

# Balancing Openness and Protection: Homogenization of Regulatory Laws in Digital Service Trade

Cuihong Yang, Xiaolin Wang, Huijuan Wang, Yan Xia \*

Digital service trade has emerged as a pivotal engine for global economic transformation and development. However, the implementation of differentiated regulatory measures for trade in digital services among economies has led to increasingly frequent trade disputes. This paper constructs a regulatory homogeneity network for digital service trade in 60 major economies, and systematically evaluates the structural characteristics of the network and the regulatory homogeneity among economies from 2014 to 2021. Furthermore, this paper empirically examines the impact of the partnership characteristics of regulatory homogenization in the network of major economies on their exports. The analysis of the network structure shows that major economies are more inclined to optimize and simplify existing trade partnerships, and are moving towards more diversified restrictive measures in the regulatory model of digital services trade, which has led to the rise of trade protectionism. The empirical text results show that expanding and deepening the regulatory homogeneous partnership of trade in digital services promotes the export of digital services in major economies. This promotion effect is mainly achieved by reducing the cost of digital service trade and enhancing business trust. In addition, the export promotion effect of developing regulatory homogenization partnerships is better than that of increasing the openness of digital service trade, and the homogenization of policies between openness and protection is more important. This paper provides important implications for coordinating the openness and security of digital services trade: China should actively cooperate with multilateral and bilateral digital service trade partners to jointly build a homogeneous environment for regulatory regulations. In particular, it is necessary to deepen the regulatory homogeneity partnership with Asian and developing economies to expand the influence of the “China model” in the global regulation of digital services trade.

**Keywords:** digital service trade, regulatory cooperation, regulatory homogenization partnerships, high-quality trade development

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## 1. Introduction

In recent years, digital service trade has gradually become the main way for the development of international service trade. According to UNCTAD STAT data, from 2005 to 2022, the proportion of global digital services exports in service trade increased from 45.04% to 57.11%. Nonetheless, there are clear differences in the focus of different economies on trade benefits, which has led to the emergence of new trade barriers that hinder the free flow of digital service trade. These barriers mainly include restrictive regulation and differentiated regulatory measures, the latter of which has gradually become a common hidden trade barrier with the increasingly stringent global regulatory environment, leading to an increasing number of trade disputes. For example, in the field of data security supervision, countries around the world have issued relevant laws and regulations. In 2021, China implemented a series of laws and regulations related to data security, such as *the Data Security Law and the Personal Information Protection Law*. The European Union implements the well-known *General Data Protection Regulation (GDPR)*; U.S. states act under their own statutes, such as *the California Consumer Privacy Protection Act*; Economies such as India and Singapore have introduced or updated personal data protection laws. For export service providers, ignoring the laws and regulations of the exporting economy can lead to significant economic losses. On September 2, 2021, *the Irish Data Protection Commission* announced a fine of €225 million for the instant messaging tool WhatsApp. The reason is that WhatsApp has failed to comply with GDPR regulations, and properly informing users about the way it shares personal data with parent company Facebook poses a threat to user privacy. It can be seen that when an economy promotes digital economic and trade cooperation, in addition to weighing whether it is fully open or implementing protective policies to limit it, it is also necessary to consider whether its regulatory regulations are homogeneous with those of multilateral and bilateral trading partners.

At present, there is still insufficient research in the field of homogenization of digital service trade regulations. Most studies focus on bilateral trade agreements rather than unilateral domestic regulations. In this aspect, Shi and Qi (2023) used RTA text data to construct a network of digital service trade rules, and found that the improvement of the network centrality of node economies can significantly promote their digital service exports. These studies explore the impact of RTA rules on international trade by quantifying the degree of liberalization of their different rules.

Some studies have noted the role of domestic regulations in digital trade transactions, focusing mainly on the restrictive measures of domestic regulations and their negative externalities. Meltzer (2019) found that governments are increasingly restricting global data flows in order to maintain the integrity of domestic regulations, undermining the economic benefits of digital trade. Qi and Qiang (2021), Zhou and

Yao (2021), and Suh and Roh (2023) found that the restrictive measures of domestic regulations will have different degrees of trade suppression effect on both exporting and importing countries. However, there is currently a lack of a unified system of international rules for digital trade to guide and monitor these restrictive measures. Economies should understand the differences in domestic regulations and regulations of their trading partners, and reduce the restrictions on digital trade activities imposed by differentiated standards (Liu, 2020; Xie *et al.*, 2020). However, there is relatively little quantitative research on differentiated regulatory measures and their potential impact on digital service trade. Nordås (2016) proposed a heterogeneity index for the Restrictive Index on Service Trade, emphasizing that this difference is a new type of barrier to service trade, but the study focuses on traditional cross-border service trade. Overall, there is a lack of assessment of the regulatory homogeneity of multilateral and bilateral trading partners and their specific impact on digital service trade. Therefore, it is still necessary to systematically assess the homogeneity of regulatory regulations between an economy and its bilateral trading partners, and to study the specific impact and mechanism of such homogeneity on digital service trade.

Based on the 2014–2021 United Nations Conference on Trade and Development (UNCTAD) database of bilateral subdivided category service trade, the Organisation for Economic Co-operation and Development's (OECD) Digital Service Trade in Restriction Index (DSTRI) and Service Trade Restriction Index (STRI) regulatory database, this paper focuses on the structural characteristics of the regulatory homogeneity network of digital service trade formed by 60 major economies. At the same time, this paper focuses on the partnership of regulatory homogenization in the network, and its impact on the digital service exports of major economies and its mechanism, so as to provide more direct evidence for the development of digital service trade in the world's major economies at the multilateral and regional levels. Compared with existing studies, the possible marginal contributions of this paper are: ①In terms of research topics, this paper focuses on the homogeneity of digital service trade regulatory regulations, breaking through the existing single research perspective that only focuses on specific digital service trade agreements. This paper is one of the earliest studies on the regulatory homogeneity of digital service trade in China, which provides a new perspective for measuring the complex relationship between the regulatory regulation of digital service trade and global trade flows. ②In terms of theory and methodology, this paper places the transaction of digital service trade, the degree of regulatory openness, and the degree of regulatory homogenization into a unified analytical framework, and on this basis, introduces the intensity index of regulatory homogenization of digital service trade, which can more comprehensively describe and explain the breadth and depth of regulatory homogenization between economies and trading partners. ③In terms of policy recommendations, based on the characteristics of the partnership and its impact effect of regulatory homogenization

in major economies around the world, this paper puts forward targeted suggestions on the regulatory strategy of China's digital service trade: China should find a balance between openness and protection through regulatory homogeneity while maintaining the moderate openness of digital service trade. In particular, priority should be given to developing regulatory homogeneous partnerships with Asian and developing economies to expand the influence of the "China model" in the global regulatory field of digital service trade.

