



Re-evaluation of trade in services from the
perspective of trade in service intermediates

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Abstract

With the rapid economic development and social progress, the service sector now accounts for an increasing proportion of the national economy. However, the available trade statistics appear to underestimate the sector's contributions. From the perspective of trade in service intermediates, this study examines the export trade of manufactured goods of embodied service intermediates using Chinese input–output tables from 2007 to 2017. The study finds that direct service industry exports are relatively small and that the contribution of services is principally represented by indirect, implicit exports of the manufacturing sector. While analyzing, it was observed that the scale of intermediate trade in services was significantly larger than that of direct trade. Based on industry, wholesale and retail sales, electric power, transportation, finance, business services, scientific research, and technical services accounted for a large proportion of trade in services as a whole.

Keywords

trade in services, intermediate services, input–output model.

1. Introduction

The service industry plays an increasingly important role as an integral part of the modern economy. The Heckscher–Ohlin (HO) theory (1933) is based on Ricardo's (1817) comparative advantage theory that presents a model to examine the fundamental comparative differences in resource endowments and product characteristics in multiple countries. Heckscher and Ohlin believe that the richness of production factors in each country is not the same. The production factors required for the manufacture of different products differ. In this case, if a country produces a particular product and intensively uses relatively abundant domestic production factors, it can enjoy a comparative advantage in making such a product. The Heckscher–Ohlin–Vanek (HOV) theory (1968) presents an extended version of the HO theory that predicts the factor content amount of production (indirect factor trade) embodied in trade under certain assumptions. This study applies the HOV framework to investigate trade in service intermediates. Services have two characteristics: intangible and non-storable. Given the recent technological advancements, some service products are subjects of direct transactions, but many of them continue to be input as intermediate goods; for example, Chinese college students domestically import American research and education services by buying American books, but statistics only record the import of the books. These students purchase American research and education; thus, focusing only on direct trade underestimates the trade in research and education in services.

Since the 12th Five-Year Plan, China's service industry has continued to reach new heights, becoming the main driving force of China's economic growth and reshaping the nation's industrial sector. According to the input–output table 2012 and 2017 data illustrates a service value-added in 2012 exceeded secondary industry, accounting for 54.1% of the gross domestic product (GDP) by 2017. Trade in services also continued to grow. Services accounted for 18.0% of exports in 2012, reaching 18.1% by 2017. Imports also grew from 8.6% in 2012 to 14.9% in 2017. Notably, according to balance-of-payments data, the importance of trade in services has not been fully evaluated, and a contradiction remains with regard to the relatively low proportion of trade in services captured. According to existing evaluations, China's trade in services as a proportion of total goods trade in the 1990s reached a maximum of 25% (see appendix), but declined gradually. If tourism is excluded, which appear to be inconsistent with the current economic growth patterns.¹

Empirical analyses of technology spillover effects have concluded that technology spillovers from developed to developing countries are mainly channeled through foreign direct investment, the purchase of technology (licensing and patent acquisition), and the import of capital goods, such as machinery and equipment (Coe and Helpman, 1995; Tong Jiadong, 1995; Coe, Helpman, and Hoffmaister, 1995; Chen Zhiyuan, 2001; Barba Navarett and Soloaga, 2002; Tang Zhi, 2008). Among them, as the carrier of advanced technology,

¹ Please refer to Appendix 1 and Appendix 2 for detailed data.

capital imports from developed countries to developing countries have been demonstrated to exert a technology spillover effect. However, domestic and foreign literature on this issue mainly engage a theoretical verification level of the capital import technology spillover effect. Thus, the validity of this hypothesis can be considered unconfirmed using real-world data, and the analysis of trade in goods in embodied services can further investigate the validity of this hypothesis.

