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Does Net Sophistication of Service Export Increase the Value-Added Rate of Manufacturing Exports?
——*Empirical Evidence from Input-Output Analysis of 42 Countries*

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ABSTRACT
In order to accurately explore the impact of domestic technology contained in service exports, this article calculates the net technology export complexity of service industries in each country and the export domestic value-added rate of the manufacturing industry, based on the input-output data of 42 countries from 2001 to 2014, excluding the foreign contribution of service industry and manufacturing exports. Afterwards conducting the empirical research by using panel data, the result shows that the domestic technology content of service exports of 42 countries is rising, which plays an important role in improving the vertical specializing rate and decrease the export value-added rate of the manufacturing industry. However, the negative impact of net sophistication of modern services is less than that of traditional services. This negative effect has a greater impact on the medium-tech the manufacturing industry where the production process is standardized. The marginal contribution of this article is to measure the domestic technology content of a country's service industry exports by excluding the impact of foreign imports and intermediate inputs, so as to analyse the impact of service industry export quality on the high-quality development of manufacturing trade.

Keywords: *Service Export, Net Export Sophistication, Manufacture Industry, Export Value -Added Rate*

1. INTRODUCTION

Nowadays the world is undergoing unprecedented changes, the international environment is gradually becoming more complex, and the outbreak of the COVID-19 outbreak in 2020 has significantly increased uncertainty and instability. To cope with the great changes, the central government has put forward a new development pattern of accelerating the domestic cycle as the main body and mutually promoting the domestic and international double cycles. The key to promoting the double cycle of China's economy is to consolidate or strengthen China's position in the global value chain, which requires increasing the domestic added value of China's exports. Related research believes that the service industry imports the advanced factors of production, such as technology, information, and human capital into the production process of manufactured goods in the form of fly-wheels [3]. So the domestic value-added of manufactured goods exports is indirectly determined by the service industry (and wood letter, 1990), and the key to enhancing the domestic value-added of manufacturing exports lies in the service industry.

The service industry of China is developing steadily and improving. In 2019, the added value of the tertiary industry was 53423.3 billion yuan, an increase of 6.9%, accounting for 53.9% of GDP. At the same time, the total trade volume in the service industry was 5,415.3 billion yuan, an increase of 2.8% over the previous year. Among them, exports of 1956.4 billion yuan has account for an increase of 8.9%. According to statistics from the World Bank, the proportion of world service trade in the world's gross national product has also risen from 6.76% in 1985 to 12.99% in 2018. The growth rate of trade in services not only exceeds the growth rate of global GDP, but also faster than the growth rate of trade in goods, especially in transition economies and developing countries.

Under the conditions of opening up, with the deepening integration and development of service industries and manufacturing industries ,National manufacturing export products include domestic and foreign added value that contribute to domestic factors, On the one hand, the service industry exports have domestic technology content, and on the other hand, they also contain foreign technology content due to the import of intermediate goods and services from other countries.. Logically, there is the possibility that the export technology content of a country's service industry is overestimated because of imports of intermediate goods and services. Therefore, from the perspective of the domestic technology content, we can accurately grasp the actual technical level of a country's service industry exports, and analyze its impact on the domestic value-added rate of manufacturing exports. It is significant for countries around the world especially China" to promote the integrated development of manufacturing and modern service industries, accelerating the construction of a manufacturing power".

2. LITERATURE REVIEW

2.1. Research on the Technical Complexity of the Service Industry Export and the Content of Domestic Technology in Export

The complexity of export technology was first proposed by Rodrik (2006) and Hausmann et al. (2007). This index is widely used to reflect the technological level of a country's export products. It is based on the theory of comparative advantage that the higher the level of technology and wages is, the easier it to produce and export products with high technological complexity. Compared to the position index and location index in the Global Value Chain (GVC), Wu Xianfu (2019) believes that the export technology complexity index [4] has lower requirements for measuring data and can be performed using trade data, macroeconomic variables, and input-output models. With the development of service economy and service trade, Dong Tingqing (2010) and other scholars began to use the concept of export technology complexity into the field of trade in services [5], Dai Xiang (2012) believes that there is a big gap between the complexity of export technology and the complexity of import technology of China's service industry and developed countries [6]. Although the tradability of the service industry is relatively low compared to the manufacturing industry, it is also embedded in the global value chain through segmented production to a certain extent. However, as the WTO (2019) pointed out, exports of services depend heavily on domestic supply-side capacity, with domestic services accounting for 81 percent of exports and imports of services accounting for 9 percent of exports [7]. Thus, it is necessary to exclude the direct and indirect technical contributions produced by imported intermediate products in the production process when reflecting the domestic technological content of service industry exports or the net technological complexity of exports. However, in a large number of studies on the technical complexity of service exports, the influence of foreign intermediate inputs including service imports has not been considered. Therefore, there are relatively few studies on the net technical complexity of service exports.