The structure of the remaining paper is as follows: the second part is based on the existing research literature, reviews the mechanism of the regulatory homogeneous partnership of digital service trade on digital service trade, and puts forward the research hypothesis of this paper. The third part introduces the method of constructing a regulatory homogeneous network for digital service trade, and analyzes the structural characteristics of the network by using the network characteristic index. The fourth part introduces econometric models, sets specific variables, and reports benchmark regression, robustness tests, mechanism tests, and heterogeneity tests. The fifth part concludes and provides policy recommendations for the development of China's digital service trade.

## 2. Theoretical Mechanisms and Research Hypotheses

The complexity of the regulation of digital service trade and the international regulatory differences are not only related to consumer rights, service quality, and national sovereignty and security, but also pose a major obstacle to the global expansion of service providers. While ideally harmonized regulatory standards can help service providers achieve economies of scale. In reality, however, as each economy tends to protect its own consumer interests and digital sovereignty, service providers often face inconsistent eligibility requirements in different markets. This not only increases the cost of entry into new markets and limits the realization of economies of scale (Kox and Lejour, 2005; Kox and Nordås, 2007), but also leads many service providers, including large companies such as Google and Yahoo, as well as many small and medium-sized enterprises with limited resources, to exit or abandon cross-border business expansion (Cusumano, 2015; Stevens *et al.*, 2016).

Based on the model framework of Eaton and Kortum (2002) and Jiang *et al.* (2023), this paper constructs an estimation model of the cost of digital service trade. The basic assumption is that  $\tau_{i,j}^h$ , the cost of digital service of category  $h$  trade between economy  $i$  and economy  $j$ , is determined by  $D_j$ , the openness of digital service trade of economy  $j$ ,  $T_{i,j}$ , the degree of regulatory homogeneity of digital service trade between economy  $i$  and economy  $j$ , and other cost  $R_{i,j}$ . The specific expression is as follows:

$$\ln \tau_{i,j}^h = \alpha_1^h D_j + \alpha_2^h T_{i,j} + \alpha_3^h R_{i,j} \quad (1)$$

Based on the above assumptions, the total export value of digital services from economy  $i$  to economy  $j$  is expressed as follows:

$$X_{i,j} = \prod_{h=1}^H X_{i,j}^h = \prod_{h=1}^H M_i^h (\tau_{i,j}^h \omega_i^\delta)^{-\theta^h} \left( \frac{P_j^h}{\gamma^h} \right)^{\theta^h} X_j^h \quad (2)$$

Among them,  $M_i^h$  is the technical parameter of digital service of category  $h$  of economy  $i$ ,  $\omega_i^\delta$  is the marginal cost of production of economy  $i$ , which is determined by its wage level and parameter  $\delta$ ,  $\theta^h$  is the parameter and the value is positive,  $P_j^h$  is the price of digital services trade in economic  $j$  category  $h$ ,  $\gamma^h$  is a constant and the value is positive, and  $X_j^h$  is the total import value of digital services of category  $h$  of economy  $j$ .

Further, this paper considers the constraint relationship of trade cost  $\tau_{i,j}^h$  on the export of digital service, and its correlation can be further expressed as:

$$\ln X_{i,j} = \sum_{h=1}^H \ln M_i^h - \sum_{h=1}^H \theta^h \ln \tau_{i,j}^h - \delta \ln \omega_i^\delta \sum_{h=1}^H \theta^h + \sum_{h=1}^H \theta^h \ln P_j^h - \sum_{h=1}^H \theta^h \ln \gamma^h + \sum_{h=1}^H \ln X_j^h \quad (3)$$

Substituting Equation (1) into Equation (3), the export of digital services is re-represented as follows:

$$\begin{aligned} \ln X_{i,j} = & \sum_{h=1}^H \ln M_i^h - \sum_{h=1}^H \theta^h \alpha_1^h D_j - \sum_{h=1}^H \theta^h \alpha_2^h T_{i,j} - \sum_{h=1}^H \theta^h \alpha_3^h R_{i,j} - \delta \ln \omega_i^\delta \\ & - \sum_{h=1}^H \theta^h + \sum_{h=1}^H \theta^h \ln P_j^h - \sum_{h=1}^H \theta^h \ln \gamma^h + \sum_{h=1}^H \ln X_j^h \end{aligned} \quad (4)$$

Finally, this paper obtains a quantitative relationship between the impact of regulatory homogeneity on the export of digital services:

$$\frac{\partial \ln X_{i,j}}{\partial T_{i,j}} = \frac{\partial \ln X_{i,j}}{\partial \ln \tau_{i,j}^h} \frac{\partial \ln \tau_{i,j}^h}{\partial \ln T_{i,j}} = - \sum_{h=1}^H \theta^h \alpha_2^h \quad (5)$$

Among them, parameter  $\theta^h > 0$ ,  $\alpha_2^h$  is the impact of the degree of regulatory homogenization of digital service trade in the two economies on the trade cost, and the higher the degree of regulatory homogeneity, the lower the trade cost, so  $\alpha_2^h < 0$ . Based

on this, this paper proposes that expanding and deepening the regulatory homogeneous partnership of digital service trade will reduce the cost of digital service trade, and then promote the export of digital service.

Further, even if protective policies are generally implemented to limit opening-up, regulatory homogeneity can still promote digital service trade to a certain extent. For example, the European Union's GDPR sets high standards for data privacy protection and establishes a meticulous review mechanism. Moreover, the provisions of the GDPR can be effective outside the territory in addition to territorial jurisdiction. In contrast, the United States has implemented a model that emphasizes the free flow of data and reduces government regulation. The conflict between US and EU legislative patterns and standards in this area was reflected in a July 2020 legal ruling: the Court of Justice of the European Union ruled that the US failed to provide adequate personal data protection and ruled that *the US and EU Privacy Shield* were invalid. This ruling had a significant impact on many parties, including 5,380 businesses and organizations, and caused huge losses to the electronic communications and data service business in the United States (Huang and Wei, 2021). Japan received the European Commission's first adequacy certification for strict data protection, and the two companies have further advanced their digital partnership. These examples show that a homogeneous regulatory environment can help increase business trust between trading partners, which in turn increases the likelihood of cooperation. Therefore, this paper argues that expanding and deepening the regulatory homogeneity partnership of digital service trade will enhance business trust, which in turn will promote the export of digital service. To sum up, this paper proposes:

Hypothesis 1: Expanding and deepening regulatory homogeneous partnerships for digital service trade will promote digital service exports.

