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Article

Digital services trade between China and V4 countries : a study of trade complementarity and regulatory restrictiveness

Digital Services Trade between China and V4 Countries – A Study of Trade Complementarity and Regulatory Restrictiveness

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Abstract

Digital services trade has definitely played an important role in the innovation of the bilateral trade cooperation mechanism between China and the Visegrád Group (V4), but the complementarity of their bilateral digital services trade has been little studied. We examine the complementarity of V4 countries' digital services trade with China, based on the UNCTAD classification of ICT-enabled services. The results show that the V4 countries have complementarity with China mainly in education services, intellectual property fees, architectural and engineering services. However, we also find that the regulatory heterogeneity of digital services between China and the V4 countries is negatively associated with their bilateral trade. Therefore, China and V4 countries should better enhance regulatory policy synergy for future trade cooperation in digital services.

Keywords: *digital services trade, trade complementarity, Visegrád group, regulatory restrictiveness, DSTRI heterogeneity*

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Introduction

As a key link to Euro-Asia, the Central and Eastern European Countries (CEECs) have an inseparable relationship with China, given their strategic location and excellent economic prospects. As early as 2012, China proposed the

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"16+1" cooperation, which establishes a cooperation mechanism between China and the 16 CEECs. The Belt and Road Initiative (B&R), proposed by Chinese President Xi Jinping in 2013, has further strengthened economic and trade cooperation between China and the CEECs. The political and cultural alliance known as the Visegrád Group (V4), comprising the Czech Republic, Hungary, Poland and Slovakia, has become an important economic force in the CEECs. In recent years, the trade volume between China and the V4 countries accounted for more than 70% of the total volume in the CEECs. The V4 countries have become China's long-term and deep international trade partners.

Over the past twenty years, advances in information and communications technology (ICT) and the growth of air transport have reduced services trade costs by a quarter to a half. Digital services trade now requires whole-of-government strategies to promote services trade competitiveness (Benz et al., 2022). Blázquez et al. (2023) argue that small European economies and Singapore highly depend on foreign digital services trade in their exports. In this context, in 2021 the V4 countries held the 30th Anniversary Heads of Government Summit in Krakow, Poland, where four prime ministers signed the Digital Manifesto, implying cooperation with other countries in digital development through V4+. China's "14th Five-Year" Service Trade Development Plan was also proposed to deepen service trade cooperation with countries along the B&R and innovate the multilateral service trade cooperation mechanism with CEECs. Based on the common policy orientation, the opportunities for cooperation between China and V4 countries in digital services trade would increase. However, the new international situation with the growing trend of anti- globalisation and frequent trade protectionism has also brought new challenges to the digital trade cooperation between China and V4 countries. Therefore, it is necessary to study the complementarity of import and export structure of digital services under the new situation where opportunities and challenges coexist, in order to provide strategies for improving China-V4 trade cooperation, which has hardly been noticed by scholars.

The remainder of this paper is structured as follows. Section 1 presents related studies in the field of digital services trade. Section 2 discusses the data source and measures. Section 3 reports the complementarity of digital services trade and analyses the impact of digital services trade restrictiveness and heterogeneity on bilateral trade between China and V4 countries. The last section concludes the study.

1. Literature Review

Digital services trade is a new concept in international trade, along with the emergence of digitally-enabled trade. It differs from cross-border e-commerce trade in goods, which uses digital technologies to facilitate transactions in

services. Technological change is a key driver of the transformation that makes non-tradable service sectors highly tradable (WTO, 2019, p. 14). (OECD, 2018, p. 33) defines digital services trade as those service products that can be delivered remotely through ICT networks. However, for some subsectors of services, there is no reliable way to identify their digital delivery scale. This study is based only on digital services that can be measured.

We find there is little research on the complementarity of digital services trade, while the research by scholars on the complementarity of traditional trade in services has some reference value. Baláž et al. (2020, p. 129) found that services trade between China and the EU is not highly complementary, implying that the EU can strengthen its bargaining power with China by increasing trade diversification. In addition to studying the overall comparative advantage and complementarity of services, scholars have focused more on the subcategories of services. Liu and Jin (2018, p. 59) studied the competitive advantages of China and South Korea and found that the two countries have trade complementarity in product-related services, cultural and recreational services, and other business services. Divisekera (2016, p. 1191) confirmed the complementarity between transport and tourism through cross-price elasticities in the United States and the United Kingdom.