2.2. Research on the Domestic Value-added Rate of Manufacturing Exports

The export domestic value-added rate is an indicator that measures the profitability of a country or region from participating in international trade and the development of trade. The factors affecting the domestic value-added rate of exports include two aspects: one is the characteristic factors of the enterprise at the micro-level. Bai Dongbei (2019a) found that entrepreneurial activities affect the export domestic value-added rate of enterprises through two channels, such as the rate of increase and price substitution effect [8]. Bai Dongbei et al. (2019b) believe that technological innovation of enterprises can improve the domestic value-added rate of exports by increasing the relative price and quality of imported intermediates [9]. The second is the impact of environmental characteristics in the context of value chain theory. For example, Ma Hong (2018), Jiang Yue et al. (2018) paid attention to the relationship between the openness of service trade and the domestic value added of exports[10][11]. Peng Dongdong et al. (2016) attach importance to the liberalization of trade in intermediate products [12]. Shao Yuchen et al. (2017) noted the impact of regional financial development and financing constraints[13].To note the impact of regional financial development and financing constraints, Gao Xiang (2018) and Lv Yue (2018) examined the impact of factor market distortions and market segmentation [14][15], respectively. Gong Jing (2019) explored from the perspective of the manufacturing servitization [16], and believed that the servitization of the manufacturing industry increased the export value-added rate through the dual effects of technology spillover and productivity. Provides ideas and foundation for the research of this article, but there are

few kinds of literatures to study from the perspective of the domestic technical content of service industry exports. From the aspect of the net technical complexity of the service industry export, this article promotes the development of the manufacturing industry by improving the development quality of the service industry, so that the two are continuously integrated and interactively upgraded.

Current research on the complexity of net exports is mainly focused on manufacturing, but there is also the possibility that the domestic technological content of services exports is overestimated because of the use of import inputs. In recent years, the overall export of services and services under the sub-sectors of domestic technology content change trend. Compared with the rest of the world, China's service industry in the overall and sub-sectors of the characteristics of the key questions we should answer this article. Under the framework of how the quality improvement of the service industry promotes the quality upgrading of the manufacturing industry, this paper uses panel data to conduct an empirical study on the domestic technology content of service industry exports and the domestic value-added rate of manufacturing exports.

3. THE IMPACT OF NET TECHNICAL COMPLEXITY OF SERVICE INDUSTRY EXPORT ON THE DOMESTIC VALUE-ADDED RATE OF MANUFACTURING EXPORTS: MECHANISM ANALYSIS

The heterogeneous firm trade theory points out that the firm with the lowest marginal production cost has a selection effect, meaning that it can choose to enter the international market. Although the export of service industry does not have a direct forward link spillover effect on the domestic the manufacturing industry, the technical elements of export enterprises in the same industry will spread to non-export enterprises due to competition, imitation, factor flow, and resource reallocation, so that the overall technical content of the service industry will rise. The service companies dominated by the domestic market spill over to the industrial sector through the vertical input-output relationship with the manufacturing industry. Therefore, the export of the service industry will affect the manufacturing industry through a certain transmission mechanism.

3.1. The Impact Mechanism of the Domestic Technology Content of Service Industry Exports on the Overall Technology Level of the Service Industry

Gu Guoda et al. (2017) believe that the main method of export trade technology spillover is the horizontal link spillover between service export companies and non-export companies [17], and the conduction effects between them include:

(1) The imitation effect of non-exporting enterprises in the service industry. Export-oriented companies are often the companies with the lowest marginal costs or the highest productivity. to cope with the fierce competition in the international market, export-oriented companies often continuously improve their technological level through the introduction and independent R&D and innovation, accumulate management experience, and improve international competitiveness , which has played an exemplary role for non-export enterprises;

(2) The competitive effect within the industry. While introducing advanced technology and driving the rapid development of the whole industry, the export enterprises in the service industry have also intensified the competition within the industry. Low-productivity companies at the marginal shutdown point withdraw from the export market, and factors flow into higher-productivity manufacturers, which has increased the overall productivity of the industry in the export market;

(3) The flow effects of human capital among enterprises. As a service provider, the labor force often has high human capital, and the knowledge spillover generated by the flow of labor between enterprises has an important impact on the improvement of service industry productivity. With the flow of labor in the service industry among heterogeneous enterprises, the technology of high-productivity enterprises will overflow to low-productivity enterprises;

(4) The resource reconfiguration effect between service departments. Export activities encourage enterprises with higher productivity to expand, while enterprises with lower productivity shrink. Resources will flow from low-productivity enterprises and will be re-allocated to high- productivity service enterprises. Their production efficiency and technical level will be further improved and the production efficiency of the overall industry has also been improved.

