

Connotation Deconstruction and Multidimensional Impact Study of Digital Trade Barriers

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Abstract—The global scale of digital trade has exceeded 7 trillion US dollars. Yet digital trade barriers have gradually become a core obstacle to global economic integration. Based on the research frameworks of international organizations such as the WTO and UNCTAD, this paper first clarifies the connotation and core characteristics of digital trade barriers. It then systematically analyzes their specific manifestations in areas such as data flow, technical standards, and market access. Finally, from three dimensions—enterprise operations, the global economic structure, and international relations—the paper conducts an in-depth analysis of their far-reaching impacts, combining empirical data and typical cases. The study finds that digital trade barriers have characteristics such as strong concealment, rapid dynamic evolution, and fragmented rules. They not only lead to a surge in corporate compliance costs and hinder technological innovation. They also trigger systemic risks such as the fragmentation of the global digital market and intensified trade disputes. To address these issues, this paper proposes that an open and inclusive digital trade governance system should be built through paths such as multilateral rule coordination, mutual recognition of technical standards, and deepened regional cooperation.

Keywords—digital trade barriers, cross-border data flow, technical standards, global economic impact

I. INTRODUCTION

From a definitional perspective, digital trade barriers represent an extension and alienation of traditional trade protectionism in the digital economy era. To safeguard data sovereignty, protect local industries, and ensure national security, countries or regions adopt measures such as laws, regulations, technical standards, and administrative supervision (Cai & Ji, 2025). These measures impose restrictions on the cross-border flow of digital goods, services, and data factors. This constitutes the core connotation of digital trade barriers.

The “Handbook on Measuring Digital Trade,” jointly released by the WTO and OECD, clearly classifies them as a special form of non-tariff barriers (Shi, 2025). Unlike traditional tariff barriers, their targets mainly focus on four areas: digital products, digital services, data flow, and digital platforms. They cover diverse scenarios, including software transactions, cloud computing services, cross-border e-commerce operations, and telemedicine cooperation.

In essence, the core contradiction of digital trade barriers lies in the balance between national security and free trade. A 2023 report released by UNCTAD shows that 83% of countries worldwide have introduced at least one digital trade restriction policy. Among these, the coverage rate of

data sovereignty legislation has increased by 37% compared to the previous year. This data fully reflects the growing demand for risk prevention and control as countries advance their digital transformation (Ying & Lexiang, 2025).

Digital trade barriers take various forms. Some are explicit measures, such as data localization requirements. Others are concealed restrictions, including algorithm discrimination and implicit technical standards. These measures intersect with each other, forming a multi-level and composite trade barrier system.

Beyond the definitional aspect, digital trade barriers also exhibit distinct characteristics that differ significantly from traditional trade barriers. Firstly, they are highly concealed and ambiguous (Takamatsu & Chiba, 2025). Traditional tariffs clearly specify tax rates. However, measures like algorithm reviews and data security assessments in digital trade barriers often use “regulatory necessity” as a pretext. In practice, they create market access thresholds.

For example, the European Union’s “Digital Services Act” includes compliance requirements for platforms. Many countries have criticized these requirements as disguised trade restrictions. The reason is that these requirements lack clear quantitative standards, making it difficult for enterprises to accurately grasp the boundaries of compliance (Daily Compilation of Presidential Documents, 2025).

Secondly, digital trade barriers are highly dynamic and iterative. With the rapid development of new technologies such as quantum computing and artificial intelligence, new types of trade barriers continue to emerge. The United States has included 7 categories of quantum technologies in its export restriction list. This move is equivalent to building a “digital iron curtain” for technological blockades. As technology updates, the restriction list may further expand. This forces enterprises to constantly adjust their response strategies to adapt to the rapidly changing forms of barriers.

Thirdly, digital trade barriers have significant policy and strategic implications. In the current international environment, many countries use digital trade barriers as tools for geopolitical games. For instance, the “Clean Network” program promoted by the United States and the “Digital Silk Road” proposed by China show obvious competition in terms of rules. This competition directly leads to a camp-based trend in global digital governance. Countries in different camps formulate digital trade rules that favor their own interests, further intensifying the fragmentation of rules.

These characteristics are further reflected in the specific implementation forms of digital trade barriers, which have

formed four core types. The first type is restrictions on data flow. Data localization requirements are typical examples of this type. Russia's "Personal Data Law" clearly stipulates that citizens' data must be stored on local servers within the country (Wang, Zhang, & Zhu, 2024). The EU's GDPR sets strict compliance conditions for the cross-border transfer of personal data. Enterprises need to go through multiple rounds of review to achieve cross-border data transmission.

