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China's Service Export Challenges and Future Potential: Benchmarking the USA

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Abstract

China's service trade deficit has increased sharply since 2010, raising questions about the competitiveness of its exports. One way to measure competitiveness is to compare China with its top competitors. In this paper, revealed comparative advantage (RCA) indices of China's service exports are calculated based on the "forward linkage value added export" concept and compared with one of its top competitors – the US over the period from 2000 to 2014. The results show that only four of China's service sectors RCAs, namely (1) construction, (2) wholesale and retail trade, (3) administration and food service activities, and (4) arts, entertainment and recreation, exceed those of the US while RCAs of other service sectors are lower. Furthermore, some Chinese services sector RCAs, especially those in the labor- and capital-intensive service industries, show a downward trend while the US has advantage in knowledge-intensive service industries. To compete successfully, China needs to upgrade its technology-rich service sectors and exports.

Keywords: *service trade, comparison between China and US, forward linkage value added export, revealed comparative advantage, export structure*

1. Introduction

One of the hallmarks of economic advance is the growth of the tertiary sector (services) relative to that of the secondary sector (manufacturing). Together with this advance is the transformation of economic globalization with its concomitant shift from the trade in goods to the trade in services. The development of the services industry is not confined within national borders but can seize opportunities from "globalization" and "product fragmentation". It is also expected that countries that are strong in merchandise trade should be strong in services trade.

In this context, China has become a global powerhouse for merchandise exports, having overtaken the US to become the world's top exporter in 2009. At the same time, it has accelerated the development of its service industry through international specialization. According to the World Trade Organization's (WTO) Trade Statistics, China's total services exports were only US $ 2.5 billion in 1982, but reached US$234 billion in 2018, an increase of nearly 94 times within 37 years.

With exports of goods slowing, service exports would appear to have the potential to be a new driver of China's export growth. However, unlike its merchandise exports, China has suffered quite large service trade deficits for quite a long time. This deficit had increased from US$62 billion in 1995 to US$136.6 billion in 2015, the largest service trade deficit in the world (China's Statistics of Trade in Services,

2015). Even worse, the country's service trade deficit had increase sharply since 2010. Therefore, it is important to first understand the causes of this deficit, and then to address this deficit through improving export competitiveness.

As reported by the IMF, the scale of global trade in services has increased from US$ 2.95 trillion in 2001 to US$10.8 trillion in 2018. Meanwhile, the proportion of world services trade to total trade rose from 19.3 percent to 24.2 percent during 2001 to 2018. Among them, from 2001 to 2018 service trades in the United States increased from US$0.48 trillion to US$1.37 trillion, making it the largest service trader in the world as of 2018.

Furthermore, according to statistics published by the OECD, the Unites States is the largest trading partner of China's service import which contributed US$57.1 billion in 2018. It is also the second largest trading partners of China's service export, second only to Hong Kong. In addition, the People's Republic of China Ministry of Commerce reported that Unites States is the largest source country of China's trade deficit in services and the deficit has grown rapidly in recent years. From 2006 to 2016, the total volume of China-US trade in services increased by 3.3 times, while the deficit increased by 33.7 times.

Understanding the real situation of China's export competitiveness and the gap between China and its powerful competitors represents an important first step to upgrade the nation's industrial structure. This is the primary objective of this paper.

This paper is organized as follows. The next section elaborates the main characteristics of China's service industry and how service trade has become a new engine of the China's exports. Section 3 contains a brief literature review of previous work on industry competitiveness using different statistical methods. Section 4 describes the methodology and data description for this study. Section 5 presents the comparative

analysis for China and the US, its top service trade partner while the last section concludes the study.

2. China's Service Industry

Services currently represent more than two thirds of World Gross Domestic Product (WTO, 2010). Recently, due to its increasing importance in international trade and investment, services sector has been identified as the new engine of growth for most countries, especially in developing countries (Park and Shin, 2012). Furthermore, service trade can generate high value-added. According to OECD statistics, services' value-added accounted for around 70 percent of GDP in developed countries in 2016, up from 65 percent in 1997. Except in a few major developing nations such as Indonesia, China, and India, services sector contributed over 60 percent of total value-added in 2017 in all major economies.

World Bank database reported that the export of services in China increased from US$117 billion in 2010 to US$206 billion in 2017, with an average annual increase rate of 11 percent. China's services trade accounted for 17 percent of total international trade in 2017, signaling its importance in the international trade arena. According to the Peoples' Republic of China Ministry of Commerce, China's service industry has become a new engine for economic growth, accounting for 52 percent of the country's total GDP. Despite starting only at a late stage, there has been rapid development in China's services trade. The Peoples' Republic of China Ministry of Commerce reported that the average annual growth rate of China's service trade has increased by nearly 10 percent which is much higher than the 3.9 percent observed in the United States and 2.1 percent in Japan in the last decade. In 2018, China's total service trade volume stood at US$759.4 billion, the second

largest in the world.

