

Discussion on Coordination Mechanism of Digital Trade Barriers Formed by Data Governance Differences from the Perspective of Gravity Model

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Abstract: A gravity model can be used to examine how digital trade barriers form at the level of theory. This paper applies the above framework to explore how different data governance models in various countries lead to trade restriction effects via institutional distance. The three governance models in the United States, the European Union and China are a market-oriented system, a rights-based system and a security-oriented system, respectively, and differ in terms of values and regulatory paths. The institution has added new forms of trade barriers, such as higher cross-border compliance costs and greater regulatory uncertainty. The OECD Digital Services Trade Restrictiveness Index (Digital STRI) covers 91 economies as of 2024, spanning the period 2014–2024. The data show that global digital services trade barriers rose by 25% cumulatively between 2014 and 2023. By early 2023, 40 countries had introduced around 100 data localisation measures, and China ranked 71st out of 85 economies. Breakdown of these barriers requires the establishment of a hierarchical and progressive coordination mechanism at the three levels of bilateral mutual recognition, regional cooperation and multilateral systems, and the data governance rules can gradually shift from a fragmented state to one of compatibility and mutual recognition, thereby reducing the inhibiting effect of institutional distance on digital trade.

Keywords: Gravity model; Data governance; Digital trade barriers; Institutional distance; Coordination mechanism.

1. Introduction

Digital trade is changing the basic form of world trade. Goods trade barriers are based on physical boundaries and mainly include tariffs and non-tariff measures. At the same time, institutionalised digital trade barriers are not uniform and restrict all links of cross-border data flow, compliance paths and regulatory coordination in different areas. As data have become necessary factors of production, various governance rules for data are now one of the reasons for declining global trade. Countries have put forward reasons for issuing data governance rules, such as national security, privacy protection and industrial development, and thus have created many digital trade barriers.

The gravity model can be used to explain this phenomenon. The two countries' trade will be determined by the size of the economy and their "distance" according to this model. The scope of "distance" includes geography, institutions, culture and regulation, etc [1]. Differences in the rules for data in the field of digital trade are also types of institutional distance.

A growing body of literature has examined digital trade issues empirically using the gravity model. Some studies combined the gravity model with the restrictive index and found that importing countries' restrictions on digital service trade have a significant inhibitory effect on exports, and this inhibition is mainly caused by restrictions on electronic transactions [2]. Other scholars, based on bilateral digital service export data from 50 economies worldwide from 2010 to 2021, discovered that the higher the level of commitments on cross-border data flow in regional trade agreements, the larger the volume of bilateral digital service trade between the contracting countries, and cross-border data flow rules can promote the development of digital service trade by shortening institutional distance [3]. In terms of data localization, strict data localization regulations have also been

proven to greatly inhibit the efficiency of service exports [4]. These studies provide a theoretical basis for this paper to understand the trade effects of data governance differences from the perspective of institutional distance.

Global Digital Trade Governance is fragmented. Multilateral negotiations on e-commerce at the WTO began in 2017, and by July 2024, all parties had reached an agreed-upon stable text. However, it has not been added to the multilateral system of the WTO. The first-level rules will be released in the area. The three models in the United States, the European Union and China focus on different areas: market efficiency, the rule of law and security guarantees. Thus, there are different concepts of governance and legal traditions. According to the OECD data, the cumulative barriers to digital service trade around the world have increased by 25% since 2014 and remain at a relatively high level. Apply the gravity model to analyze the internal logic of the transformation from differences in data governance to trade barriers and explore coordination paths, providing both academic research and practical references. The following section presents the theoretical foundation of the gravity model and its application to digital trade.

2. Theoretical Framework of the Gravity Model and Its Applicability in Digital Trade Analysis

The first is the law of universal gravitation by Newton. After being presented to the world by Tinbergen and Pöyhönen, it gradually became a general-purpose tool for studying cross-border trade [5]. The model in the above is to assume that the total trade volume between two countries is directly proportional to the size of their economies and inversely proportional to the distance between them. In the early days, distance generally meant only how far away

something was. As the theory has developed overtime, more scholars have been studying other reasons for differences, such as institutional quality, cultural proximity and language barriers. Thus, the explanatory power of the gravity model has been increased.

