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Impact of Digital Services Trade Barriers on the Quality of China's Manufacturing Export Products

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Abstract: In the context of increasing fragmentation in global digital trade rules, this paper examines the impact of digital services trade barriers on China's manufacturing export product quality. Using Chinese product–destination–year export data from 2014–2023, combined with the OECD Digital Services Trade Restrictiveness Index and input–output tables, this study constructs a country–industry-level measure of digital services trade barriers. The results show that digital services trade barriers significantly reduce export product quality. The findings remain robust after instrumental variable estimation, alternative measurements, and higher-dimensional fixed effects. Furthermore, institutional quality mitigates this negative effect. This study highlights digital services trade barriers as an important institutional factor affecting manufacturing export quality upgrading.

Keywords: Digital services trade barriers; Export quality; Manufacturing exports; Institutional quality

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1. Introduction

Against the backdrop of rapid digital transformation and the restructuring of global trade rules, digital services have become important inputs in manufacturing production and export activities. Services such as communication, data processing, software, digital platforms, and digital payments facilitate information flows and transaction efficiency, thereby influencing manufacturing export quality.

However, the liberalization of digital services trade remains uneven across countries. Regulatory measures concerning data security, privacy protection, intellectual property rights, electronic transactions, and digital payments have contributed to the emergence of digital services trade barriers. Unlike traditional tariffs, these barriers indirectly affect manufacturing exports by increasing the cost and reducing the efficiency of firms' access to and use of digital services.

Existing studies mainly examine digital trade restrictions and export quality separately. This paper

combines the OECD DSTRI with industry-level digital input intensity to construct a country–industry-level measure of digital services trade barriers. Using Chinese manufacturing product–destination–year export data from 2014–2023, this study examines the impact of digital services trade barriers on export product quality and the moderating role of destination-country institutional quality.

2. Literature review

2.1. Digital services trade barriers

The OECD Digital Services Trade Restrictiveness Index (DSTRI) and the ECIPE Digital Trade Restrictiveness Index (DTRI) are widely used to measure such restrictions. Among them, the DSTRI captures restrictions in infrastructure, electronic transactions, payment systems, intellectual property rights, and other policy areas [1].

2.2. Export product quality and its determinants

Export product quality reflects manufacturing competitiveness and export upgrading. Unlike export volume or price, quality emphasizes vertical differentiation among similar products. Hallak and Schott, and Khandelwal et al. measure product quality using structural demand models, which have been widely applied in subsequent studies [2–3].

Digital economic development promotes quality upgrading by reducing information frictions and search costs, while trade barriers and institutional costs influence quality through cost adjustment and technological upgrading mechanisms [4–6].

2.3. The impact of digital services trade barriers on manufacturing activities

As digital services increasingly become important intermediate inputs, restrictions on digital service utilization may reduce firms' access to digital resources and weaken production efficiency [7–8]. Recent research also finds that digital trade barriers negatively affect export product quality upgrading by increasing transaction costs and limiting firms' ability to utilize digital resources [9–11].

2.4. Literature review and research contributions

Existing studies provide important foundations for understanding digital services trade barriers and export product quality. However, the role of destination-country institutional quality in mitigating the negative effects of digital services trade barriers requires further investigation.

Therefore, this paper combines destination-country DSTRI with industry-level digital input intensity to construct a country–industry measure of digital services trade barriers and examines their impact on China's manufacturing export product quality. Furthermore, this paper investigates the moderating role of institutional quality.

3. Theoretical analysis and research hypotheses

3.1. The impact of digital services trade barriers on export product quality

However, digital services trade barriers restrict firms' access to digital service inputs through limitations on data flows, electronic transactions, and digital platforms [12–13]. Consequently, firms may face greater

difficulties in product innovation and quality upgrading.

Therefore, this paper proposes:

H1: Digital services trade barriers have a significant negative impact on the quality of China's manufacturing export products.

3.2. The moderating role of institutional quality

Institutional quality influences firms' international operations by shaping regulatory transparency, policy stability, and contractual protection [14–15].

Therefore, institutional quality may weaken the negative impact of digital services trade barriers on export product quality.

Accordingly, this paper proposes:

H2: Institutional quality mitigates the negative impact of digital services trade barriers on the quality of China's manufacturing export products.

4. Research design

4.1. Variable measurement and model construction

4.1.1. Explanatory variable: Digital Services Trade Barrier Index (cdstri)

The core explanatory variable is the digital services trade barrier index. Since the OECD Digital Services Trade Restrictiveness Index (DSTRI) is measured at the country level and manufacturing industries differ in their dependence on digital service inputs, this paper combines destination-country DSTRI with industry-level digital service input intensity to construct a country–industry-level indicator of digital services trade barriers, following Zhang G et al. [10].