Policy barriers are important determinants of services trade flows (Gervais, 2018, p. 743). Traditional GATT-type safeguards are no longer suitable for regulating the ever-expanding digital services trade, where barriers tend to be much more diverse (Kim, 2020, p. 813). Moreover, restrictions on data localization measures would disrupt digital trade (Hodson, 2019, p. 579). Some countries also rely on narrow interpretations of intellectual property law to restrict the cross-border transfer of digital services (Bieron and Ahmed, 2012, p. 545). The impact of the restrictiveness of digital trade regulations on trade in different digital services sectors has been tested empirically. Van der Marel and Shepherd (2013, p. 1402) show that the impact of trade regulations is heterogeneous across sectors and is negatively associated with trade in commercial and financial services. Hellmanzik and Schmitz (2016, p. 697) found that trade policy restrictions have a negative impact on audiovisual imports. Van der Marel and Ferracane (2021, p. 747) also found that regulatory data policies have an impact on digital-intensive services.

The establishment of the V4 and China's long-term trade cooperation, coupled with the policy direction of digital services development, has facilitated bilateral digital services trade cooperation. Jiang and Lin (2020, p. 3033) studied the international competitiveness of China's trade in various service sectors and found that China has no competitive advantage in most capital- and technology-intensive

services, such as finance, insurance, and patents and royalties. This creates potential trade complementarity with countries that have a comparative advantage in these services. However, the domestic trade regimes of China and the V4 countries have posed certain challenges to their bilateral digital services trade. (Ferracane and Lee-Makiyama, 2017, p. 259) examined China's digital trade policies and found that there are more than 70 measures that negatively affect digital trade. Ker-san-Skabic (2021, p. 99) found that barriers to cross-border digital trade in EU members are very heterogeneous due to the development of ICT, and some countries impose high restrictions on the conduct of digital trade. Chen et al. (2020, p. 19) found that service restrictions have a greater impact on bilateral trade costs between China and EU countries.

2. Research Methodology

2.1. Data

With regard to trade statistics in digital services, the OECD (2007, p. 7) first defines ICT services based on the Central Product Classification (CPC) Ver. 2. However, the CPC classification is not mainly used to collect statistics on trade in services. Therefore, UNCTAD (2007, p. 120) used the concept of ICT-enabled services to measure them, which includes 7 categories of BOP services such as communication services, insurance services, financial services, computer and information services, royalties and license fees, other business services and personal cultural and recreational services. The OECD, WTO and IMF (2019, p. 83) then developed this classification based on EBOPS 2010-CPC Ver. 2.1, as shown in Table 1. We use data on imports and exports of sub-digital services classified in Table 1 from the "OECD Statistics on International Trade in Services" database.

T a b l e 1

Digital Services Trade Classification

Sub-categories	SDMX DSD	EBOPS 2010
Insurance and pension services	SF	6
Financial services	SG	7
Charges for the use of intellectual property n.i.e.	SH	8
Telecommunications, computer, and information services	SI	9
Research and development services	SJ1	10.1
Professional and management consulting services	SJ2	10.2
Architectural, engineering, scientific and other technical services	SJ31	10.3.1
Other business services n.i.e.	SJ35	10.3.5
Audiovisual and related services	SK1	11.1
Health services	SK21	11.2.1
Education services	SK22	11.2.2
Heritage and recreational services	SK23	11.2.3

Source: UNCTAD-led TGServ Task Group.

2.2. Methods

The trade complementarity index (TCI) is the most widely used method of measuring how closely a country's export of a good or service matches another country's import. The TCI was defined by Peter Drysdale (1969, p. 23) and can be expressed as:

$$C_{ij}^{k} = RCA_{xi}^{k} \times RCA_{mj}^{k} \tag{1}$$

$$RCA_{xi}^{k} = \left(X_{i}^{k} \,/\, X_{i} \right) / \left(X_{w}^{k} \,/\, X_{w} \right) \tag{2}$$

$$RCA_{mj}^{k} = \left(M_{j}^{k} \,/\, M_{j} \right) / \left(M_{w}^{k} \,/\, M_{w} \right) \tag{3}$$

