



The Impact of Digital Finance on the Export Technological Complexity

--An Empirical Analysis Based on the Data of Cities in China

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Abstract. This study investigates the effect of digital finance on export technological complexity using the merged data of 288 Chinese cities. After calculating the export technological complexity of each cities, the study introduces infrastructure development as a mediating variable to test the theoretical mechanism. The finding reveals digital finance can significantly promotes export technology complexity and infrastructure construction is a transmission path for digital finance to enhance export technological complexity. Additionally, the study finds that in less developed regions digital finance has a greater impact on trade through infrastructure construction, Based on the above theoretical analysis and empirical research, this study puts forward policy recommendations.

Keywords: digital finance, export technological complexity, infrastructure construction, mechanism analysis

1 Introduction

In recent years, China has vigorously advocated industrial transformation and upgrading, hoping to enhance China's trade status and the innovation ability of Chinese industries by upgrading the technological level of export products. How to maintain the continuous growth of export as well as improve the technical level of export trade is the focus of the trade industry and academia at present.

Through reading a large amount of literature, it is found that there are some links between digital finance, the level of infrastructure construction and the level of trade technology. Digital financial development has a positive impact on the level of various types of infrastructure development. On the one hand, financial services can support the construction of urban infrastructure, alleviate the financial bottleneck constraints of urbanization, meet the financial needs of large-scale and rapid modernization and urbanization in the region, and thus promote the development of infrastructure construction and urbanization.^[1] On the other hand, under the impetus of digital finance policies, the region has increased its investment in the construction of a variety of new digital infrastructure such as 5G, data centers, artificial intelligence, and the Internet of Things. Infrastructure construction promotes the technological level of regional export

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products, and theoretically its intrinsic reasons are explained from the following two points: first, infrastructure construction can generate economies of scale. Convenient transportation paths for raw materials and products can improve production efficiency, and low water and electricity costs can reduce production costs, thus attracting more enterprises to gather.^[2] Competition and exchanges between enterprises can promote the upgrading of production technology. Secondly, as transportation and economic hubs, cities with well-developed infrastructures usually gather a large number of colleges, universities and research institutes that export high-quality talents and scientific research results, which is conducive to the absorption of technological talents by enterprises and the direct conversion of knowledge into production capacity, thus facilitating the technological innovation of enterprises.^[3] Digital finance may have the role of promoting the technological level of regional export trade products by promoting regional infrastructure construction. The level of infrastructure construction may be the mediating variable between digital finance and regional export technology level.

To sum up, although there is a consensus on the positive role and impact of digital finance, the number of studies on the impact of digital finance on export technological complexity is relatively small, and the literature is still missing on specific mechanism about the mediating role played by infrastructure construction. This paper examines the role of infrastructure construction in the impact of digital finance on the export technological complexity based on the data of 288 Chinese cities, and analyzes the mechanism in depth, which to a certain extent fills the gaps in the relevant research field. Additionally, this paper distinguish the effect in different regions, which has strong policy implication.

2 Data and empirical methodology

2.1 Regression model and mediation effect testing mechanism

Based on the above research hypotheses, this paper establishes a regression equation on the technology level of export trade in region i . The regression model is based on the following assumptions:

$$TC_{it} = \alpha_1 + \alpha_2 IFI_{it} + \alpha_3 control_{it} + p_i + \varepsilon_{it} \quad (1)$$

In (1), TC_{it} denotes the export technological complexity of region i in year t . IFI_{it} denotes the digital finance development index of region i in year t , and $control_{it}$ denotes a series of control variables. p_i indicates the region's inherent non-objective factors affecting the level of technology, and ε_{it} represents the random perturbation term.

In order to verify the possible mechanism of action between digital finance and the export technological complexity, with reference to the mediation effect test mechanism designed by Wang, Han, and Zhu (2022)^[4], this paper sets the following regression model to represent the effect of digital finance on the mediating variable:

$$TC_{it} = \alpha_1 + \alpha_2 IFI_{it} + \alpha_3 control_{it} + p_i + \varepsilon_{it} \quad (2)$$

$$TC_{it} = \gamma_1 + \gamma_2 IFI_{it} + \gamma_3 ROAD_{it} + \gamma_4 control_{it} + p_i + \varepsilon_{it} \quad (3)$$

In (2) and (3), $ROAD_{it}$ denote the mediator variable (level of infrastructure development) for region i in year t , β_2 denote the extent to which digital finance affects the mediator variable, and γ_2 denote the direct effect of the digital financial development affecting the export technological complexity after controlling for the mediator variable.

