	(0.278)	(0.264)	(0.784)
LnLC	0.009	0.007	0.196
	(0.030)	(0.065)	(0.155)
LnFR		−0.007	−0.020
		(0.074)	(0.042)
LnESR			−0.098**
			(0.048)
AR(1)	0.0104	0.0125	0.0072
AR(2)	0.1138	0.2633	0.1917
Sargan test	1.0000	1.0000	0.2047
Observations	0.009	0.007	0.196
Number of id	(0.030)	(0.065)	(0.155)

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5. CONCLUSIONS

Based on the WIOD, we use the framework proposed by WWZ (2013) to decompose China's manufacturing exports into four parts: DVA, RDV, FVA, and PDC. Next, we categorize their content as either domestic or foreign. The domestic content is defined as the sum of DVA, RDV, and domestic PDC, and the foreign content as the sum of FVA and overseas PDC. We calculate the shares of services in China's domestic content, foreign content, and gross manufacturing exports respectively. We analyze their characteristics at the aggregate and sector levels, and conduct an international comparative analysis of Japan and the United States, two representative countries that are sources of the service components of China's manufacturing exports. Finally, we explore the economic factors that influence the service components through empirical study.

The main conclusions are as follows. First, the shares of services in China's manufacturing exports and domestic content, respectively, presented U-shape trends between 2000 and 2009, and decreased after 2009. This is a special feature of China's manufacturing exports, not observed in Japan or the United States. The shares of services in foreign content showed similar trends in all three countries over the entire period. Second, the shares of services in exports differed across manufacturing sectors. Changes in ST over the sample period were driven by within-industry changes in ST rather than a between-industry reallocation of exports. Compared with the shares of the other five sectors in China's manufacturing exports, the share of wholesale and retail trade (G45-47) showed the greatest fluctuation. Third, labor cost in production, and investment structure were the two important factors affecting service components of China's manufacturing exports. Clearly, other factors may affect the variations of service components, but these remain beyond the scope of our paper and are left for future study.

APPENDIX: DECOMPOSITION FRAMEWORK OF WWZ (2013)

Using the link across industries and countries, it is possible to trace gross output in all stages of production that is needed to produce one unit of final goods. Let us assume a G-country world, in which each country produces goods in N differentiated tradable industries. Goods in each sector can be consumed directly or be used as intermediate inputs, and each country exports both intermediate and final goods to the others. The production and trade system can be written as $X = AX + Y$, and then we get $X = (I - A)^{-1}Y = BY$, where $(I - A)^{-1} \equiv B$. X and B can be written in block matrix notation,

$$\begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1G} \\ X_{21} & X_{22} & \cdots & X_{2G} \\ \vdots & \vdots & \ddots & \vdots \\ X_{G1} & X_{G2} & \cdots & X_{GG} \end{bmatrix} = \begin{bmatrix} B_{11} & B_{12} & \cdots & B_{1G} \\ B_{21} & B_{22} & \cdots & B_{2G} \\ \vdots & \vdots & \ddots & \vdots \\ B_{G1} & B_{G2} & \cdots & B_{GG} \end{bmatrix} \begin{bmatrix} Y_{11} & Y_{12} & \cdots & Y_{1G} \\ Y_{21} & Y_{22} & \cdots & Y_{2G} \\ \vdots & \vdots & \ddots & \vdots \\ Y_{G1} & Y_{G2} & \cdots & Y_{GG} \end{bmatrix},$$

and

$$B = \begin{bmatrix} B_{11} & B_{12} & \cdots & B_{1G} \\ B_{21} & B_{22} & \cdots & B_{2G} \\ \vdots & \vdots & \ddots & \vdots \\ B_{G1} & B_{G2} & \cdots & B_{GG} \end{bmatrix} = \begin{bmatrix} I - A_{11} & -A_{12} & \cdots & -A_{1G} \\ -A_{21} & I - A_{22} & \cdots & -A_{2G} \\ \vdots & \vdots & \ddots & \vdots \\ -A_{G1} & -A_{G2} & \cdots & I - A_{GG} \end{bmatrix}^{-1}$$

where $X_{sr}(N \times 1)$ is the gross output of in Country s that is eventually absorbed by Country r's final demand; $B_{sr}(N \times N)$ denotes the $N \times N$ block Leontief inverse matrix, which is the total requirement matrix that gives the amount of gross output in producing Country s required for a one-unit increase in final demand in Country r; $Y_{sr}(N \times 1)$ is the final goods produced by Country s for consumption in Country r; $A_{sr}(N \times N)$ is the direct input-output coefficient that gives units of the intermediate goods produced in Country s that are used in the production of one unit of gross output in Country r.

