

Digital Trade 2.0: How Emerging Technologies (AI, IoT, and 5G) Are Redefining the Global Exchange of Goods and Services

Kenneth Baayeh¹, Idris Oyewale Oyelakin², Anthony Aubynn³, Doris Enimil⁴, Isaac Yeboah⁵, Waris Ali Khan⁶

Abstract

This paper explores the Chinese digital service trade (DST) and examines its competitiveness through Porters Diamond Model considering the latest developments in technologies, such as the 5G network, Internet of Things (IoT), and artificial intelligence (AI). Through multidimensional indices (Revealed Comparative Advantage, Trade Competitiveness, Market Share, Michaely Fluctuation Index) and Entropy-TOPSIS method, we identify the impact of trade freedom, government efficiency, digital infrastructure, and industry openness on DST competitiveness. The findings indicate that China has an escalating degree of competition because of the robust digital foundation and trade incorporation, and integration of trade and DST exports has a high positive long-run enhancement to the growth of the importing countries. The research fills the significant gaps in the existing research on the role of digital trade rules and technology to determine the effects of global trade, particularly in developing markets. Examples such as the USMCA and the DEPA show that the fragmentation of regulations due to the current debate on whether goods or services ought to be classified as digital transmissions is hindering global governance initiatives. Our study offers a policy recourse to developing countries that seek to reduce institutional barriers and enhance competitiveness by adopting digital trade rule-making and digital investments in infrastructure, which will lead to inclusive growth in international trade.

Keywords: *Digital Trade, Digital Economy, Trade Competitiveness, Digital Infrastructure, Industrial Growth.*

Introduction

Emerging technologies like artificial intelligence (AI), the Internet of Things (IoT), and 5G connection are driving digital trade, which is changing global economic interactions around the world. Nevertheless, the issue of competitiveness in digital service trade (DST) and its drivers is understudied, especially in the regulatory fragmentation environment and technological improvements. In order to fill in knowledge gaps regarding the relationship between technology and trade governance, this study uses Porter's Diamond Model to investigate how institutional factors (trade freedom, government efficiency) and technological infrastructure (AI, IoT, 5G) affect China's DST competitiveness in comparison to CPTPP member states.

Digital trade, which is one of the essential elements of the digital economy and industrial growth, becomes more important in the world economy [1-2]. Global commerce in digital services increased

¹ Faculty of Business and Communication, INTI International University, Malaysia; Email: i25030451@student.newinti.edu.my, (Corresponding Author), ORCID ID: 0009-0005-8349-7079

² Senior Lecturer, Faculty of Business and Communication, INTI International University, Malaysia; Email: oyelakin.idris@newinti.edu.my; ORCID ID: 0000-0003-3693-3243.

³ Senior Lecturer, Africa Institute of Extractive Industries (AIEi), Ghana; Email: kwesiaubynn@gmail.com; ORCID ID: 0000-0003-4645-7383

⁴ Faculty of Business and Communications, INTI International University, Malaysia, Email: i25030475@student.newinti.edu.my; ORCID ID: 0009-0004-0029-8078

⁵ Faculty of Business and Communications, INTI International University Nilai, Malaysia, Email: i25033276@student.newinti.edu.my; ORCID ID: 0009-0004-6423-1083

⁶ Graduate Business school, UCSI university, Kuala Lumpur, Malaysia, 56000, Malaysia, University of Lahore, Punjab, 54000, Malaysia; Email: warissalikhan@gmail.com; ORCID: <https://orcid.org/0000-0003-2988-7920>

from US\$4,080.2 billion in 2011 to US\$5,890.4 billion in 2020, and by 2024, digitally delivered services will be worth \$4.7 trillion [3] see Figure 1. However, global governance efforts are hampered by the absence of a common definition and legal framework, which is exacerbated by the dispute over the classification of goods and services [4]. The current study seeks to conduct an in-depth examination of the DST competitiveness, and with the help of an advanced set of methodologies, it will inform policy and practice.

Building on this basis, the quick expansion of digital trade highlights its vital significance in the world economy. The digital trade cannot be discussed outside the context of the Internet revolution that has essentially changed economic activity because it has evolved into a communication tool to become one of the major economic utilities [5-6]. A key component of the Fourth Industrial Revolution, the digital economy brought about this new era of business [7-9]. Modern technologies, such as big data analytics, machine learning, cloud computing, mobile Internet, and Artificial Intelligence, have contributed to the increased influence of the digital economy on promoting the globalization process, collaboration, and innovation [10-11]. With the removal of the traditional boundaries such as time, space, and language barriers, digital technologies contribute to much higher efficiency of transactions, reduction of the trade cycle, and reduction in prices [1, 8-9].