To better understand and analyze the role of services in international trade, this paper uses Chinese input–output tables for 2007, 2012, and 2017 to both reevaluate the proportion and role of trade in services focusing on service intermediates and to estimate the embodiment of those service intermediates in the export of manufactured goods. Service intermediates refer to direct and indirect trade in services, and we consider not only direct trade but also indirect embodied service intermediates in manufactured goods exports. The contributions of this paper to the contemporary literature are twofold. First, it develops the first measurement of embodied service intermediaries in imports and exports of the manufacturing industry, with a complementary effect of uncovering the existing statistical underestimation of trade in services. Second, it reevaluates the role of embodied service intermediates in trade in services, revising the widely accepted notion of “heavy manufacturing, light services,” enhancing the competitiveness of China’s service industry.

2. Literature Review

2.1 Definition of service industry

Generally, the definition of the service industry concept is divided into broad and narrow perspectives according to its use. In a broad sense, the service industry refers to a tertiary industry other than agriculture, forestry and fishery, mining, manufacturing, and construction, including electricity/gas/water, wholesale/retail, finance/insurance, real estate, transportation, telecommunications, and service industries (in a narrow sense), government services, and other services. The narrowly defined service industry includes entertainment, food, accommodation, laundry/hairdressing/beauty/bath, education, medical/welfare and other personal services, advertising, product leasing, car/machine maintenance, research, and other commercial services.

This research refers to the broad definition of service industry, which is hereafter generally referred to as “service industry.” Unless otherwise specified, all references are to the service industry in the broad sense.

2.2 The definitions of “embedded” and “embodied” service trade

An important issue is the assumption of the real contribution of services to exports being much greater than currently recognized, as elements of service cost can be traded by embedding them in manufactured products, or as intermediate inputs in the production of goods. Thus, these elements can be divided into categories of “embedded” and “embodied”²

2 Grubel (1988) refers to service intermediate as input embodied services.

services. Embodied services are services encapsulated in mining, agricultural, and manufactured products, such as energy, transportation, communications, insurance, accounting, design, and intangible elements. Other services, such as financing, training, maintenance, and other after-sales services, are embedded in commodity sales nodes. For many high value-added or expensive manufactured goods, the value of “embodied” or “embedded” services is particularly high. However, the value of embodied or embedded services in products is included in the value of manufactured goods, not in the value of services. For many consumer goods, the combination of goods and embedded services is becoming the key consideration of commodity differentiation in the market and is also an important way to realize added transparency in the overall value of products.

2.3 The role of trade in service intermediates

In the empirical analyses of international economics, most scholars analyze implied elements. A review of the relevant literature revealed that the research in this area was predominantly conducted in the 1980s, with few empirical analyses examining the role of embodied service intermediates on exports. Grubel (1988) examined embodied service intermediaries in Canadian exports from 1973 and 1983. Over that decade, Canadian embodied services exports substantially increased, to the point at which Canada enjoyed a surplus in embodied services trade but a deficit in cross-border services. By separating direct and indirect trade in services data, Grubel revealed that the number of indirect intermediate services implied as intermediates in manufactured goods was comparable to Canada’s trade deficit. Tucker and Sundberg (1988) analyzed trade in service exports from Australia, Thailand, and Singapore, finding that 50% of all Australian services exports—defined here as the sum of cross-border service exports and embodied service exports—were embodied services, whereas they were 30% for Thailand and 18.5% for Singapore. Sazanami and Urata (1990) assessed embodied service intermediates in the export of goods, targeting Japan in 1975 and 1985 and the United States in 1982. The results indicated that embodied services trade was significantly greater than cross-border trade for both countries. Based on Sazanami and Urata’s previous analysis, Urata (1994) conducted a further detailed analysis of different sectors, including electricity, natural gas and water, commerce, finance, transportation, and communications, finding that in 1990, the embodied services trade in Japan’s manufactured exports accounted for a substantial proportion of total trade in services, with imports and exports at 78% and 76%, respectively. Marcella (2015) investigated the relationship between manufacturing exports and embodied producer services in the Philippines and the critical importance of productive services in manufacturing exports.

Very little research in this area has been conducted by Chinese scholars. Among them, Xia Jiechang and Ni Hongfu (2017) analyzed the role of China’s service industry in export trade from a value chain perspective, finding that value-added direct exports of the service industry are relatively small and channeled mainly through implied indirect exports in the

manufacturing sector. This paper endeavored to measure embodied intermediate services in the export of goods trade to evaluate the role of the service industry in trade and value creation.