However, China has been recording large service trade deficit. According to statistics published by the IMF, China's service trade deficit was US$292.2 billion in 2018, accounting for 41 percent of the global service trade deficit, making it the country with the largest service trade deficit in the world. On a sectoral basis, China's service trade surplus is mainly seen in telecommunications, computer and information services, and construction. On the other hand, the country records deficit in travel (including study abroad, tourism, medical treatment), intellectual property and transportation.

3. Literature Review

The concept of revealed comparative advantage is a common yardstick for measuring export competitiveness. For China's service trade, extensive work has been undertaken to estimate this index (Zhao and Li, 2005; Zhao and Xu, 2007; Chen and Li, 2014; Li and Zhang, 2015; Dai, 2015). However, many of these are calculated using gross exports. Since the phenomenon of intermediate services across multiple borders is becoming more popular, the source of value of many products actually involves many countries or regions. Official trade statistics do not necessarily represent the ultimate sources and destination of a country's trade. In view of this, Timmer *et al.* (2013) pointed out that the sectoral comparative advantage index proposed by Balassa (1965) may produce erroneous conclusions. To overcome these drawbacks, Koopman, Wang and Wei (2012) calculated sectoral revealed comparative advantage from the perspective of value added. This method removes the value added from imported foreign intermediate products.

Using Koopman, Wang and Wei (2012), Brakman and Van Marrewijk (2017) applied the data of 35 sectors in 40 economies over 15

years to compare two RCA indices calculated from total gross export and value-added export data and found that value added exports are more concentrated than gross exports. Dai (2015) calculated the RCA of China's 35 sectors using the same types of export values and found that all service subsectors lacked significant comparative advantage and the RCA values calculated from traditional statistical method were larger than RCAs calculated using value added. However, Wang, Wei and Zhu (2013) hold that the sectoral comparisons should be analyzed from the perspective of departmental creation of value added, for which they define the sectoral forward value added exports and the backward value added exports, respectively, from a producer's and user's perspectives. Measuring the value-added forward linkage exports requires deducting the value added created by other countries and the value added created by other domestic departments from the total export value of the sector, while adding the value added created by this sector but indirectly exported through other sectors.

Pu and Ma (2015) compared the service trade competitiveness for the "BRICS" based on Trade in Value Added (TiVA) database. Since TiVA trade database eliminates double counting and takes into account the service trade implicit in the exports of manufacturing sectors it corrects for the error in misjudging competitiveness in official trade data. Using the same data source and methodology, Li and Zhang (2015) investigated the changes of international competitiveness for five Chinese service sectors – wholesale and retail trade, accommodation and food service activities, financial, and commercial services from the perspectives of trade balance and comparative advantage index. In addition, Guo and Liu (2015) corrected and estimated the international market share and RCA index for China taking into account both the direct export value added in specific service sectors and the value added implicit in the indirect export of manufacturing industries. Chen (2017)

analyzed the competitiveness of China's service trade based on TiVA database and found China's service trade to be weaker than the results calculated based on traditional method. Like Chen (2017), Zheng and Yan (2018) measured China's service trade competitiveness based on the value added perspective by applying OECD-TiVA database from 1995 to 2011. They found that China's service trade had RCA in labor-intensive industries but weak RCA in other knowledge-intensive industries. The above studies had the advantage of measuring China's service trade using value-added. However, TiVA has its own drawbacks. First, its classification of service industry is relatively simple, and second is the discontinuity of input-output series.

The gradual updating of WIOD provides solid data for studying service trade competitiveness. Fan and Huang (2014) estimated the participation of China's service industry in the global value chain by applying time services data extracted from the WIOD database and found that knowledge intensive service industries developed the fastest. However, this study did not identify specific industries. Dai (2015), however, calculated value added RCAs of China's service sectors at sub-industrial and factor intensity levels from 1995 to 2011 and compared these to RCA indices calculated using traditional statistical method. It was found that China's service sectors lack RCA based on backward linkage value added exports. These were opposite to those found using the traditional statistical methods. Realizing the defects of using the backward-linkage value added export, Li and Feng (2015) calculated the RCA based on forward linkage value added export from 1995 to 2011. The result showed that the RCA of manufacturing industry lies in labor-intensive industries.

Niu, Ma and Song (2016) compared the RCAs of service sectors in China and the US using forward linkage value-added export data for the period from 1995 to 2011. The findings shown that the RCA of China's

service sectors are relatively lower than that of the US. China's RCA lies in the labor and capital intensive areas, while that for the US lies in knowledge intensive industries. Dong and Yong (2018) provided a more recent estimate using the forward linkage value added exports and comparing it with estimates from gross exports. China has weak RCA no matter which method was applied.

From the world review, Seleka and Kebakile (2017) evaluated Botswana's beef export competitiveness by using Normalized Revealed Comparative Advantage (NRCA) index. The result demonstrated that value-added export should be taken into account for analysing one sector's competitiveness. Ceglowski (2017) examined countries' manufacturing and services export competitiveness by using the same method as Seleka and Kebakile (2017). However, Ceglowski (2017) gauged the competitiveness based on the Trade in Value-Added (TiVA) database which covers the year from 1995 to 2009. The results indicated that using the gross export values overestimate countries' competitiveness in sectors and China has less competitive in electrical and optical equipment through the lens of domestic value-added. In addition, Brakman and Van Marrewijk (2017) compared the distributions of good's revealed comparative advantage (RCA) in terms of value-added and gross export data. The findings indicated that they are significantly different by applying different data.