2.2 Explanation of Variables and Statistical Description of Data

Export technological complexity (TC_{it}) is the dependent variable. This paper utilizes data from the China Customs Database and the United Nations Commodity Trade Statistics Database to complete this calculation process. The two-step measurement method of Hausmann et al. (2007) [5] will be borrowed in the study. In the first step, the technical complexity index ($Prody_{kt}$) of the products of an industry is measured as follows:

$$Prody_{kt} = \sum_{j=1} \frac{\frac{X_{jkt}}{X_{jt}}}{\sum_{j=1} \frac{X_{jkt}}{X_{jt}}} \cdot GDP_{jt} \quad (4)$$

In (4), X_{jkt} represents the export amount of k industries in region j in year t ; X_{jt} represents the total export amount of all industries in region j in year t ; and GDP_{jt} represents the level of per capita income in region j in year t (which is expressed in this paper by the per capita GDP of the region).

In the second step, according to the technological complexity of the products, this paper takes the export amount of each industry as the weight, and calculates the overall export technological complexity of each city:

$$TL_{it} = \sum_{k=1} \frac{X_{ikt}}{X_{it}} \cdot Prody_{kt} \quad (5)$$

In (5), X_{it} denotes the total export value of all industries in city i in year t . In this paper, the city's export product data are compared to the commodity code comparison table to match the sample data, intercepted to the HS six-digit code, and the sample data are categorized and calculated according to the year.

This paper uses the inclusive finance index compiled by the Digital Finance Research Center of Peking University[6] as core independent variable. Other data come from China Statistical Yearbook of the National Bureau of Statistics, China Science and Technology Investment Statistical Bulletin, State Intellectual Property Office and statistical yearbooks of provinces and cities. In the process of calculation, in order to make the data distribution more reasonable and eliminate the scale, this paper takes the logarithmic treatment of the control variables.

Table 1 shows the descriptive statistics of the dependent variables, core independent variable, control variables and mediating variables. The data scope is limited to 288 cities in mainland China from 2011 to 2017. Considering the comparability of data, this study excludes Hong Kong, China, Macau, China and Taiwan, China.

Table 1. Descriptive statistics

Variables	Definition	Mean	Standard Deviation
<i>TC</i>	export technological complexity	47403.2	9722.5
<i>IFI</i>	digital finance index or inclusive finance index	144.0	58.2
<i>FDI</i>	the amount of foreign capital actually used in the year	98025.6	226204.8
<i>GDP</i>	economic growth rate	9.3	4.5
<i>HR</i>	number of college students per 10,000 people	202.4	238.3
<i>PATR</i>	growth rate of the number of patents	0.3	0.5
<i>GREEN</i>	the greening coverage of the built-up area of the region	39.4	11.1
<i>ROAD</i>	the area of real urban roads	1877.8	2397.5

3 Results

3.1 Analysis of benchmark regression results

Table 2. Results of Regression

Variables	TC	TC	TC
	(1)	(2)	(3)
IFI	0.053*** (3.94)	0.040** (3.15)	0.070*** (4.91)
Control	NO	YES	YES
Two Fixed Effect	YES	NO	YES
Observations	1571	1436	1436

Note: Cluster standard errors are in parentheses; *, ** and *** denote $p < 0.1$, $p < 0.05$ and $p < 0.01$ respectively.