3. Methods and Data

3.1 Methods

Suppose that there are i ($=1\cdots i$) industries, and the balance of production and consumption is written as follows:

$$\mathbf{X} \equiv \mathbf{A}\mathbf{X} + \mathbf{D} + \mathbf{E} - \mathbf{M} \quad (1)$$

where \mathbf{X} is the output vector; \mathbf{D} , the domestic final demand vector; \mathbf{E} , the export vector; \mathbf{M} , the import vector; and \mathbf{A} , the matrix of input–output coefficients a_{ij} . Note that input–output coefficients are computed as follows:

$$a_{ij} = X_{ij}/X_j \quad (2)$$

where X_{ij} is the intermediate demand flow from industry i to industry j , and X_j is the total input used by industry j . From the balance of production and consumption, \mathbf{X} is isolated in the left-hand side of the equation such as that:

$$\mathbf{X} \equiv (\mathbf{I} - \mathbf{A})^{-1}(\mathbf{D} + \mathbf{E} - \mathbf{M}) \quad (3)$$

where $(\mathbf{I} - \mathbf{A})^{-1}$ is the Leontief inverse or multiplier matrix. The magnitude of production induced by exports and imports (import substitution) can then be described as follows:

$$\mathbf{X}_E \equiv (\mathbf{I} - \mathbf{A})^{-1}\mathbf{E} \quad (4)$$

and

$$\mathbf{X}_M \equiv (\mathbf{I} - \mathbf{A})^{-1}\mathbf{M} \quad (5)$$

As for the computation of services embodied in goods trade, suppose that service industries are labeled from e_1 to e_g in i . In other words, if $i \leq g$, sector i is agriculture or manufacturing (merchandise), whereas if $i > g$, sector i is services. Let $\mathbf{E}'_g = [e_1, e_2, \dots, e_g, 0, \dots, 0]$ and $\mathbf{M}'_g = [m_1, m_2, \dots, m_g, 0, \dots, 0]$ represent export and import vectors of goods. Domestic production induced by exports and imports of goods can be obtained as \mathbf{E}'_s and \mathbf{M}'_s as follows:

$$\mathbf{E}'_s \equiv (\mathbf{I} - \mathbf{A})^{-1}\mathbf{E}'_g \quad (6)$$

and

$$\mathbf{M}'_s \equiv (\mathbf{I} - \mathbf{A})^{-1}\mathbf{M}'_g \quad (7)$$

Trade in services as a whole is equal to the sum of direct and indirect trade, described in Eqs. 8 and 9, respectively.

$$\mathbf{E}'_s^T = \mathbf{E}'_s^I + \mathbf{E}'_s^D = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{E}'_g + \mathbf{E}'_s^D \quad (8)$$

$$\mathbf{M}'_s^T = \mathbf{M}'_s^I + \mathbf{M}'_s^D = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{M}'_g + \mathbf{M}'_s^D \quad (9)$$

3.2 Data

The data used in this study are from Chinese input–output tables for 2007, 2012, and 2017. It is important to note that there are some differences in the sectoral classifications of trade industry and services in the Chinese input–output tables and those of the International Monetary Fund and World Trade Organization. For example, the sectoral classifications in the Chinese tables do not include patent royalties or transactions between Chinese enterprises and subsidiaries of multinational corporations in China. Industries are classified into 39 sectors, of which 17 represent service sectors: electric power production, steam and hot water production and supply, gas production and supply, water production and supply, wholesale and retail trade, transportation, warehousing and post, hotels and restaurants, telecommunication, software and information technology services, finance, real estate, rental and business services, scientific research and technical services, geological prospecting and water conservancy, private households, repairs and other services, education services, health and social work, culture, sports and recreation, public administration, social welfare, and other community services.³

4. Results

Tables 1a and **1b** present the direct and indirect exports of trade in services during the analysis period. Direct services trade in wholesale and retail, transportation, warehousing and postal services, and rental and business services sectors accounted for more than 80% of all trade in services between 2007 and 2017. The scale of indirect trade in services is much larger than that of direct trade, four times more in 2017. Therefore, it is imperative to consider intermediate services when evaluating trade and value creation in services. Consider the following: in direct trade in services, balance of payments may exhibit a deficit, but after including consideration of intermediate services, the balance of payments of trade in services may shift from a deficit to a surplus. This result has been validated in Grubel (1988) and Sazanami and Urata (1990).