3.2. The Impact Mechanism of Service Industry Technology Level on Manufacturing Export value-added Rate

After the export enterprises of the service industry drive the overall productivity and technological

content of the service industry to improve, the mechanism of the service industry for the manufacturing sector is achieved by the following means:

(1) The development of the service industry promotes the deepening of partial labor in the manufacturing industry. The Jones model shows that the fragmented production layout and vertical specialization of the manufacturing industry benefit from the development of the service industry and the reduction of service costs. In addition, this deepening of the division of labor can further reduce the production cost of the manufacturing industry and improve its production efficiency;

(2) The economies of scale in the service industry lead to an increase in the production efficiency of the manufacturing industry. The level of specialization is often positively correlated with the production scale or market capacity of an enterprise. After opening up to the international market, the domestic service industry can make better use of economies of scale due to market expansion, and the average productivity of the industry has increased, which ultimately promotes the improvement of production efficiency in the manufacturing sector. Using panel data at the urban level in China, Gu Naihua (2011) supports the cluster of service companies and economies of scale to increase productivity in the manufacturing sector [18];

(3) The spillover effect of technology content in the service industry on the manufacturing industry. The producer service industry is an intermediate input in the manufacturing industry, which has the characteristics of knowledge-intensive, technology-intensive and other factors. So in the process of participating in the division of labor and production, the production efficiency of the manufacturing industry is also put forward higher requirements. It contained technology, knowledge and other spillover into the manufacturing industry to improve the production efficiency of the manufacturing industry.

It is necessary to do empirical analysis to find whether the improvement of manufacturing productivity increases with the international competitiveness makes the domestic value-added rate of domestic exports increase, or makes the domestic the manufacturing industry integrate more closely in the global value chain to reduce the domestic value-added rate of domestic exports. Based on this, the following assumptions are put forward：

Hypothesis 1: There is a positive correlation between the net technical complexity of services exports and manufacturing export value-added rate.

Hypothesis 2: The net technical complexity of service industry exports will increase the vertical specialization rate and reduce the export value-added rate of the manufacturing industry. The two are inversely related to each other.

4. THE IMPACT OF THE NET TECHNICAL COMPLEXITY OF SERVICES EXPORTS ON THE DOMESTIC VALUE-ADDED RATE OF MANUFACTURING EXPORTS：EMPIRICAL TEST

4.1. Variable Selection and Model Setting

The impact of the net technical complexity of services exports on the value-added rate of manufacturing exports is modelled as follows:

$$DVS_{it} = \beta_0 + \beta_1 lnDTC_{it} + \beta_2 lnFDI_{it} + \beta_3 RD_{it} + \beta_4 GFC_{it} + \beta_5 EXIMP_{it} + u_i + \varepsilon_{it} \quad (1)$$

Among them, DVS it represents the domestic value-added rate of each country's the manufacturing industry, DTC_{it} represents the net domestic technological complexity of service exports in different countries, u_i represents the individual effect, and ε_{it} represents the perturbation item. i represents the country, t represents the year.

Based on the relevant research, the following indicators are selected as the control variables of the model: (1) Foreign Direct Investment (FDI). Tang Yihong (2017) analyzed the mechanism of FDI ’s impact on domestic value-added exports [19] and found that on the one hand , FDI locked the host country’s manufacturing division at the low end through global value chain embeddings, hindering the increase in export value-added, on the other hand, Through the expansion of internal connections and enterprises' demand for labor and the spillover of knowledge and technology, the added value of domestic exports of a country's the manufacturing industry can be increased. In this paper, the inflow of foreign direct investment in the sample period is taken as an index; (2) Trade openness (EXIMP).

Table 1 Descriptive statistics of control variables

Control variable	Observations	Average value	Standard deviation	Minimum	Max	Median
lnFDI	588	8.308	3.813	-11.088	12.632	9.118
RD	588	1.504	0.935	0.045	4.288	1.288
GFC	588	23.429	5.0873	11.544	45.514	22.412
EXIMP	588	93.290	59.0308	19.798	392.804	77.953

Source: UNCTAD STAT database, World Bank WDI data

This paper uses the proportion of a country's total imports and exports to GDP as a proxy variable, the higher the proportion, the higher the degree of trade openness. This includes the opening of trade in final products, intermediate products and services. When discussing the liberalization of trade in intermediate goods and the added value of export trade, Peng Dongdong et al. (2016) pointed out [12] that the liberalization of trade in intermediate goods reduces the import cost of intermediate goods and also reduces the domestic value-added rate. However, considering the differential tariff treatment of China's processing trade and general trade, the liberalization of intermediate goods trade may reduce the import cost of general trade with a relatively high domestic value-added rate, and increase the domestic value-added rate of China's exports as a whole. Ma Hong (2018) proposed that the degree of service trade openness may affect the domestic value-added rate of exports through direct substitution effects and implicit trade effects [10]. The direct substitution effect means that when domestic services, have price advantages due to competition especially for the productive services, , manufacturers will use domestic purchases instead of foreign service purchases provided by cross-border delivery to increase the domestic value-added rate; The implied trade effect means that when the trade of service products is restricted, manufacturers will replace service imports with the import of service-intensive intermediate products, which will also reduce the domestic value-added rate of exports; (3) Capital accumulation ratio (GFC) . This article uses the ratio of fixed capital formation to GDP to represent the capital accumulation ratio. (4) Research and innovation capability (R D). This article uses the proportion of a country's R&D expenditure to GDP as an indicator of R&D innovation capability. Gu Guoda (2017) believes that a country's fixed capital accumulation ratio and research and development innovation ability both contribute to the improvement of domestic manufacturing productivity, thereby changing the relative competitive position of domestic manufacturing throughout the value chain and making exporters more inclined to replace imports with domestic production, thereby increasing the domestic value-added rate of manufacturing. The measurement data of the above four indicators come from the WDI database of UNCTAD and the World Bank.