Hypothesis 2: Expanding and deepening the regulatory homogeneity partnership of digital service trade will reduce the cost of digital service trade, thereby promoting digital service exports.

Hypothesis 3: Expanding and deepening regulatory homogeneous partnerships for digital service trade will enhance business trust, which in turn will promote the export of digital service.

### **3. Regulatory Homogeneity Network and Its Structural Characteristics of Digital Service Trade**

#### *3.1. Definition of Regulatory Homogeneous Network for Digital Service Trade*

The regulatory homogeneity network of digital service trade shows the similarity of laws and regulations and most-favored-nation treatment among economies with active digital service trade. Each economy in the network is given a "trade policy"

attribute, i.e., the degree of regulatory openness ( $DSTOI_{i,t}$ ) for digital service trade. The core of the network includes the regulatory homogeneity index of digital service trade ( $DSRHI_{i,j,t}$ ) and  $DSTOI_{i,t}$ . Both indicators are derived from the DSTRI regulatory database and have a range of [0,1]. However, they don't measure the same angle.  $DSRHI_{i,j,t}$  compares the consistency of the two economies' implementation of standards in five areas.<sup>1</sup>  $DSTOI_{i,t}$  focuses on the standards for the implementation of these measures in a single economy, assessing whether these standards are more open or more restrictive for foreign service providers. It is worth further clarifying that the regulatory homogeneity network of digital service trade only covers active digital service trade economies, that is, countries or regions where there is digital service trade in the current year. The network connected edge between these economies is formed only when there is a value of digital services imports and exports ( $trade_{i,j,t}$ ) between the two economies, and this edge is given a value of  $DSRHI_{i,j,t}$ . By integrating digital service trade and regulatory homogenization into a unified analytical framework, this paper constructs a network that explores the breadth and intensity of regulatory homogeneity between economies in a more in-depth and comprehensive manner.

### 3.2. Construction of Regulatory Homogeneous Network for Digital Service Trade

This paper constructs regulatory homogeneity network ( $G_t$  and  $G_t^s$ ) of digital service trade and its seven main sub-categories among 60 economies from 2014 to 2021. All networks are undirected weighted. In the  $G_t$  network, the nodes ( $\mathbf{V} = [v_i]$ ) represent the 60 economies with digital service trade, and the adjacency matrix  $\mathbf{A}_t = [a_{i,j}^t]$  indicates whether there is trade among these economies, and the  $DSTHI_{i,j,t}$  is the edge weight, and the weight matrix is  $\mathbf{W}_t = [w_{i,j}^t]$ . In addition, the policy-trade attribute of each economy is represented by  $DSTOI_{i,t}$ , which is reflected in the attribute vector  $\mathbf{O}_t = [DSTOI_{i,t}]$ . Therefore, the annual regulatory homogenization network of digital service trade can be expressed as  $G_t = (\mathbf{V}, \mathbf{A}_t, \mathbf{W}_t, \mathbf{O}_t)$ . For the sub-category networks, including insurance and pension services, financial services, intellectual property services, telecommunication services, computer services, professional and management consulting services, audio-visual and related services, and other 7 networks, they are marked as  $G_t^{SF}$ ,  $G_t^{SG}$ ,  $G_t^{SH}$ ,  $G_t^{SI1}$ ,  $G_t^{SI2}$ ,  $G_t^{SJ2}$ ,  $G_t^{SK1}$ .

When building a network, the key is to get data about  $trade_{i,j,t}$ 、 $DSRHI_{i,j,t}$

<sup>1</sup> The five areas covered by  $DSRHI_{i,j,t}$  are: infrastructure and interconnectivity, electronic transactions, payment systems, intellectual property rights, and other barriers to digital service trade (Ferencz, 2019).

and  $DSTOI_{i,t}$ . Among them,  $trade_{i,j,t}$  is measured by using UNCTAD and the U.S. Department of Commerce's narrow caliber digital trade measurement method. The methodology considers that digital trade is the part of the Balance of Payments Services Extended Classification (EBOPS) sub-category of services that can be delivered by digital means. Specifically,  $trade_{i,j,t}$  is the sum of the service trade of the six sub-categories<sup>1</sup> of economy  $i$  and economy  $j$  in EBOPS in period  $t$ . When processing trade data, this paper refers to the method of Fagiolo *et al.* (2010) to solve the mismatch of bilateral trade data caused by statistical methods, reporting delays, and other factors.  $DSRHI_{i,j,t}$  and  $DSTOI_{i,t}$  are obtained by inversely converting the heterogeneity indicators of the digital services restrictive index ( $DSTR I_{i,j,t}$ ) and the digital services restrictive index ( $DSTR I_{i,t}$ ) published by the OECD, respectively.  $DSRHI_{i,j,t}$  reflects the degree of regulatory homogeneity of bilateral digital service trade, and the closer the value is to 1, the higher the degree of homogeneity of the regulatory measures of digital service trade between the two economies.  $DSTOI_{i,t}$  represents the degree of regulatory openness of economy  $i$  to foreign service providers in period  $t$ , and the closer the value is to 1, the less restrictive measures the economy has on foreign service providers and the more open regulation is.

In addition, in order to deeply analyze the market access status and cooperation opportunities of different digital service types, this paper constructs regulatory homogeneity network for seven sub-categories.

These networks are constructed by using the bilateral imports and exports of service ( $trade_{i,j,s,t}$ ) of each category as the basis of connected edge, and weighted by the regulatory homogeneity index of service trade ( $SRHI_{i,j,s,t}$ )<sup>2</sup>. The index reflects the degree of regulatory homogeneity of digital service trade in specific service categories, involving the degree of regulatory homogeneity in five areas: foreign entry, movement of people, competitive barriers, regulatory transparency and other discriminatory measures. At the same time, the regulatory openness of the corresponding category of service trade ( $STOI_{i,s,t}$ )<sup>3</sup> indicates the policy trade attribute of the economy.

<sup>1</sup> The six sub-categories of EBOPS covered by  $trade_{i,j,t}$  are: Insurance and Pension Services (SF), Financial Services (SG), IP Royalties not included elsewhere (SH), Telecommunications, Computer and Information Services (SI), Other Business Services (SJ), and Personal, Cultural and Recreational Services (SK).