Data from the World Bank shows that such policies can increase enterprises' IT expenditures by 30% to 60%. This significantly raises the cross-border operation costs of enterprises.

The second type is differences in technical standards. Encryption algorithms and certification systems vary across countries, and they are not mutually recognized. This imposes additional adaptation costs on enterprises. Take China's SM4 encryption algorithm and the AES standard used in Europe and the United States as examples. There are differences in their technical parameters. To enter different markets, enterprises need to develop products that comply with local standards separately.

Data from 2022 shows that such technical standard conflicts directly caused a loss of approximately 21 billion US dollars in global digital service trade. As the digital service sector continues to expand, such losses may further increase (Liu, Jiang, Zhang, Dai, & Cheng 2024).

The third type is market access barriers. Some countries indirectly block the digital market through measures such as foreign ownership restrictions and license approval. For example, in China's cloud computing sector, foreign enterprises are required to operate through joint ventures. This limits the independent development space of foreign cloud computing enterprises in China (Gao, Yuan, & Li, 2024). Such barriers not only affect the market expansion of foreign enterprises. They may also lead to insufficient competition in the local market, which is not conducive to the overall innovation of the industry.

The fourth type is discriminatory tax policies. The digital services tax introduced by the European Union stipulates that enterprises with global revenues exceeding 750 million euros will be subject to additional taxes. This policy directly increases the comprehensive tax burden of multinational digital enterprises by 8 to 12 percentage points. Such tax policies have obvious targeting effects. They are likely to trigger countermeasures from other countries, thereby leading to tax disputes in the field of digital trade.

II. IN-DEPTH ANALYSIS OF THE MULTIDIMENSIONAL IMPACTS OF DIGITAL TRADE BARRIERS

At the enterprise operation level, the micro-impacts of digital trade barriers are the most direct. Firstly, they lead to a significant increase in operating costs, which in turn compresses enterprises' profit margins. To meet the compliance requirements of different countries, multinational enterprises need to invest huge resources in adjustments. These adjustments include establishing professional compliance teams, upgrading data storage systems, and adapting to local technical standards.

According to survey data from PwC, the "extraterritorial jurisdiction" principle of the EU's GDPR increases enterprises' average annual compliance costs by 1.4 million

US dollars. Additionally, the "dual compliance" pressure from China's "Personal Information Protection Law" and the EU's GDPR extends the compliance cycle for digital trade between China and the EU by 60 days. This not only increases time costs. It may also cause enterprises to miss market opportunities.

Small and Medium-Sized Enterprises (SMEs) are more severely affected (Yan & Liu, 2024). A study by the International Trade Centre points out that differences in technical standards can increase the digital trade costs of SMEs by more than 25%. For many SMEs, this additional cost is unbearable. Eventually, they have to withdraw from the international market.

Take SMEs in the cross-border e-commerce sector as an example. They originally relied on flexible operation models to gain a foothold in the international market. However, in the face of data compliance requirements and technical standards from different countries, they need to invest a large amount of funds in transformations. Many enterprises, due to insufficient funds, have to abandon overseas markets and focus on the domestic market instead. This limits the development space of SMEs to a certain extent.

Beyond operating costs, digital trade barriers also hinder enterprises in terms of technological innovation. They lead to the misallocation of R&D resources and impede collaborative innovation. Data is the core production factor of the digital economy. Restrictions on cross-border data flow directly disrupt the global technological collaboration chain (Chen & Chen, 2024).

For example, in the field of artificial intelligence R&D, enterprises need a large amount of cross-border data for model training. However, data flow restrictions prevent enterprises from obtaining sufficient data sources. They can only carry out R&D based on limited local data. This not only reduces R&D efficiency. It may also lead to deviations in R&D directions. Statistics show that this misallocation of resources causes a waste of approximately 12 billion US dollars in R&D resources each year.

In industries highly dependent on data, such as finance and healthcare, data controls have also created "data silos". Take cross-border fintech cooperation as an example. Different countries impose strict restrictions on the cross-border flow of financial data. Enterprises cannot achieve real-time data sharing. This reduces the efficiency of businesses such as cross-border payments and risk control model optimization by 40%. It severely restricts the innovative breakthroughs of fintech.