Table 1 shows the descriptive statistics of each control variable.

4.2. Measurement of Net Technical Complexity of Service Industry Exports and Domestic Value-added Rate of Manufacturing Exports

(1) Net technical complexity of services exports. If intermediate inputs are not excluded, the calculation formula for the technical complexity TSI_k measurement of a country's export of services is:

$$TSI_K = \sum \frac{X_{KS}}{X_K} * PRODY_S = \sum \frac{X_{KS}}{X_K} * \sum_K \frac{x_{ks} / X_k}{\sum_K (x_{ks} / X_k)} Y_k \quad (2)$$

In formula 2, k refers to the country,s refers to the service industry, x_{sk} refers to the export volume of service, X_k, Y_k represent the regression parameters the total exports of all service industries in country k and the GDP per capita in this country respectively

In order to eliminate the impact of imported intermediate input services on the technical complexity of service exports, we refer to Song Zhijie's research (2018) and use the vertical specialization index to revise the export value of services from various countries [20].Vertical specialization is an intermediate input that measures imports from other countries that are included in a country's exports, and the ratio of vertical specialization to total exports is:

$$VSS \equiv \frac{VS_k}{X_k} = \frac{\sum_s VS_{ks}}{\sum_s X_{ks}} = \frac{\sum_s (VS_{ks}/X_{ks}) * X_{ks}}{\sum_s X_{ks}} = \sum_s [(\frac{X_{ks}}{X_k})(\frac{VS_{ks}}{X_{ks}})] \quad (3)$$

Data such as import inputs, domestic inputs and exports at the industry level can be obtained from non-competitive input-output tables. At the same time, the direct consumption of imported intermediate inputs and the complete consumption coefficient of exported

products can also be obtained. Accordingly, formula 3 can be transformed into the following formula 4.

$$VSS = \frac{VS_k}{X_k} = u\,A^M X_{ks}/X_k = u\,A^M[I - A^D]^{-1}X_{ks}/X_k \quad (4)$$

Among them, u refers to a (1×n)-dimensional vector whose elements are 1, X_{ks} refers to the (n×1)-dimensional export vector of s sectors in k countries , A^M refers to the imported intermediate product coefficient matrix, A^D refers to the domestic Direct Consumption Coefficient Matrix.Hummels et.al （2001） believes that the calculation formula applies both product trade and service trade.

Liu Zunyi (2007) pointed out that the domestic value-added coefficient of a country's export products can be obtained by subtracting the vertical professional index (VSS) from 1 [21].Now use the domestic value-added coefficient to get the revised export technology complexity NTSI:

$$NTSI = \sum_s \frac{(1-vss_{ks})x_{ks}}{\sum_s (1-vss_{ks})x_{ks}} * NPRODY_s \quad (5)$$

$$NPRODY_s = \sum_k \frac{(1-vss_{ks})x_{ks}/\sum_s (1-vss_{ks})x_{ks}}{\sum_k [(1-vss_{ks})x_{ks}/\sum_s (1-vss_{ks})x_{ks}]} * Y_k \quad (6)$$

The domestic technical content of service exports includes two service sectors, one is the sector that provides intermediate services directly and the other is the technical level of other service sectors that provide intermediate services, and the formula for calculating the domestic technical content of a country's s sector:

$$DTC_{sk} = \sum_u b_{su}^D \times NPRODY_u + a_v^s \times NPRODY_s \quad (7)$$

b_{su}^D represents the complete consumption coefficient of the intermediate services provided by the domestic sector s to the u sector,a_v^s represents the direct value-added coefficient of the domestic sector s, where

$$b_{su}^D = \ (E - a_s)^{-1} - E \quad DTC_k = \sum_s e_{sk} \times DTC_{sk} \quad (8)$$

Afterwards, in order to obtain the net technical complexity of service industry exports at the national level(DTC) , then we take the export proportion (e_{sk}) of the s sector in country k as the weight and perform a weighted average of 12 service industries, as shown in Formula 8 .