<sup>2</sup>  $SRHI_{i,j,s,t}$  is an inverse conversion ( $SRHI_{i,j,s,t} = 1 - STRI_{i,j,s,t}$ ) of the heterogeneity index ( $STR I_{i,j,s,t}$ ) of the restricted index on service trade in the corresponding sectors of the  $s$  category published by the OECD. Referring to the study by Marel and Ferracane (2021), the correspondence between category and OECD divisions was used to convert between category  $STR I$  and departmental  $STR I$ .

<sup>3</sup>  $STOI_{i,s,t}$  is an inverse conversion ( $STOI_{i,s,t} = 1 - STRI_{i,s,t}$ ) of the restrictive index on service trade ( $STR I_{i,s,t}$ ) for the corresponding sector of the  $s$  category published by the OECD.

### 3.3. Description of the Characteristic Indicators of the Regulatory Homogeneity Network of Digital Service Trade

This paper defines four core indicators in detail to analyze the structural characteristics and trends of the regulatory homogeneous network of digital service trade. Network density  $\delta_t$  measure the degree of participation in digital service trade between economies, and when the  $\delta_t$  is close to 1, it indicates that there are frequent exchanges of digital service trade in the network.  $\delta_t$  close to 0 means that many economies do not yet have a digital service trade relationship (as shown in Equation (6)). The mean value of regulatory homogeneity  $AS_t$  calculate the ratio of the sum of the weights of all connected edges in the network to the total number of connected edges, and high values indicate that the regulation of digital service trade in the network is more consistent. Otherwise, the difference is large (as shown in Equation (7)). The mean value of regulatory openness  $AO_t$  reflects the average degree of openness of digital service trade in the network, and high values indicate that there are fewer restrictions on foreign service providers between economies. Conversely, it means that the lower the average level of regulatory openness of digital service trade in the network, the more restrictive measures foreign service providers are generally subject to (as shown in Equation (8)). The intensity of regulatory homogeneity  $PRHS_{i,t}$  assesses the proximity of economic  $i$  to its trading partners in the regulatory regime for digital service trade and the number of regulatory homogenization partners, with high values indicating that the regulatory system of economic  $i$  is more consistent with that of its main trading partners, which is conducive to reducing cross-border operating costs (as shown in Equation (9)). These indicators provide a quantitative analysis tool for studying the regulatory homogeneity of digital service trade.

$$\delta_t = \frac{\sum_{i=1}^N \sum_{j=1, j \neq i}^N a_{i,j}^t}{N \times (N-1)} \quad (6)$$

$$AS_t = \frac{\sum_{i=1}^N \sum_{j=1, j \neq i}^N w_{i,j}^t}{\sum_{i=1}^N \sum_{j=1, j \neq i}^N a_{i,j}^t} \quad (7)$$

$$AO_t = \frac{\sum_{i=1}^N DSTOI_{i,t}}{N} \quad (8)$$

$$PRHS_{i,t} = \sum_{j=1, j \neq i}^N w_{i,j}^t \quad (9)$$

Among them,  $N$  represents the size of the network, i.e., the number of all economies in the  $G_t$ .

### 3.4. Regulatory Homogeneity Network and its Structural Characteristics of Digital Service Trade

This paper shows a network diagram of regulatory homogeneity in digital service at the beginning and end stage. As shown in Figure 1, the size of the node circle represents the regulatory openness of the economy, the thickness with the edges represent the degree of regulatory homogeneity with the partner economy, and the node type represents the region, where the gray solid node, the black solid node, and the black hollow node represent the economies of the Americas, Asia, and Europe, respectively.

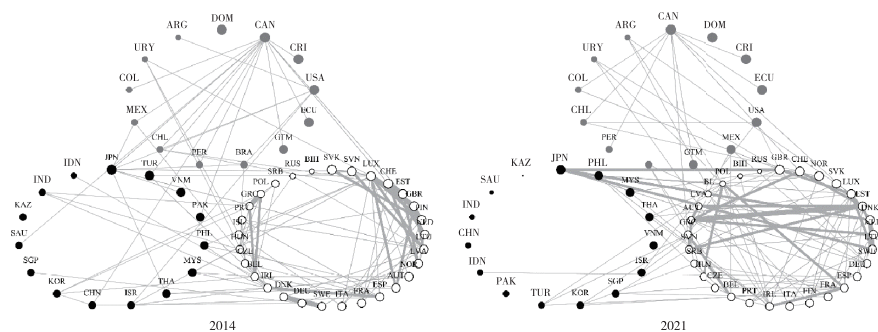


Figure 1. Regulatory Homogenization Network of Digital Service Trade in 2014 and 2021

Note: The economy shown in the network diagram belongs to the Americas, Asia, or Europe. The network diagram shows the top three edges with the largest regulatory homogeneity index for each economy, and ensures that these index values are all greater than or equal to 0.8.

In terms of the degree of regulatory openness and protection, most economies in Asia and Europe in 2021 are generally less open to regulation than in 2014, and tend to implement more protective policies to limit openness. Among them, Asian economies had the largest average decline of 10.81%. In contrast, although some European economies have a low degree of regulatory openness, they are relatively similar in the implementation of protective policies, which in turn has formed a number of highly homogeneous trade partnerships. New restrictive regulatory measures in Asia are often not adopted by their trading partners. For example, India, China, and Saudi Arabia reduce their regulatory openness at the same time as their highly homogeneous regulatory partnerships are decreasing. In 2021, these economies did not have partnerships with a regulatory homogeneity of more than 0.80. From the perspective of regulatory homogeneity, Europe has established a relatively consistent network of regulatory rules, and its highly homogeneous regulatory partnerships are concentrated in the European

region. However, the highly homogeneous regulatory partnerships of Asian economies are largely absent from the Asian region, and this trend has become more obvious over time.

Considering that the characteristic indicators of the network are more representative, the overall characteristics of the network and the characteristics of the node economy can be comprehensively and exhaustively displayed. The following part further expounds the dynamic evolution characteristics of the  $G$ , from the aspects of the overall characteristics of the regulatory homogeneous network and the characteristics of the node economy.