This summary revealed that existing literature has made major contributions to understanding China's service sector competitive advantage. However, some issues remain. First, the TiVA database does not contain sufficient detail to permit a detailed analysis of the entire service sector. Second, existing research fails to consider specific industries. For instance, Fan and Huang (2014) only divided China's service industry into four categories based on factor intensity, but did not analyze specific industries. Third, the current literature using value

added data usually ignores value added of the sector which is embedded in the export of other sectors (indirect exports). To correct these errors, this study applies continuous time series data (2000-2014) extracted from the WIOD database, using the approach of Wang, Wei and Zhu (2013) in estimating forward linkage value added exports to compare the RCA of sectors in China and the US.

4. Methodology and Data

4.1. Decomposition of Value Added Based on Forward Linkage

Following Wang, Wei and Zhu (2013), this study uses the method of forward linkage value added exports to more accurately measure RCA. The data used for this estimation are from the World Input-Output Table with continuous time series for the period 2000-2014.

Methodologically, it is assumed that there are N countries and S sectors and all countries and sectors employ their own domestic factors (initial inputs) and intermediate inputs for production. The output of each sector can be used as an intermediate product or as a final product for domestic and international use and consumption. Thus, the input-output table has the following balance relationship on the row vector:

Intermediate use + Final use = Gross output. It can be denoted as:

$$\begin{bmatrix} B^{ll} & B^{lm} & B^{ln} \\ B^{ml} & B^{mm} & B^{mn} \\ B^{nl} & B^{nm} & B^{nn} \end{bmatrix} \begin{bmatrix} T^{l} \\ T^{m} \\ T^{n} \end{bmatrix} + \begin{bmatrix} F^{ll} + F^{lm} + F^{ln} \\ F^{ml} + F^{mm} + F^{mn} \\ F^{nl} + F^{nm} + F^{nn} \end{bmatrix} = \begin{bmatrix} T^{l} \\ T^{m} \\ T^{n} \end{bmatrix} \quad (1)$$

Equation (1) is derived from the equation:

$$\begin{bmatrix} Y^{ll} + Y^{lm} + Y^{ln} \\ Y^{ml} + Y^{mm} + Y^{mn} \\ Y^{nl} + Y^{nm} + Y^{nn} \end{bmatrix} + \begin{bmatrix} F^{ll} + F^{lm} + F^{ln} \\ F^{ml} + F^{mm} + F^{mn} \\ F^{nl} + F^{nm} + F^{nn} \end{bmatrix} = \begin{bmatrix} T^{l} \\ T^{m} \\ T^{n} \end{bmatrix}$$

through defining the input coefficient $B^{lm} \equiv Y^{lm} (T^m)^{-1}$ where B represents country B, T represents the total output, the superscript of l, m and n stands for the source country L, partner country M and third country N separately. Y^{lm} and F^{lm} denote the intermediate input and final use parts absorbed by country M but produced by country L. With n sectors in one country, Y is a n×n matrix, while T and F are n×1 column vectors.

Equation (1) can be rearranged to produce the classic Leontief formula:

$$\begin{bmatrix} T^l \\ T^m \\ T^n \end{bmatrix} = \begin{bmatrix} C^{ll} & C^{lm} & C^{ln} \\ C^{ml} & C^{mm} & C^{mn} \\ C^{nl} & C^{nm} & C^{nn} \end{bmatrix} \begin{bmatrix} F^{ll} + F^{lm} + F^{ln} \\ F^{ml} + F^{mm} + F^{mn} \\ F^{nl} + F^{nm} + F^{nn} \end{bmatrix} \tag{2}$$

where

$$\begin{bmatrix} C^{ll} & C^{lm} & C^{ln} \\ C^{ml} & C^{mm} & C^{mn} \\ C^{nl} & C^{nm} & C^{nn} \end{bmatrix} = \begin{bmatrix} 1 - B^{ll} & -B^{lm} & -B^{ln} \\ -B^{ml} & 1 - B^{mm} & -B^{mn} \\ -B^{nl} & -B^{nm} & 1 - B^{nn} \end{bmatrix}^{-1}$$

denotes the Leontief's classical inverse matrix. Since total output = intermediate input + value added, formula (2) can be rearranged as:

$$\begin{aligned} \begin{bmatrix} T^l \\ T^m \\ T^n \end{bmatrix} &= \begin{bmatrix} B^{ll} & 0 & 0 \\ 0 & B^{mm} & 0 \\ 0 & 0 & B^{nn} \end{bmatrix} \begin{bmatrix} T^l \\ T^m \\ T^n \end{bmatrix} + \begin{bmatrix} F^{ll} + E^l \\ F^{mm} + E^m \\ F^{nn} + E^n \end{bmatrix} \\ &= \begin{bmatrix} B^{ll} & 0 & 0 \\ 0 & B^{mm} & 0 \\ 0 & 0 & B^{nn} \end{bmatrix} \begin{bmatrix} T^l \\ T^m \\ T^n \end{bmatrix} + \begin{bmatrix} VA^l \\ VA^m \\ VA^n \end{bmatrix} \end{aligned} \tag{3}$$