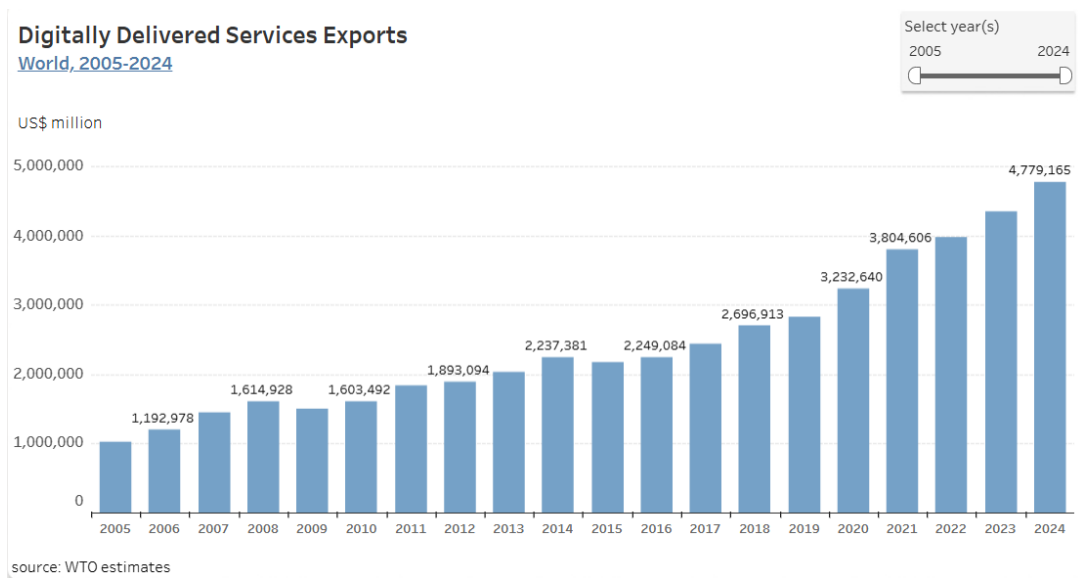


Figure 1: Growth in Digitally Delivered services export from 2005 to 2025

Source: Wto.org, [42]

The power of digital trade was particularly felt during the COVID 19 pandemic when global digital services were very resilient by recording a decline of 1.8% as opposed to 20% in global traditional services exports [12-13]. This good performance as illustrated in figure 2 below supports the argument that digital is a critical tool of guaranteeing global economic growth and recovery.



In 2022, digitally deliverable exports grew slower than during COVID-19

Index of digitally deliverable exports in current prices (2010=100)

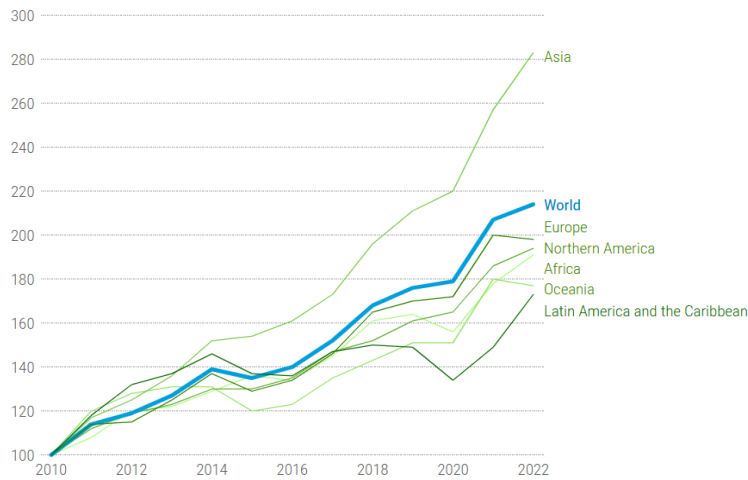


Figure 2: Growth of Digitally Deliverable Exports During Covid-19

Source: UN Trade and Development (UNCTAD), [43]

Emerging Technologies Driving Digital Trade 2.0

Digital trade is a growing concept, which is continuously being complemented and expanded [11, 14]. The last stage in its evolution, which is referred to as Digital Trade 2.0, is marked by extensive adoption of the modern digital technologies in all economic sectors that go beyond the simplest digitization or e-commerce [15]. This paper will also examine how three significant emerging technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), and 5G connectivity have established industrial growth and the flow of goods and services around the world. Such technological developments have an uprooting effect on trade:

Artificial Intelligence (AI), Intelligent Services: AI is a new technological paradigm, which changes the traditional trade modes. The implementation of AI is essential to develop a smart economic system, which allows providing more decision support and automated services [10]. Moreover, AI helps in innovative designs and modernization of products thus enhancing competitiveness of technical products internationally [16]. The successful utilization of digital technologies requires AI which is necessary to complete the correct transfer of the physical products, digital products, and services [11].