The basic form proposed by Tinbergen and Poyhonen is:

$$X_{ij} = A \frac{Y_i Y_j}{D_{ij}}$$

Here, X_{ij} represents the export volume from country i to country j , while Y_i and Y_j denote the GDP of the two countries, D_{ij} represents the geographical distance, and A is a constant. Subsequent studies gradually incorporate variables such as population, common language, and common border. Anderson and van Wincoop (2003) further developed this into a structural gravity model, within which the OECD embedded the Digital Services Trade Restrictiveness Index (Digital STRI) as an institutional variable. The gravity equation at the sectoral level is as follows:

$$X_{ij}^k = \frac{Y_i^k E_j^k}{Y^k} \left(\frac{T_{ij}^k}{\Pi_i^k P_j^k} \right)^{-\theta_k}$$

The variables are defined as follows: X_{ij}^k is the bilateral trade flow in sector k , Y_i^k is the output (supply capacity) of the exporting country, E_j^k is the expenditure of the importing country, Y^k is world output, T_{ij}^k is the bilateral trade cost, θ_k is the sector-specific trade elasticity, and Π_i^k and P_j^k are the outward and inward multilateral resistance terms. In the empirical specification, trade flows are regressed on standard gravity variables, including bilateral distance, common border, common language, and colonial history, along with digital trade-related variables such as the Digital STRI.

The scope of application for the gravity model has been extended to the domain of digital trade. Digital services have reduced the limitations of distance to a certain extent, but institutional distance, that is, differences in regulatory systems and legal cultures among countries, has become a more prominent problem. The OECD has added the Digital Services Trade Restrictiveness Index to the set of institutional factors in the gravity model. A large number of empirical studies have shown that factors such as the scale of the economy, openness to trade, and level of digital infrastructure are positively correlated with bilateral digital service trade, and institutional barriers are the main limiting factors.

Therefore, in the analysis of digital trade, the concept of distance needs to be redefined; at present, the influence of geography is declining, and the weight given to institutions and regulations is rising. Based on the above, the following text will explore in more detail the specific mechanism through which differences in data governance are converted into trade barriers via the distance variable in the gravity model [6].

Data governance differences affect the distance variable in the gravity model through three mechanisms. First, the regulatory measures at the local level to retain data and limit cross-border transmission have raised operating costs for digital services. The incremental cost is reflected in the model framework as trade resistance caused by the distance factor. Second, due to differing degrees of data protection and law enforcement around the world, a multinational enterprise is subject to various sets of compliance obligations concurrently. The resulting institutional distance is a new type of gap, and thus, it can effectively promote the digital service export indicated in the empirical study. Third, the uncertainty of a country's data policy reduces enterprises' confidence in cross-border business, and to avoid risks, many enterprises have begun to reduce the scale of cross-border data business. The three reasons above show that the difference in data governance has increased the negative impact of distance on digital trade through multiple paths.

3. Analysis of the Mechanism of Converting Data Governance Differences into Digital Trade Barriers

Different Data Governance Models are the underlying reasons for the barriers to digital trade. The paths of the United States, the European Union and China are not the same: The United States has followed a market-based model and promoted the free flow of data globally; the European Union has established a rights-based system under the General Data Protection Regulation and is extending its extraterritorial application; China is seeking a balance between security and development and exploring a classification-and-grading governance system. The Location of data sovereignty, privacy protection standards and outbound management rules varies across the three models, forming a "governance gap". The conduction mechanism is shown in Figure 1.

