FDI-based Producer Services Trade and Domestic Value Added Ratio of the Enterprise’s Export

Abstract: This paper investigates the impact of FDI-based producer services trade on DVAR of the Enterprise’s Export. Using enterprise-level data, the research identifies an inverted U-shaped pattern, where initial engagement in FDI-based producer services enhances DVAR but excessive reliance can be detrimental. This paper also explores the impact of different enterprise types and technological levels within industries on this relationship, revealing that high-technology industries gain more from FDI in services compared to low-technology sectors. The results suggest the need for targeted policies to promote a balanced industrial ecosystem, with a focus on sectors that can boost manufacturing value-added and innovation.

Keywords: FDI; DVAR; Global value chains; Manufacturing enterprises

I. Introduction

Since the 1990s, China has been an active participant in the global value chain (GVC), leveraging its labor force to ascend rapidly as a global economic powerhouse. Despite this, the Chinese manufacturing sector is primarily anchored in lower-value-added segments of the GVC, characterized by slim profit margins and a technological innovation deficit.

According to the "Global Value Chain and China's Trade Value-Added Accounting Report," China's unit export value-added is typically low, with the domestic value-added rate for products exported to developed countries falling below 60%. In the face of rising labor costs and the advancement of 'Industry 4.0' and 'reindustrialization' in developed nations, Chinese manufacturing firms must continuously upgrade to climb the global value chain ladder and maintain their competitive edge. Global manufacturers like Philips and IBM, capitalizing on their vast multinational networks, have outsourced manufacturing processes and focused on high-value-added areas such as R&D design and sales terminal control, integrating into more specialized and sophisticated service chains and transitioning towards service-oriented manufacturing. This transformation serves as an exemplary model for the strategic evolution and enhancement of Chinese manufacturing enterprises. Xuan and Yu (2017) demonstrated that the integration of services into manufacturing aids in technological upgrading of Chinese enterprises; Zhao and Wu (2016) highlighted its role in bolstering export competitiveness and product complexity (Cai & Li, 2017; Chen & Liu, 2016). Liu et al. (2016) found that sericitization not only increases Chinese enterprises' involvement in the GVC but also significantly refines their role within the GVC's labor division.

However, China's producer services industry remains relatively underdeveloped, lacking specialization and high material input efficiency. The availability of high-end services, such as R&D design and information technology, is limited, leading to a low value-added ratio (Cheng, 2008). In this context, relying solely on the development of producer services within the manufacturing sector for upgrading is unlikely to yield substantial short-term results. Compared to China, developed countries, particularly OECD members, have a more advanced producer services sector (Cheng, 2008; Gu & Zhou, 2010). Consequently, leveraging trade in producer services to enhance the domestic manufacturing export enterprises within the GVC appears to be a more viable strategy. This paper utilizes enterprise-level data from China to investigate the influence of producer services trade on the domestic value-added ratio in manufacturing enterprise exports.

II. Literature Review

In recent years, academic discourse has centered on the precise and rational quantification of domestic and foreign value-added within the global value chain (GVC) framework. The current research mainly encompasses two dimensions: the macro-level analysis, which employs the input-output methodology to calculate the domestic and foreign value-added in exports (Hummels et al., 2001; Koopman et al., 2008, 2014); the micro-level analysis, which leverages firm-level data to estimate these value-added components (Upward et al., 2012; Zhang et al., 2013; Lu et al., 2015; Kee & Tang, 2016). The refinement and enhancement of these methodologies have significantly improved the accuracy of accounting for value-added in exports under the GVC framework.

Building upon established methodologies for value-added calculations, scholars have recently shifted their focus to the factors influencing DVAR in manufacturing enterprises' exports. Kee and Tang (2016) have developed a theoretical model to elucidate the mechanisms affecting DVAR at the enterprise level, positing that an increase in the DVAR of manufacturing enterprises' exports is primarily facilitated through two channels: cost markup and the rise in the relative prices of imported intermediate goods. Other scholars have analyzed this from various perspectives, including financing constraints (Lu et al., 2017; Manova & Yu, 2016), trade liberalization (Mao & Xu, 2019), upstream monopolies (Lu & Lu, 2018), and market segmentation (Lu et al., 2018b).

Expanding on Kee and Tang's (2016) theoretical framework, productive services trade emerges as a significant factor influencing the DVAR of enterprises' exports. Productive services trade, a subset of service trade, primarily operates through cross-border delivery and commercial presence (Josep, 1990). Productive services traded under cross-border delivery are primarily executed via import and export transactions, while those under commercial presence are delivered by foreign-invested enterprises. Regardless of the delivery mode, productive services trade impacts both the cost markup of enterprises and the relative prices of imported intermediate goods, thereby affecting the DVAR of enterprises' export.

This influence manifests in two key ways. Firstly, productive service trade impacts cost markup by enhancing the production efficiency of manufacturing firms. Burgess (1990) observed that productive service trade significantly improves the efficiency of domestic goods production sectors. Supporting this, empirical findings by Francois & Woerz (2008) reveal that business service trade, especially in technology-intensive manufacturing sectors, significantly boosts productivity. Moreover, Coucke & Sleuwaegen (2008) and Amiti & Wei (2009) demonstrated the resource reallocation effect of productive service imports on the host country's manufacturing sector. This enables manufacturing enterprises to outsource less competitive service segments and focus on more efficient manufacturing processes, thereby enhancing productivity. Shu & Wang (2018) further found that importing productive service intermediates to substitute less efficient domestic service segments, results in in-product resource reallocation and improves manufacturing firms' cost markup. Secondly, productive services trade influences cost markup by reducing production costs and facilitating technological advancements. Dai (2014) discovered that the diverse implicit knowledge, technologies, and information embedded in productive services can effectively reduce the input costs of finished goods production, consequently increasing the cost markup of manufacturing firms. Furthermore, empirical studies by Chen & Liu (2014), Qiu & Cui (2014), and Dong (2016) affirmed the technological spillover effects of productive services trade, suggesting that it can significantly promote technological advancement in domestic manufacturing, thus enhancing productivity.