Based on China's 2017 input–output table, the digital service input intensity of industry kkk is calculated as:

$$\alpha_k = \sum_{s \in D} \alpha_{ks} \tag{1}$$

where α_k represents the digital input intensity of manufacturing industry k; α_{ks} represents the proportion of the digital service sector s used as an intermediate input by industry k; and D represents the set of digital service sectors.

The digital services trade barrier index is then constructed as:

$$cdstri_{dkt} = \ln\left(DSTRI_{dt} \times \alpha_k\right) \tag{2}$$

Where $cdstri_{dkt}$ represents the digital services trade barrier faced by the manufacturing industry k from destination country d in year t; $DSTRI_{dt}$ represents the digital services trade restrictiveness index of destination country d in year t; and α_k represents the digital service input intensity of industry k.

This indicator captures both destination-country digital service restrictions and industry dependence on digital service inputs. A higher value indicates stronger digital services trade barriers faced by industries exporting to countries with stricter digital service regulations. Therefore, the expected coefficient is negative.

4.1.2. Dependent variable: Export product quality (quality)

The dependent variable is export product quality. Following Shi and Shao, this paper measures export

product quality based on the CES demand framework [16].

Assuming CES preferences among destination-country consumers, export product quality can be inferred from the demand equation:

$$\ln q_{dgt} = x_{dt} - \sigma \ln p_{dgt} + \mu_{dgt} \tag{3}$$

where q_{dgt} and p_{dgt} denote the export quantity and price of product g from China to destination country d in year t, respectively. x_{dt} represents destination-country–year fixed effects, and μ_{dgt} contains information on product quality. Therefore, export product quality is obtained from the regression residual:

$$quality_{dgt} = \frac{\mu_{dgt}}{\sigma - 1} \tag{4}$$

To facilitate comparison across products, this paper further normalizes the estimated quality measure:

$$rquality_{dgt} = \frac{quality_{dgt} - \min\left(quality_{dgt}\right)}{\max\left(quality_{dgt}\right) - \min\left(quality_{dgt}\right)} \tag{5}$$

where $rquality_{dgt}$ represents the relative export product quality at the product level, with values ranging from 0 to 1.

4.2. Empirical model

4.2.1. Baseline model

To examine the impact of digital services trade barriers on China's manufacturing export product quality, this paper constructs the following baseline model:

$$rquality_{dgt} = \alpha + \beta cdstri_{dkt} + \gamma X_{dgt} + \mu_g + \lambda_d + \delta_t + \varepsilon_{dgt} \tag{6}$$

where $rquality_{dgt}$ represents the relative export product quality of product g exported by China to destination country d in year t; $cdstri_{dkt}$ is the core explanatory variable. X_{dgt} denotes control variables, including tariffs, mobile communication development, economic development level, exchange rates, population size, and regional trade agreements. μ_g, λ_d, and δ_t represent product, destination-country, and year fixed effects, respectively.

The coefficient of interest is β. A significantly negative β indicates that digital services trade barriers inhibit the upgrading of China's manufacturing export product quality.

4.2.2. Moderating effect model

To examine whether institutional quality moderates the impact of digital services trade barriers on export product quality, this paper introduces the interaction term between digital services trade barriers and institutional quality:

$$rquality_{dgt} = \alpha + \beta_1 cdstri_{dkt} + \beta_2 M_{dt} + \beta_3 \left(cdstri_{dkt} \times M_{dt}\right) + \gamma X_{dgt} + \mu_g + \lambda_d + \delta_t + \varepsilon_{dgt} \tag{7}$$

where M_{dt} represents institutional quality measured by WGI_{dt}, and $\left(cdstri_{dkt} \times M_{dt}\right)$ is the interaction term. A significantly positive β_3 suggests that higher institutional quality weakens the negative effect of digital services trade barriers on export product quality.

5. Empirical results

5.1. Baseline regression results

To examine the impact of digital services trade barriers on China's manufacturing export product quality, this paper estimates the baseline model with product, destination-country, and year fixed effects. The results are reported in **Table 1**.

Column (1) includes only the core explanatory variable. Column (2) further controls for tariff levels, while Column (3) incorporates additional destination-country characteristics, including mobile communication penetration, GDP per capita, exchange rates, market size, and regional trade agreements.

Across all specifications, the coefficient of digital services trade barriers remains negative and statistically significant at the 1% level, indicating that higher digital services trade barriers significantly inhibit the quality upgrading of China's manufacturing exports. The estimated coefficient remains stable after progressively introducing control variables, suggesting that the negative effect is robust.

Overall, the baseline regression results confirm that digital services trade barriers have a significant negative impact on manufacturing export product quality, supporting Hypothesis 1.