where VA^l is 1 ×S vector, if $\Phi = \hat{A}$ ($\hat{A}$ represents a diagonal matrix), thus the equation (3) can be rewritten as:

$$\begin{bmatrix} VA^l \\ VA^m \\ VA^n \end{bmatrix} = \begin{bmatrix} 1-\Phi^{ll} & 0 & 0 \\ 0 & 1-\Phi^{mm} & 0 \\ 0 & 0 & 1-\Phi^{nn} \end{bmatrix} \begin{bmatrix} T^l \\ T^m \\ T^n \end{bmatrix} = \begin{bmatrix} V^{ll} & 0 & 0 \\ 0 & V^{mm} & 0 \\ 0 & 0 & V^{nn} \end{bmatrix} \begin{bmatrix} T^l \\ T^m \\ T^n \end{bmatrix} \quad (4)$$

where $V^{ll} = 1 - \Phi^{ll}$, since Φ^{ll} represents the intermediate input rate of gross output, $1 - \Phi^{ll}$ represents the value-added rate of total output. Combining equation (2) and (4), we derived:

$$\begin{bmatrix} VA^l \\ VA^m \\ VA^n \end{bmatrix} = \begin{bmatrix} V^{ll} & 0 & 0 \\ 0 & V^{mm} & 0 \\ 0 & 0 & V^{nn} \end{bmatrix} \begin{bmatrix} C^{ll} & C^{lm} & C^{ln} \\ C^{ml} & C^{mm} & C^{mn} \\ C^{nl} & C^{nm} & C^{nn} \end{bmatrix} \begin{bmatrix} F^{ll} + F^{lm} + F^{ln} \\ F^{ml} + F^{mm} + F^{mn} \\ F^{nl} + F^{nm} + F^{nn} \end{bmatrix} \quad (5)$$

Thus, VC denotes the value-added rate of final use. If we rewrite the right side of equation (5) as an n×n diagonal matrix we obtain:

$$\begin{bmatrix} VA^l \\ VA^m \\ VA^n \end{bmatrix} = \begin{bmatrix} V^{ll}C^{ll}F^{ll} & V^{lm}C^{lm}F^{lm} & V^{ln}C^{ln}F^{ln} \\ V^{ml}C^{ml}F^{ml} & V^{mm}C^{mm}F^{mm} & V^{mn}C^{mn}F^{mn} \\ V^{nl}C^{nl}F^{nl} & V^{nm}C^{nm}F^{nm} & V^{nn}C^{nn}F^{nn} \end{bmatrix} \quad (6)$$

Rearranging equation (6) leads to

$$\begin{aligned} vt_1^l &= V_1^l C^{ll} F^{lm} + V_1^l C^{lm} F^{ll} + V_1^l C^{ln} F^{nm} \\ &= [v_1^l \ 0] \begin{bmatrix} c_{11}^{ll} & c_{12}^{ll} \\ c_{21}^{ll} & c_{22}^{ll} \end{bmatrix} \begin{bmatrix} f_1^{lm} \\ f_2^{lm} \end{bmatrix} + [v_1^l \ 0] \begin{bmatrix} c_{11}^{lm} & c_{12}^{lm} \\ c_{21}^{lm} & c_{22}^{lm} \end{bmatrix} \begin{bmatrix} f_1^{mm} \\ f_2^{mm} \end{bmatrix} + [v_1^l \ 0] \begin{bmatrix} c_{11}^{ln} & c_{12}^{ln} \\ c_{21}^{ln} & c_{22}^{ln} \end{bmatrix} \begin{bmatrix} f_1^{nm} \\ f_2^{nm} \end{bmatrix} \\ &= v_1^l \sum_j^2 c_{1j}^{ll} f_j^{lm} + v_1^l \sum_j^2 c_{1j}^{lm} f_j^{mm} + v_1^l \sum_j^2 c_{1j}^{ln} f_j^{nm} \end{aligned} \quad (7)$$

Koopman, Wang and Wei (2014) define the value added export for country l and sector i as:

$$VAX\_F_i^l + RCA\_F_i^l = \sum_{m \neq l}^{G} V_i^l C^{ll} F^{lm} + \sum_{m \neq l}^{G} V_i^l C^{ll} F^{mm} + \sum_{m \neq l}^{G} V_i^l B^{lm} \sum_{n \neq l,m}^{G} F^{ln} + \sum_{m \neq l}^{G} V_i^l C^{lm} F^{ml} \quad (8)$$

where *G* denotes there are G economies in the world,

$$VAX_{F_i^l} = \sum_{m \neq l}^{G} V_i^l C^{ll} F^{lm} + \sum_{m \neq l}^{G} V_i^l C^{ll} F^{mm} + \sum_{m \neq l}^{G} V_i^l B^{lm} \sum_{n \neq l,m}^{G} F^{ln}$$

implies the value added production by the sector *i* of country *l* and absorbed by foreign countries via the parts of final products or intermediate goods, and

$$RCA\_F_i^l = \sum_{m \neq l}^{G} V_i^l C^{lm} F^{ml}$$

denotes the value added produced by sector *i* of country *l* and exported through intermediate goods, while finally returns to domestic country.