(1) The overall characteristics of the regulatory homogeneous network. As shown in Figure 2(1), although the participation in digital services trade rebounded in 2021, the overall trend is inverted U-shaped. Over the same period, there has been a significant increase in imports and exports of digital services, suggesting that economies are tending to optimize and simplify existing trade partnerships rather than seeking new ones. In addition, the average value of regulatory homogeneity is declining as a whole, and the regulation of digital service trade is developing in the direction of more diversified restrictive measures. Comparing the average regulatory openness of digital service trade, it can be seen that the regulatory mode of digital service trade in various economies is developing in the direction of alienation, and generally biased towards more diversified restrictive measures. From the comparative analysis of each sub-graph in Figure 2, it can be seen that the characteristics of the regulatory homogenization network of digital service trade in sub-divided categories are different from those of digital service trade. From the perspective of the breadth of digital service trade, the degree of participation of economies in trade of audiovisual and related services is significantly lower than that of digital service trade and other sub-categories. From the perspective of regulatory homogeneity and openness, for professional and management consulting services, intellectual property services, financial services, and computer services, which account for a large proportion of the import and export volume of sub-categories, the homogeneity and openness of the economy are relatively stable, or they are developing in the direction of regulatory homogenization of more restrictive measures. For some emerging sub-categories such as insurance and pension services, the regulation is moving towards homogenization to reduce restrictive measures.

(2) Characteristics of node economies. Based on the ranking of the 8-year average of the regulatory homogenization intensity of digital service and its sub-categories in the network economies from 2014 to 2021, this paper divides the economies of each category into three groups, taking the regulatory homogenization network of digital service trade as an example<sup>1</sup>: the high regulatory homogeneity group (top 20th), the

<sup>1</sup> The grouping basis of the regulatory homogeneous network for digital service trade in 7 sub-categories is as follows: the top 15 in the high group; 16th–35th in the middle group; The lower group is ranked 36th–60th.

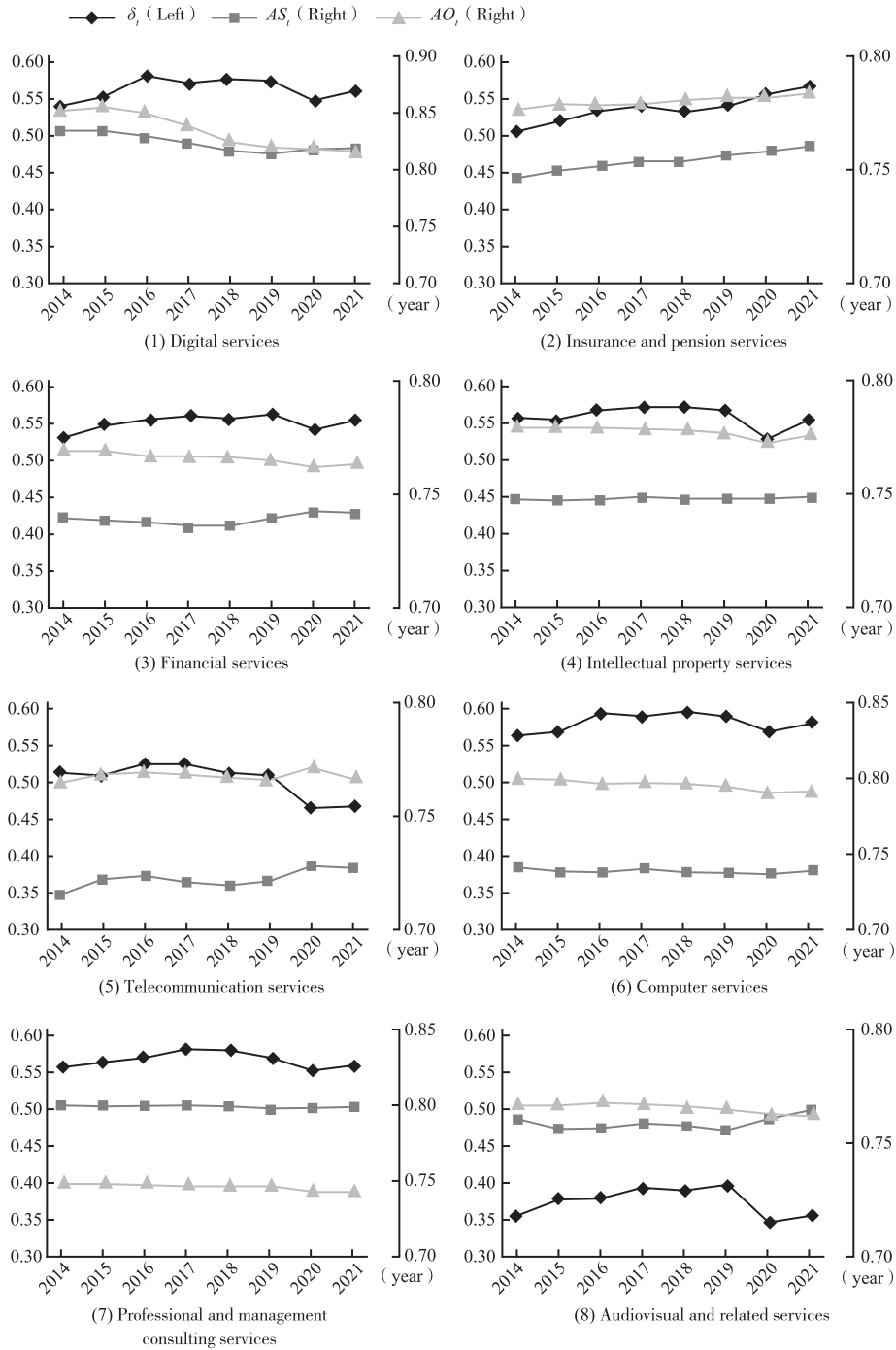


Figure 2. Overall Characteristics of the Regulatory Homogeneity Network of Digital Service and Their Sub-Categories of Digital Service Trade from 2014 to 2021

middle group (21st to 40th), and the low group (41st to 60th). As Figure 3 shows, economies in the high group show higher coherence in regulatory measures with their trading partners, while the lower and middle groups are more volatile. In terms of specific economies, the economies with the largest increases in 2021 compared to 2014 were the United Kingdom (6.26%), Iceland (4.83%) and Bosnia and Herzegovina (59.17%), while the largest decreases were Canada (-0.44%), Russia (-11.20%) and Israel (-24.97%). In terms of sub-categories, the United States ranks among the top three in the sub-categories of intellectual property services, telecommunications services, professional and management consulting services, and audio-visual and related services, while Canada is primarily prominent in the areas of computer services and professional management consulting services. This reflects the coherence of different economies in the formulation of regulatory measures for digital service trade, but also shows independence or differences in different regulatory areas.