where

C_{ij}^{k} indicates TCI between country *i* and *j*, RCA_{xi}^{k} is the revealed comparative advantage (RCA) of export good or service *k* in country *i*, RCA_{mj}^{k} is the revealed comparative disadvantage of import good or service *k* in country *j*. X_{i}^{k} and X_{w}^{k} are the export of good or service *k* in country *i* and the world respectively, X_{i} and X_{w} are the total export of country *i* and the world respectively. M_{j}^{k} and M_{w}^{k} are the import of good or service *k* in country *j* and the world respectively, M_{j} and M_{w} are the total export of country *j* and the world respectively. In addition, $C_{ij}^{k} > 1$ indicates importer and exporter have trade complementarity in good or service *k*. The opposite will be true if $C_{ij}^{k} < 1$.

3. Empirical Analysis

3.1. Trade Complementarity Analysis

Trade complementarity reflects the consistency of the structure of imports and exports of products or services between two countries. And the stronger the trade complementarity between two countries, the more economic benefits can be maximized through trade cooperation, which is conducive to maintaining trade balance. To analyze the trade complementarity in digital services between China and V4 countries, we first report their digital services trade competitiveness and compare the advantages.

3.1.1. Competitiveness of Digital Services Trade between China and V4 Countries

Table 2 shows the shares of digital services export accounts in total services export of China and V4 countries, implying their digital services export structures. It is known that the shares of digital services export in V4 countries were

generally higher than that of China from 2011 to 2020, indicating that China's digital services export is relatively disadvantaged. Perhaps this is because China's ICT industry has been lagging behind in recent years, and related digital products are largely dependent on imports from developed countries. In addition, it is worth noting that Hungary's digital services export is stable at a high level from 2011 to 2020, with its ratio in the range of 0.370 to 0.401.

Table 2

Shares of Digital Services Exports

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
CHN	0.092	0.112	0.122	0.137	0.156	0.167	0.177	0.225	0.244	0.277
CZE	0.327	0.339	0.358	0.361	0.352	0.368	0.370	0.375	0.390	0.400
HUN	0.393	0.398	0.387	0.390	0.391	0.396	0.401	0.389	0.388	0.370
POL	0.304	0.314	0.313	0.324	0.338	0.348	0.352	0.366	0.380	0.365
SVK	0.101	0.124	0.350	0.331	0.325	0.335	0.389	0.383	0.391	0.424

Note: No units. Values stand for the shares of digital services export accounts for total services export.

Source: WTO database and own calculations.

Table 3

Trade Competitiveness (TC) of Digital Services Trade

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
CHN	–0.370	–0.341	–0.368	–0.340	–0.133	–0.190	–0.195	–0.092	–0.037	–0.052
CZE	–0.025	–0.046	–0.025	–0.037	0.011	0.031	0.039	0.024	0.004	0.040
HUN	–0.053	–0.022	–0.065	–0.041	–0.044	–0.004	0.033	0.041	0.017	0.050
POL	–0.121	–0.083	–0.047	–0.020	0.011	0.038	0.076	0.109	0.138	0.126
SVK	–0.235	–0.152	–0.056	–0.069	–0.097	–0.063	0.023	0.022	0.029	0.077

Note: No units. TC stand for the shares of digital services import and export balance accounts for the total services import and export volume.

Source: WTO database and own calculations.

Table 3 shows the trade competitiveness (TC) indices of China and V4 countries, indicating the international competitiveness of the country's digital services export over import. The country's digital services could be more competitive when the index is closer to 1. China's TC indices were less than zero from 2011 to 2020, indicating that China's digital services trade competitiveness was relatively weak. It is related to the development of China's ICT industry, digital technologies are relatively backward compared to developed countries. Czech Republic and Poland's TC indices have changed from a negative value to a positive value since 2015, and Poland's digital services trade has become the most internationally competitive among V4 countries in the past three years. Thanks to strong government support for digital infrastructure, Poland has become one of the fastest growing e-commerce markets in Europe.

3.1.2. RCA of Digital Services Trade by Category in V4 Countries

Due to the development of digital infrastructure and the boom of e-commerce market, V4 countries' digital services trade has a competitive advantage over China. Next, we calculate the RCA to further measure the competitive advantage of the V4 countries' digital services trade sub-categories, the calculation method is the same as in section 2.2.