4.2. Revealed Comparative Advantage

Balassa (1965) first put forward the revealed comparative advantage (RCA) concept to calculate the relative advantage or disadvantage of a certain country in certain sectors. It is defined as the relative weight of a percentage of total export of products or services in a nation divide by the percentage of world export of that products or services. Thus, the RCA formula is expressed as

$$RCA_{ij} = \left(X_{ij}/X_j\right)/(X_{iw}/X_w) \quad (9)$$

The larger the RCA value, the stronger the international competitiveness. When the RCA is greater than 1, a sector has a revealed comparative advantage; otherwise it has a revealed comparative disadvantage. In the context of economic globalization, however, the RCA index fails to take into account international productive specialization and it ignores domestic division of labor as well. First, RCA index ignores the fact that the total export of one country's sector

contains foreign value added and double-counted items. Second, the RCA index also fails to consider the fact that one country sector's value added is embodied in the export of other parts of the country. Therefore, based on equation (8), this study made a revision to the Balassa index, and derived the RCA Index based on forward linkage value added exports:

$$RCA_{Value\ Added_i^r} = \frac{(vax\_f_i^r + rdv\_f_i^r)/\sum_i^n (vax\_f_i^r + rdv\_f_i^r)}{\sum_r^G (vax\_f_i^r + rdv\_f_i^r)/\sum_r^G \sum_i^n (vax\_f_i^r + rdv\_f_i^r)} \quad (10)$$

In an open economy, the revealed comparative advantage index can reflect one country's current situation of competitiveness. However, trade in intermediate goods may move across country borders multiple times. According to Koopman, Wang and Wei (2010), the values of the products accrue to many countries or regions and should not be captured solely by the country or region that ultimately exports the product as reflected in official trade statistics. Based on discussed above, this study will calculate China's revealed comparative advantage from the perspective of forward-linkage value added and compare with US.

4.3. Sample and Data Description

As indicated earlier, this study uses the WIOD which provides a 15-years World Input-Output Table (WIOT) from 2000 to 2014. This dataset, released at the end of 2016, is the latest version available. WIOD includes 43 countries (regions), developed, developing spread over five continents. The trade volume of these 43 economies account for over 80 percent of total global trade. According to the WIOT database, in 2014, China's exports to the other 42 countries accounted for 60 percent of total world trade, while its services export to 42 economies accounted for 79 percent of world service exports. Therefore, it is important to measure the decomposition of China's services industry

export value added to these economies which are the main services trade partners of China.

According to the International Standard Industrial Classification (ISIC) Rev.4, services are divided into 12 categories. To be more meaningful, this study follows Fan and Huang (2014) who divide services industry into four categories based on factor intensity (Table 1).

Table 1 Service Industry Classification by Factor Intensity

Category	Industry
Labor Intensive	c27 construction; c28-c30 wholesale and retail trade; c36 accommodation and food service activities
Capital Intensive	c31-c35 transportation and storage; c37-c40 information and communication; c44 real estate activities
Knowledge Intensive	c41-c43 financial and insurance activities; c45-c49 professional,scientific and technical activities
Human health, education and public services	c50 administrative and support service activities; c52 education; c53 human health and social work activities; c54 arts, entertainment and recreation

Note: c27 is construction, c28-c30 is wholesale and retail trade, c31-c35 is transportation and storage, c36 is accommodation and food service activities, c37-c40 is information and communication, c41-c43 is financial and insurance activities, c44 is real estate activities, professional, c45-c49 is scientific and technical activities, c50 is administrative and support service activities, c52 is education, c53 is human health and social work activities, arts, c54 is entertainment and recreation.

Source: Author.

5. Comparing Data Estimates between China and the US

5.1. Results and Comparisons

By whatever standard, the US is a major trade partner for China, it being the top country running a trade deficit with China but against which it has a perennial service trade surplus. The RCAs of 12 service sectors between China and US based on WIOD database from the year 2000 to the year 2014 were estimated and the results are shown in Tables 2 and 3. Comparing the forward linkage RCA between two countries in 2014, China has a comparative advantage for c27 construction, c28-c30 wholesale and retail trade, c36 accommodation and food service activities, and c54 arts, entertainment and recreation. The RCAs of China's c27 construction and c28-c30 wholesale and retail trade were lower than for the US before 2010, but exceeded those of the US thereafter. Accommodation and food service activities (c36) showed a downward trend even though it has revealed comparative advantage.