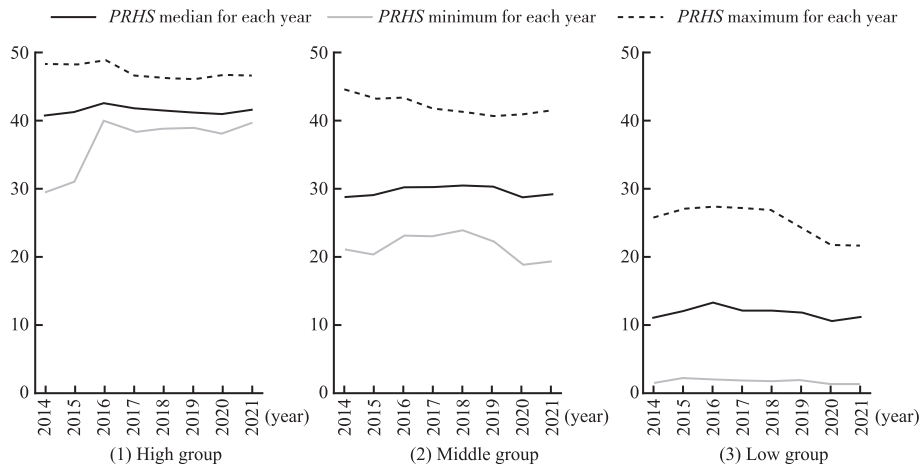


Figure 3. Intensity of Regulatory Homogenization of Digital Service Trade in Each Group from 2014 to 2021

#### 4. The Impact of Regulatory Homogenization of Partnerships on Digital Service Trade

##### 4.1. Model Settings and Variable Descriptions

This paper mainly investigates the relationship between the regulatory homogeneity intensity of digital service trade and digital service exports, and constructs the following benchmark regression model:

$$\ln Export_{i,t} = \alpha_0 + \alpha_1 PRHS_{i,t} + \gamma Controls + \lambda_i + \eta_t + \varepsilon_{i,t} \tag{10}$$

Among them,  $i$ ,  $t$  represent the economy and year, respectively. The explained variable is  $\ln Export_{i,t}$ , which represents the natural logarithm of the total digital services exports of economy  $i$  to the other 59 economies in the network in year  $t$ . The core explanatory variable is  $PRHS_{i,t}$ , which is the regulatory homogeneity intensity of digital service trade in economy  $i$  in year  $t$ , which is obtained from Equation (9). *Controls* represent a set of control variables at the “economy-year” level.  $\lambda_i$  and  $\eta_t$  represent national and annual fixed effects, respectively.  $\varepsilon_{i,t}$  is a error term. In addition, in order to reduce heteroskedasticity, the control variables except the ratio are logarithmic, and the robust heteroskedasticity standard error is used for the regression analysis. By reviewing the literature (Chen and Zhang, 2010; Francois and Hoekman, 2010; Chen *et al.*, 2011; Ferencz, 2019; Tu and Wan, 2023), the control variables included in the benchmark regression model in this paper are as follows: ① Regulatory openness of digital service trade ( $DSTOI_{i,t}$ ). ② Gross Domestic Product ( $GDP_{i,t}$ ). ③ Export dependence ( $Dep\_Export_{i,t}$ ); ④ Degree of outward foreign direct investment ( $ODI_{i,t}$ ). ⑤ Fixed broadband subscription rate ( $Fixband_{i,t}$ ). ⑥ The number of patent applications ( $Patent_{i,t}$ ). Data are obtained from the OECD and the World Bank’s World Development Index (WDI) database. The test found that the variance inflation factor (VIF) of the core explanatory variable and each control variable is less than 10, and the average VIF is 1.45, indicating that the degree of collinearity between the core explanatory variable and the control variable is low. The selection of variables satisfies the basic requirements of regression analysis.

#### 4.2. Empirical Results

This paper uses the Ordinary Least Squares (OLS) method with robust heteroskedasticity to estimate the impact of the regulatory homogeneity intensity of economic digital service trade on its digital service exports. Due to significant differences between years and economies, time and country fixed effects are taken into account in all regressions. Table 1 shows the estimates for the different model settings. Column (1) includes only the core explanatory variable, i.e., the intensity of regulatory homogenization of digital service trade. Column (2) adds the control variable of regulatory openness to digital service trade, reflecting the openness of economies to digital service trade at the policy level. Column (3) includes control variables of GDP, export dependence and OFDI to reflect the macroeconomic structure of the economy. Column (4) includes the control variables of fixed broadband subscriptions and patent applications, which reflect the internet penetration and innovation capacity of the economy. In all the regressions, the regression coefficient of the core explanatory

variable *PRHS* is positive at the significance level of 1%, indicating that the expansion and deepening of the regulatory homogeneous partnership of digital service trade in the economy will promote the export of digital service. It is important to note that although increasing regulatory openness to digital service trade may boost digital service exports, this effect is not statistically significant.

Table 1. Benchmark Regression Results: the Impact of Regulatory Homogeneity of Digital Service Exports on Digital Service Trade

Variable	Explained variables: $\ln Export$			
	(1)	(2)	(3)	(4)
<i>PRHS</i>	0.6504*** [0.2089]	0.6255*** [0.2091]	0.6741*** [0.2059]	0.6737*** [0.2077]
<i>DSTOI</i>		0.1489 [0.1489]	0.1543 [0.1439]	0.1594 [0.1428]
$\ln GDP$			1.2076*** [0.2631]	1.1683*** [0.2610]
<i>Dep_Export</i>			0.3607* [0.2093]	0.3446* [0.2042]
<i>ODI</i>			-0.0131** [0.0052]	-0.0131** [0.0054]
<i>Fixband</i>				0.0427 [0.1613]
$\ln Patent$				0.6411** [0.2896]
Constant terms	7.3172*** [0.4136]	6.1916*** [1.2099]	-26.6349*** [7.6667]	-25.8339*** [7.6882]
Fixed effect	Yes	Yes	Yes	Yes
Observed value	480	480	480	480
$R^2$	0.9773	0.9778	0.9794	0.9795

Note: Values in parentheses are robust standard errors. \*, \*\*, and \*\*\* represent statistical significance at the level of 10%, 5%, and 1%, respectively. For the ease of interpretation, *PRHS*, *DSTOI*, and all ratio types of variables are normalized by dividing their standard deviations. The following tables are the same.