Productive service trade also influences the DVAR in exports by shaping the relative prices of imported intermediate products. Xu et al. (2017) and Zhu et al. (2018) demonstrated that productive service trade intensifies domestic competition, fostering technological advancements and diversification in domestic productive service products (Zhang et al., 2013; Shu & Wang, 2018; Kee & Tang, 2016). This competitive dynamic leads to a reduction in the prices of domestic productive services, thereby enabling them to substitute for foreign intermediate inputs. The consequence of this substitution is an increase in DVAR of exports.

In addition to the promotional mechanisms previously discussed, productive services trade can also present challenges to DVAR of export enterprises. On the one hand, Domestic manufacturing enterprises' over-reliance on imported productive service inputs can potentially diminish their enthusiasm for R&D, design, and innovation in management models (Burgess, 1990), consequently reducing the DVAR.

Since productive service inputs contribute to a final product's overall value, a high proportion of imported service intermediates for a specific final product can supplant the value contributed by domestic intermediate inputs. This displacement directly curtails the potential increase in DVAR of exported products from manufacturing firms. Moreover, multinational corporations exploit their absolute advantage, leveraging resource superiority and core competencies to erect technical barriers in productive services on a global scale, hindering the industrial upgrading of developing countries (Gu & Xia, 2006; Zheng & Chen, 2007; Dai & Jin, 2013).

From the analysis of these mechanisms, it is evident that the development of productive services trade has both positive and negative effects on enhancing the DVAR of a country's export enterprises, and a nonlinear relationship may exist (Xu, 2017; Du & Peng, 2018). To empirically assess the actual effect of the development of productive services trade on the enhancement of DVAR in China's manufacturing export enterprises, further data-driven verification is required. This thesis primarily employs data from the China Customs Statistics Database, China Industrial Enterprises Database, WIOD Database, and China Statistical Yearbook to match and test the relationship between FDI productive services trade and the DVAR of manufacturing export enterprises.

III. Research Design

1. Econometric Model

To investigate the relationship between FDI-based productive service trade and DVAR of the enterprise’s export, this paper adopts the research methods of Shu et al. (2018) and Xu et al. (2017) to construct the basic econometric model:

$$DVAR_{\mathrm{ijt}} = \alpha + \beta_1 serlib_{jt} + \gamma Z + \delta_t + \delta_i + \varepsilon_{ijt}$$

where i represents the firm, t represents the year, and j represents the industry of the manufacturing sector in which the firm operates.

The dependent variable DVAR represents the ratio of domestic value-added in exports at the firm level, reflecting a firm's ability to create domestic value-added. The specific calculation method for DVAR is introduced later in subsequent sections. The variable $\mathrm{serlib}_{\mathrm{jt}}$ quantifies the engagement in productive services trade, indicating the use of FDI-based productive services in industry j during period t. The specific measurement method for $\mathrm{serlib}_{\mathrm{jt}}$ is also explained later. Z represents a suite of firm-level control variables, which include: 1) Firm age (age), calculated as the current year minus the year of establishment plus one; 2) Firm size (size), represented by the logarithm of the number of employees; 3) Capital intensity (lncap), calculated as the logarithm of the ratio of net value of fixed assets to total employment; 4) Total factor productivity (tfp), calculated using the LP method. δ_i represents firm fixed effects, δ_t represents year fixed effects, ε_{ijt} is the random error term.

2. Measurement of Core Variable

(1) DVAR. Following the methodology of Upward et al. (2013) and Zhang et al. (2013), classifies Chinese enterprises into three distinct categories: general trade enterprises, processing trade enterprises, and mixed trade enterprises. DVAR for each enterprise type is calculated individually, with the specific formula detailed as follows:

$$DVAR_{it} = \begin{cases} 1 - \dfrac{imp_{it}^{o}|_{BEC} + imp_{it}^{F}}{Y_{it}^{o}}, \text{if shipment} = O \\ 1 - \dfrac{imp_{it}^{p} + imp_{it}^{F}}{Y_{it}^{p}}, \text{if shipment} = P \\ w_o\left(1 - \dfrac{imp_{it}^{o}|_{BEC} + imp_{it}^{F}}{Y_{it}^{o}}\right) + w_p\left(1 - \dfrac{imp_{it}^{p} + imp_{it}^{F}}{Y_{it}^{p}}\right), \text{if shipment} = M \end{cases}$$

where O, P, and M represent general trade, processing trade, and mixed trade respectively. $imp_{it}^{o}|_{BEC}$and imp_{it}^{p} represent the imported intermediate inputs for general trade enterprises and processing trade enterprises respectively. imp_{it}^{F} represents the foreign element portion of the imported intermediate inputs. During the calculation process, this paper employs the following specific adjustments:

1. Trade Agent. Given that many Chinese enterprises engage in international trade indirectly through specialized trade agents rather than through direct import or export activities, neglecting these indirect imports could lead to an overestimation of DVAR for Chinese export enterprises. Following the method of Zhang (2013), this paper identifies enterprises as intermediate trade agents if their names in the customs database include terms such as 'Import-Export', 'Trade', 'Foreign Trade', 'Scientific Trade', or 'Foreign Economic'. For each manufacturing industry classified under the HS two-digit code, the proportion of imports conducted by these trade agents is calculated. This proportion, representing the ratio of a company's indirect imports via trade agents to its total imports, is subsequently applied to determine the actual import value (imp_{it}) for each enterprise. In the final stage of the analysis, trade agents are excluded from the database.