Internet of Things (IoT) and the Datafication of Goods: Smarter and connected goods are now part of the digital trade [15]. The use of digital technology in conventional goods like automobiles, home appliances, and industrial gear has increased significantly as a result of the acceptance of technologies like the Internet of Things (IoT) [14, 17]. This tendency, which is anticipated to grow significantly, makes the vast amounts of data produced and depended upon by these interconnected products essential to the trade of tangible goods [14, 17]. IoT can be used to facilitate e-commerce across borders by assisting in intelligent logistics, which emulates human judgment and thought in goods transport [18].

5G Network and Developed Infrastructure: High-speed internet connectivity is the key to the development of digital trade, which will guarantee the rapid and consistent transfer of the growing amount of data [19]. One of the factors that will impact digital trade will be 5G networks. Governments are recognizing the strategic role of such infrastructure by emphasizing the need to scientifically distribute R&D investment in such areas as big data and 5G, to develop first-mover advantages in innovative trade and enhance the effect of digital service trade technological innovativeness [19].

AI, IoT, and 5G have the potential to augment the efficiency of the trade when used together and the technological complexity of export production. The acceleration needs a Digital Trade 2.0 structure to make these technologies more accessible to the market.

The Challenge: Governance in Digital Trade 2.0.

The growing virtual and platform-related concept of digital trade pose challenges to the relevance of existing international regulations of trade and enforcement. The process of digitizing goods and integrating digital services into the physical products has become one of the fundamental challenges to the core conceptualizations of international trade regime such as the distinctions between goods and services as explained by the World Trade Organization (WTO) [4]. The creation of regulatory structures has lagged behind the development of technology which has created a highly dynamic and fragmented landscape. Policy divergence between key economies like the US, EU and China regarding matters of data governance such as cross-border data flows, data localization and protection of data privacy has been one of the most disputable matters in trade dealings [20]. Such a difference in regulations could deter digital trading, especially to smaller companies, and tends to end with the division of the global market. As a way of dealing with these complexities, global trade rules ought to be painstakingly reviewed comprehensively so that the enormous potential of these new technologies can be achieved without causing any significant risks to national security, imbalance, and increasing digital divide [21].

Literature Review

Literature on digital trade has developed as it is critical to the global economy. Preliminary studies focused on e-commerce and relevancy of ICT in aiding cross-border transactions [18, 22]. More recent research has shifted to broader definitions of digital trade, incorporating technologies like AI, IoT, and 5G [23]. For example, Huwei et al. [10] and Wu et al. [24] both focus on the effectiveness and competitiveness of trade with the help of these technologies, but their studies are frequently based on macro-level indicators, and there is no theoretical framework to discuss the dynamics of competitiveness.

Infrastructure and government efficiency are important elements in traditional trade, according to studies using Porter's Diamond Model [25], however their applicability to digital trade is still lacking. On the same note, although Ferracane and Marel [6] and Xiyang and Yihuan [26] discuss the effects of regulatory fragmentation on digital trade, they do not discuss the relationship between emerging technologies and institutional factors to influence competitiveness. Besides, the majority of the literature is based on high-income economies (US, EU), and little is done to examine emerging markets such as China or CPTPP countries [27].

The research paper aims to fill three gaps: (1) insufficient theoretical framework to examine digital trade competitiveness, (2) underrepresentation of emergent technologies (AI, IoT, 5G) into the competitiveness framework, and (3) a dearth of data on the role of institutional factors in emerging economies. Using the Diamond Model and multidimensional indexes, Porters (RCA, TC, MS, MI) help this study provide a new dimension of understanding the technological and institutional factor that leads to DST competitiveness in China and CPTPP countries.