The world's top 10 cloud service providers have to establish regional independent nodes to avoid data flow risks. This decentralized operation model disperses the concentrated investment in technological R&D. Core technologies that could have been developed with concentrated resources are difficult to advance due to fragmented nodes. This slows down the technological upgrading speed of the entire industry (Guo, 2024).

At the meso-level of the global economic structure, the impact of digital trade barriers is mainly reflected in intensifying market fragmentation and weakening the growth momentum of the digital economy. A study by McKinsey shows that global restrictions on data flow may

reduce GDP growth by 0.5% to 1.5%. This impact is more pronounced in countries with a high proportion of digital economy.

Data from UNCTAD also indicates that countries adopting data localization measures have a digital service import growth rate 6.8 percentage points lower than the global average. This trade diversion effect not only distorts the global allocation of resources. It also hinders the inclusive development of digital trade. It makes it difficult for some developing countries that rely on imported digital services to obtain advanced digital technologies and services. This affects the development process of their domestic digital economies.

From 2020 to 2024, the average annual growth rate of global digital trade reached 12.1%. However, affected by barriers, the growth rate of digitally delivered trade was only 9.7%. This is significantly lower than the 12.3% growth rate of digitally ordered trade. This data difference reflects that the service trade sector is subject to more severe restrictions.

Digitally delivered trade mainly includes businesses that require real-time data transmission, such as cloud computing and remote services. These businesses are highly dependent on cross-border data flow. Once restricted, their growth rate will decline significantly (Jeongmeen, Joohyoung, & Jaeyoun, 2023). This in turn affects the overall growth quality of digital trade.

In terms of the industrial competition pattern, digital trade barriers have also triggered a restructuring. This has formed a regionalization trend under “rule fragmentation”. Different economies have established differentiated institutional frameworks around data sovereignty. For example, the digital trade chapter of RCEP and Chapter 19 of USMCA differ in 42 sub-items regarding data localization exemption clauses.

These subtle differences force enterprises to formulate differentiated operation strategies for different regional markets. Take multinational retail enterprises as an example. To enter the RCEP regional market, they need to comply with relatively flexible data flow rules. To enter the USMCA regional market, they face stricter data localization requirements. Enterprises need to establish two separate operation systems. This not only increases operating costs. It also reduces the market response speed of enterprises.

This fragmented state has also led to a Matthew effect in the global digital industry—“the strong become stronger, and the weak become weaker” (Suh & Roh, 2023). Due to insufficient technological capabilities, developing countries are often in a passive position when formulating digital trade rules. They face more stringent digital trade restrictions.

For example, in the field of digital infrastructure construction, developing countries need to import equipment and technologies from developed countries. However, developed countries may restrict the export of relevant technologies on the grounds of “national security”. This leads to delayed digital infrastructure construction in developing countries. It further widens the digital divide between developing and developed countries. This gap is not only reflected in the technical aspect. It also affects the right to speak of developing countries in global digital trade,

forming a vicious cycle.

At the macro-level of international relations, digital trade barriers have become a core trigger for international disputes. They have intensified geopolitical tensions. Data from the WTO Dispute Settlement Body shows that after 2018, the annual growth rate of trade litigation cases involving data localization reached 210%. The 2023 ruling in Case DS512 further exposed the regulatory gaps of existing rules in relation to data-driven services.

In this case, two countries had a trade dispute over data localization requirements. However, the existing WTO rules could not clearly define the dispute. Eventually, the dispute could only be resolved through lengthy negotiations. This not only wasted a lot of time and resources. It may also affect the trade relationship between the two countries.

The digital services tax dispute between the United States and the European Union, as well as the sanctions and counter-sanctions between China and the United States in the field of 5G technology, are essentially institutional conflicts triggered by digital trade barriers. After the European Union introduced the digital services tax, the United States believed that this policy targeted its domestic Internet enterprises. It immediately announced additional tariffs on some EU goods as a countermeasure.

In the field of 5G technology, the United States restricted its domestic enterprises from cooperating with Chinese 5G equipment manufacturers on the grounds of “national security”. China also adopted corresponding countermeasures. These disputes not only affect digital trade between the two countries. They may also spread to other fields, intensifying global geopolitical tensions.

At the level of international rule-making, digital trade barriers have also caused a deadlock in the multilateral trading system. Traditional rules of the WTO, such as the “Information Technology Agreement” and the “General Agreement on Trade in Services,” were mainly formulated for the traditional trade field. They cannot cover emerging digital trade areas.