2. Import of Intermediate Goods by General Trade Enterprises. The imports of general trade enterprises classified under the HS 6-digit code are matched with the BEC code to identify the value of imported intermediate goods for general trade enterprises, represented as $imp_{it}^{o}|_{BEC}$.

3. Foreign Elements in Domestic Intermediate Inputs. Acknowledging that domestic intermediate goods used by Chinese processing trade enterprises contain foreign components, Koopman's (2012) research suggests that this proportion ranges from 5% to 10%. This study

assumes a consistent 5% share of foreign elements in domestic intermediate goods, and this portion is deducted from the DVAR calculation. Since the China Industrial Enterprises Database does not provide data on intermediate inputs of enterprises from 2008 to 2010, this paper uses the missing value-added data adjusted for foreign elements in intermediate inputs as a robustness check for the verification process.

(2) Manufacturing Input of FDI-based Productive Services. The productive service trade as defined in this paper refers to FDI-based productive services trade. Following the method of Zhang et al. (2014) and Shu et al. (2017), this paper utilizes the World Input-Output Database to calculate the complete consumption coefficients of various service sectors for the Chinese manufacturing industry. This calculation measures the reliance of different manufacturing sectors on service sectors in China. The measurement indicator for productive services trade of Chinese manufacturing industries in the form of commercial presence is:

$$serlib_{jt} = \sum_{j=1}^{n} a_{jkt} * FDI_{kt}$$

where j, t, and k represent the manufacturing industry sector, the year, and the productive service sector respectively. a_{jkt} represents the complete consumption coefficient of the manufacturing industry sector j in year t for the productive service sector k. FDI_{kt} represents the total actual FDI absorbed by the productive service sector k in year t.

Furthermore, building on the definitions of the productive service industry by scholars like Liu (2016), Lu et al. (2017), and Xu et al. (2017). Utilizing the data sources, productive services are classified into six distinct categories following the ISIC and national economic industry classification standards. These sectors include transportation and storage, postal services, information transmission, computer services and software, wholesale and retail, finance, leasing and business services, scientific research, technical services, and surveying and mapping. Detailed explanations and explanations can be found in Table 1.

3. Data Description

This paper employs data from several key databases: the China Industrial Enterprises Database, China Customs Database, China Statistical Yearbook, and the World Input-Output Database. The China Statistical Yearbook provides data on the total actual utilized foreign investment in various service industries for the period from 2004 to 2013. WIOD provides the input-output tables for China from 2004 to 2013, enabling the calculation of complete consumption coefficients of FDI-based productive service sectors for the manufacturing industry. The data for various control variables of enterprises are derived from the China Industrial Enterprises Database, and data related to types of trade come from the China Customs Database.

This paper calculates DVAR from 2004 to 2013 using matched data from both the China

Industrial Enterprises Database and the China Customs Database. Regarding the matching of the China Industrial Enterprises Database with the China Customs Database, this paper mainly follows the approach of Yu et al. (2013), which involves matching data based on company names, years, and telephone numbers. However, there are inconsistencies in the Industrial Enterprises Database in 2009, which poses challenges in matching with the Customs Database. To address this, this paper uses the previously matched Industrial Enterprises Database of 2008 and subsequent data to supplement information for the relevant manufacturing enterprises.

Furthermore, this paper addresses the challenge of discrepancies in industry classification standards prevalent across different databases. For instance, WIOD employs ISIC Rev.4, which organizes industries into 18 manufacturing sectors and 14 service sectors. In contrast, Chinese enterprise data and yearbook industry data are classified according to the National Economic Industry Classification Standard, with variations in different years due to industry classification revisions. To address these discrepancies, this paper first aligns the Chinese enterprise data with the 2002 National Economic Classification Standard. It then matches these classifications with the WIOD data. As a result, the manufacturing industry is divided into 16 sectors (c1-c16), and the service industry is divided into 6 sectors. The specifics of these classifications and their corresponding sectors are detailed in the following Table 1:

Table 1 Industry Descriptions

Manufacturing Industry			
Industry Code	ISIC Rev4	2002 NEC	Description
c1	C10-C12	C13-C16	food, beverages and tobacco products
c2	C13-C15	C17-C19	textiles, clothing, leather and related products
c3	C16	C20	timber, wood products and cork products (other than furniture), straw and woven articles
c4	C17	C22	Paper and paper products
c5	C18	C23	Printing and reproduction of recording media
c6	C19	C25	coke and refined petroleum products
c7	C20	C26+C28	chemicals and chemical products
c8	C21	C27	essential pharmaceutical products and pharmaceutical preparations
c9	C22	C29-C30	rubber and plastic products
c10	C23	C31	other non-metallic mineral products
c11	C24	C32-C33	base metals
c12	C25+C28	C34-C36	metal products and general equipment
c13	C26	C40-C41	computers, electronics, and optical products

c14	C27	C39	electrical equipment
c15	C29+C30	C37	automobiles, trailers and semi-trailers and other transport equipment
c16	C31+C32	C21+C24+C42	Furniture manufacturing, other manufacturing
Service Industry			
Industry Code	ISIC Rev4	2002 NEC	Description
f1	H	F	Transportation, warehousing, and postal services
f2	J61+J62+J63	G	Information transmission, computer services and software
f3	G	H	Wholesale and retail trade
f4	K	J	Finance
f5	M69+M70+ M73+N	L	Leasing and business services
f6	M71+M72+ M74	M	Scientific research, technical services and site surveys

IV. Regression Results and Analysis

1. Benchmark Regression

Upon conducting the Hausman test, this paper determined that panel fixed effects regression is the most appropriate method for the analysis. The Benchmark regression results are presented in Table 2. Columns (1) to (6) demonstrate that as control variables are incrementally introduced into the regression model, the linear term exhibits a significant positive effect, while the quadratic term shows a significant negative effect. This pattern suggests a clear inverted U-shaped relationship between the importation of productive services and DVAR of manufacturing enterprises' exports. This can be interpreted as the importation of productive services initially providing a more superior and diverse array of productive service elements to the domestic market, which has a more pronounced positive impact on DVAR of manufacturing enterprises' exports. However, if the importation of productive service products is increased indiscriminately, beyond a certain threshold, an excessive reliance on imported productive service elements becomes counterproductive to the transformation and upgrading of domestic manufacturing enterprises.