Conceptualizing Digital Trade 2.0

Digital trade represents a new phase in the development of commercial and trade activities, continuing traditional trade, e-commerce, and cross-border e-commerce, and is characterized by ongoing upgrades and changes driven by the increasing digitization of information [28]. The inherent fluidity of digital trade, driven by technological and legal transformations, has made its definition a challenging task [4]. Nevertheless, this concept is essential for understanding contemporary global trade, as digital trade is regarded as both a key foundation of the digital economy development and its beneficiary [29-30].

Defining Digital Trade

This study is conceptually underpinned by digital trade that incorporates digitally ordered and delivered transactions [18]. The general definition involving cross-border e-commerce, digital services and data flows coincides with our interest of how Artificial Intelligence (AI), the Internet of Things (IoT) and 5G connectivity facilitate competitiveness in trade. The recent controversy regarding the inclusion of digitally delivered products as goods or services [4] highlights the importance of such a theoretical framework as the Diamond Model by Porter as the means of evaluating competitiveness in the context of this rapidly evolving landscape.

According to Mira and Rodrigo [22], the concept of digital trade has developed from the more specific word "electronic commerce," or "e-commerce," which refers to the production, distribution, marketing, sale, or delivery of products and services through electronic means. The recent literature

and trade agreements have migrated to the inclusive term digital trade that includes the use of such technologies as big data, IoT, and cloud computing [11, 23]. To help alleviate the problems of regulatory fragmentation, the current paper applies the general definition of the OECD that includes digitally ordered and delivered transactions to examine the effects of institutional variables and technical advances to the competitiveness of DST in China and CPTPP countries.

Bleeding Borders and Conceptual Hurdles

Digital trade eliminates traditional geographical boundaries within the scope of which one can bring business operations to an international level and maintain them on a global scale. It successfully breaks the conventional boundaries of geographical distance, time and language [8, 9]. More fundamentally, digitalization puts a strain on the conceptual basis of the international trade regime and the unambiguous separation of goods and services [6]. This implies that the trade of physical products is closely connected with the flow of information and computer-related services, which creates a serious challenge to the traditional functioning patterns of the international system [14, 17].

Data-Driven Economy (Datafication)

The main characteristic of modern digital trade is the emphasis on the data that is initiated by almost every transaction. The digital age has seen the emergence of information as a key factor of production and strategic resource [10]. Information is a crucial element of digital commerce, which can be an asset and a channel of service delivery and coordination of world value chains. This is defined by datafication, where all the interactions in everyday life are turned into data and then used in a social and economic context [15]. The Internet of Things (IoT) and other technologies promote the extensive popularity of digital technology in the physical product, and the ensuing data is a major element of the traditional goods transactions [17].

Increasing Productivity and Developing Innovative Technologies

The digital technologies help to improve efficiency of transactions, shorten time of trade and significantly decrease costs of variables by lowering entry barriers. The efficient operation of digital service trade relies on the usage of the digital technologies at various stages [24]. Nations are realizing the strategic importance of investing in digital infrastructure, namely 5G networks. China for instance, concentrates on R&D investment in 5G, big data, and blockchain to gain the first-mover advantage. Moreover, 5G and blockchain technologies enhance the online implementation of services within such sectors as finance and insurance [19]. Digital service trade positively impacts high-quality manufacturing. Big data, cloud computing, and artificial intelligence (AI) are technologies that infiltrate the manufacturing production management, supply chain management, and product design. This enhances resource allocation, and low cost of production [32-33].

Implications to Global Governance and Regulatory Concerns.

In the traditional trade era, digital trade blurred geographical boundaries. Digitally delivered products and tangible goods that have been fitted with digital services disrupt the fundamental operational mechanism of the international system, specifically the goods-services dichotomy, and the supply modalities in agreements such as the General Agreement on Tariffs and Services (GATS) [4, 6]. The need to regulate such emergent activities is driving the discussion of digital trade efforts and concerns about future trade agreements that include extensions of existing regulations or the addition of new regulations to address emerging issues, such as blockchain.

Singapore for example, leads in terms of implementation of new technologies, such as AI and data innovation, in new agreements, such as the Digital Economy Partnership Agreement [34]. Cooperation on the most advanced issues also falls under the New Digital Economy Agreements, including the adoption of ethical and governance principles that can promote the responsible, secure, and trusted use of AI technologies [21]. The freedom enjoyed by the autonomy states over the governance of the Internet has resulted in increased divergence in digital arena regulations. The digital sphere presents policymakers with challenges in coping with non-traditional business models and anti-competitive behaviors. In the absence of coordination, the threat of incompatible policy frameworks across regions and regulatory fragmentation cannot be discounted and will destroy the digital economy's potential [20, 26].