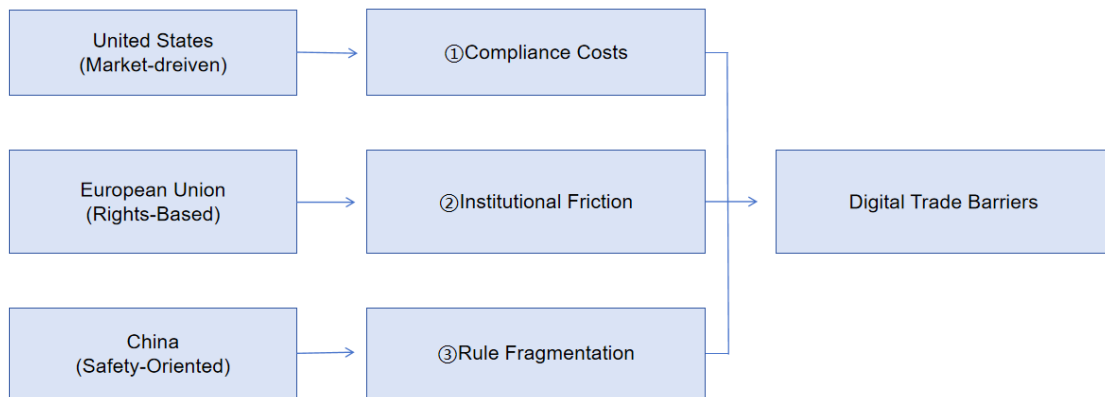


Figure 1. Transmission mechanism from data governance differences to digital trade barriers

The above deficiencies have led to various forms of trade restrictions. The reason is a higher cost of compliance. If a company operates in an area with lower regulatory demands,

it will not be subject to all of them. Articles 44-49 of Part V of the General Data Protection Regulation (GDPR) establish a high threshold for transferring personal data outside the EU

to a third country and have set up different institutional arrangements for data transfers between the EU and third countries. Based on the above data, the GDPR has limited the amount of digital service exports from China. The channels of its impact are an increase in compliance costs and search costs. Based on the above estimates, such policies have increased the compliance costs for processing enterprises by an average of 2.1 percentage points over the past three years, and for enterprises that handle highly sensitive data, this increase has reached 58%. Compliance will reduce the volume of trade eventually and thus lower export amounts [7]. Previous studies have also confirmed that the reduction of institutional distance is conducive to promoting the development of China's digital service trade.

In addition to an increase in compliance costs, the second path is an expansion of institutional friction. According to the gravity model, an increase in the extent of divergence in the regulatory systems of the two sides will raise trade costs and thus reduce trade. The larger the difference in data governance rules between the two countries, the higher the institutional uncertainty for enterprises, and thus the stronger the trade barriers will be [8].

Rules are also scattered and disorganized. At present, the governance of digital trade is developing in regions and multilaterally at the same time, and the rules of various agreements are quite different. The e-commerce chapter of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) stipulates the principle of free cross-border data flow and prohibition of localisation; the Regional Comprehensive Economic Partnership (RCEP) has added basic security exception clauses, but the meaning of "basic security interests" and the self-determined boundaries of the contracting parties are not clear; and the Digital Economy Partnership Agreement (DEPA) is modularly designed and can be joined selectively by contracting parties. Internal inconsistencies in the rule system are institutional barriers; that is to say, enterprises find it difficult to form a stable business expectation under multiple and even conflicting compliance requirements, and the resulting compliance costs and legal risks further restrict the development of digital trade.

4. Empirical Investigation of Data Localization Measures as Core Barriers

The fragmented pattern shown above is the typical and most influential type of restrictive measure, data localisation requirements. Based on the practices of many countries, the above measures require enterprises to carry out data collection, storage or processing within the country and set a high threshold for overseas data transmission. The DSTRI indicator system of the OECD covers five dimensions: infrastructure and connectivity, electronic transactions, payment systems, intellectual property rights, and other barriers. Statistics show that the requirement for data localization has appeared more frequently in digital trade policies of various countries than other categories [9]. The reason for the significant effect of the above measures is that they have increased the institutional costs of cross-border data flow and, more importantly, have altered the allocation logic of data as a production factor around the world; in the gravity model, this change is directly reflected in an increase in the "distance" variable.

In terms of the dimension of time, the speed at which data

localisation measures have spread is relatively high. In 2008, there were fewer than 20 requirements for data storage and processing around the world. By 2023, this number had risen to about 100, and the statistical sample covered 40 countries; more than two-thirds of these measures had dual attributes of local storage and prohibition of outbound transfer. Given the rising interest in data sovereignty and security around the world, the amount of data has also increased significantly. However, considering the restrictions on the flow of cross-border digital services in terms of trade should also be done. The several parts of the OECD's Digital Service Trade Restriction Index are infrastructure, electronic transactions, payment systems and intellectual property rights. Among them, data localisation policies have had the most significant restrictive effect in the infrastructure and electronic transaction areas.