Enterprises with higher total factor productivity and larger scales tend to have a higher DVAR in their exports. DVAR in exports exhibits an inverted U-shaped relationship with enterprise age. Nevertheless, there is no significant correlation between the labor-capital ratio of an enterprise and DVAR in exports. This lack of a significant relationship may be because Chinese enterprises, predominantly focus on low-value-added processing stages, which results in a less pronounced correlation. These results are shown in Table 2.

Table 2 Benchmark Regression Results

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	DVAR	DVAR	DVAR	DVAR	DVAR	DVAR
serlib	0.149***	0.158***	0.111***	0.156***	0.194***	0.151***
	(0.069)	(0.058)	(0.027)	(0.034)	(0.067)	(0.019)
serlib^2	-0.427***	-0.420***	-0.404***	-0.371***	-0.326***	-0.303***
	(0.054)	(0.044)	(0.041	(0.042)	(0.303)	(0.051)
tfp		0.069***	0.064***	0.072***	0.063***	0.075***
		(0.004)	(0.005)	(0.003)	(0.003)	(0.003)
size			0.020***	0.017***	0.023***	0.024***
			(0.002)	(0.002)	(0.002)	(0.002)
age				0.020***	0.023***	0.019***
				(0.001)	(0.001)	(0.001)
age^2					-0.000***	-0.000***
					(0.000)	(0.000)
lncap						0.000
						(0.001)
_cons	-0.020***	-0.020***	-0.020***	-0.020***	-0.020***	-0.020***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Firm fixed	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed	Yes	Yes	Yes	Yes	Yes	Yes
N	131210	131210	131210	130074	130074	129668

2. Robustness Test

(1) Indicator Selection

Changing the measure of DVAR. In the benchmark regression, the calculation of DVAR did not consider the composition of foreign elements in enterprise intermediate inputs. For robustness tests, this paper recalculates DVAR, assuming a 5% proportion of foreign elements in intermediate inputs, following the method of Xu et al. (2017). Given that the industrial enterprise database lacks intermediate input data post-2008, the revised DVAR indicator spans the period from 2000 to 2007. The results presented in Table 3 reveal a significant inverted U-shape relationship between FDI-based productive services trade and DVAR.

Changing the measure of productive service trade. The productive service trade import and export data used in this paper come from the China Statistical Yearbook and the Ministry of Commerce. There are minor discrepancies in industry classification when compared to the regression database. To address this, this paper reorganizes the productive service trade import and export data into four distinct categories for robustness tests. Regression results based on this new indicator, as shown in the Table 3, maintain significance.

Table 3 Robustness Tests Results

	(1)	(2)	(3)
Variables	DVAR2	DVAR3	DVAR4
serlib	0.134***	0.174***	0.245***
	(0.014)	(0.024)	(0.023)
$serlib^2$	-0.206*	-0.237***	-0.137***
	(0.024)	(0.035)	(0.060)
tfp	0.052***	0.061***	0.062***
	(0.002)	(0.002)	(0.002)
size	0.025***	0.025***	0.024***
	(0.002)	(0.002)	(0.002)
age	0.017***	0.018***	0.021***
	(0.001)	(0.001)	(0.001)
age^2	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
lncap	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)
_cons	-2.168***	-4.238***	-5.136***
	(0.325)	(0.343)	(0.446)
Firm fixed	Yes	Yes	Yes
Time fixed	Yes	Yes	Yes
N	117959	117959	100237

（2）Data Exclusion. Considering inconsistencies in the China Industrial Enterprises Database around 2009, such as missing telephone numbers and other critical information in the post-2009 database, difficulties arose in matching it with the Customs Database. To address this concern, the robustness test excluded data for 2009 and 2010, focusing on the 2000-2008 period. The regression result in Table 3 continues to show a significant inverted U-shape relationship.

3. Endogeneity Test

The benchmark regression of this paper, incorporating both time fixed effects and firm fixed effects, effectively addresses endogeneity concerns that may arise from omitted variables. Additionally, the regression utilizes industry-level productive service trade data for the explanatory variable and firm-level DVAR data for the dependent variable, thereby alleviating issues of reverse causality. However, considering that control variables at the firm level might have reverse causality with DVAR, this paper employs a two-stage regression approach with lagged one-period and two-periods of productive service trade as instrumental variables to address potential endogeneity issues. The results shown in Table 4 indicate that an inverted U-shape relationship between productive service trade and the DVAR remains robust, both under the commercial presence and cross-border delivery modes.

Table 4 Endogeneity Test Results

	commercial presence		cross-border delivery	
Variables	lagged one	lagged two	lagged one	lagged two
serlib	1.046***	0.549***	0.108***	0.233**
	(0.231)	(0.135)	(0.031)	(0.097)
$serlib^2$	-0.006*	-0.036***	-0.037***	-0.062***
	(0.004)	(0.009)	(0.007)	(0.018)
tfp	0.058***	0.058***	0.059***	0.060***
	(0.002)	(0.003)	(0.002)	(0.002)
size	0.018***	0.025***	0.013***	0.013***
	(0.003)	(0.004)	(0.002)	(0.002)
age	-0.186***	0.092***	0.020***	0.013***
	(0.058)	(0.031)	(0.002)	(0.005)
age^2	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
lncap	0.001	0.003	-0.002*	-0.003**
	(0.002)	(0.002)	(0.001)	(0.002)
_cons	-8.580***	-2.296***	0.151***	0.114***
	(2.038)	(0.745)	(0.027)	(0.035)
Firm fixed	Yes	Yes	Yes	Yes
Time fixed	Yes	Yes	Yes	Yes
N	142129	77507	206235	135067

V. Extended Test Results and Analysis

1. Heterogeneous Service Trade Tests.

Recognizing that different sectors within productive service trade may exert distinct influences and operate through different mechanisms on enterprises, this paper categorizes service industries under the Chinese economic industry classification standards. It then conducts separate regressions for each category of service trade and DVAR. The specific results are presented in Tables 5 and 6. Table 5 shows the regression results of various industries within productive service trade under the commercial presence mode and DVAR. Table 6 displays the regression results for different types of productive service trade under the cross-border delivery mode and DVAR.