However, other Chinese service sectors such as information and communication (c37-c40), professional, scientific and technical (c45-c49), administrative and support service activities (c50) have weak comparative advantage in comparison with the US. Furthermore, the RCA of information and communication (c37-c40) shows a decreasing trend, while professional, scientific and technical (c45-c49) shows an increasing trend. For education (c52), human health and social work activities (c53) service sectors, China's RCA values surpassed US in earlier years but were overtaken by the US more recently.

In Table 3, the competitive disadvantage of US's service sectors were in construction (c27), accommodation and food service activities (c36), education (c52), human health and social work activities (c53), arts, entertainment and recreation (c54). Specifically, for the c36 sector, US had no comparative advantage and China's RCA far exceeded that of

the US in this sector. Most of the service sectors in the US have RCA greater than 1 especially in wholesale and retail trade (c28-c30), information and communication (c37-c40), financial and insurance activities (c41-c43), real estate activities (c44), professional, scientific and technical activities (c45-c49), administrative and support service activities (c50) from the period of 2000-2014.

Table 2 China's RCA Index of Service Sectors Based on Forward Linkage Value Added Export, 2000-2014

Sectors	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
c27	0.381	0.356	0.320	0.275	0.257	0.223	0.225	0.252	0.303	0.313	0.369	0.434	0.448	0.477	0.444
c28-c30	0.900	0.926	0.979	0.882	0.815	0.816	0.788	0.780	0.884	0.995	1.051	1.126	1.180	1.164	1.176
c31-c35	1.070	1.064	1.038	0.937	0.926	0.886	0.890	0.880	0.874	0.849	0.844	0.880	0.875	0.864	0.849
c36	1.158	1.161	1.220	1.191	1.228	1.274	1.279	1.255	1.252	1.160	1.051	0.985	0.972	0.939	0.932
c37-c40	0.415	0.421	0.425	0.411	0.433	0.429	0.439	0.430	0.380	0.323	0.303	0.305	0.307	0.312	0.301
c41-c43	0.744	0.691	0.669	0.618	0.579	0.580	0.650	0.770	0.853	0.851	0.887	0.936	0.967	1.005	1.038
c44	0.538	0.529	0.528	0.531	0.525	0.548	0.642	0.749	0.694	0.840	0.926	0.956	0.996	0.995	0.979
c45-c49	0.481	0.483	0.513	0.535	0.590	0.597	0.631	0.645	0.669	0.716	0.744	0.743	0.748	0.724	0.735
c50	0.008	0.008	0.008	0.010	0.013	0.016	0.019	0.019	0.022	0.026	0.028	0.028	0.045	0.043	0.044
c52	0.456	0.446	0.498	0.447	0.454	0.512	0.522	0.482	0.466	0.477	0.391	0.343	0.343	0.346	0.396
c53	0.558	0.542	0.607	0.673	0.762	0.906	0.949	0.996	0.844	0.638	0.441	0.347	0.293	0.299	0.323
c54	2.220	2.683	2.712	2.215	1.658	1.664	1.504	1.404	1.394	1.379	1.321	1.325	1.336	1.303	1.288

Note: c27 is construction, c28-c30 is wholesale and retail trade, c31-c35 is transportation and storage, c36 is accommodation and food service activities, c37-c40 is information and communication, c41-c43 is financial and insurance activities, c44 is real estate activities, professional, c45-c49 is scientific and technical activities, c50 is administrative and support service activities, c52 is education, c53 is human health and social work activities, arts, c54 is entertainment and recreation.

Source: Author's calculation based on WIOTs.

Table 3 US's RCA Index of Service Sectors Based on Forward Linkage Value Added Export, 2000-2014

Sectors	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
c27	0.457	0.475	0.453	0.428	0.407	0.427	0.413	0.480	0.456	0.371	0.363	0.384	0.411	0.385	0.377
c28-c30	1.166	1.155	1.133	1.152	1.187	1.217	1.222	1.212	1.147	1.081	1.077	1.054	1.085	1.100	1.091
c31-c35	0.901	0.893	0.889	0.875	0.880	0.895	0.920	0.865	0.912	0.889	0.926	0.950	0.940	0.935	0.933
c36	0.570	0.579	0.596	0.572	0.555	0.545	0.543	0.533	0.538	0.488	0.509	0.524	0.524	0.542	0.551
c37-c40	1.448	1.448	1.531	1.535	1.577	1.590	1.532	1.580	1.640	1.617	1.675	1.692	1.629	1.650	1.628
c41-c43	1.163	1.272	1.322	1.318	1.318	1.387	1.369	1.278	1.183	1.291	1.312	1.340	1.398	1.355	1.347
c44	1.265	1.285	1.313	1.326	1.383	1.459	1.307	1.268	1.218	1.088	1.200	1.196	1.171	1.150	1.175
c45-c49	1.457	1.502	1.537	1.458	1.461	1.492	1.529	1.551	1.616	1.599	1.682	1.738	1.751	1.688	1.687
c50	1.222	1.266	1.324	1.332	1.350	1.390	1.391	1.373	1.412	1.345	1.368	1.441	1.456	1.427	1.406
c52	0.376	0.397	0.411	0.415	0.453	0.432	0.480	0.451	0.474	0.521	0.559	0.601	0.584	0.565	0.572
c53	0.345	0.373	0.376	0.373	0.391	0.385	0.410	0.417	0.443	0.439	0.416	0.459	0.495	0.486	0.562
c54	0.880	0.781	0.779	0.754	0.743	0.698	0.714	0.743	0.736	0.713	0.717	0.736	0.747	0.717	0.705