Table 1. Baseline regression results

Variables	(1)rquality	(2)rquality	(3)rquality
cdstri	-0.003***	-0.003***	-0.003***
	(-4.363)	(-4.632)	(-4.215)
Product fixed effects	YES	YES	YES
Country fixed effects	YES	YES	YES
Year fixed effects	YES	YES	YES
N	507746	505434	422639
R-squared	0.478	0.480	0.488

Note: Values in parentheses are t-statistics. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Unless otherwise specified, the notes apply to all subsequent tables.

5.2. Endogeneity test

To address potential reverse causality between digital services trade barriers and export product quality, this paper uses the one-period lagged digital services trade barrier index as an instrumental variable. As shown in **Table 2**, the Kleibergen–Paap rk LM statistic rejects the null hypothesis of under-identification, and the Kleibergen–Paap rk Wald F statistic exceeds the conventional threshold of 10, indicating that the instrument is valid and not weak.

The second-stage regression shows that the coefficient of digital services trade barriers is -0.005 and significant at the 1% level, consistent with the baseline results. This suggests that the negative impact of digital services trade barriers on manufacturing export product quality remains robust after addressing potential endogeneity.

Table 2. Instrumental variable estimation results

Variables	(1)First stage	(2)Second stage
cdstri_t-1	0.643***	
	(214.259)	

cdstri		-0.005***
		(-3.299)
Product fixed effects	YES	YES
Country fixed effects	YES	YES
Year fixed effects	YES	YES
N	336984	336984
K-P rk LM statistic	-	17481.62(0.0000)
K-P rk Wald F statistic	-	45906.88

Note: The values in parentheses after the K-P rk LM statistic are *P*-values.

5.3. Robustness checks

Several robustness checks are conducted to verify the reliability of the baseline results, including winsorizing the dependent variable at the 1% level, replacing the core explanatory variable with an alternative bilateral digital services trade barrier measure, and adding industry–year fixed effects.

As reported in **Table 3**, the coefficient of digital services trade barriers remains significantly negative across all specifications. These results indicate that the baseline finding is robust to alternative samples, variable measurements, and higher-dimensional fixed effects.

Table 3. Robustness checks

Variables	(1) 1% Two-sided Winsorization	(2) Alternative Core Variable	(3) Industry-Year Fixed Effects
cdstri	-0.003***	-0.062***	-0.003***
	(-4.138)	(-6.458)	(-3.878)
Product fixed effects	YES	YES	YES
Country fixed effects	YES	YES	YES
Year fixed effects	YES	YES	NO
Industry-year fixed effects	NO	NO	YES
N	422639	430529	422639
R-squared	0.500	0.489	0.493

5.4. Moderating effect of institutional quality

To examine whether institutional quality moderates the effect of digital services trade barriers on export product quality, this paper introduces WGI and its interaction term with digital services trade barriers.

Table 4 shows that the coefficient of cdstri remains significantly negative, while the interaction term cdstri×WGIcdstri \times WGIcdstri×WGI is significantly positive at the 1% level. This indicates that institutional quality weakens the negative impact of digital services trade barriers on export product quality.

Therefore, better institutional environments can reduce regulatory uncertainty and compliance costs, thereby mitigating the adverse effects of digital services trade barriers.

Table 4. Moderating effect of institutional quality

Variables	(1)rquality
cdstri	-0.0048***
	(-5.69)

WGI	0.0109***
	(5.06)
cdstri×WGI	0.0014***
	(5.66)
Product fixed effects	YES
Country fixed effects	YES
Year fixed effects	YES
N	422,639
R-squared	0.488

6. Conclusions and policy implications

6.1. Conclusions

Using Chinese manufacturing product–destination–year export data from 2014 to 2023, this paper constructs a country–industry level measure of digital services trade barriers by combining the OECD Digital Services Trade Restrictiveness Index with industry-level digital input intensity. The results show that digital services trade barriers significantly inhibit China's manufacturing export product quality, and the findings remain robust after addressing potential endogeneity and conducting robustness checks.

Further analysis indicates that institutional quality mitigates this negative effect, suggesting that favorable institutional environments can reduce the adverse impact of digital trade restrictions on export quality upgrading.

Overall, digital services trade barriers constitute an important external institutional constraint on manufacturing export quality improvement. The findings should be interpreted as evidence of a significant inhibitory effect rather than a strict causal conclusion.

6.2. Policy implications

First, China should promote digital trade rule coordination and strengthen cooperation in cross-border data flows, electronic transactions, digital payments, and intellectual property protection to reduce unreasonable digital services trade barriers.

Second, policies should support firms' digital service utilization by improving digital infrastructure, digital trade services, and compliance support, particularly for small and medium-sized exporters.

Third, differentiated policies should be implemented to enhance firms' capacity to cope with digital services trade restrictions, with particular attention to digital transformation and institutional adaptation.

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