Table 4

RCA of Czech Republic's Digital Services Trade by Category

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SF	0.552	0.577	0.479	0.509	0.510	0.502	0.502	0.668	0.565	0.483
SG	0.241	0.209	0.231	0.273	0.278	0.247	0.243	0.226	0.193	0.190
SH	0.226	0.285	0.308	0.385	0.389	0.329	0.276	0.293	0.396	0.424
SI	1.363	1.457	1.475	1.589	1.579	1.760	1.826	1.673	1.664	1.828
SJ1	0.739	0.473	0.589	0.977	1.015	0.894	0.936	0.988	0.958	0.900
SJ2	1.880	1.773	1.701	1.598	1.534	1.454	1.483	1.368	1.278	1.414
SJ31	3.616	3.533	2.561	1.621	1.636	1.639	1.412	1.660	2.092	–
SJ35	1.972	1.943	2.052	1.096	1.183	1.105	1.043	1.162	1.100	–
SK1	0.562	0.804	0.895	0.954	0.784	1.121	0.935	1.040	1.149	1.589
SK21	4.397	2.252	2.632	2.906	2.990	2.575	4.933	4.763	5.106	–
SK22	4.633	4.062	3.378	4.306	4.880	4.903	6.744	10.509	9.350	–
SK23	2.478	3.746	2.460	2.485	2.459	1.152	1.417	1.213	1.187	–

Note: No units. Values' detailed compute process see section 2.2. There are a lot of "–" null values in 2020, probably caused by the influence of COVID-19 on some service sectors' output and export.

Source: WTO database and own calculations.

From the RCA of Czech Republic, we can find that architectural, engineering, scientific and other technical services, health services and education services have relatively stronger competitive advantages. The Hungarian government has strongly supported and invested in the modernization of domestic health care. Hungary's health services, education services, cultural and recreational services, and employment services have relatively stronger competitive advantages, but the latter two have been declining year by year (see Table A.1 in the Appendix). Poland's health services, education services, heritage and recreation services have relatively stronger competitive advantages (see Table A.2 in the Appendix); attracting foreign students and expanding trade in education services have been seen as important means of promoting economic development. Digital services trade started relatively late in the Slovak Republic, and only health and education services have a relatively strong competitive advantage (see Table A.3 in the Appendix).

3.1.3. TCI of Digital Services Trade among China and V4 Countries

Based on the comparative advantages of the V4 countries and the comparative disadvantages of China in digital services, we further explore the complementarity of the V4 countries with China for 12 subcategories of digital services.

Table 5

TCI of Czech Republic-China in Sub-categories of Digital Services

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SF	0.068	0.085	0.064	0.077	0.091	0.111	0.110	0.144	0.154	0.132
SG	0.131	0.126	0.128	0.177	0.183	0.149	0.150	0.149	0.164	0.181
SH	0.174	0.225	0.231	0.412	0.363	0.320	0.269	0.332	0.442	0.984
SI	0.629	0.497	0.501	0.544	0.509	0.590	0.606	0.604	0.781	1.447
SJ1	0.122	0.092	0.119	0.362	0.326	0.245	0.290	0.350	0.340	0.327
SJ2	0.588	0.592	0.378	0.371	0.300	0.277	0.295	0.284	0.319	0.382
SJ31	6.263	5.451	1.895	1.428	1.066	1.523	1.257	1.570	2.630	–
SJ35	0.755	0.756	0.796	0.370	0.426	0.237	0.265	0.462	0.552	–
SK1	0.104	0.178	0.234	0.292	0.030	0.562	0.455	0.338	0.030	0.027
SK21	0.304	0.129	0.360	0.140	0.314	0.230	0.614	0.356	–	–
SK22	8.741	8.182	6.123	8.808	0.248	11.950	15.204	22.447	26.234	–
SK23	0.387	0.541	0.023	–	0.054	0.020	0.058	0.051	0.061	–

Note: No units. Values' detailed compute process see section 2.2.

Source: WTO database and own calculations.

From Table 5, we can see that the Czech Republic has a stable trade complementarity with China in architectural, engineering, scientific and other technical services and education services. And the trade complementarity with China is strongest in education services, which generally increased year by year. However, there is no obvious trade complementarity with China in other subcategories of digital services, so Czech Republic would be better to strengthen diversified cooperation in digital services with China.