Table 2 presents the share of indirect services of total trade in services and the overall export ratio of embodied intermediate services in manufactured exports, at 75.9%, 72.9%, and 73.5%, respectively, confirming the importance of indirect trade in trade in services. The result mirrors Japan's experience in the 1980s.

³ Among them, the input–output table sector classification for 2007 and 2012 is based on the 2002 national industry classification, and the input–output table sector classification for 2017 is based on the 2011 national industry classification.

Table 1a. Direct and indirect export of services (unit: Billion Chinese yuan)

	Direct Export			Indirect Export			Total Export		
	2007	2012	2017	2007	2012	2017	2007	2012	2017
Electricity, Steam and hot water production and supply	7	8	10	1,279	1,355	1,239	1,286	1,362	1,248
Gas production and supply	0	0	0	31	30	55	31	30	55
Water production and supply	0	0	0	33	21	23	33	21	23
Wholesale and retail trade	401	1,177	1,363	570	1,202	1,757	970	2,380	3,120
Transportation, Warehousing and Post	403	569	797	723	1,114	1,464	1,127	1,684	2,260
Hotel and restaurant	74	57	47	206	229	326	279	286	374
Telecommunication, Software and Information Technology Service	45	100	210	161	156	395	205	255	605
Finance and Insurance	9	41	59	517	1,091	1,129	526	1,133	1,189
Real Estate Activities	0	0	0	102	173	343	102	173	343
Renting and Other Business Activities	321	413	283	281	685	1,077	602	1,099	1,360
Scientific research and technical services	3	3	131	70	390	266	72	393	396
Geological prospecting and water conservancy	0	11	9	129	38	45	129	48	54
Private Households, repair and other service	28	12	3	103	147	182	132	159	184
Educational services	3	4	0	20	16	14	22	20	14
Health and Social Work	4	4	8	38	7	12	42	11	21
Culture and sports and recreational services	33	55	41	44	57	68	77	112	109
Public administration, social welfare and Other Community	4	6	11	4	25	17	8	32	29
Service total	1,374	2,538	3,055	4,329	6,827	8,442	5,703	9,364	11,496

Data source: calculated by the authors.

Table 1b. Direct and indirect export of services

	Direct Export			Indirect Export			Total Export		
	2007	2012	2017	2007	2012	2017	2007	2012	2017
Electricity, Steam and hot water production and supply	0.5%	0.3%	0.3%	29.6%	19.8%	14.7%	22.5%	14.5%	10.9%
Gas production and supply	0.0%	0.0%	0.0%	0.7%	0.4%	0.6%	0.5%	0.3%	0.5%
Water production and supply	0.0%	0.0%	0.0%	0.8%	0.3%	0.3%	0.6%	0.2%	0.2%
Wholesale and retail trade	29.2%	46.4%	44.6%	13.2%	17.6%	20.8%	17.0%	25.4%	27.1%
Transportation, Warehousing and Post	29.3%	22.4%	26.1%	16.7%	16.3%	17.3%	19.8%	18.0%	19.7%
Hotel and restaurant	5.4%	2.2%	1.6%	4.8%	3.4%	3.9%	4.9%	3.1%	3.3%
Telecommunication, Software and Information Technology Service	3.2%	3.9%	6.9%	3.7%	2.3%	4.7%	3.6%	2.7%	5.3%
Finance and Insurance	0.6%	1.6%	1.9%	11.9%	16.0%	13.4%	9.2%	12.1%	10.3%
Real Estate Activities	0.0%	0.0%	0.0%	2.4%	2.5%	4.1%	1.8%	1.8%	3.0%
Renting and Other Business Activities	23.4%	16.3%	9.3%	6.5%	10.0%	12.8%	10.6%	11.7%	11.8%
Scientific research and technical services	0.2%	0.1%	4.3%	1.6%	5.7%	3.1%	1.3%	4.2%	3.4%
Geological prospecting and water conservancy	0.0%	0.4%	0.3%	3.0%	0.6%	0.5%	2.3%	0.5%	0.5%
Private Households, repair and other service	2.1%	0.5%	0.1%	2.4%	2.2%	2.2%	2.3%	1.7%	1.6%
Educational services	0.2%	0.2%	0.0%	0.5%	0.2%	0.2%	0.4%	0.2%	0.1%
Health and Social Work	0.3%	0.2%	0.3%	0.9%	0.1%	0.1%	0.7%	0.1%	0.2%
Culture and sports and recreational services	2.4%	2.2%	1.3%	1.0%	0.8%	0.8%	1.3%	1.2%	0.9%
Public administration, social welfare and Other Community	0.3%	0.2%	0.4%	0.1%	0.4%	0.2%	0.1%	0.3%	0.3%
Service total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Data source: calculated by the authors.