(2) Measurement of the domestic value-added rate of manufacturing exports. Hummels et al. (2001)were the first scholars who began to use the input-output table to measure the foreign value of a country's export products. He proposed a vertical specialization index measure (VSS), represents intermediate inputs to imports included in a country's export products. After rigorous derivation and calculation, Liu Zunyi (2007) pointed out that the domestic value-added coefficient of a country's export products can be obtained by subtracting the vertical professional index (VSS) from 1 [21], and the domestic value-added can be used to measure the economic benefits a country obtains from participating in the global division of labor. However, due to the particularity of processing trade, the Hummels-based calculation method for VSS will bias the calculation of VSS in developing countries with a large amount of processing trade. Koopman (2008) distinguishes between processing trade and general trade. This paper draws on this calculation method, removes the influence of import intermediate input on export products according to the non-competitive input-output table of each country, and calculates the domestic value-added rate of each department's export. Finally, we get the DVS of the domestic value-added rate of exports of the manufacturing industries of various countries.

(3) Net technical complexity of services exports and manufacturing export value-added rate: statistical comparison. Select 42 countries except Taiwan, China,12 services sector,18 type of manufacturing. The time span is 2001-2014. The total service exports of 42 countries account for 80% of the total global service exports. The per capita GDP data of each country comes from the World Bank database. According to the above method, the net technical complexity of service industry exports and the value-added rate of manufacturing exports of 42 countries from 2001 to 2014 are calculated, as shown in Table 2.

In general, the net technical complexity of the overall service industry exports of the 42 countries during the sample period showed an upward trend, with a marked decline in 2009-2012, mainly due to the impact of the financial crisis. The major exporters of service trade, such as the United States, the United Kingdom, Germany, France, Italy, and developed economies such as Australia and Canada, all have relatively high net technical complexity in service exports. Chinese net exports of technical complexity of the service sector increased significantly from 42nd place in 2001 to 22nd place in 2014, at a moderate level.

The export value-added rate of manufacturing in the 42 countries in the sample period showed an overall downward trend, which partly reflects the fact that countries are deepening their integration into

Table 2. Descriptive statistics of 42 countries' service industry export net technical complexity and manufacturing export value-added rate

Year	Number of samples	Average value	Max	Minimum	Median	Standard deviation	Year	Number of samples	Average value	Max	Minimum	Median
Service export domestic technical content							Value added rate of manufacturing exports					
2001	42	12833	15534	10216	12773	1261	2001	42	0.688	0.889	0.453	0.69
2002	42	13934	16850	11256	13681	1380	2002	42	0.693	0.886	0.465	0.691
2003	42	16747	20577	13882	16527	1654	2003	42	0.689	0.882	0.455	0.692
2004	42	19185	23772	16390	18913	1899	2004	42	0.673	0.886	0.411	0.683
2005	42	20370	25311	17137	19758	2015	2005	42	0.661	0.881	0.422	0.672
2006	42	21740	27252	17312	21552	2267	2006	42	0.644	0.888	0.375	0.657
2007	42	24961	30765	19178	24982	2507	2007	42	0.645	0.9	0.417	0.658
2008	42	27246	33193	19519	26981	2727	2008	42	0.632	0.898	0.372	0.634
2009	42	24827	29899	16892	24312	2449	2009	42	0.662	0.91	0.37	0.676
2010	42	25491	30722	17633	25203	2501	2010	42	0.63	0.913	0.336	0.638
2011	42	27918	33963	19686	27574	2798	2011	42	0.611	0.91	0.333	0.607
2012	42	26683	32565	19113	26839	2735	2012	42	0.608	0.905	0.356	0.595
2013	42	27620	33601	20894	27621	2748	2013	42	0.611	0.894	0.346	0.609
2014	42	28013	33615	22048	28277	2702	2014	42	0.614	0.88	0.341	0.616

Source: Calculated based on data in the WIOD database and the World Bank WDI database.

global value chains, thus reducing the domestic value-added rate. Developed economies such as the United States, Japan and the BRICS countries, including China, India, Russia and Brazil, have higher value-added rates for manufacturing exports (0.7), while transition economies such as Estonia and Slovakia and smaller economies such as Luxembourg and Malta have lower value-added rates for manufacturing exports (0.4). Overall, the average of developed economies is higher than that of developing economies. China's figures did not change significantly and were consistently among the 42 countries with higher export value-added rates.

4.3. Benchmark Regression Results

In order to eliminate the endogeneity of the model, we adopted the 2SLS estimation method. Empirical results such as Table 3 show that the impact of net technical complexity of services exports is significant and negative, indicating that the increase in net technical complexity of services exports significantly promoted the verticalization of the manufacturing industry, and was better able to promote the integration of domestic manufacturing into global value chains, reducing the domestic value-added rate of domestic exports. Among other control variables, the ratio of foreign direct investment and capital accumulation attracted by a country has a significant effect on the increase of the domestic value-added rate of manufacturing exports, while the higher the degree of openness of a country, the deeper the degree of integration into the global value chain, the value-added rate of exports will decrease.