Hungary is known to be complementary with China in many categories of digital services, such as fees for the use of intellectual property, health services and education services (see Table A.4 in the Appendix). However, Hungary's complementarity with China in employment services, heritage and recreational services has disappeared since 2013, as its comparative advantages in these two services have decreased year by year. From China's perspective, it is better to develop its own employment services, heritage and recreational services in order to reduce its export dependence on Hungary.

Poland has obvious trade complementarity with China in architectural, engineering, scientific and other technical services, health services and education services (see Table A.5 in the Appendix). Among these three services, trade complementarity is strongest in education services, as Poland's president welcomed the deepening of economic, trade, and education cooperation between Poland and China as early as 2011.

The Slovak Republic has less trade complementarity with China in most categories of digital services, except for education services, as its digital services trade has relatively weak export competitiveness compared to the other three countries. The Slovak Republic's trade in digital services is still largely dependent on imports.

3.2. Regulatory Restrictiveness and Heterogeneity on Bilateral Digital Services Trade

International services trade is often hindered by domestic policy barriers in trade regulations, and regulatory differences also increase the trade costs of bilateral services cooperation. In this section, we examined the impact of digital services trade restrictiveness and heterogeneity on bilateral trade flows between China and V4 countries, and proposed some corresponding strategies for their future digital services trade cooperation.

3.2.1. Model and Estimation

Following the recent studies on services trade restrictiveness, such as Ciuriak et al. (2020, p. 373), we adopt the gravity model to examine the impact of digital services trade restrictiveness on bilateral digital services trade between China and V4 countries. The gravity model, developed by Tinbergen (1962, p. 265) and Pöyhönen (1963, p. 94), has been used for empirical trade literature. The econometric model can be expressed as:

$$X_{ijt} = \beta_0 DSTRI_{it}^{\beta_1} DSTRI_{jt}^{\beta_2} DSTRIH_{ijt}^{\beta_3} Y_{it}^{\beta_4} Y_{jt}^{\beta_5} POP_{it}^{\beta_6} POP_{jt}^{\beta_7} DIST_{ij}^{\beta_8} F_{ij}^{\beta_9} \mu_{ijt}$$

where i represents V4 countries, j represents China. X_{ijt} denotes the digital services exports from V4 countries to China in period t. Y_{it} and Y_{jt} denote GDP in period t of V4 countries and China respectively. POP_{it} and POP_{jt} denote the population in period t of V4 countries and China respectively. $DIST_{ij}$ denotes the geographical distances between China and V4 countries. F_{ij} is a set of dummies are controlled: common language, contiguity, and common legal origins. The data are all taken from the CEPII database. $DSTRI_{it}$ and $DSTRI_{jt}$ are digital services trade restrictiveness index of V4 countries and China in period (2014 – 2020) from OECD database, imply the digital services trade policy barriers and domestic regulations. $DSTRIH_{ijt}$ is the digital services trade restrictiveness heterogeneity indices between China and V4 countries in period (2014 – 2020), implies the bilateral differences in regulation on digital services trade. We average the digital services-related sectors' data, selected from OECD: "Services trade restrictiveness index – heterogeneity indices" datasets. The sectors include accounting, commercial banking, computer, insurance, legal motion pictures, sound recording and telecom, but they are not perfectly consistent with our above digital services trade classification in Table 1, so we can only measure them approximately. Finally, μ_{ijt} denote random disturbance terms, including

the omitted multilateral resistance (MR) terms, which we describe it in more detail in the following section.

We estimate this model using the Poisson pseudo-maximum (PPML) estimator, which has been the most widely used in recent trade gravity studies because it can obtain consistent and unbiased estimates when the empirical model is in the presence of heteroskedasticity and a high frequency of zeros (Santos Silva and Tenreyro, 2006, p. 653). The results of the estimation are presented in Table 6.