### 4.3. Robustness Test

(1) Variable remeasures and sample adjustments. ① The OECD Balanced Trade in Services database is used to replace the UNCTAD bilateral sub-category trade in

services database, and the  $\ln Export$  is remeasured and the network is reconstructed. ② Delete the data before 2016 and adjust the sample time range to 2016–2021. ③ The  $DSRHI_{i,j,t}$  calculated by the SCORE method is used to replace the original edge weight, and the network is reconstructed based on this. ④ Replace the measurement method of core explanatory variables with the eigenvector centrality method. ⑤ Explained variables are subdivided into six categories of digital service exports to expand sample size. Based on the above adjustments, a series of robustness tests are carried out. The regression results are shown in Table 2, and the benchmark results remain robust and credible after remeasurement and sample adjustment of various variables.

Table 2. Robustness Test Results: Variable Remeasures and Sample Adjustments

Variable	Explained variables: $\ln Export$					
	(1)	(2)	(3)	(4)	(5)	(6)
	Replace the explained variable	Network Restructuring 1	Adjust the sample time interval	Network Restructuring 2	Replace the core explanatory variables	Expand sample size
<i>PRHS</i>	0.0531** [0.0251]	0.0849*** [0.0307]	0.4111*** [0.0457]	0.6737*** [0.2077]		0.5679*** [0.1289]
<i>Centrality</i>					0.8400*** [0.2673]	
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observed value	360	360	360	480	480	2880
$R^2$	0.9984	0.9985	0.9861	0.9795	0.9803	0.8989

(2) Retest of model setting. ① The lagged term of the endogenous variable is selected as the instrumental variable. In this paper, the one period lagged ( $IV1$ ) of the regulatory homogeneity intensity of digital service trade is selected as an instrumental variable for the two-stage least squares estimation. Before regression analysis, this paper first performs the test of insufficient identification and weak instrumental variables. ② Construct a two-stage least squares estimation of the regulatory quality similarity ( $IV2$ ) tool variable between economies and their trading partners of information and communication technology (ICT) goods with a lag of 10 periods. On the one hand, it is highly likely that ICT goods trading partners will develop into

digital service trading partners. Ten years ago, the similarity of regulatory quality between the two is likely to affect the regulatory homogeneity of their digital service trade. The tool variable satisfies the relevance condition. On the other hand, these similarities were determined 10 years ago and have little impact on the current explained variable. Instrumental variables meet the independence assumption. After the test of underrecognition and weak instrumental variables, a two-stage least squares estimation is carried out. ③ The high-dimensional fixed-effect panel Poisson pseudo-maximum likelihood estimation (PPML) method was used to reestimate the model. As shown in Table 3, the model setting reestimation results are consistent with the basic conclusions, indicating that the conclusions obtained from the benchmark regression results are robust.

Table 3. Robustness Test Results: Model Setting Retest

Variable	<i>PRHS</i>	<i>ln Export</i>	<i>PRHS</i>	<i>ln Export</i>	<i>Export</i>
	(1)	(2)	(3)	(4)	(5)
	Instrumental variable1		Instrumental variable2		PPML
	One-stage	Two-stage	One-stage	Two-stage	
<i>PRHS</i>		0.5154*** [0.0846]		0.9245** [0.4029]	0.3381*** [0.0245]
<i>IV</i> 1	0.6298*** [0.1095]				
<i>IV</i> 2			0.0794*** [0.0164]		
Underrecognition test	7.832***		11.303***		
Weak instrumental variable test	33.060 {16.38}		23.531 {16.38}		
Control variable	Yes	Yes	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes	Yes	Yes
Observed value	420	420	480	480	480
R <sup>2</sup>		0.1503		0.1703	

#### 4.4. Mechanism Text

This paper further explores the mechanism of the regulatory homogenization intensity of digital service trade on digital service exports. Due to the problems of endogeneity bias and unclear identification of some channels in the mediating effect

test (Jiang, 2022), this paper refers to the research ideas of Liu and Zhen (2022) to test the mechanism by observing the influence of core explanatory variables on mediating variables. According to the theoretical analysis, the mediator digital service trade cost and business trust have a direct and obvious impact on exports, and the mechanism analysis of digital service trade cost is based on the basic assumption of Equation (1). Therefore, this paper explores the overall impact of the regulatory homogenization intensity of digital service trade on the cost of digital service trade and the cost of six categories of digital service trade through Equation (11) and Equation (12), and explores the impact of regulatory homogenization intensity of digital service trade on business trust through Equation (13).

$$Cost_{i,t} = \alpha_0 + \alpha_1 PRHS_{i,t} + \gamma Controls + \lambda_i + \eta_t + \varepsilon_{i,t} \quad (11)$$

$$Cost_{i,h,t} = \alpha_0 + \alpha_1 PRHS_{i,t} + \gamma Controls + \lambda_i + \eta_t + \varepsilon_{i,t} \quad (12)$$

$$Conf_{i,t} = \alpha_0 + \alpha_1 PRHS_{i,t} + \gamma Controls + \lambda_i + \eta_t + \varepsilon_{i,t} \quad (13)$$

Among them,  $Cost_{i,t}$ 、 $Cost_{i,h,t}$ 、 $Conf_{i,t}$  represent the cost of digital service trade, the cost of digital service trade in category  $h$ , and business trust, respectively, for economy  $i$  in year  $t$ .

(1) Mechanism test of trade cost. This paper first estimates the cost of digital service trade in importers faced by foreign service providers  $\varphi_{j,t}$  and the cost of digital services trade faced by importers with category  $h$   $\varphi_{j,h,t}$  (Johanson *et al.*, 2019; Peng *et al.*, 2022). Then, the annual export target market share of each economy's digital service trade in category  $h$  is taken as the weight, and the  $\varphi_{j,t}$  and  $\varphi_{j,h,t}$  are weighted and summed respectively to obtain the digital service trade cost  $Cost_{i,t}$  and the digital service trade cost  $Cost_{i,h,t}$  faced by digital service exporters in each economy in each year. Substituting  $Cost_{i,t}$  into Equation (11) to estimate the relationship between the intensity of regulatory homogeneity and costs of digital service trade. The results in column (1) of Table 4 show that for every 1 standard deviation increase in  $PRHS$ , the mean cost of digital service trade decreases by 0.23 standard deviations. This suggests that expanding and deepening partnerships of regulatory homogenization can help reduce the cost burden on exporters of digital service in economies in the face of different regulatory requirements, and significantly reduce the fixed costs of cross-border digital service trade across wide network of partners. Furthermore, the impact of regulatory homogenization on the cost of trade in various types of digital service is examined to verify the rationality of the basic assumptions. The results show that the increase in the intensity of regulatory homogenization will significantly reduce the trade costs of financial services, intellectual property services, telecommunications,

computer and information services, and other business services, but will have no significant impact on the trade costs of insurance and pension services, personal, cultural and entertainment services. Considering that insurance and pension services exports, personal, cultural and recreational services exports accounted for less than 9% of total digital services exports over the years, the trade costs of these segments have less of an impact on overall digital services exports. It can be seen that regulatory homogenization is more effective in reducing the trade cost of digital service categories with higher trade volumes, further emphasizing the value of regulatory homogenization in the global digital services market: in more market-oriented and competitive service sectors, such as intellectual property services and other business services, regulatory homogenization brings a more obvious competitive advantage to digital service exporters in this category by reducing the average trade cost. In summary, hypothesis 2 is valid.