Define $V_s(1 \times N)$ as a $1 \times N$ direct value-added coefficient vector, $\mu(1 \times N)$ as a $1 \times N$ unity vector, and $VB(G \times GN)$ as the total value-added coefficient matrix as follows:

$$\begin{aligned} VB &= \begin{bmatrix} V_1 & 0 & \cdots & 0 \\ 0 & V_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & V_G \end{bmatrix} \begin{bmatrix} B_{11} & B_{12} & \cdots & B_{1G} \\ B_{21} & B_{22} & \cdots & B_{2G} \\ \vdots & \vdots & \ddots & \vdots \\ B_{G1} & B_{G2} & \cdots & B_{GG} \end{bmatrix} \\ &= \begin{bmatrix} V_1B_{11} & V_1B_{12} & \cdots & V_1B_{1G} \\ V_2B_{21} & V_2B_{22} & \cdots & V_2B_{2G} \\ \vdots & \vdots & \ddots & \vdots \\ V_GB_{G1} & V_GB_{G2} & \cdots & V_GB_{GG} \end{bmatrix} \end{aligned}$$

where $V_s = \mu[I - A_{ss} - \sum_{r \neq s}^{G} A_{sr}]$.

The decomposition of the country/sector level value-added and final goods production as a direct application of the Leontief insight can be expressed as follows:

$$\begin{aligned} \hat{V}BY &= \begin{bmatrix} \hat{V}_1 & 0 & \cdots & 0 \\ 0 & \hat{V}_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \hat{V}_G \end{bmatrix} \begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1G} \\ X_{21} & X_{22} & \cdots & X_{2G} \\ \vdots & \vdots & \ddots & \vdots \\ X_{G1} & X_{G2} & \cdots & X_{GG} \end{bmatrix} \\ &= \begin{bmatrix} \hat{V}_1 \sum_r^G B_{1r}Y_{r1} & \hat{V}_1 \sum_r^G B_{1r}Y_{r2} & \cdots & \hat{V}_1 \sum_r^G B_{1r}Y_{rG} \\ \hat{V}_2 \sum_r^G B_{2r}Y_{r1} & \hat{V}_2 \sum_r^G B_{2r}Y_{r2} & \cdots & \hat{V}_2 \sum_r^G B_{2r}Y_{rG} \\ \vdots & \vdots & \ddots & \vdots \\ \hat{V}_G \sum_r^G B_{Gr}Y_{r1} & \hat{V}_G \sum_r^G B_{Gr}Y_{r2} & \cdots & \hat{V}_G \sum_r^G B_{Gr}Y_{rG} \end{bmatrix} \end{aligned}$$

where $\hat{V}_s(N \times N)$ is a diagonal matrix that is direct value-added coefficient vector in Country s.

This matrix gives the estimates of sector and country sources of value added in each country's final good production. Each element in the matrix represents the value added from a source sector of a source country directly or indirectly used in the production of final goods in the source country.

Define Country s's gross exports as follows:

$$E_s = \sum_{r\neq s}^{G} E_{sr} = \sum_{r\neq s}^{G}(A_{sr}X_r + Y_{sr}) = X_s - A_{ss}X_s - Y_{ss}$$

By the definition of backward-linkage decomposition and the fact that $\sum_{r\neq s}^{G} V_r B_{sr} + V_s B_{ss} = \mu$, we get

$$E_s = \sum_{r\neq s}^{G} E_{sr} = \sum_{r\neq s}^{G}(V_s B_{ss})^T \# E_{sr} + \sum_{r\neq s}^{G}\sum_{t\neq s}^{G}(V_t B_{ts})^T \# E_{sr}$$

where the first part of right hand side is domestic content and the second part is the foreign content, # denote the multiplication of the corresponding elements of two matrices (vectors). Let $L_{rr} = (I - A_{rr})^{-1}$, hence $X_r = L_{rr}Y_{rr} + L_{rr}E_r$. Finally, we get