Empirical Analysis

The current section is devoted to the general empirical analysis of digital trade that entails strict assessing and comparison of the competitiveness of the digital service trade in the leading economies

across the globe. A strict regression analysis was carried out to identify the main factors that result in competitiveness in the sphere of digital services export and import [31].

Research Design and Methodology

The paper uses the mixed-method design to identify the competitive advantage of digital service trade (DST) in China and CPTPP countries between 2010 and 2022, using the Porters Diamond Model. The research design will be based on two steps: (1) comparative analysis of the DST competitiveness based on multidimensional indices (Revealed Comparative Advantage [RCA], Trade Competitiveness [TC], Market Share [MS], and Michaely Fluctuation Index [MI]) and (2) a regression analysis that will be applied to identify the factors influencing the competitiveness of DST.

The multidimensional indices were chosen to represent many aspects of competitiveness: stability is measured by MI, global market presence is reflected by MS, trade balance is evaluated by TC, and comparative advantage is measured by RCA [31]. These indices were synthesized by the Entropy-TOPSIS technique into a holistic competitiveness score, which is objective because the weighting component is based on data [31]. To test the hypotheses of the Diamond Model, a fixed-effects regression model, which was supported by Hausman test ($p < 0.001$), was used, and the robustness was checked by the Variance Inflation Factor (VIF) test (mean VIF < 10). The DID model was applied to estimate the potential long-term economic effect of digital trade policies by relying on the policy differences across nations [35].

The values of the trade were obtained through the World Trade Organization [3] and extended with the data of the World Bank on infrastructure and economic indicators. Sensitivity analyses were carried out before using linear interpolation to obtain the missing data of Brunei, Chile, Mexico and Vietnam so as to ensure strength. This approach will make the DST competitiveness holistically and theoretically informed.

Digital Service Trade Competitiveness: Measurement and Comparative Analysis

The level of trade in digital services between China and the CPTPP countries was measured by the four adopted indexes. These indicators involve a subtle impression of the relative advantages, existence, and stability of the market [36]. The results of TC index are attributed to the 2010-2022 that indicates the competitive position of the region. In the recent analyses, it is noted that China is becoming more competitive in the digital service trade compared to CPTPP member countries [37].

The United Kingdom had the highest TC index with varying values of 0.3–0.6, indicating that it has a strong competitive advantage and a high market share in the international digital services market. China’s TC index was rated second with a high growth rate and negative to positive change by 2018, indicating the initiation of a weak competitive advantage. In 2018, Singapore shifted from a negative to positive. Other Asian nations, such as Japan, Canada, Australia, Malaysia, and Vietnam, had weak competitive disadvantages (TC values of -0.3 to 0) and were largely import-oriented in the trade of digital services. Low TCs were observed in countries such as Chile, Peru, New Zealand, Mexico, and Brunei, indicating very weak international competitive disadvantage [27]. Table 1 below gives a picture of the average competitiveness indices with priority given to the UK, transition to export competitiveness in China, and the barriers to import-oriented countries such as Peru and Brunei [27, 44].

Table 1: Values of Average Competitiveness Indices Digital Service Trade (2010-2022). TC >0 and RCA >1 are the measures of export competitiveness; MS = export global digital services.

Country	Avg. TC Index	Avg. RCA Index	Avg. MS (%)	Avg. MI Index	Key Insights (per Narrative)
United Kingdom	0.45	1.45	8.2	0.25	Strong and consistent exporter
Singapore	0.35	1.3	6.5	0.18	Shift to positive TC in 2018
China	0.15 (post2018:+0.10)	1.1	5.8	+0.05 (2021+)	Rising from disadvantage
Japan	-0.1	0.95	4.2	-0.05	Import-oriented, weak TC
Canada	-0.05	1.05	3.8	-0.02 (post2020)	Minor advantage lost in 2021–2022

Australia	-0.15	0.9	3.5	-0.08	Weak disadvantage
Peru	-0.4	0.6	1.2	-0.2	Largest disadvantage
Brunei	-0.5	0.5	0.8	-0.25	Lowest across indices

Data Source: Li, J., & Wang, F. [37] and Hu et al. [27] for MI specifics.