Table 2. The proportion of indirect service trade of overall service trade

	2007	2012	2017
Electricity, Steam and hot water production and supply	99.5%	99.4%	99.2%
Gas production and supply	100.0%	100.0%	100.0%
Water production and supply	100.0%	100.0%	100.0%
Wholesale and retail trade	58.7%	50.5%	56.3%
Transportation, Warehousing and Post	64.2%	66.2%	64.7%
Hotel and restaurant	73.6%	80.2%	87.3%
Telecommunication, Software and Information technology Service	78.2%	60.9%	65.3%
Finance and Insurance	98.4%	96.3%	95.0%
Real Estate Activities	100.0%	100.0%	100.0%
Renting and Other Business Activities	46.7%	62.4%	79.2%
Scientific research and technical services	96.4%	99.3%	67.0%
Geological prospecting and water conservancy	100.0%	77.8%	83.1%
Private Households, repair and other service	78.4%	92.6%	98.5%
Educational services	88.4%	78.5%	100.0%
Health and Social Work	90.0%	61.7%	59.7%
Culture and sports and recreational services	57.1%	50.7%	62.2%
Public administration, social welfare and Other Community	49.2%	80.2%	60.3%
Service total	76.4%	73.2%	73.9%

Data source: calculated by the authors.

5. Conclusion and Implications

The existing statistics resulting from research on trade in services do not fully evaluate the role of services in international trade. The contribution of the service industry to foreign trade is underestimated as the embodied intermediate services in exported manufactured goods are not fully recognized. This paper reexamines the role of the service industry in international trade from the perspective of intermediate services (embodied services) using Chinese input-output data. Our research demonstrates that, as the liberalization of economic services progresses, most services are invested in manufacturing production process as intermediates and eventually exported overseas to achieve value-added. During the period of analysis, the scale of intermediate trade in services was much larger than that of direct trade, and by industry, electric power, wholesale and retail sales, transportation, finance, business services, and scientific research and technical services accounted for a larger proportion of trade in services as a whole.

Based on the above conclusions, three policy implications emerge.

- (1) The improvement of statistical methodology. Fully aware of the importance of intermediary services, the existing balance-of-payments-centric statistics on trade in services must be refined.
- (2) Enhancing the marketization of services. The government should promote reforms in service industry regulations, reduce or eliminate unreasonable discriminatory and/or non-

discriminatory controls, and give full acknowledgment of the role of domestic and foreign service inputs.

(3) Improve training of technology-intensive talent. The proportion of intermediate services trade in information transmission, software and information technology services, finance, scientific research, and technical services has gradually increased. To improve the competitiveness of the manufacturing industry in the future, human capital accumulation should be augmented, and the technological advantages of domestic service inputs should be cultivated.