Note: c27 is construction, c28-c30 is wholesale and retail trade, c31-c35 is transportation and storage, c36 is accommodation and food service activities, c37-c40 is information and communication, c41-c43 is financial and insurance activities, c44 is real estate activities, professional, c45-c49 is scientific and technical activities, c50 is administrative and support service activities, c52 is education, c53 is human health and social work activities, arts, c54 is entertainment and recreation.

Source: Author's calculation based on WIOTs.

Furthermore, from the perspective of factor intensity, the results show that the RCAs of China's service sectors are mostly in labor-intensive service industries, such as c28-c30, and c36. For the US, capital intensive, knowledge intensive, human health, education and public services are its comparative advantage. Examples are c31-c35, c37-c40, c44, c41-c43, c45-c49 and c50 which fall under these three factor intensity categories. For the c52 and c53 sectors, both of them have the comparative disadvantage. Clearly, the disadvantage suffered

by China in its service exports with the US lies in the lower value added of those services in which it has an RCA, and with the RCAs falling over time.

Starting from the labor-intensive service industry such as c27 and c28-c30, China's revealed comparative advantage of two service sectors are below US's. After that China's two service keep increasing and US keep decreasing which leads to US being overtaken by China. This finding contradicts the conventional wisdom that China has RCA in labour-intensive services. A possible explanation is low labor productivity in China. For the other sectors, the RCAs of most of China's service sectors that are capital-intensive lose out to those in the US which is in accordance with expectations. For the knowledge intensive service industry, China's RCA index increased in sectors c41-c43, achieving comparative advantage in the last two years. However, there is comparative disadvantage for China's c45-c49 sectors. Thus, it can be inferred that the main reason for China's service industry lagging behind the US was the former's disadvantage in knowledge intensive service industries, caused by low productivity (Li and Feng, 2015). For the human health, education and public health sectors, a big gap also exist between China and US and this gap is increasing.

From the discussion above, China lacks comparative advantage in most of the service sectors compared to the US. Additionally, six of China's service sectors have very strong competitive disadvantage and their RCAs are falling. Urgent upgrades of the service industry are needed.

5.2. Factor Intensity of China and US Service Exports

Beyond comparing specific sectors, the factor intensity of the two countries' service exports can be compared using the factor intensity classifications discussed earlier. From Table 4, it can be seen that a big

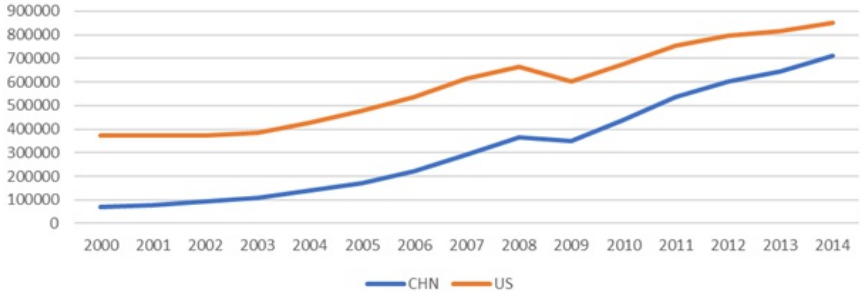
gap exists between China and US's service trade structure in terms of factor intensity. China's service exports focus on labor-intensive industry with the value-added exports at more than 30 percent of the total value added exported. For the US, knowledge intensive industry exports rose during 2000-2014, accounting for around 30 percent of total value-added exports, the largest export category with strong RCA compared to other service exports from the US. The structure of China's service trade is likewise reliant on knowledge-intensive service sectors to generate export value added. However, China still has a way to go to catch up with the US in terms of both quantity and quality of services as shown in Figure 1.

Table 4 Value Added as a Percentage of Total Gross Export Value for Four Service Categories, China and the US

Year	China				US			
	Labour Intensive	Capital Intensive	Knowledge Intensive	Health, Education	Labour Intensive	Capital Intensive	Knowledge Intensive	Health, Education
2000	38.805	32.442	20.585	8.168	29.522	28.758	28.534	13.186
2001	38.544	31.842	19.837	9.777	28.400	28.363	29.950	13.287
2002	39.361	30.822	19.875	9.942	27.056	28.824	30.638	13.482
2003	38.436	31.145	21.440	8.979	27.294	29.149	30.223	13.330
2004	36.934	32.971	22.759	7.337	27.238	29.936	29.911	12.915
2005	36.912	32.410	22.954	7.723	27.050	29.981	30.203	12.767
2006	35.265	32.482	25.182	7.070	27.097	29.001	31.133	12.768
2007	33.975	32.059	27.556	6.410	27.082	28.840	31.269	12.808
2008	37.330	29.546	27.250	5.874	26.770	29.852	30.489	12.889
2009	39.314	27.208	27.810	5.668	25.583	29.294	32.441	12.681
2010	40.960	26.639	27.304	5.096	25.771	29.985	31.893	12.351
2011	42.558	26.151	26.606	4.685	25.492	29.713	32.127	12.668
2012	43.232	25.257	26.700	4.810	26.062	28.394	32.957	12.586
2013	42.551	25.188	27.401	4.860	26.243	28.715	32.558	12.484
2014	42.382	24.405	28.284	4.928	25.999	28.525	33.019	12.458

Source: Author's calculation based on WIOTs.