The way in which data localisation measures restrict trade can be viewed from two angles. First of all, in order to meet the localisation requirements of different markets, enterprises need to build data infrastructure in multiple countries; therefore, a single data-processing system cannot be used to achieve economies of scale and the operating costs will be high [10]. As shown in a study by the OECD, the above demands may also reduce the company's buffer against market fluctuations and other unforeseen events. Second, stringent localisation policies will increase the perceived uncertainty of the institutional environment for foreign-owned service enterprises, and the resulting "distance" effect will further strengthen the intensity of trade friction in the gravity model. China is the 71st largest economy among the 85 countries of the OECD, and one of the reasons for this relatively low ranking is relatively strict data localisation requirements and other factors. A typical governance problem in all countries is how to achieve a more balanced institutional arrangement of security and development.

5. The Necessity and Realistic Challenges of Coordinating Data Governance Differences

The tension between security and development mentioned above is precisely the problem that the coordination mechanism needs to solve. Although the trade barriers that have been created by differences in data governance are not insurmountable, the urgency and difficulty of coordination work are also increasing at the same time, and this conflict should not be ignored. Digital trade has become a new driver of growth for the world economy, and in recent years, cross-border data flows have been expanding rapidly. If each country establishes its own governance system, it will not promote the development of digital trade, and one must also be cautious that data regulation is not used to build new barriers to trade. Research shows that cross-border data flow and inclusive cooperation-based rules can help reduce the regulatory differences among economies at the regional level gradually, and the policy barriers within the borders will also be reduced accordingly. Coordination is relatively high; however, the actualisation path is somewhat long-winded.

The first set of problems are the internal conflicts between the demands for sovereignty and the goal of liberalisation [11]. The tension between data sovereignty and the goal of liberalisation makes it difficult for countries to reach a consensus on cross-border data regulation. Seeking institutional intersections without touching the sovereignty

bottom line is in itself a difficult structural problem.

The second set of problems is that the governance models of these large countries are also quite different. There is no intersection point in the short run. Policy orientation in the United States aims to promote market efficiency and reduces obstacles to data flow; the European Union has built institutional barriers to protect privacy via GDPR, and China has thus far sought a cautious balance between security and development. The three paradigms are based on different political logics, legal systems and stages of development. Achieving convergence among these paradigms remains a challenging task in the short run. The game of major powers over data is, in fact, a competition for the power of rules and market space.

The third is that the mechanism of multilateral coordination is functionally delayed. Although many talks by multiple countries to discuss cross-border e-commerce have been held in recent years at the World Trade Organization, little progress has been made on the fundamental problem of cross-border data flow. The multilateral mechanism has complex

procedures and slow iterations, and cannot keep pace with the changes in the digital economy. Due to the blockage of the multilateral mechanism, countries have opted for regional arrangements of institutions. CPTPP, RCEP and DEPA are all free trade agreements that have created different sets of rules for the world's trade system. Given this fragmented landscape, returning to a unified coordination framework will become even more difficult.

6. Construction Path of the Coordination Mechanism Based on the Gravity Model

The Gravity model can be used to build the theoretical foundation for a coordination mechanism. The Goals of coordination are to reduce institutional distance, lower trade costs and decrease regulatory uncertainty. Based on the above reasoning, the path can be promoted in three stages: bilateral, regional and multilateral [12]. The three-level progressive structure is shown in Figure 2.

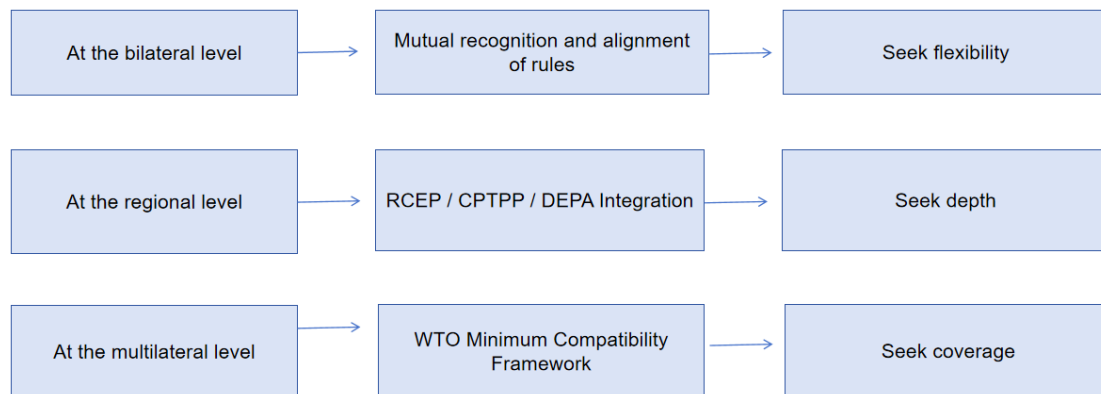


Figure 2. Bilateral-regional-multilateral three-tier progressive coordination mechanism