3.2.2. Results and Analysis

T a b l e 6

PPML Estimation Results on Bilateral Digital Services Trade

	Basic PPML	**One-way FE**	**DSTRI pair**
$DSTRI_{it}$	1.225 (1.558)	10.488 (2.772)	3.146 (2.410)
$DSTRI_{jt}$	10.703 (7.115)	7.118 (13.223)	
$DSTRIH_{ijt}$	–25.469*** (6.523)	–52.339*** (14.863)	–24.864*** (7.022)
Y_{it}	3.071*** (0.512)	–	3.150*** (0.505)
Y_{jt}	0.890 (1.250)	2.865 (1.324)	0.503 (1.058)
POP_{it}	–109.625*** (27.387)	–	–115.161*** (26.547)
POP_{jt}	–21.046* (11.902)	–29.229 (16.644)	–15.359* (8.420)
$DIST_{ij}$	24.066*** (7.233)	52.993*** (10.308)	23.291*** (6.663)
Country-specficl FE	–	Y	Y
Number of Obs.	28	28	28
Adj. R-sq	0.946	0.822	0.950

Note: Robust standard errors of z-statistics in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01. "Basic PPML" column is estimated by PPML not considering MR terms. "One-way FE" column is estimated by controlling importer fixed effects. DSTRI pair = ($DSTRI_{it}^{\left(\frac{Y_{it}}{Y_{it}+Y_{jt}}\right)}$) * ($DSTRI_{jt}^{\left(\frac{Y_{jt}}{Y_{it}+Y_{jt}}\right)}$).

Source: OECD, CEPII database and own calculations.

In the "Basic PPML" column, the regulatory restrictiveness on digital services trade of China and V4 countries is not significant to their bilateral trade, which means that the current digital services regulations of both are relatively imperfect, and do not work for digital services trade. Therefore, China and V4 countries should properly complete their domestic digital services regulations and reduce the policy barriers on digital services export, thus expanding the diversification of digital services trade. In addition, the regulatory heterogeneity of digital services trade is a serious obstacle to their trade. It means that there are certain differences in digital services regulation, such as data openness and service

import and export mode, which are not conducive to bilateral trade cooperation. Therefore, they need to strengthen bilateral digital services trade cooperation communication in the future to reduce the regulatory heterogeneity of digital services trade. It is better to establish an effective cooperation mechanism in this field as soon as possible.

We also find that the GDP of the V4 countries as exporters is positively related to their digital services exports to China, while population growth is unlikely to boost digital services exports. Finally, surprisingly, we find that large distances between trading partners are no longer a major barrier in the digital age. On the contrary, it will motivate bilateral trade in digitally delivered services, as the Internet has significantly reduced distance-related trade costs (Gomez-Herrera et al., 2014, p. 83). However, the gravity model is theoretically constructed with some trade costs (MR terms) not directly observed by the policymaker, which should be properly controlled to avoid omitted variable bias. This can be addressed by including exporter time and importer time fixed effects in the panel gravity model (Yotov et al., 2016, p. 18). However, this method is not properly feasible because DSTRI is point-in-time data, the effect of which could be absorbed by country fixed effects. Following (Nordås and Rouzet, 2016, p. 1168), we perform two robustness checks.

First, we test the sensitivity of the exporters' DSTRI estimates to the inclusion of importer fixed effects. The "One-way FE" column in Table 6 includes the V4 countries' DSTRI along with a set of China characteristic fixed effects for each year. The PPML regressor results remain robust, and the negative effect of DSTRI heterogeneity and the distance coefficient are larger after controlling for the MR terms. Moreover, there is no need to test the sensitivity of the importer DSTRI estimates to the inclusion of exporter fixed effects, as only China is included as an importer in this study. Second, we include a full set of importer and exporter fixed effects and construct a DSTRI pair variable that measures the geometric mean of the DSTRI of the V4 countries and China for each year, weighted by their respective shares in total GDP. The results are robust to the use of full country-specific fixed effects, as reported in the "DSTRI pair" column of Table 6. Moreover, the DSTRI pair is also insignificant for trade volume.

Conclusion

This study first discussed the complementarity of digital services categories between China and V4 countries. Specifically, Czech Republic and Poland have a sustainable trade complementarity with China in architectural, engineering, scientific and other technical services sector and education services sector during

2011 – 2020. Hungary has a trade complementarity with China in fees for the use of intellectual property, health services and education services. The Slovak Republic has trade complementarity with China mainly in educational services. In order to deepen bilateral trade cooperation, China and V4 countries should better expand the diversification of trade in digital services. Then, based on the gravity model, we examined the impact of digital services' trade restrictiveness and heterogeneity on bilateral trade. In conclusion, the regulatory heterogeneity of digital services between China and V4 countries is negatively associated with their bilateral trade. Therefore, China and V4 countries need to strengthen bilateral trade policy communication in future cooperation and enhance policy synergy on digital services trade.