The service industry not only plays the role of "service chain" in the global value chain, but also plays an important role in the value-added of the manufacturing industry from R&D, design, human resource training to final marketing, after-sales service. The higher the net technical complexity of services exports to China, the more capable it is of providing high-quality or low-cost services to domestic manufacturing. In this way, as Jones (2011) points out, the optimization of intermediate inputs has increased the efficiency of cross-industry and cross-border allocation of capital and labor [22]. The efficiency will increase the domestic value-added rate of the country,

or further integrates into the global value chain due to the strengthening of the international competitiveness of the country's manufacturing export link, which reduces the domestic value-added rate of the country. From the results of the benchmark regression, the current increase in the net technical Judging from the results of benchmark regression, the improvement of the net technical complexity of the service industry is mainly to better promote the division of labor in the global value chain of the manufacturing industry in various countries.

Table 3. Regression results of the empirical model of the net technical complexity of service exports

	(1)DVS	(2)DVS	(3)DVS
lnDTC	-0.0838*** (-11.93)	-0.123** (-2.37)	-0.0990* (-1.73)
lnFDI	0.00301** (2.33)	0.00350*** (2.71)	0.00310** (2.45)
RD	-0.00771 (-1.18)	0.00346 (0.60)	-0.00570 (-0.86)
GFC	0.00184*** (4.18)	0.00156*** (3.36)	0.00183*** (3.91)
EXIMP	-0.00100*** (-9.85)	-0.00112*** (-9.68)	-0.000815*** (-5.77)
Country fixed effect	YES	NO	YES
Time fixed effect	NO	YES	YES
Constant	1.516*** (24.04)	1.911*** (3.56)	1.650*** (2.78)
N	546	546	546
R^2	0.573	0.606	0.611

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

5. IMPACT OF NET TECHNICAL COMPLEXITY OF SERVICES EXPORTS ON DOMESTIC VALUE-ADDED RATES OF MANUFACTURING EXPORTS: HETEROGENEITY ANALYSIS

5.1. Divide the Service Industry into Traditional Service Industry and Modern Service Industry

There are large gaps in the knowledge level and technical content of different service sectors, which will have different degrees of impact on the quality of the manufacturing industry. Refer to Dai Xiang's classification of trade in services, We measured the domestic technology content of traditional service export and modern service export, and used the net technical complexity of their exports as core explanatory variables to perform empirical regression with the manufacturing export value-added rate. The comparison of regression results is shown in Table 4, where lnTRA is the natural number of net technical complexity of traditional services exports and lnMOR is the natural number of net technical complexity of modern services exports. The difference in the role of the traditional service industry and the modern service industry is investigated by setting dummy variables.

The results show that the net technical complexity of traditional and modern service exports has the same effect on the value-added rate of manufacturing exports. But the degree of influence is different. They have led to the deepening of vertical specialization of manufacturing and deeper integration into the value chain. With the increase of foreign value-added, the domestic value-added rate has decreased. However, compared with the modern emerging service industry, the degree of vertical specialization caused by traditional service industries is even greater. The traditional service industry contains relatively low knowledge, technology and other factors, more in favor of the lower level of technology, but the role of advantageous manufacturing export companies' integration into the global value chain is more obvious. Jones (1990) shows that the decline in service costs has significantly led to a vertically specialized division of labor in manufacturing, while wholesale and retail, transport and storage in traditional services are the most typical chains of services linking different production segments [23].

5.2. Divide Manufacturing into High, Medium and Low Technology

According to the OECD 's assessment of the R&D input content of various manufacturing sectors, combined with the classification standards of the National Bureau of Statistics of the high-tech industry (manufacturing), we divide the 18 manufacturing sectors in the WIOD input-output table into three categories: high technology industry sector (C20 , C21 , C26 , C27 , C28 , C29 , C30), medium technology industry sector (C19 , C22 , C23 , C24 , C25, and low technology industry sector (C10-C12 , C13-C15 , C16 , C17) , C18 , C31-C32). The descriptive statistics of the domestic export domestic value-added rate of the three technology categories of manufacturing are shown in Table 5. The low-tech manufacturing sector has the highest average value of the export domestic value-added rate, and the high-tech level The average value of the export domestic value-added rate of the manufacturing sector is relatively low, indicating that the export domestic value-added value of high-tech products is concentrated in a few developed countries.

Table 4. Heterogeneity analysis: comparison of group regression results between traditional service industry and modern service industry

DVS(1)		DVS(2)		DVS(3)	
lnTRA	-0.0847***	*lnMOD*	-0.0923***	*lnDTC*	-0.0888***
	(-12.03)		(-10.17)		(-14.00)
lnFDI	0.00280**	*lnFDI*	0.00323**	*lnFDI*	0.00301***
	-2.18		-2.34		-3.2
RD	-0.00686	*RD*	-0.00783	*RD*	-0.00713
	(-1.05)		(-1.10)		(-1.45)
GFC	0.00167***	*GFC*	0.00197***	*GFC*	0.00182***
	-3.82		-4.13		-5.63
EXIMP	-0.000972***	*EXIMP*	-0.000982***	*EXIMP*	-0.000974***
	(-9.50)		(-8.82)		(-12.65)
lnMOD	Dum MOD	*lnTRA*	Dum MOD	*Dum MOD*	0.0158***
					-7.92
Constant term	1.520***	Constant term	1.603***	Constant term	1.556***
	-24.16		-19.66		-27.93
N	546	*N*	546	*N*	1092
R^2	0.574	R^2	0.51	R^2	0.526