Competitive advantage direction was also explained using the Michaely Fluctuation Index (MI) analysis. The UK MI index was also consistently positive and indicated that the competitive edge of export of digital services was rising. The MI index of China showed that a small competitive advantage was gained. Canada enjoyed a slight competitive edge over the world in 2010-2020, but lost competitiveness in 2021 and 2022, which contributed to the emergence of a comparative disadvantage. Most of the countries that had not disengaged CPTPP members had a competitive disadvantage in exporting digital services and Peru had the greatest disadvantage [27]. Lastly, the entropy weighting approach to synthesizing the four indices (RCA, TC, MS, and MI) led to the Comprehensive Score of Competitiveness. Table 2 is a summary of the entropy-weighted total competitiveness score on comprehensive competitiveness, with the UK leading, China improving at a rapid rate and Brunei showing a steady lead in digital service trade competitiveness (see Table 2).

Table 2: Entropy-Weighted Comprehensive Competitiveness Scores and Rankings for Digital Service Trade (2010–2022) Scores >0.5 indicate competitive advantage

Country	2010 Rank/Score	2018 Rank/Score	2022 Rank/Score	Overall Trend (2010–2022)
United Kingdom	1 / 0.82	1 / 0.78	1 / 0.75	Stable leader, slight decline
Singapore	2 / 0.70	2 / 0.72	2 / 0.74	Consistent strength and steady rise
China	5 / 0.35	4 / 0.48	3 / 0.55	Rapid improvement post-2018
Japan	3 / 0.65	3 / 0.60	4 / 0.52	Moderate decline
Canada	4 / 0.58	5 / 0.50	6 / 0.45	Weakening post-2020
Australia	6 / 0.50	6 / 0.48	5 / 0.48	Stable but import-oriented
Peru	10 / 0.20	10 / 0.18	10 / 0.15	Persistent disadvantage
Brunei	11 / 0.10	11 / 0.08	11 / 0.05	Lowest, no improvement

Data Source: Li, J., & Wang, F. [37]; WTO [3] for base trade values

Regression Analysis on the Factors Affecting the Competitiveness of digital services trade.

This paper applies a fixed-effects regression, which is based on the Diamond Model proposed by Porter, to determine the factors that affect the competitiveness of digital service trade (DST) in terms of logarithmic export (LnExport) and import (LnImport) between 2010 and 2021. The supportive industries (goods trade exports [GTE]) are listed as independent variables, as are the factors of production (digital infrastructure [LnFBS], tertiary education rate [EDU], service sector employment [EMP]), the supporting industry strategy (industry openness [LnDSTO], foreign direct investment [LnFDI]) and the government (government efficiency [LnGOV], trade freedom [LnTF]) [25, 38]. LnExport, LnImport, LnFBS, LnDSTO, LnGOV and LnTF were transformed using logarithmic transformations to reduce correlation and to fit the model assumptions.

Table 3 gives the results of the regression. Digital infrastructure (LnFBS) was found to have a significant positive impact on exports (0.31 $p < 0.05$) and imports (0.28 $p < 0.01$), which underscores the important role that digital infrastructure plays in aiding trade. The institutionally oriented Diamond Model was supported by Industry openness (LnDSTO) to have significant effects on exports ($\beta = 0.45$, $p < 0.01$) and imports ($\beta = 0.42$, $p < 0.01$). The trade freedom (LnTF) had a positive impact on imports (0.22, $p < 0.05$) but not exports (0.12, not sig), which is a selective institutional effect. The impact of

service sector employment (EMP) was two-fold as it increased the competitiveness in exports (0.18, $p < 0.01$) and decreased the competitiveness in imports (0.10, $p < 0.05$), indicating labor specialization as a source of exports benefits (Yeerken and Deng, 2023). The rate of tertiary education (EDU) was found important on imports (0.20, $p < 0.05$) but not on exports (0.15, not sig.) and goods trade exports (GTE) had a positive impact on exports (0.35, $p < 0.01$) but not on imports (0.14, not sig.). The efficiency of the government (LnGOV) had a positive impact on exports ($\beta = 0.28$, $p < 0.05$) and imports ($= 0.25$, $p < 0.01$), with institutional support [39]. Both (0.08/ 0.09, not significant) were insignificant in relation to foreign direct investment (LnFDI).

The stability of results was checked by robustness checks such as using alternative model specification and omitting interpolated data. Nonetheless the explanatory power of the model ($R^2 = 0.67$ exports, 0.64 imports) demonstrates that other unmeasured variables such as innovation at the firm-level might affect competitiveness and this will be the subject of future research.