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Appendix

Table A.1

RCA of Hungary's Digital Services Trade by Category

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SF	0.061	0.057	0.068	0.052	0.056	0.048	0.049	0.059	0.065	0.057
SG	0.204	0.167	0.177	0.170	0.172	0.177	0.206	0.227	0.229	0.263
SH	1.604	1.634	1.613	1.499	1.220	1.238	1.034	1.047	0.861	0.984
SI	0.914	0.934	1.011	1.028	0.976	0.977	1.087	1.085	1.010	1.214
SJ1	0.952	1.043	0.968	0.954	1.009	0.919	0.943	0.940	0.937	1.243
SJ2	1.188	1.156	1.107	1.231	1.305	1.350	1.264	1.282	1.259	1.658
SJ31	1.547	1.552	1.211	0.819	1.006	1.167	1.207	1.425	2.079	–
SJ35	4.001	3.858	3.914	2.170	2.428	2.137	2.166	1.916	1.918	–
SK1	1.291	1.087	1.672	2.632	2.403	2.186	2.260	2.149	3.419	2.927
SK21	21.429	19.578	18.940	20.541	19.100	24.559	22.122	22.667	20.656	–
SK22	2.136	2.467	1.768	1.693	1.914	2.522	9.756	4.925	4.390	–
SK23	12.077	9.306	7.481	4.640	6.873	6.467	5.861	4.591	5.600	–

Source: WTO database and own calculations.

Table A.2

RCA of Poland's Digital Services Trade by Category

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SF	0.535	0.338	0.375	0.279	0.517	0.484	0.435	0.329	0.350	0.328
SG	0.236	0.239	0.237	0.249	0.227	0.211	0.238	0.216	0.210	0.216
SH	0.146	0.121	0.154	0.157	0.192	0.174	0.188	0.166	0.165	0.298
SI	1.025	1.086	1.190	1.352	1.391	1.527	1.516	1.449	1.392	1.409
SJ1	0.945	0.880	0.878	1.047	1.043	0.904	0.934	0.978	0.930	1.105
SJ2	1.896	1.871	2.057	2.070	1.971	1.901	1.835	1.829	1.761	2.108
SJ31	2.408	2.705	1.883	1.477	1.468	1.591	1.691	1.883	2.466	–
SJ35	4.694	4.220	2.818	1.272	1.257	1.081	1.120	1.095	1.198	–
SK1	0.427	0.406	0.524	0.535	0.431	0.435	0.371	0.403	0.351	0.485
SK21	29.138	38.980	40.860	45.851	29.331	34.306	37.146	41.298	34.687	–
SK22	10.747	10.761	9.354	6.791	7.620	7.519	5.859	5.252	6.470	–
SK23	–	–	5.417	6.812	6.079	11.944	9.789	9.406	9.162	–

Source: WTO database and own calculations.

T a b l e A.3

RCA of Slovak Republic's Digital Services Trade by Category

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SF	0.530	1.009	0.210	0.317	0.401	0.241	0.301	0.298	0.334	0.269
SG	0.549	0.524	0.210	0.301	0.404	0.294	0.214	0.224	0.253	0.205
SH	0.034	0.030	0.058	0.069	0.069	0.069	0.048	0.090	0.068	0.085
SI	3.963	3.827	1.586	1.604	1.550	1.977	2.001	1.902	1.712	1.657
SJ1	–	–	0.402	0.344	0.264	0.302	0.385	0.384	0.411	0.369
SJ2	–	–	1.874	2.215	2.263	1.832	2.004	1.982	1.924	2.251
SJ31	–	–	3.525	1.797	1.681	1.942	1.051	0.953	1.131	–
SJ35	–	–	1.647	0.942	0.739	0.770	0.913	0.837	1.099	–
SK1	–	–	0.017	–	0.020	–	0.056	0.014	0.064	0.126
SK21	–	–	7.399	1.275	4.045	6.247	8.009	8.295	12.926	–
SK22	–	–	7.596	7.657	5.675	5.949	4.121	3.412	1.844	–
SK23	–	–	2.074	1.696	2.911	4.194	1.643	2.212	2.185	–

Source: WTO database and own calculations.