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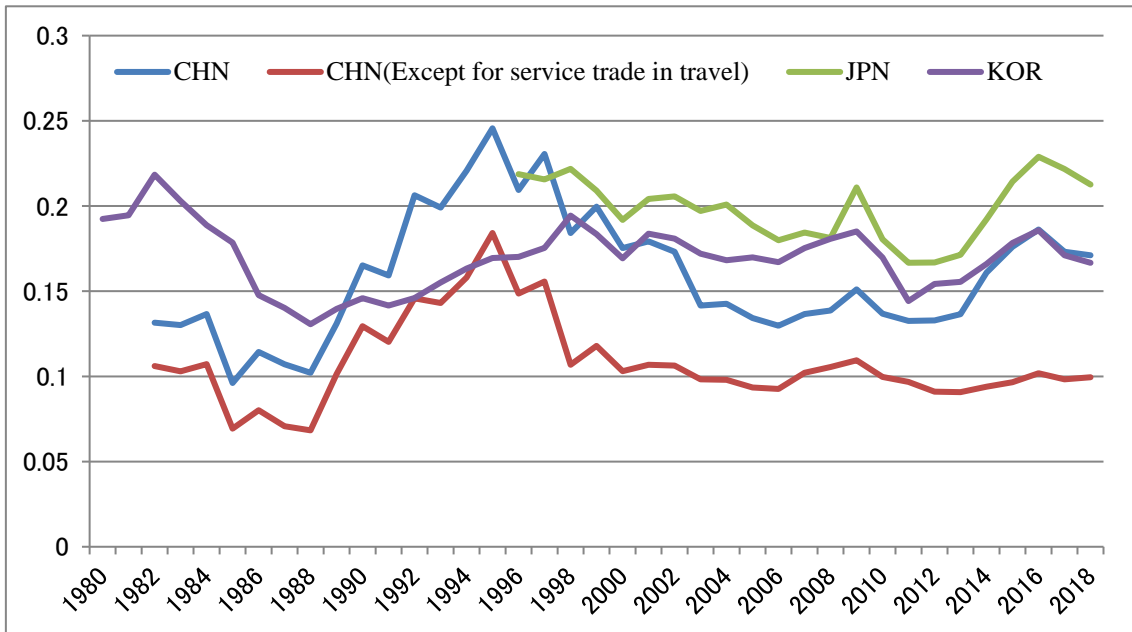
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Appendix 1 Structural changes in China's service industry

Share (%)	Output			Value Added			Export			Import		
	2007	2012	2017	2007	2012	2017	2007	2012	2017	2007	2012	2017
Electricity, Steam and hot water production and supply	13.9%	9.7%	6.5%	7.8%	4.9%	4.0%	0.5%	0.3%	0.3%	0.3%	0.2%	0.1%
Gas production and supply	0.5%	0.6%	0.6%	0.2%	0.3%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Water production and supply	0.5%	0.3%	0.3%	0.5%	0.3%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wholesale and retail trade	12.7%	14.4%	13.5%	15.4%	19.6%	17.3%	30.1%	47.8%	45.9%	0.0%	0.0%	0.0%
Transportation, Warehousing and Post	14.3%	12.4%	12.0%	13.3%	9.0%	10.4%	30.2%	23.1%	26.8%	18.9%	31.0%	27.8%
Hotel and restaurant	6.6%	4.7%	4.4%	4.9%	3.7%	3.1%	5.5%	2.3%	1.6%	9.0%	11.0%	19.1%
Telecommunication, Software and Information technology Service	4.4%	5.0%	6.6%	5.4%	4.6%	6.6%	3.3%	4.1%	7.1%	6.8%	7.0%	8.2%
Finance and Insurance	8.6%	11.8%	11.0%	11.9%	13.8%	12.1%	0.6%	1.7%	2.0%	2.2%	4.2%	6.2%
Real Estate Activities	6.5%	8.4%	9.1%	11.0%	12.3%	13.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Renting and Other Business Activities	5.2%	6.9%	8.4%	3.4%	4.4%	5.3%	24.1%	16.8%	9.5%	41.2%	26.6%	9.2%
Scientific research and technical services	0.6%	5.0%	6.0%	0.5%	3.6%	4.6%	0.2%	0.1%	4.4%	10.7%	2.1%	12.4%
Geological prospecting and water conservancy	2.9%	1.2%	1.1%	3.1%	1.0%	0.9%	0.0%	0.4%	0.3%	0.0%	2.1%	2.8%
Private Households, repair and other service	3.9%	3.1%	3.2%	3.6%	3.2%	3.2%	2.1%	0.5%	0.1%	3.5%	1.3%	1.2%
Educational services	5.8%	4.4%	4.3%	6.5%	6.4%	5.9%	0.2%	0.2%	0.0%	0.8%	1.3%	1.3%
Health and Social Work	4.9%	4.1%	4.9%	3.4%	3.5%	3.8%	0.3%	0.2%	0.3%	0.3%	0.8%	1.5%
Culture and sports and recreational services	1.6%	1.4%	1.6%	1.4%	1.4%	1.6%	2.5%	2.2%	1.4%	5.2%	11.8%	9.2%
Public administration, social welfare and Other Community	7.0%	6.7%	6.5%	7.7%	7.9%	7.6%	0.3%	0.3%	0.4%	1.1%	0.6%	1.1%
Service total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