$$\begin{aligned} E_s &= \sum_{r\neq s}^{G}(V_s B_{ss})^T \# E_{sr} + \sum_{r\neq s}^{G}\sum_{t\neq s}^{G}(V_t B_{ts})^T \#(A_{sr}X_r + Y_{sr}) \\ &= \sum_{r\neq s}^{G}(V_s B_{ss})^T \# E_{sr} + \sum_{r\neq s}^{G}\sum_{t\neq s}^{G}(V_t B_{ts})^T \# Y_{sr} \\ &+ \sum_{r\neq s}^{G}\sum_{t\neq s}^{G}(V_t B_{ts})^T \# A_{sr}L_{rr}Y_{rr} + \sum_{r\neq s}^{G}\sum_{t\neq s}^{G}(V_t B_{ts})^T \# A_{sr}L_{rr}E_r \end{aligned}$$

where the second part of the right-hand side is domestic value added that returns home (RDV), the third part is foreign value added (FVA), and the fourth part is other additional pure double counted terms (PDC).

APPENDIX: TABLES

TABLE 1: Sector-level Shares of Services (Unit: %)

S-S	Sectors	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
ST	C10-16	5.59	5.49	5.28	4.53	4.37	4.25	4.28	4.81	5.44	5.66	5.11	4.92	5.12	4.68	4.65
	C17-18	22.60	23.55	23.99	21.11	19.86	18.83	18.87	20.21	22.24	23.28	21.67	21.55	21.74	19.64	18.93
	C19-23	8.76	8.63	8.12	7.14	6.98	6.89	7.05	7.82	8.09	8.28	8.07	7.24	7.13	6.60	6.36
	C24-25	6.44	6.63	6.14	4.95	4.20	4.27	4.17	4.52	4.68	5.28	4.79	4.69	4.74	4.59	4.46
	C26-28	5.82	5.81	5.27	4.02	3.52	3.39	3.32	3.47	3.67	3.73	3.55	3.67	3.63	3.62	3.56
	C29-30	19.33	19.75	19.43	15.78	13.30	12.02	11.66	12.10	12.11	12.72	11.33	10.94	10.69	10.67	10.49
SD	C10-16	5.25	5.20	4.99	4.16	3.93	3.77	3.79	4.28	4.89	5.11	4.51	4.31	4.49	3.93	3.84
	C17-18	24.10	25.30	25.63	22.43	21.13	19.77	20.04	21.52	23.77	24.70	23.00	23.06	23.08	20.30	19.34
	C19-23	8.67	8.59	8.03	6.83	6.59	6.45	6.72	7.52	7.75	7.95	7.71	6.85	6.58	5.79	5.44
	C24-25	6.32	6.51	5.91	4.53	3.65	3.62	3.50	3.81	3.92	4.58	4.03	3.97	3.93	3.59	3.34
	C26-28	5.54	5.53	4.87	3.44	2.86	2.65	2.56	2.62	2.74	2.83	2.62	2.76	2.66	2.46	2.29
	C29-30	20.26	20.84	20.50	16.23	13.36	11.74	11.38	11.77	11.46	12.44	10.98	10.50	10.19	10.12	9.78
SF	C10-16	8.92	8.35	8.00	7.93	8.07	8.58	8.49	9.46	10.05	10.50	9.95	9.32	9.82	10.07	10.28
	C17-18	15.75	15.39	16.62	15.06	14.24	14.68	13.83	14.49	15.83	16.75	16.15	15.65	16.38	17.05	17.33
	C19-232-14	9.12	8.78	8.50	8.38	8.47	8.59	8.31	8.94	9.31	9.62	9.38	8.59	9.13	9.51	9.65
	C24-25	6.86	7.07	7.03	6.51	6.08	6.65	6.41	6.99	7.27	8.16	7.69	7.21	7.76	8.21	8.49
	C26-28	7.07	7.05	7.06	6.59	6.46	6.71	6.54	7.17	7.73	7.89	7.47	7.33	7.66	8.25	8.62
	C29-30	14.46	14.09	14.19	13.33	13.03	13.32	12.95	13.66	15.12	14.38	13.24	13.30	13.46	13.46	13.84

Source: Authors, based on WIOD.

Note: S-S refers to shares of services.