T a b l e A.4

TCI of Hungary-China in Sub-Categories of Digital Services

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SF	0.007	0.008	0.009	0.008	0.010	0.011	0.011	0.013	0.018	0.016
SG	0.111	0.101	0.098	0.111	0.113	0.107	0.127	0.150	0.195	0.251
SH	1.231	1.291	1.211	1.603	1.139	1.204	1.006	1.188	0.963	2.286
SI	0.422	0.319	0.344	0.352	0.315	0.327	0.361	0.391	0.474	0.961
SJ1	0.157	0.203	0.196	0.354	0.324	0.252	0.292	0.333	0.332	0.451
SJ2	0.372	0.386	0.246	0.286	0.255	0.257	0.251	0.266	0.314	0.448
SJ31	2.679	2.395	0.896	0.722	0.656	1.085	1.075	1.348	2.614	–
SJ35	1.532	1.501	1.518	0.732	0.874	0.459	0.550	0.762	0.962	–
SK1	0.239	0.240	0.437	0.805	0.092	1.096	1.100	0.699	0.089	0.050
SK21	1.479	1.119	2.593	0.992	2.009	2.196	2.753	1.695	–	–
SK22	4.030	4.969	3.204	3.463	0.097	6.147	21.995	10.521	12.318	–
SK23	1.888	1.343	0.069	–	0.151	0.112	0.240	0.195	0.286	–

Source: WTO database and own calculations.

T a b l e A.5

TCI of Poland-China in Sub-Categories of Digital Services

	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SF	0.066	0.050	0.050	0.042	0.092	0.107	0.096	0.071	0.096	0.089
SG	0.128	0.144	0.131	0.162	0.149	0.128	0.147	0.143	0.179	0.206
SH	0.112	0.095	0.116	0.168	0.179	0.169	0.182	0.189	0.184	0.692
SI	0.473	0.371	0.405	0.463	0.449	0.512	0.503	0.523	0.654	1.115
SJ1	0.156	0.171	0.178	0.388	0.335	0.248	0.289	0.347	0.330	0.402
SJ2	0.593	0.625	0.457	0.481	0.386	0.362	0.365	0.380	0.439	0.570
SJ31	4.170	4.173	1.393	1.302	0.957	1.479	1.505	1.781	3.102	–
SJ35	1.797	1.642	1.093	0.429	0.452	0.232	0.284	0.435	0.601	–
SK1	0.079	0.090	0.137	0.163	0.016	0.218	0.181	0.131	0.009	0.008
SK21	2.012	2.227	5.593	2.214	3.085	3.067	4.622	3.089	–	–
SK22	20.273	21.676	16.952	13.891	0.387	18.325	13.208	11.219	18.154	–
SK23	–	–	0.050	–	0.134	0.206	0.401	0.399	0.469	–

Source: WTO database and own calculations.

T a b l e A.6

TCI of Slovak Republic-China in Sub-Categories of Digital Services

	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SF	0.065	0.148	0.028	0.048	0.071	0.053	0.066	0.064	0.091	0.073
SG	0.299	0.316	0.117	0.196	0.265	0.178	0.132	0.148	0.216	0.195
SH	0.026	0.023	0.043	0.074	0.064	0.067	0.047	0.102	0.076	0.198
SI	1.829	1.306	0.539	0.550	0.500	0.663	0.664	0.686	0.804	1.312
SJ1	–	–	0.081	0.128	0.085	0.083	0.119	0.136	0.146	0.134
SJ2	–	–	0.417	0.514	0.443	0.349	0.399	0.412	0.480	0.608
SJ31	–	–	2.608	1.583	1.096	1.805	0.936	0.902	1.422	–
SJ35	–	–	0.639	0.318	0.266	0.165	0.232	0.333	0.551	–
SK1	–	–	0.005	–	0.001	–	0.027	0.004	0.002	0.002
SK21	–	–	1.013	0.062	0.425	0.559	0.996	0.620	–	–
SK22	–	–	13.767	15.662	0.288	14.498	9.290	7.288	5.175	–
SK23	–	–	0.019	–	0.064	0.073	0.067	0.094	0.112	–

Source: WTO database and own calculations.