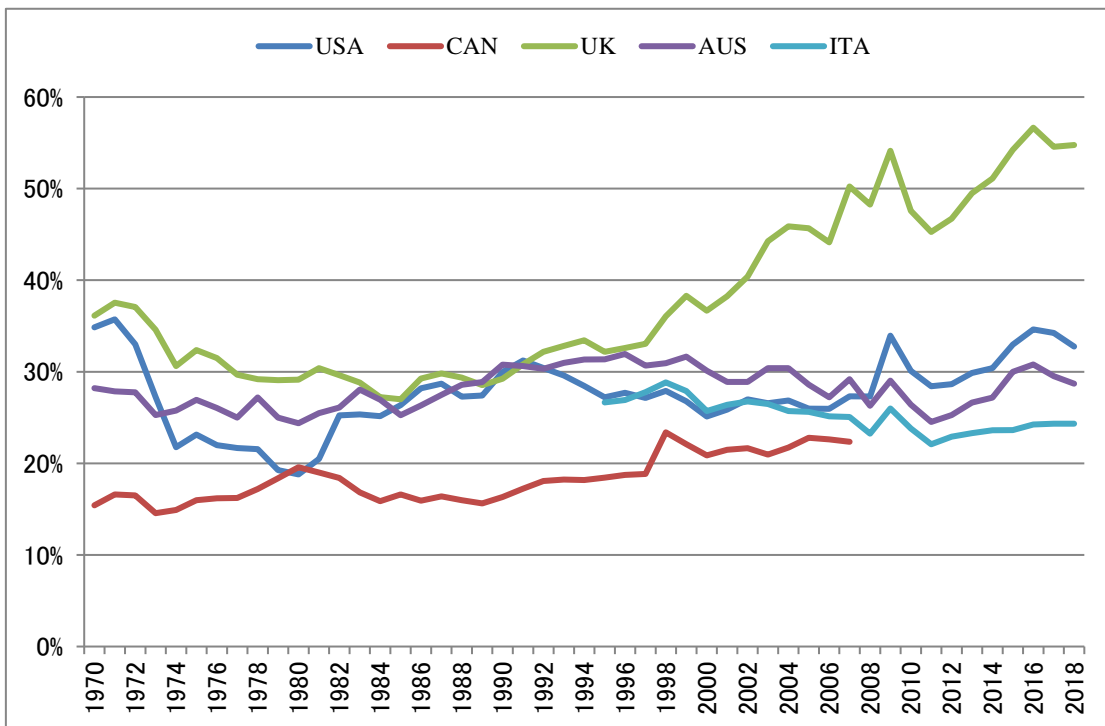
Data source: Calculated based on Input Output Table2007, 2012 and 2017.

Appendix 2-1 The proportion of service trade in goods trade



Data source: Calculated based on OECD, State Administration of Foreign Exchange BoP (Sixth Edition) data.

Appendix 2-2 The proportion of other developed countries' service trade in goods trade



Data source: calculation based on BoP (6th edition)/OECD data.