Table 5 Commercial Presence Mode Results

	Commercial Presence Mode					
Variables	F1	F2	F3	F4	F5	F6
serlib	0.549***	0.358***	0.111***	0.156***	0.294***	0.051***
	(0.069)	(0.058)	(0.027)	(0.034)	(0.067)	(0.019)
$serlib^2$	-0.027***	-0.020***	-0.004***	-0.010***	-0.016***	-0.003***

	(0.004)	(0.004)	(0.001)	(0.002)	(0.003)	(0.001)
tfp	0.072***	0.072***	0.072***	0.072***	0.072***	0.072***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
size	0.024***	0.024***	0.024***	0.024***	0.024***	0.024***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
age	0.018***	0.016***	0.010***	0.022***	0.023***	0.020***
	(0.002)	(0.001)	(0.003)	(0.003)	(0.001)	(0.003)
age^2	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lncap	0.001	0.001	0.001	0.001	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
_cons	-2.630***	-1.445***	-0.475***	-0.506***	-1.307***	-0.100
	(0.343)	(0.236)	(0.136)	(0.134)	(0.328)	(0.071)
Firm fixed	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed	Yes	Yes	Yes	Yes	Yes	Yes
N	202975	202975	202975	202975	202975	202975

Table 6 Cross-border Delivery Mode Results

	Cross-border Delivery Mode					
Variables	F1	F2	F3	F4	F5	F6
serlib	0.150***	2.029***	0.147***	-0.213	0.195***	-0.824***
	(0.036)	(0.261)	(0.041)	(0.186)	(0.053)	(0.133)
$serlib^2$	-0.246***	14.081***	-0.276***	3.881***	-0.327***	3.217***
	(0.030)	(1.495)	(0.037)	(0.701)	(0.057)	(0.595)
tfp	0.077***	0.077***	0.077***	0.077***	0.077***	0.077***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
size	0.024***	0.023***	0.024***	0.024***	0.024***	0.023***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
age	0.019***	0.017***	0.020***	0.020***	0.019***	0.023***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
age^2	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lncap	-0.000	-0.000	-0.000	-0.000	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
_cons	0.058***	0.036	0.056**	0.058**	0.060***	0.070***
	(0.022)	(0.023)	(0.022)	(0.025)	(0.023)	(0.022)
Firm fixed	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed	Yes	Yes	Yes	Yes	Yes	Yes
N	283764	283764	283764	283764	283764	283764

The results in Table 5 for the commercial presence mode of productive service trade are largely consistent with the benchmark regression results, showing a significant inverted U-shaped relationship. Specifically, the regression coefficients for foreign investment in transportation, storage, and postal sectors are markedly higher compared to other sectors, followed by information transmission, computer technology, software, leasing, business services, finance, wholesale and retail, and scientific research and development. The relatively smaller regression coefficients in high-tech productive service industries are primarily due to two reasons. Firstly, the manufacturing enterprises in the database are mostly engaged in low-end processing manufacturing, resulting in lower demand for high-end technology-intensive services. Therefore, labor-intensive foreign investments have a greater impact on DVAR of these manufacturing enterprises. Secondly, the high market monopolization in China's financial and professional technological sectors can impede market competition and product innovation, thereby diminishing the apparent effects of FDI in these industries. As a result, the absolute values of the coefficients are comparatively smaller.

Compared to the results under the commercial presence mode, the impact of productive service trade on the DVAR under the cross-border delivery mode is more diversified. Table 6 shows that industries such as transportation, storage, postal services, information transmission, computer technology, software, wholesale and retail, and leasing and business services continue to show an inverted U-shaped relationship with DVAR. However, for finance and scientific research and technology sectors, the regression results display a positive U–shaped relationship: the coefficients of the squared terms are significantly positive, while the linear terms are negative. This indicates that in the short term, imports of productive service elements in these sectors might negatively impact manufacturing enterprises. Nevertheless, in the long term, they are likely to considerably enhance DVAR. These results could be attributed to the relatively closed nature of China's finance and scientific research and technology sectors, which are less open and more underdeveloped domestically, leading to a higher demand for imports. A substantial volume of imports increases foreign value-added, which in turn suppresses domestic value-added. However, the development of these two high-tech productive service trades is likely to enhance domestic competition in similar sectors, with significant spillover effects. In the long run, this is beneficial for domestic enterprises as it can alleviate financing constraints and improve domestic research and development, thereby positively influencing DVAR.

2. Heterogeneous Enterprise Types Tests

Different enterprise type, shaped by distinct policies, capabilities, and sources of funding, demonstrate considerable variation in market performance. This study classifies enterprises according to the nature of their registered capital into four distinct categories: state-owned enterprises, privately-owned enterprises including collective enterprises, private enterprises, enterprises with investments from Hong Kong, Macao, and Taiwan, and foreign-invested enterprises. Separate regression analyses are conducted for each category, with the results detailed in Table 7.