Figure 1 Export Value Added of Service Trade between China and US during 2000-2014 (unit: billion dollars)



Source: Author's calculation based on WIOTs.

From the perspective of changing trends, the capital intensive and health, education intensive service sectors show a decrease trend in China (from 32.4 percent to 24.4 percent and from 8.2 percent to 4.9 percent respectively), while the percentage of knowledge intensive shows a significant increasing trend, specifically from 20.585 per cent in 2000 to 28.284 per cent in 2014. Labor intensive exports keep increasing during 2000-2014 to account for 42.4 percent of China's service exports in 2014. Just as with merchandise exports, China's service exports are still heavily reliant on labor intensive services industries. The growth of labor-intensive service exports does signify improvements in service quality and speed in these sectors. The other positive finding from Table 4 is that knowledge intensive service industries show a significant increase trend. It is noteworthy that China should pay more attention to improve the competitiveness of knowledge intensive industries in the global value chain so as to optimize China's service industry structures.

In contrast to China's experience, the percentage of US's labor-intensive service exports show a downward trend. In addition, there is an

inverse V-shape trend for US capital intensive service exports, with its percentage share almost unchanged between years 2000 and 2014. Between China and the US, the export rate of China's capital-intensive services was higher than that of the US, but this was reversed in the last seven years. US' knowledge intensive exports grew monotonically during the entire period, and it is the biggest contributor to US service exports. It seems clear that the high value-added service exports like those that are knowledge intensive is the new index to measure each country's service trade competitiveness. That the ICT industry is mobile across countries gives countries like China hope in achieving rapid catch-up in knowledge intensive service exports.

The export share of China's human health, education and public services show a downward trend from 2000 to 2014, in contrast to the US where the share remains at around 13 per cent. Since the export share of human health, education and public services are relatively small, the differences in competitiveness have not had too much influence on the countries' service export structure. Still, promoting the competitiveness of human health, education and public services can enhance the development quality of China's service industry and its exports.

As a final basis for comparison, Table 4 shows that in areas where China has an RCA edge, i.e. labor-intensive service exports, its share of value added in gross export value is consistently higher than for the US. In terms of capital-intensive service exports, while China had the upper hand with respect to the share of value added early on, it was overtaken by the US by 2008, with the US superior thereafter. The US is also consistently superior in terms of the value-added share when it comes to knowledge intensive service exports. It is also superior for the health and education service exports. With the US ahead in all except labor intensive service exports, the advantage of the US in service exports is manifestly clear.

6. Conclusion

Estimating RCAs from forward linkage value added exports using WIOD data from 2000 to 2014, this study came to the overall conclusion that China's service exports have at most weak comparative advantage compared to those from the US. For specific sectors, the RCAs of China's service exports are higher than those for the US in construction, wholesale and retail trade, accommodation and food service activities, arts, entertainment and recreation. China's RCAs in other service sectors are significantly lower than those for US. Furthermore, the RCAs of transportation and storage, accommodation and food service activities, information and communication, education, human health and social work activities, arts, entertainment and recreation show a downward trend. In terms of trade structure, China is dominated by labor and resource intensive service exports, while US relies heavily on knowledge intensive service exports. China's service exports have a long way to go before they can catch up on competitiveness with their trading partners in services. However, a positive development is the rising share of China's knowledge intensive service exports as a clear indicator of catch-up higher global value chain.

This study has important policy implications for China's industrial upgrading brought about by the development of the service industry and also for service exports. Understanding the comparative advantage of China's service industry would help promote the service industry and its exports. This will involve firstly changing the direction of exports from labor intensive to knowledge intensive. Second, it is important to realize that individual service sectors are not functioning in parallel but rather self-reinforcing. For example, strengthening investment in higher education would upgrade service quality and other capabilities. Third, further expanding the open strategies of "going out" and "bringing in"

will promote the competitiveness of knowledge intensive industries while also expand capital-intensive service exports. Meanwhile, "bringing in" refers to relaxation of foreign investment in China's service industry under the establishment of a sound supervision mechanism.

As a final footnote, and in the context of the ongoing trade war between China and the US, service trade can provide an additional instrument which China can use against the US. By importing services from alternative countries to the US or by curbing service imports, China can adversely affect US export receipts. It remains to be seen if China will resort to this strategy should the conflict deteriorates. The limitation for this study is the outdated data and future research should focus on applying other methods to calculate one country's competitiveness using the value-added data.

Notes

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