This paper investigates the impact of digital finance on export technological complexity according to (1). The results in Table 2 show that digital financial has a positive effect on export technological complexity and passes the 1% significance test. The regression coefficient is 0.053, which means, for every 1% increase in the digital finance index, the regional export technological complexity increases by 0.053%. Next, after adding control variables to the regression, as shown in column (3), digital finance still has a positive impact and its significance increases. Stimulating the development of regional digital finance can give rise to information, data and other innovative elements, promote product technology upgrading, encourage enterprises in various industries to improve productivity and technology, and promote the progress of regional export technological complexity. [7]

3.2 Mechanism test

Table 3 demonstrates the econometric results obtained from the fixed effects regression through the two-step method in (2) and (3). Columns (1) and (2) show that the digital financial promotes the local infrastructure development and is significant at the 1% level. For every 1% increase in the regional digital financial development index, the

level of its infrastructure development rises by 0.204%. Columns (3) and (4) show the results of the analysis of equation (3). The digital financial still has a positive effect on export trade technology with the same level of significance. The regression coefficient decreases to 0.055. The total effect of digital finance is 0.066, of which the indirect effect played by infrastructure construction is 0.011 ($= 0.204 \times 0.055$), the mediating effect in the total utility of 16.67%.

The mediation effect two-step test proves that digital finance positively affects the export technological complexity by enhancing the level of regional infrastructure construction. Digital finance can alleviate the financing constraints of the region, meet the demand for planning, development and construction funds, and promote the construction of infrastructure.^[8] That enables production and innovation factors such as technology and information to flow and be exchanged more easily. This provides more opportunities for product upgrading for enterprises.^[9]

Table 3. Mediating effect and mechanism test results

Variable	ROAD		IFI	
	(1)	(2)	(3)	(4)
IFI	0.204*** (23.73)	0.210*** (19.54)	0.039*** (4.17)	0.055*** (4.71)
ROAD			0.063** (2.90)	0.055* (2.31)
Control	NO	YES	NO	YES
Two Fixed Effect	YES	YES	YES	YES
Observations	1947	1781	1538	1412

Note: Cluster standard errors are in parentheses; *, ** and *** denote $p < 0.1$, $p < 0.05$ and $p < 0.01$ respectively.

3.3 Heterogeneity Analysis

Considering the possible influence of geographic factors, this paper carries out sub-sample regression for the central, western and eastern regions. The results in Table 4 show that the direct upgrading effect of digital finance in the eastern is more significant, and the indirect and combined effects in the western are more significant.

For direct effect, the insignificant and smaller regression coefficients in the western and central regions. This is because in the eastern region, where the industrial chain and infrastructure are complete, digital finance has a better foundation and can exert greater influence on regional export technological complexity. In the imperfect financial market conditions in the other regions digital finance is difficult to give full play to its role, thus its impact is limited.^[10]

In terms of indirect effects, it is more pronounced in the western region. This may be due to the fact that infrastructure development can have a greater impact in the western region, where basic facilities are incomplete and production capacity is weak. The western region has uneven distribution of cities and natural resources. Therefore, more investment in infrastructure construction can significantly improve the efficiency of

resource transportation and utilization, and satisfy the production needs of enterprises. The direct effect of digital finance in the western region is 0.070, the indirect effect is 0.031, and the total effect is 0.101, which is significantly higher than the other regions.

Table 4. Results of heterogeneity test

Variables	Eastern		Central		Western	
	ROAD (1)	IFI (2)	ROAD (3)	IFI (4)	ROAD (5)	IFI (6)
IFI	0.126*** (5.43)	0.109*** (4.11)	0.010 (0.51)	0.037 (1.64)	0.045 (1.52)	0.067 (1.41)
ROAD		-0.017 (-0.31)		0.028 (0.80)		0.147* (2.62)
Control	NO	YES	NO	YES	NO	YES
Two Fixed Effect	YES	YES	YES	YES	YES	YES
Observations	633	600	610	579	328	240

Note: Cluster standard errors are in parentheses; *, ** and *** denote $p < 0.1$, $p < 0.05$ and $p < 0.01$ respectively.

3.4 Robustness Test

Because some cities in the west are relatively backward in digital finance, and export, so all cities in Tibet, Xinjiang and Qinghai are excluded from the regression in order to further ensure the robustness of the conclusion. According to Table 5, the coefficient becomes larger and the significance level rises compared with the full sample regression, and the impact of digital finance on the export technological complexity is more obvious after removing the special regional sample, which confirms the positive impact of digital finance on China's export technological complexity.