Table3: Regression Results for Factors Affecting Trade in Digital Services (2010–2021)

Variable	LnExport Coefficient	LnExport Significance	LnImport Coefficient	LnImport Significance
Digital Infrastructure (LnFBS)	0.31	**($P < 0.05$)	0.28	***($P < 0.01$)
Industry Openness (LnDSTO)	0.45	***($P < 0.01$)	0.42	***($P < 0.01$)
Trade Freedom (LnTF)	0.12	Not Sig.	0.22	**($P < 0.05$)
Tertiary Education Rate (EDU)	0.15	Not Sig.	0.20	**($P < 0.05$)
Government Efficiency (LnGOV)	0.28	**($P < 0.05$)	0.25	***($P < 0.01$)
Service Sector Employment (EMP)	0.18	***($P < 0.01$)	-0.10	**($P < 0.05$)
Goods Trade Exports (GTE)	0.35	***($P < 0.01$)	0.14	Not Sig.
Foreign Direct Investment (LnFDI)	0.08	Not Sig.	0.09	Not Sig.

Source: Adapted from Suh & Roh, [39]; Zhao et al.,[40]; Kaššaj & Peráček, [19]; Yeerken & Deng, [38].

Discussion

Discussion and Research Contributions

This research contributes to the use of Porter's Diamond Model by showing how trade openness and digital infrastructure boost the competitiveness of digital service trade (DST), especially in developing nations like China. As opposed to previous studies of traditional trade [25], our results offer a new perspective on the goods-services dichotomy of the digital trade regulation by emphasizing the unique role of artificial intelligence (AI), the Internet of Things (IoT), and 5G connectivity in the re-definition of trade relations [4]. By integrating these new technologies into the Diamond Model, the study will fill a significant gap in knowledge regarding the impact of the technological transformation in trade.

The study also contributes to the methodology as it uses a multifaceted method of assessing the competitiveness of DST, which integrates Entropy-TOPSIS method with the Michaely Fluctuation Index (MI), Market Share (MS), Trade Competitiveness (TC), and Revealed Comparative Advantage (RCA) indices [41]. This approach offers a critical and fair evaluation of the competitiveness of China versus the CPTPP countries, which overcomes the limitations of single-measure analyses. These findings can be used to govern global trade by highlighting the need to have policies that leverage on technical innovation and reduce the regulatory barriers to encourage inclusive economic development.

Competitiveness Findings

The empirical data available in various economies and trade relations make strong conclusions about the competitiveness of digital trade and the effectiveness of regulation based on its measures.

This was proven by the overall grading of the digital service trade competitiveness between 2010 and 2022, which indicated that the United Kingdom retained the dominant competitive edge, followed by fast-developing economies such as Singapore (ranked second) and China (ranked third) [27]. Strong infrastructure and trade integration are the main drivers of China's sharp increase in digital service trade competitiveness, especially after 2018 [27, 37]. Competitiveness levels in other CPTPP member countries are very low and unstable, with countries such as Australia, New Zealand, Malaysia, Chile, Mexico, Vietnam, and Peru scoring low and Brunei getting the lowest overall competitiveness scores [36, 44].

Table 4: Competitiveness of digital service trade and key drivers

Country	2022 Competitiveness Rank (IMD)	Key Contributing Factors (High impact in 2022)
United Kingdom	7	Digital infrastructure and services readiness, strong trade openness, relatively high government efficiency
Singapore	3	Outstanding digital infrastructure and e-government, very high trade openness / logistics, strong government efficiency
China	5	Robust infrastructure and economic performance, improving governance, high trade integration
Japan	34	Strong physical and technological infrastructure and human capital, but weaker trade openness and regulatory flexibility
Brunei	Not ranked / low	Weak digital infrastructure and connectivity, low trade openness, limited government efficiency

Source: Hao et al., [36]; Hu et al., [27]

Table 4 above compares competitiveness positions of China and some other CPTPP countries in 2022 and highlights the most important factors that contributed to their relative positions. Infrastructure and trade integration are the strengths of China, with Singapore and UK having the benefit of having well developed digital infrastructure, open trade systems, and good governance. The competitiveness of Japan is based on technology and human capital and is constrained by the less trade openness and regulatory flexibility. On the other hand, Brunei is the least competitive as a result of low infrastructure, in transparency, and ineffective government.