(2) Mechanism test of business trust. Under the existing data conditions, it is difficult to find indicators that directly measure business trust. Referring to Liu and Zhen (2022) on the construction of the mediating variables of business psychological defense, this paper selects the ownership and control degree index ( $Prot_{i,t}$ ) in the *World Bank's Doing Business Report* as a proxy indicator to reflect the degree of standardization of the legal environment and corporate governance requirements among economies. The closer the index is to 100, the more stringent and effective regulation an economy has in terms of transparency of corporate governance structures, fairness of business practices, protection of the rights and interests of investors and minority shareholders. These factors are key to building and maintaining business trust, and can therefore be seen as an indirect indicator of business trust between economies. The commercial trust level calculated by Equation (14) reflects not only the governance norms of the country, but also the governance norms of major trading partners based on the distribution of export importance. This provides a more comprehensive picture of the business trust environment faced by digital service exporters of economy  $i$ .

$$Conf_{i,t} = Prot_{i,t} + \sum_j \left( \frac{Export_{i,j,t}}{Export_{i,t}} \times Prot_{j,t} \right) \quad (14)$$

Table 4, column (2), shows that for every 1 standard deviation increase in  $PRHS$ , the mean increase in business trust is 0.11 standard deviations. This shows that expanding and deepening partnerships of regulatory homogenization can help companies conduct business in a more regulated, transparent and legally protected trading environment, thereby enhancing business trust among partners. This finding validates Hypothesis 3.

Table 4. Result of Mechanism Test: Trade in Digital Services

Variable	<i>Cost</i>	<i>Conf</i>
	(1)	(2)
<i>PRHS</i>	-0.2321*** [0.0779]	0.1088* [0.0556]
Control variable	Yes	Yes
Fixed effect	Yes	Yes
Observed value	480	420
R <sup>2</sup>	0.8626	0.9721

The above analysis results show that the increase of regulatory homogeneity will promote the export of digital services through two mechanisms: reducing the cost of digital service trade and enhancing business trust.

## 5. Conclusions and Policy Recommendations

The importance of digital service trade in global economic development is highlighted, and differentiated regulatory measures are increasingly becoming a key factor affecting digital service trade. This paper examines the structural characteristics of the regulatory homogenization network of digital service and their sub-categories of digital service trade, as well as impact of multilateral and bilateral partnerships of regulatory homogenization on the corresponding categories of service trade, using data resources such as the UNCTAD bilateral database on service trade of sub-categories, the DSTRI of the OECD, the STRI regulatory database, and the WDI database.

Specifically, through the analysis of the characteristics of network structure, this paper finds that: ① economies participating in digital services and their sub-categories of digital services trade are more inclined to optimize and simplify existing trade partnerships. ② The open mode of digital service trade is moving towards differentiation, and economies generally adopt diversified restrictive measures for supervision, and trade protectionism is on the rise. ③ Compared with other regions, European economies have the highest intensity of regulatory homogeneity in various types of digital service trade, forming a relatively unified regulatory network.

Based on the above findings, this paper further analyzes the impact of multilateral and bilateral partnerships of economic regulatory homogeneity on exports through empirical tests, and draws the following conclusions: ① Expanding and deepening the regulatory homogeneous partnership for digital service trade will promote the export of digital service from major economies. ② This promotion effect is mainly achieved

through two mechanisms: reducing the cost of digital service trade and enhancing business trust. ③ Although there is heterogeneity in the impact of expanding and deepening the partnership of regulatory homogenization on exports, in general, the export promotion effect of the partnership of developing regulatory homogenization is better than that of increasing the openness of digital service trade. Homogeneity between policies of openness and protection is even more important.

With the expansion of digital services trade, China needs to adopt precise strategies to address the challenges in digital economic and trade cooperation. In view of China's close trade with Asian economies and its low degree of regulatory homogeneity and openness, when dealing with the core issues of digital service trade regulation with developed economies such as the US and Europe, China should not limit itself to full opening-up or adopt protective policies to limit opening-up, but should consider adopting similar regulatory regulations with major trading partners and seek cooperation opportunities. Accordingly, this paper proposes three policy recommendations: First of all, China should actively participate in and lead the unification and coordination of international digital trade rules, and promote the formation of digital trade rules that will benefit a wide range of benefits through in-depth exchanges with WTO member states. Second, we should actively cooperate with major multilateral and bilateral digital service trade partners to jointly build a homogeneous regulatory environment, reduce the cost of digital service trade, and promote the process of accession to *the Digital Economy Partnership Agreement* and the CPTPP. Finally, to build a "China model" that is in line with China's national conditions. China should give priority to deepening its regulatory homogeneity partnership with Asian and developing economies, respecting the special needs of developing economies, establishing an effective dispute resolution mechanism, enhancing the regulatory homogeneity of digital service trade, and exerting greater influence in the global regulatory field of digital service.

Digital service trade inject new momentum into the strategy of becoming a trading power, but there are significant differences in the trade benefits that different economies focus on due to the different stages of development of the digital economy. Therefore, the formulation of top-level design, the coordination of openness and security, and the construction of a high-standard open system are particularly crucial to promote a higher level of opening up. This paper proposes a possible strategy to reduce trade disputes and increase digital service exports by adopting similar regulations with major trade partners. This study is still a preliminary attempt, and we will delve into the key aspects of the regulatory regulations in the future, and provide strategic guidance for regulation development and mutual recognition of regulations among partners. At the same time, it will also focus on the role of digital elements in the industrial chain, the distribution of benefits of regulatory homogenization, and digital security issues, so as to deepen the understanding of the impact of regulatory homogenization.

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