At the bilateral level, coordination aims to promote mutual recognition and alignment of rules. The two countries, based on their respective governance and development contexts, respect each other's data sovereignty and negotiate the terms of cross-border data transfer accordingly. For example, the two countries can establish a system of mutual recognition for the assessment of data export security and personal information protection certification. Data processing activities that meet the requirements of the exporting country will be recognised in the importing country, and thus the enterprise will not need to operate independently in these two areas. Therefore, the institutional distance is relatively small and compliance costs are low.

Cooperation at the regional level will be in line with the existing trade agreements. The RCEP has created a certain foundation for the Asia-Pacific region, but some problems, such as cross-border data flow and localisation, have not yet been solved. The scope of application and interpretation rights for the exception clauses are not clear [13]. In light of the RCEP, the participating countries can further promote rule upgrading and establish an operational consensus mechanism for areas such as data classification, cross-border data transfer conditions, and regulatory cooperation. China is preparing to join the CPTPP and is a group of countries cooperating regionally. DEPA is a module that can be selected, and not all clauses need to be signed; only the relevant ones according to the country's actual circumstances are required. Convergence of the rules will be advanced at the regional level to reduce institutional distance among member countries and expand

the scope of trade.

The construction of the general system at the multilateral level has not been further promoted through the WTO. Although the speed of negotiation is low, its institutional authority and coverage are still irreplaceable. Cooperation among many countries does not aim to close the gap in the rule system of different countries; rather, it seeks to build a system of minimum common standards that provides some basic safeguards for rights and obligations in areas such as cross-border data flow, localisation requirements and privacy protection. The United Nations' "Global Digital Compact" and the OECD's STRI index offer new instruments for institutional design and evidence support, respectively.

The range of cooperation at the three levels is different: Bilateralism is relatively small, Regionalism is large-scale, and Multilateralism involves many parties. They are not replacements, but rather an accumulation process from the bottom up, and finally reach the lowest level of acceptable compatibility for all parties.

7. Conclusion

The Design Logic of the coordination path is still based on the gravity model. The gravity model served as the continuous analytical thread throughout this paper. Considering the differences in data governance as a new form of institutional distance, this paper investigates its inhibiting effect on digital trade and offers some theoretical support for such a study. Research has found that, at present, the different forms of data governance are mainly converted into trade barriers through

three channels: an increase in compliance costs; strengthening of institutional friction; and fragmentation of the rule system. These three factors are interdependent and, collectively, expand the "distance" term in a gravity model. The Design Logic of the Coordination Mechanism is reversed; shorten institutional distance and reduce trade costs to offset the negative effects caused by differences.

Limitations of this study include that only the construction of the theoretical system and the deduction at the mechanism level have been addressed. It does not carry out extended monitoring of changes in data governance policies at the country level, and micro-empirical studies at the industry or enterprise level have not been conducted. The gravity model can show whether there is a general trend of association between institutional distance and trade volume, but not the specific reasons for this difference at the level of the data governance data itself. The OECD's DSTRI indicator is not yet perfect. The connections among the coordination mechanisms at the bilateral, regional and multilateral levels are relatively complex and not in a simple progressive manner as shown in this paper. The above are the shortcomings of this study. In the future, the following three directions of research are planned: more granular industrial data will be collected and empirical studies on the effects of trade will be conducted; the iterative evolution path of data governance rules in major economies will be traced to explore the underlying motivations for rule convergence or divergence; and the data governance provisions in the regional frameworks of RCEP, CPTPP and DEPA will be compared and evaluated to provide empirical support for the design of a multilateral institution. China is 71st in the DSTRI. To advance institutionalised opening-up in a safe manner, the country needs to strengthen its own general capabilities and determine the direction of global digital governance in the future.

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