Table 7 Heterogeneous Enterprise Types Regression Results

	commercial presence				cross-border delivery			
Variables	private	state	HMT	foreign	private	state	HMT	foreign
serlib	0.582	-4.808	-1.088	3.494***	0.216	0.047	-0.369	0.468**
	(0.645)	(6.846)	(1.225)	(0.707)	(0.171)	(5.652)	(0.368)	(0.216)
$serlib^2$	-0.026	0.207	0.044	-0.146***	-0.080	0.718	0.122	-0.153**
	(0.027)	(0.297)	(0.052)	(0.030)	(0.060)	(2.034)	(0.124)	(0.072)
tfp	0.052***	0.109	0.139***	0.166***	0.052***	0.089	0.139***	0.164***
	(0.008)	(0.099)	(0.012)	(0.009)	(0.008)	(0.093)	(0.012)	(0.009)
size	0.059***	0.024	0.195***	0.167***	0.058***	0.036	0.195***	0.168***
	(0.010)	(0.057)	(0.011)	(0.009)	(0.010)	(0.054)	(0.011)	(0.009)
age	-0.055***	-0.127	-0.160***	-0.163***	-0.060***	-0.098	-0.171***	-0.154***
	(0.010)	(0.144)	(0.018)	(0.012)	(0.009)	(0.088)	(0.016)	(0.011)
age^2	0.000*	0.001**	0.000	0.000	0.000*	0.001*	0.000	0.000
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
lncap	0.000	-0.000	-0.000	-0.000	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
_cons	-2.431	29.982	7.529	-20.11***	0.741***	-0.205	1.158***	0.390***
	(3.821)	(41.216)	(7.214)	(4.180)	(0.127)	(3.093)	(0.247)	(0.147)
Firm fixed	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed	YES	YES	YES	YES	YES	YES	YES	YES
N	22240	652	17812	31120	22240	652	17812	31120

The regression analysis from the first major column focusing on the commercial presence mode of productive service trade reveals an inverted U-shaped relationship between FDI-based productive services and DVAR of privately-owned and foreign-invested manufacturing enterprises. However, this relationship is not statistically significant for privately-owned enterprises.

In contrast, for state-owned enterprises and those from Hong Kong, Macao, and Taiwan, the results are not only insignificant but also exhibit an opposite trend. This may be attributed to the relatively low openness of China's service sector, where productive services in the commercial presence mode, often expensive, are less beneficial for privately-owned enterprises and are predominantly utilized by domestic and foreign-invested enterprises. Foreign-invested manufacturing enterprises, which adhere to international production standards, more readily integrate services offered by foreign productive service providers. State-owned enterprises, traditionally privileged in domestic sectors like finance, have their productive service requirements readily met and are cushioned against market share risks due to their state backing. Enterprises from Hong Kong, Macao, and Taiwan, which capitalize on China's low labor costs for processing and primarily re-export products back to their regions, have minimal reliance on such services as many are locally available.

In the second major column of the cross-border delivery mode, the most pronounced inverted U-shaped relationship is observed with foreign-invested enterprises. The relationship exists but is not significant for privately-owned enterprises. State-owned enterprises show a positive but insignificant relationship, while those from Hong Kong, Macao, and Taiwan exhibit a positive U-shaped relationship, which is also not significant. Notably, the regression result for privately-owned enterprises, although not significant, shows an increased t-value compared to the commercial presence mode. This suggests that the development of productive service trade under the cross-border delivery mode has a more substantial impact on privately-owned enterprises.

3. Heterogeneous Enterprise Technology Tests

Considering the potential variation in enterprise value-added due to technological differences in the industries they operate, which could affect the impact of productive service trade, this paper adopts a technological perspective within the manufacturing sector. Utilizing the 'Classification of Technology Industries (Manufacturing)' released by the International Statistical Bureau in 2017 and the 'Comparison Table of National Economic Industry Classification 2011-2002-1994,' this paper categorizes manufacturing enterprises in the database into high-technology and low-technology sectors. The regression outcomes for these technological categorizations are detailed in Table 8.

Table 7 Heterogeneous Enterprise Technology Regression Results

	commercial presence		cross-border delivery	
Variables	Low-tec	High-tec	Low-tec	High-tec
serlib	0.353***	1.306***	0.049***	0.051
	(0.065)	(0.289)	(0.015)	(0.068)
$serlib^2$	-0.015***	-0.060***	-0.026***	-0.026
	(0.003)	(0.013)	(0.004)	(0.020)
tfp	0.070***	0.082***	0.075***	0.087***
	(0.003)	(0.008)	(0.003)	(0.007)
size	0.025***	0.021***	0.023***	0.028***
	(0.003)	(0.008)	(0.003)	(0.006)
age	0.012***	0.026**	0.019***	0.026***
	(0.002)	(0.012)	(0.001)	(0.003)
age^2	-0.0002***	-0.001***	-0.0002***	-0.0002***
	(0.000)	(0.000)	(0.000)	(0.000)
lncap	0.001	0.009**	-0.002	0.011***
	(0.002)	(0.005)	(0.002)	(0.004)
_cons	-1.916***	-7.146***	0.089***	-0.147**
	(0.366)	(1.586)	(0.024)	(0.066)
Firm fixed	YES	YES	YES	YES
Time fixed	YES	YES	YES	YES
N	175914	27061	246854	36910

In the regression results under the commercial presence mode of productive service trade development and DVAR, the FDI-based productive services exhibits an inverted U-shaped relationship with DVAR of enterprises across different technological manufacturing industries, like the benchmark regression results. The regression coefficients for high-technology industries, both linear and quadratic terms, are significantly higher than those for low-skill industries. This is primarily because high-skill manufacturing industries, such as pharmaceutical and aerospace manufacturing, are typically knowledge and technology-intensive. These industries have a high demand for productive services, especially high-end services like R&D design, information technology, and finance. They benefit more from the spillover effects of FDI technology compared to low-skill enterprises, resulting in greater absolute values of regression coefficients for FDI-based productive service in high-technology manufacturing industries. However, looking at the regression results from the cross-border delivery mode of productive services, a significant inverted U-shaped relationship is observed in low-technology industries, while the coefficients for high-technology manufacturing industries are not significant. The primary reason is that the import of productive service elements in China includes a smaller proportion of high-technology services such as finance and technological R&D, failing to meet the high-end service demands of domestic high-end manufacturing enterprises. Consequently, the spillover effects of technology are limited. In contrast, China's imports of productive services are mainly concentrated in business services and labor-intensive services like transportation, which inevitably displace the domestic value share of export products.