Issues such as cross-border data flow and digital platform supervision are not clearly regulated in traditional rules. Moreover, differences among countries in areas such as data privacy and intellectual property protection have slowed down the negotiations on the “Digital Economy Agreement”. Currently, countries have significant differences in data privacy protection standards. Some countries prioritize data sovereignty, while others focus more on trade freedom. These differences make it difficult to reach a consensus in negotiations. The regulatory role of the multilateral trading system in the field of digital trade is gradually weakening (Zhuo & Kunyoun, 2022).

Regional trade agreements have become the main battlefield for rule-based games. The APEC Cross-Border Privacy Rules (CBPR) system is a typical example. This system coordinates standards across different jurisdictions through certification mechanisms. It can reduce compliance costs by 30%. However, due to geopolitical factors, its global promotion has been hindered.

Some countries refuse to join the system due to different political positions. This limits the coverage of the CBPR system and prevents it from fully playing its role. This regionalized rule-based game has led to a dangerous trend

in global digital trade governance—“fragmentation” replacing “multilateralism”. If not adjusted in a timely manner, it may further split the global digital market.

III. GLOBAL GOVERNANCE AND RESPONSE PATHS FOR DIGITAL TRADE BARRIERS

To address the problems caused by digital trade barriers, the core lies in building a multilateral coordinated rule system and establishing a unified and inclusive international rule framework. As the core institution of the global multilateral trading system, the WTO needs to accelerate the digital upgrading of traditional rules. It should refer to the standards in the “Handbook on Measuring Digital Trade (2nd Edition)” to clarify the regulatory boundaries of controversial areas such as cross-border data flow and digital services tax.

For example, in terms of cross-border data flow, a hierarchical management rule can be formulated. Different flow standards can be determined based on the sensitivity of data. This will ensure national security while not hindering normal trade exchanges. In the field of digital services tax, the scope of taxation and tax rate standards can be clarified to prevent countries from introducing discriminatory tax policies.

At the same time, it is necessary to encourage the integration of rules in regional trade agreements. As the world’s largest free trade agreement, RCEP includes flexible clauses on data flow in its digital trade chapter. These clauses provide a practical sample for multilateral rules. RCEP allows member states to achieve free cross-border data flow under certain conditions. It also retains the regulatory autonomy of each country. This balanced approach is worthy of reference by other regional trade agreements (Potluri, Sridhar, & Rao, 2020).

By promoting the alignment of rules between different regional trade agreements, the differences in rules can be reduced. This will make it easier for enterprises to meet compliance requirements in different markets and lower their operating costs.

The APEC CBPR system has also proven that coordinating standards across different jurisdictions through certification mechanisms can effectively reduce compliance costs. Currently, the CBPR system has covered multiple economies, but it still has great room for expansion. In the future, the membership of the CBPR system can be further expanded. At the same time, the certification mechanism can be improved to enhance certification efficiency. This will allow more enterprises to obtain CBPR certification and achieve free cross-border data flow.

Technical solutions are also important supports for breaking digital trade barriers. Promoting the mutual recognition of technical standards and achieving innovative breakthroughs are crucial. Countries should establish a regular dialogue mechanism for technical standards. They should conduct regular communication and consultation on standards in areas such as encryption algorithms and data certification to reduce artificial differences.

When formulating technical standards, a “technology-neutral” rule-making model should be explored. This means not favoring a specific technology. Instead, standards should be formulated based on technical

performance and safety requirements. This will provide fair competition opportunities for enterprises with different technical routes.

Singapore’s TradeTrust platform is a good practical case. This platform uses blockchain technology to achieve cross-jurisdictional data mutual recognition. Through the TradeTrust platform, enterprises can convert their data certificates into digital certificates on the blockchain. Enterprises and regulatory authorities in other countries can quickly verify the authenticity of the certificates without the need for repeated audits.

Currently, the coverage rate of the TradeTrust platform is less than 15%. However, with the continuous maturity and promotion of blockchain technology, it has broad application prospects. In the future, more countries can be encouraged to learn from this model. Regional blockchain-based data mutual recognition platforms can be established to gradually achieve global data mutual recognition.

In addition, it is necessary to accelerate the R&D and application of new technologies such as federated learning and distributed ledgers. A 2024 assessment by Gartner shows that the commercial application maturity of federated learning has reached 67%. This technology allows multiple enterprises to jointly conduct model training without sharing original data. It realizes the “availability without visibility” of data. This enables collaborative technological innovation while ensuring that data does not cross borders.