Note: Standard errors are in parentheses, * p < 0.1, ** p < 0.05, *** p < 0.01

Table 6 shows the empirical regression results between the net technical complexity of service industry exports and the export value-added rate of each group of manufacturing industries. First of all, we can find that the net technical complexity of service industry exports shows a significant negative relationship with the export value-added rate of low, medium and high-tech industrial sectors. Specifically, for every 1 percent increase in the domestic technology content of service exports, the value-added rates of domestic exports in the low, medium and high-tech sectors will be reduced by about 0.037 percent, 0.105 percent and 0.068 percent, respectively. By taking the low-tech industry sector as the reference group, it can be seen that the net technical complexity of service exports has the greatest impact on the export domestic value-added rate of the medium-tech sector. Freund (2016) points out that the production processes in the global value chain sector are more standardized than in the high-tech and low-tech manufacturing sectors [24]. Participating in vertical specialization is based on economies of scale and comparative advantage, and comparative advantage has not changed much. With the rapid development of the global service industry, especially the producer service industry, the manufacturing industry is more susceptible to the influence of the service industry

when fully integrated into the global value chain and the division of labor. Relatively speaking, the domestic technology content of service exports has a relatively small impact on the value-added rate of low-tech and high-tech manufacturing industry. The possible reason is that the comparative advantage of high-tech manufacturing does not come from economies of scale or learning effects. It comes more from monopoly ownership advantages such as patents and advanced production factors. The comparative advantage of being classified as a low-tech manufacturing industry relies more on natural resources, although the increase in the domestic technology content of service exports will enable more developing countries to participate in the global division of labor between these two types of

Table 5. Descriptive statistics of the export value-added rate of low, medium and high-tech manufacturing sectors

	Number of samples	average value	Standard deviation	Minimum	median	Max
Low-tech manufacturing value-added rate	588	0.734	0.102	0.386	0.739	0.914
Mid-tech manufacturing value-added rate	588	0.608	0.137	0.260	0.607	0.937
High-tech manufacturing value-added rate	588	0.636	0.127	0.300	0.654	0.892

Table 6. Heterogeneity analysis: the impact on the export value-added rate of manufacturing at different technological levels

	(1) Low-tech sector DVS	(2) Medium technical sector DVS	(3) High-tech department DVS	(4) DVS	
lnDTC	-0.0365*** (-10.90)	-0.105*** (-21.45)	-0.0684*** (-15.59)	*lnDTC*	-0.0701*** (-7.88)
lnFDI	-0.000121 (-0.20)	0.00199** (2.21)	0.00327*** (4.05)	*lnFDI*	0.00171 (1.05)
RD	-0.0176*** (-5.68)	-0.00964** (-2.12)	-0.00994** (-2.44)	*RD*	-0.0124 (-1.51)
GFC	0.000965*** (4.60)	0.00166*** (5.40)	0.000929*** (3.38)	*GFC*	0.00118** (2.13)
EXIMP	-0.000666*** (-13.73)	-0.00150*** (-21.11)	-0.000703*** (-11.06)	*EXIMP*	-0.000956*** (-7.43)
				Dum middle	-0.128*** (-36.62)
				Dum high	-0.0988*** (-28.17)
Constant term	1.166*** (38.80)	1.756*** (39.84)	1.344*** (34.11)	Constant term	1.498*** (18.77)
N	546	546	546	*N*	1638
R^2	0.403	0.604	0.392	R^2	0.532

Note: Standard errors are in parentheses, * p < 0.1, ** p < 0.05, *** p < 0.01

manufacturing. The conversion rate has been increased, but it may be locked in processes with lower added value. After all, compared with traditional comparative advantages such as cheap labor, it is more difficult to accumulate and acquire natural resource endowments and advanced production factor endowments.

5.3. Robustness Test

Table 7. Robustness test: GMM estimation

	(1)DVS	(2)DVS	(3)DVS
lnDTC	-0.0838***	-0.0454	-0.0990*
	(-11.99)	(-1.21)	(-1.76)
lnFDI	0.00301**	0.0115***	0.00310**
	(2.34)	(3.81)	(2.49)
RD	-0.00771	0.0119***	-0.00570
	(-1.19)	(3.44)	(-0.87)
GFC	0.00184***	-0.0000771	0.00183***
	(4.20)	(-0.13)	(3.98)
EXIMP	-0.00100***	-0.00161***	-0.000815***
	(-9.90)	(-28.72)	(-5.87)
Country fixed effect	YES	NO	YES
Time fixed effect	NO	YES	YES
Constant term	no	1.107***(2.86)	no
N	546	546	546
R^2	0.573	0.700	0.611

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

Next, we use GMM estimation as a robust test to solve the problem of heterogeneity in the model. The results of the regression in Table 7 still show that the net technical complexity of services exports has a significant negative correlation with the impact of manufacturing export value-added rate.