VI. Conclusion

This paper concludes that an inverted U-shaped relationship exists between productive service trade under various trade modes and DVAR of China's manufacturing enterprises. Initially, FDI-based productive service trade boosts manufacturing value-added, but once a certain threshold is surpassed, it becomes counterproductive. Foreign investment in productive services brings quality service intermediates to the domestic market, reducing costs and enhancing DVAR for domestic manufacturing enterprises. It stimulates domestic service industry development and technological innovation, leading towards specialization. However, an accelerated and excessive expansion of foreign investment can inhibit innovation within the domestic service industry, potentially resulting in a 'low-end lock-in' scenario for manufacturing.

Considering enterprise heterogeneity, this paper finds that trade types, registration types, and technological levels within industries impact the relationship between productive service trade and DVAR. Processing trade enterprises show an insignificant relationship with productive service trade due to their lower position in the value chain. State-owned enterprises, due to their unique status, exhibit an insignificant relationship with FDI-based productive service. High-technology industries show larger regression coefficients for FDI-based productive service compared to low-technology industries, with significant negative coefficients for productive service import consumption rates.

Industry heterogeneity tests reveal that foreign investment in sectors like transportation and storage significantly impacts manufacturing DVAR, whereas high-tech sectors like R&D and finance have smaller coefficients. For finance and scientific research sectors, squared import consumption rate coefficients positively impact manufacturing value-added.

Based on the research conducted, this paper presents the following policy implications:

(1) China should implement differentiated opening policies for its productive services, tailoring them to the specific impacts on manufacturing value-added and sectoral development. Given the underdevelopment and structural imbalance in high-end services, prioritizing sectors like transportation and logistics can enhance competition and align with manufacturing needs. For sectors like finance and technology R&D, where imports positively impact manufacturing value-added, advancing financial openness and encouraging high-technology imports are crucial.

(2) To break out of the 'low-end lock-in' and promote technological innovation, China needs supply-side reforms to reduce enterprise costs. This includes lowering institutional transaction costs, taxes, and utility prices. Encouraging R&D investment and innovative development in high-technology productive services, along with improved patent protection and technology subsidies, will help extend the domestic productive service sector into high-end areas and transform the manufacturing value chain.

(3) Enhancing industrial linkage between productive services and manufacturing is vital. As the scale of China's productive service trade exceeds foreign direct investment, reducing manufacturing's dependency on foreign services and improving the domestic industrial chain are key. Introducing foreign capital related to manufacturing and guiding the development of domestic productive services will aid in integrating manufacturing with high-end productive services, fostering a more balanced and self-sufficient industrial ecosystem.

Reference

Amiti, M., Wei, S.-J., 2009. Service Offshoring and Productivity: Evidence from the US. World Economy, (2): 203-220.

Arnold, J.M., Javorcik, B.S., Mattoo, A., 2011. Does Services Liberalization Benefit Manufacturing Firms?: Evidence from the Czech Republic. Journal of International Economics, (1): 136-146.

Burgess, D.F., 1990. Services as Intermediate Goods: The Issue of Trade Liberalization. The

Political Economy of International Trade, (2): 122-139.

Cai W, Li H. Impact of the Import of Producer Service on Export Technological Sophistication of Service Trade. Science and Technology Management Research, 2017, (3): 146-152.

Chen Q, Liu Z. 2014. Empirical Analysis of the Impact of Import Producer Service on China's Manufacturing Industries' Total Factor Productivity. Quantitative Economics and Technical Economics Research, (3).

Chen X, Liu H. The Section Preference of Producer Service to Manufacturing Industry and its Effects on Manufacturing Industry's Export Sophistication: Evidence from 34 Countries' Input-Output Data from 1997 to 2011. International Trade Issues, 2016, (6): 82-93.

Chen X. 2016. Empirical Study on the Impact of Servitization of Manufacturing on the Value Chain Climbing of Manufacturing Industry. Economic Issues Exploration, (7).

Cheng D. Development Level, Structure, and Impact of Producer Services in China: An International Comparison Based on Input-Output Approach. Economic Research, 2008, (1): 76-88.

Cheng D. Growth, Structural Change, and Impact of Producer Services in China: An Analysis Based on the Input-Output Method. Finance and Trade Economics, 2006, (10): 45-52.

Coucke, K., Sleuwaegen, L., 2008. Offshoring as a Survival Strategy: Evidence from Manufacturing Firms in Belgium. Journal of International Business Studies, (39): 1261–1277.

Dai X, Jin Q. 2013. The Change in Technical Content of the Import in the Service Trade and the Development of China's Industrial Growth. Management World, (9).

Dai X. 2014. Sophistication of Service Import and Improvement of China's Manufacturing Efficiency. Scientific Research Management, (6).

Dong Y. 2016. Will Import of Producer Service Restrain China's Innovation Capability. Financial and Trade Research, (2).

Du D. 2017. Study on the Influencing Factors of China's Financial Industry FDI. Hainan University.

Fernandes, A.M., Paunov, C., 2008. Foreign Direct Investment in Service and Manufacturing Productivity Growth: Evidence from Chile. Policy Research Working Paper Series, No. 4730.

Francois, J., Woerz, J., 2008. Producer Services, Manufacturing Linkages, and Trade. Journal of Industry, Competition and Trade, (8): 199–229.