TABLE 2: Sector-level Contributions to Changes in *ST* (Unit: %)

Industry	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
C10-C12	−43.70	10.67	5.17	5.66	−5.62	172.49	8.57	18.11	17.62	21.69	5.57	−140.94	24.69	8.90
C13-C15	−49.71	40.14	7.05	7.43	11.43	−11.05	7.04	4.40	16.81	23.56	6.35	−37.60	8.35	−1.85
C16	9.47	4.46	2.60	0.45	5.21	−46.07	1.68	−1.53	7.88	8.45	−3.19	−17.47	−0.33	2.50
C17	43.84	−8.17	6.91	6.96	19.62	32.02	1.12	5.25	15.24	17.12	2.11	−6.25	12.36	4.16
C18	54.50	−16.24	12.89	14.38	37.87	131.88	−3.23	6.33	15.86	12.21	−1.48	−71.64	11.20	9.31
C19	4.90	4.70	4.00	−13.01	−17.56	−210.03	27.36	7.54	−5.23	−32.94	96.69	144.68	24.60	28.00
C20	−24.21	13.89	3.99	10.74	−5.21	199.85	11.17	14.35	−2.39	17.46	−7.84	70.16	12.41	10.01
C21	−2.09	0.71	0.54	1.93	3.41	6.38	2.76	0.59	−0.40	2.25	2.17	−7.02	−0.68	2.21
C22	22.48	0.77	7.27	7.67	22.58	71.02	−0.20	3.37	7.10	6.83	0.20	−14.88	1.08	4.81
C23	−50.27	18.70	3.57	2.74	−0.46	0.99	2.40	1.80	6.57	5.10	−7.70	−3.80	−1.23	5.65
C24	54.94	2.20	3.50	2.99	−2.27	47.86	9.24	20.63	−27.31	13.28	−12.92	121.38	19.67	6.17
C25	−3.31	7.13	3.97	1.33	4.07	−76.43	5.37	3.00	7.74	12.74	1.00	−57.65	3.31	2.67
C26	35.59	7.55	7.09	0.09	8.80	117.42	−8.92	−3.40	10.91	−26.29	0.90	−59.44	−12.16	2.41
C27	−16.49	6.52	5.38	3.63	−5.74	76.18	7.00	16.28	−6.47	−4.87	1.27	−22.54	6.87	2.46
C28	18.16	6.90	9.43	9.25	29.82	−127.72	10.22	5.04	5.91	18.24	−4.73	119.39	0.35	5.67
C29	29.89	−19.62	8.03	19.20	16.93	-24.33	12.99	7.51	19.03	−10.44	10.48	54.78	−2.89	6.50
C30	30.72	−2.60	0.61	4.36	3.13	−73.17	10.40	−3.23	3.98	4.17	12.99	55.71	−7.20	3.54
C31-C32	−14.69	22.29	8.00	14.20	−26.04	−187.28	−4.96	−6.04	7.16	11.45	−1.85	−26.87	−0.43	−3.14

Source: Authors, based on WIOD.

TABLE 3.

Manufacturing and Service Sectors

Industry	Content
C10-C12	Manufacture of food products, beverages and tobacco products
C13-15	Manufacture of textiles, wearing apparel and leather products
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
C17	Manufacture of paper and paper products
C18	Printing and reproduction of recorded media
C19	Manufacture of coke and refined petroleum products
C20	Manufacture of chemicals and chemical products
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22	Manufacture of rubber and plastic products
C23	Manufacture of other non-metallic mineral products
C24	Manufacture of basic metals
C25	Manufacture of fabricated metal products, except machinery and equipment
C26	Manufacture of computer, electronic and optical products
C27	Manufacture of electrical equipment
C28	Manufacture of machinery and equipment n.e.c.
C29	Manufacture of motor vehicles, trailers and semi-trailers
C30	Manufacture of other transport equipment
C31-C32	Manufacture of furniture; other manufacturing
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
G46	Wholesale trade, except of motor vehicles and motorcycles
G47	Retail trade, except of motor vehicles and motorcycles
H49	Land transport and transport via pipelines
H50	Water transport
H51	Air transport
H52	Warehousing and support activities for transportation
H53	Postal and courier activities
J58	Publishing activities
J59-J60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities
J61	Telecommunications

TABLE 3—*Continued*

Industry	Content
J62-J63	Computer programming, consultancy and related activities; information service activities
K64	Financial service activities, except insurance and pension funding
K65	Insurance, reinsurance and pension funding, except compulsory social security
K66	Activities auxiliary to financial services and insurance activities
M69-M70	Legal and accounting activities; activities of head offices; management consultancy activities
M71	Architectural and engineering activities; technical testing and analysis
M72	Scientific research and development
M73	Advertising and market research
M74-M75	Other professional, scientific and technical activities; veterinary activities

Source: WIOD.

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