Regression analysis demonstrated that a number of fundamental contributors to competitiveness are in line with the diamond model's theory: infrastructure digitization, openness to trade, and government efficiency have been found to have a significant impact on export and import competitiveness [19, 39-40]. Labor resources had a twofold impact, where the service industry's employment ratio is more export-competitive and simultaneously suppresses import competitiveness [38]. Along with competitiveness, the flow of digital service inputs was found to have a significant impact on importing nations' economic growth, demonstrating the high importance of the data aspect of the contemporary economy [13].

Moreover, the digital trade rules were also an essential governance instrument that played an important positive role in facilitating the export of digital services. Mechanism testing ensured that this positive effect works in part as an intermediary factor that effectively lowers trade costs [25]. This beneficial effect is not experienced uniformly across all countries. Most importantly, the introduction of digital trade regulations was observed to yield more positive effects on the digital services trade of low and middle-income countries than on the high-income countries (Qi et al., 2023). Nevertheless, the article about the digital barriers offered a needed contrast, as it found that the presence of digital service trade barriers negatively affects the positive influence of the cross-border input of digital services on economic growth to greater extent [6]. Direct restrictive policies had the most potent inhibitory impact among the disaggregated barriers, followed by data barriers [26].

Recommendations and Policy Implications

On the basis of these findings, certain policy recommendations can be drawn that deal with the increase of market openness, better governance structures, and emphasis on digital development.

Countries, especially China, must fully engage and encourage the formation and enhancement of global digital trade regulations, especially regional ones, without jeopardizing national security regulations [20]. One of the major policy goals must be to streamline the management system to trade in digital services and make industry more open with less trade barriers, since high openness is found to have the best influence on the values of trade [32]. Moreover, policymakers should proactively engage in the R&D of digital technologies and develop high-quality, innovative talents with an understanding of the international digital trade regulations [32]. Innovations in new digital infrastructure, including fiber-optic broadband and big data centers, are essential in increasing the effects of technological innovation and enhancing the overall efficiency of the trade [19]. Finally, economically feasible nations, such as China, are recommended to help technologically disadvantaged nations in implementing digital infrastructure development to facilitate efficient trade and digitalization [30].

The Limitations of This Study and Future Research Directions Should Be Considered.

The literature that has been reviewed identifies a number of limitations that can be mostly related to digital trade as a quantifiable discipline is in development stage (OECD, 2020). The main limitation of this study is the availability and completeness of data, which forced the reduction of the number of samples to a particular number of major trading partners and limited the analysis of the long-term perspective, which may compromise the applicability and validity of conclusions [38]. Methodological issues also exist, including acknowledging that the composite index used to assess DTD is not necessarily complete, as obtaining full information on the local level is more difficult [41]. In addition, there are digital service categories, such as personal, cultural and recreational services, which could contain a few economic activities that are not necessarily digital in nature, so further research needs to refine its classification [3].

The next stage of research should focus on improving the analysis volume and scope. In particular, scholars proposed going beyond macro-level panel studies and analyse the micro (firm) level in order to learn more about corporate dynamics [31]. Subsequent models should also extend the range of variables to cover a large number of intermediate and moderating variables, including enterprise innovation and customs clearance efficiency, which were not considered in the first models [33]. In addition, although recent literature focus on the number of digital service inputs, future research must consider the influences of technological content of such investments [16]. Finally, rather than comparing a country's competitiveness to the general pool of partners, the future researches should compare the nature of bilateral digital service trade to narrow down the competitiveness determinants to a country-pair basis [27].

Conclusion

The comparative techniques, combined with multiple regression models, are used in the empirical analysis, which is organized on the competitiveness of digital service trade between China and the CPTPP member countries from 2010-2022. As part of competitive analysis, the different metrics employed were the Revealed Comparative Advantage (RCA), Trade Competitiveness Index (TC), Market Share (MS), and the Michaely Fluctuation Index (MI), which demonstrated that the digital service trade competitiveness of China was relatively. This increased competitiveness of the digital service trade's export and import was confirmed by multiple regression analysis conducted on the basis of the diamond model theory which showed that factors such as level of trade freedom, government efficiency, number of fixed broadband subscriptions per 100 individuals and openness of the industry significantly improved the competitiveness of the exportation and importation process. In addition to domestic competitiveness, external assessments made it clear that the advancement of digital trade development of an importing country is a powerful facilitator. China's export of high-technology products and that the implementation of bilateral digital trade rules has an effective and strong effect on the export of digital services.

Declaration

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Data Availability Statement

The original data presented in the study are openly available in the references below with their corresponding DOI's labelled 1-43.

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Conflicts of Interest

The authors declare no conflict of interest.

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