Greenfield, H.I., 1966. Manpower and the Growth of Producer Services. London: Columbia University Press.

Grubel, H., Walker, M.A., 1989. Modern Service Sector Growth: Causes and Effects. In: Giersch, H. (Ed.), Services in World Economic Growth, Tübingen, pp. 1-34.

Gu G, Zhou L. Research on China's Trade in Producer Services Based on Global Value Chains. International Trade Issues, 2010, (5): 61-69.

Gu N, Xia J. 2010. Economic Effects of Foreign Trade and Servitization of Manufacturing Industry. Social Science Research, (5).

Hoekman, B., Mattoo, A., 2012. Services Trade and Growth. International Journal of Services Technology and Management, (2-4): 232-250.

Hu X. 2012. Beware of the Trap of Modern Service Industry. Shanghai Securities News.

Hu Z, Xia Q, Sun G. 2017. Servitization, Technological Innovation and Industrial Structure Upgrading of Manufacturing Industry. International Economic and Trade Exploration, (12).

Hummels, D., Ishii, J., Yi, K.M., 2001. The Nature and Growth of Vertical Specialization in World Trade. Journal of International Economics, (1): 75-96.

Jiang X. 2004. The Impact of Foreign Investment Attraction on China's Industrial Technological Progress and R&D Capability. International Economic Review, (2).

Jing L, Hua G. 2014. An Empirical Study on High Technology Service FDI Effects on Manufacturing Efficiency in China. Graduate School of Chinese Academy of Social Sciences Journal, (4).

Kee, H.L., Tang, H., 2016. Domestic Value Added in Exports: Theory and Firm Evidence from China. American Economic Review, (6): 1402-1436.

Koopman, R., Wang, Z., Wei, S.J., 2008. How Much of Chinese Exports is Really Made in China? Assessing Domestic Value-Added When Processing Trade is Pervasive. NBER Working Paper No.14109.

Koopman, R., Wang, Z., Wei, S.J., 2014. Tracing Value-Added and Double Counting in Gross Exports. American Economic Review, (2): 459-494.

Liu B, Wei Q, Lyu Y, Zhu K. 2016. Servitization of Manufacturing and Value Chain Upgrading. Economic Research, (3).

Liu Y. 2011. Empirical Analysis of the Relationship between Producer Services FDI and China's Technological Progress: 1983-2008. Shanghai Economic Research, (3).

Liu Z. 2008. Producer Services and Their Agglomeration: The Key Elements and Mechanisms for Climbing the Global Value Chain. China Economic Problems, (1).

Lyu Y, Li X. 2017. Servicification in Global Value Chain and Firm's Productivity. Nankai Economic Research, (3).

Lyu Y. 2017. Servitization of Manufacturing Export and International Competitiveness. Issues of International Trade, (5).

Markusen, J.R., 1989. Trade in Producer Services and in Other Specialized Intermediate Inputs. The American Economic Review, (8709C): 85-95.

Meng P. 2017. The Impact of China's Producer Services Trade on Manufacturing Upgrading. Capital University of Economics and Business.

Qiu A, Cui R. The Mechanism and Empirical Test of the Influence of Producer Services Trade on the TFP of China's Manufacturing Industry Based on Panel Data and Sub-sector Importation. International Economic and Trade Exploration, 2014, (10): 28-38.

Shu X, Wang J. 2018. Research on the Mechanism and Effect of Liberalization of Producer Service Trade on Manufacturing Productivity. Economist.

Tang Y, Yu F, Wang X. 2018. Could Chinese Service Firms Promote Their Innovation Performance from the FDI in Service Industry? Journal of Beijing Normal University, (3).

Tang Z, Gu N. 2017. Servitization of Manufacturing, Industry Heterogeneity and Labor Income Share.

Upward, R., Wang, Z., Zheng, J., 2012. Weighing China's Export Basket: The Domestic Content and Technology Intensity of Chinese Exports. Journal of Comparative Economics.

Wang X. 2016. Study on the Integration Development of Producer Services and Manufacturing Industry. Xiangtan University.

Xu H, Cheng L, Sun T. 2017. The Effect of the Input Servitization of Manufacturing on Upgrading Export Domestic Value Added of Enterprises. China Industrial Economy, (10).

Xuan Y, Yu Y. Spatial Agglomeration of Producer Service Industry and Total Factor Productivity of Manufacturing Enterprises. Quantitative Economics Technical Economics Research, 2017, (2): 89-104.

Yao Z. 2013. The Current Situation, Problems, and Countermeasures of China's Service Industry Opening. China Economy and Trade, (8).

Zhang J, Chen Z, Liu Y. 2013. Calculation and Mechanism of Change of China's Export Domestic Value Added. Economic Research, (10).

Zhang J, Yang S. FDI in Knowledge-Intensive Service Industry and Technological Progress in Manufacturing. Management Science, 2014, (2).

Zhang R. 2012. The Influence of Producer Services Imports on the Export Technology Structure of Manufactured Goods. Industrial Economic Research, (5).

Zhang Y, Tang Y, Zhou M. 2013. Does Service Trade Liberalization Improve the Production Efficiency of Manufacturing Firms? The World Economy, (11).

Zhao L, Wu M. The Influence of Producer Services on Export Advantage and Performance: An Empirical Analysis. Quantitative Economics Technical Economics Research, 2016, (3): 112-127.

Zhao Y, Wang G. 2012. Comparative Study on the Technical Progress Effects of Service FDI and Manufacturing FDI. Statistics and Decision, (4).

Zheng C, Chen L. 2007. Growth of Producer Services Trade during International Division Deepening and Apocalypse to China. World Economic Research, (1): 23-27.

Zhu Z, Huang X, Yu X. Import Intermediates Quality, Innovation and Firms' Export DVAR. China Industrial Economy, 2018, (8).