6. CONCLUSIONS AND POLICY RECOMMENDATIONS

6.1. Conclusions

The marginal contribution of this paper is that the existing literature on service exportquality makes the domestic technical level of service exports overestimated, mostly reflected by the complexity of export technology, withnot excluding the technical content of imported intermediate products. this paper accurately measures the technical complexity of service export net technology by excluding intermediate product. Link with the export value-added rate of the manufacturing industry to test the relationship between the two subjects. It has made a marginal contribution to the research related to the high-quality development of manufacturing trade in high-quality service trade. This paper draws the following conclusions:

1. Drawing on the measurement method of domestic technology content of manufacturing exports, this paper excludes the intermediate input of imports, measures the domestic technology content of service exports from 42 countries between 2001 and 2014, and finds that the domestic technology content of service exports from these countries has shown an overall upward trend, which has decreased in 2009-2012 due to the impact of the 2008 financial crisis, and the gap between 42 countries' service exports has widened. China rose from 42nd in 2001 to 22nd in 2014, and the domestic technology content of some service industries grew faster, such as wholesale and retail services, but there is still a lot of room for improvement in the overall level.

2. The results of the calculation of the domestic value-added rate of manufacturing exports in 42 countries show that all countries are more fully integrated into the division of labor in the global value chain, and with the rise of the vertical specialization

index, the domestic value-added rate of exports is on a downward trend. The higher the level of economic development is, the higher the domestic value-added rate of manufacturing exports is. China has risen from 42nd in 2001 to 22nd in 2014. The export and domestic technology content of some service industries has grown rapidly, such as wholesale and retail services, but there is still much room for improvement in the overall level.

3. The improvement of domestic technology content of service exports first spills over to the overall service industry through the horizontal link with non-export service enterprises, and then through vertical link to the manufacturing sector, and by improving the productivity of the manufacturing industry, on the one hand, it may increase the domestic value-added rate of manufacturing exports, but may also be more deeply integrated into the global value chain division of labor, resulting in a decline in the export value-added rate along with the rise in the vertical specialization rate.

4. Empirical studies show that the increase in domestic technology content of service exports will reduce the manufacturing exports of domestic value-added rate. Traditional services and modern services have the same direction of influence, while the degree of influence is different. There are differences in the impact of domestic technology content on the value-added rates of manufacturing exports at different technical levels, which promotes the global division of labor in the middle-tech manufacturing industry to a greater extent.

5. Foreign direct investment and fixed capital accumulation have a small positive effect on the value-added rate of manufacturing exports, while the degree of openness of a country has significantly increased its degree of embedding in the global value chain.

6.2. Policy recommendations

The scale of China's service trade continues to grow, with exports ranking fifth in the world, accounting for 4.6% of global service trade exports, however the domestic technology content of its service exports is lower than the average level of 42 countries. Although China is the largest exporter in commodity trade, the domestic export value-added rate of the high-tech manufacturing industry is also low. In order to promote the high-quality development of trade, this paper puts forward the following policy recommendations:

1. While promoting economic openness and continuous integration into the world economy, we strive to form a more complete industrial chain in our country to avoid falling into the "low-end lock-in" of the division of labor in the global value chain. This paper eliminates the impact of import intermediate input in export services and finds that in the context of increasing economic openness, domestic technology for export services has strengthened the integration of Chinese manufacturing in the global value chain, but it has reduced the value-added rate of domestic exports. On the one hand, it reduces China's trade profits. On the other hand, it also makes China more deeply affected when facing production fluctuations in the global industrial chain.

2. Pay attention to the development of the service industry and service trade, particularly given the appropriate policy support for emerging producer services. In the context of the ever-increasing openness of the service industry, service export companies also need to constantly align themselves with multinational service companies that provide services to foreign affiliates and enhance their domestic technology content. In addition, continue to improve the business environment, strengthen the imitation effect, competition effect, and technology spillover effects between the service industry and the manufacturing industry, so as to better improve the export quality of the manufacturing industry.

3. Strengthen fixed capital investment in infrastructure, especially new infrastructure, and improve their utilization efficiency. Fixed capital has a significant positive effect on the three technological levels of manufacturing. The promotion and application of new information technology-based infrastructure such as 5G, artificial intelligence, industrial Internet and Internet of Things can better promote the transformation and upgrade of China's manufacturing industry.

APPRECIATE SUPPORT PROJECTS AS FOLLOWS:

[1] The research of interdisciplinary project An analysis of the motivation of signing the regional trade in services agreement -- Based on the analysis framework of political economy which Support by the East China Normal University of the Fundamental Research Funds for the Central Universities.

[2] Youth project of Shanghai philosophy and social science planning project, (2019EJB003), and the impact of institutional quality on the performance of Listed Companies in China and Shanghai, 2019.

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