For example, in the medical field, hospitals in different countries can use federated learning technology to jointly train disease diagnosis models. This avoids the cross-border flow of medical data while improving the accuracy of the models. In the future, more investment should be made in the R&D of such new technologies. Their application in more fields should be promoted to provide technical support for breaking digital trade barriers.

At the enterprise and national levels, corresponding measures should also be taken to strengthen enterprise compliance capabilities and align with national strategies. From the enterprise perspective, a dynamic compliance management system needs to be established. Differentiated strategies should be formulated based on the regulatory requirements of different markets.

Multinational enterprises can learn from compromise solutions such as “data mirroring”. This solution allows enterprises to meet data localization requirements while achieving efficient data utilization. “Data mirroring” means that enterprises store a copy of data on local servers. At the same time, they store identical data copies on servers in other countries. This not only complies with local data localization requirements. It also allows enterprises to flexibly use data on a global scale (Lingduo, Shuangshuang, & Guofeng, 2022).

At the same time, enterprises should increase investment in compliance technologies. For example, they can introduce automated compliance detection tools. These tools can monitor the data flow of enterprises in real time and promptly identify compliance risks. Such tools can significantly improve compliance efficiency. They can reduce the costs and errors of manual audits and help enterprises better respond to complex compliance

requirements.

For SMEs, they can join industry associations or compliance alliances to share compliance resources and reduce compliance costs. For example, some industry associations provide compliance training and consulting services for their member enterprises. They help SMEs understand the compliance requirements of different markets and formulate compliance plans.

From the national perspective, it is necessary to improve the digital economy governance system and provide clear compliance guidelines for enterprises. The implementation of China's "Data Security Law" and "Personal Information Protection Law" is a good practical case. These two laws not only clarify the responsibilities of enterprises in data security and personal information protection. They also provide specific compliance operation guidelines for enterprises. This allows enterprises to have clear rules to follow when conducting digital trade business.

Other countries should also learn from this approach. They should accelerate the legislation related to the digital economy and improve the regulatory system. They need to ensure data security and national interests while creating a favorable development environment for enterprises.

For developing countries, it is also necessary to strengthen the construction of digital infrastructure and enhance their technical absorption capacity. Digital infrastructure is the foundation for conducting digital trade. Only with sound digital infrastructure can developing countries better respond to the challenges brought by digital trade barriers.

Developing countries can accelerate the construction of digital infrastructure such as high-speed broadband networks and data centers through means such as introducing foreign investment and strengthening international cooperation. At the same time, they should cultivate local digital technology talents and enhance their independent innovation capabilities. Only with strong technical absorption capacity can developing countries gain a more favorable position in digital trade and avoid being passive in the face of digital trade barriers.

IV. CONCLUSION

Against the backdrop of the rapid development of the digital economy, digital trade barriers have evolved from single policy restrictions to composite barriers covering multiple dimensions such as law, technology, and taxation. Their connotation continues to evolve with technological development.

In terms of the scope of impact, they cover three levels: enterprise operations, the global economy, and international relations. At the enterprise operation level, they increase the compliance costs of enterprises and hinder technological innovation. At the global economic level, they intensify market fragmentation and affect the growth momentum of the digital economy. At the international relations level, they trigger trade disputes and intensify geopolitical tensions. These impacts are intertwined, posing severe challenges to the healthy development of global digital trade.

Currently, the global scale of digital trade has exceeded 7

trillion US dollars, placing it in a critical stage of development. Addressing the problem of digital trade barriers requires joint efforts from the international community. Building a multilateral coordinated rule system can reduce rule differences and provide a unified regulatory framework for global digital trade. Promoting the mutual recognition of technical standards and achieving innovative breakthroughs can lower the technical adaptation costs of enterprises and provide technical support for digital trade. Strengthening enterprise compliance capabilities and aligning with national strategies can help enterprises better meet compliance requirements and enhance national competitiveness in digital trade. Only through the joint efforts of these three aspects can the balance between data security and trade freedom be achieved.

In the future, countries around the world need to adhere to the concept of open and inclusive development. They should abandon trade protectionism and break the governance dilemma of "digital fragmentation". When formulating digital trade rules, they should fully consider the development needs of different countries, especially the interests of developing countries. A fair and reasonable global digital trade governance system should be built. Only in this way can the growth potential of digital trade be fully released. It can promote the global economy to develop in a higher-quality and more resilient direction, and achieve common prosperity of the global digital economy.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

LD wrote the paper and conducted the research; XG combed the literature; FW and HC revised the manuscript; all authors had approved the final version.

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