Table 5. Robustness test results

Variables	ROAD		IFI	
	(1)	(2)	(3)	(4)
IFI	0.056*** (4.13)	0.073*** (5.11)	0.041*** (4.43)	0.057*** (4.94)
ROAD			0.068** (3.15)	0.056* (2.35)
Control	NO	YES	NO	YES
Two Fixed Effect	YES	YES	YES	YES
Observations	1547	1423	1514	1399

Note: Cluster standard errors are in parentheses; *, ** and *** denote $p < 0.1$, $p < 0.05$ and $p < 0.01$ respectively.

4 Conclusion

By using data in 288 cities in China from 2011 to 2017, this paper finds that digital finance enhances the regional export technological complexity by improving regional infrastructure construction; digital finance has the most significant direct impact on the eastern region, and the largest total impact on the western.

Based on the above theoretical analysis and empirical findings, this paper puts forward four policy recommendations. First, optimize the environment for the development of digital economy and digital finance. Governments should increase investment in digital infrastructure and promote the construction of 5G networks, encourage the development of electronic payments and other emerging payment methods.^[11] Second, promote the popularization of digital technology education. The government should encourage businesses, institutions and individuals to undergo digital transformation and promote the practical application of digital technology in business, finance and services.^[12] Third, support for innovation and entrepreneurship. The government should set up a special digital transformation fund for start-ups and provide financial support for businesses to undergo digital transformation.^[13] Forth, strengthen digital finance regulation and compliance. The government should strengthen the formulation and implementation of digital finance regulatory policies and enhance the supervision of digital financial institutions.^[14]

References

1. Chen Yuan. Development Finance and Urbanization in China[J]. *Economic Research*, 2010, 45(7): 4-14.
2. Wang YJ, Sheng D, Shi BZ, et al. How does infrastructure increase the technological complexity of exports? [J]. *Economic Research*, 2010, 45(7): 103-115.
3. Bai Yang, Wang Yali, Wang Jiangning. The effects of urbanization and human capital investment on the technological complexity of China's manufacturing exports: An empirical study based on provincial panel data of manufacturing industries[J/OL]. *China Business Journal*, 2022(19): 58-60. DOI: 10.19699/j.cnki.issn2096-0298.2022.19.058.
4. Wang ZX, Han CB, Zhu WQ. A study on the impact of digital financial development on export technological complexity[J/OL]. *World Economic Studies*, 2022(8): 26-42+135-136. DOI: 10.13516/j.cnki.wes.2022.08.009.
5. HAUSMANN R, HWANG J, RODRIK D. What you export matters [J/OL]. *Journal of Economic Growth*, 2007, 12(1): 1-25. DOI:10.1007/s10887-006-9009-4.
6. Guo F, Wang JY, Wang F, et al. Measuring the development of digital inclusive finance in China: indexing and spatial characterization[J/OL]. *Economics (Quarterly)*, 2020, 19(4): 1401-1418. DOI: 10.13821/j.cnki.ceq.2020.03.12.
7. Liu, H. R. Research on the impact of financial development on green total factor productivity [D/OL]. Nanjing Normal University, 2019[2023-04-16]. DOI: 10.27245 /d. cnki. gnjsu. 2019. 000288.
8. Wan, Jia Yu, Zhou Qin, Xiao Yi. Digital finance, financing constraints and corporate innovation[J/OL]. *Economic Review*, 2020(1): 71-83. DOI:10.19361/j.er.2020.01.05.
9. Jin, Z. (2022). Mechanism analysis of digital inclusive Finance influencing industrial structure upgrading. *Foreign Economic and Trade (09)*,77-80.

10. Uche U, Robinson U, Edith O, et al. Financial inclusion - economic growth nexus: traditional finance versus digital finance in Sub-Saharan Africa[J]. *Cogent Economics & Finance*, 2022, 10(1).
11. Chen Xiaodong, Deng Siyue. R&D investment, basic research and digital transformation of inclusive finance[J/OL]. *Economic Research Reference*, 2023(1): 64-82. DOI: 10.16110/j.cnki.issn2095-3151. 2023.01.006.
12. Sun Chunxing. Application and research outlook of fintech in digital inclusive finance[J]. *New Economy*, 2022(7): 20-23.
13. Ozili K P. Digital finance research and developments around the world: a literature review[J]. *International Journal of Business Forecasting and Marketing Intelligence*, 2023, 8(1).
14. Joana N. Preventing and addressing AML/CFT risks of digital finance: The European regulatory and supervisory perspective[J]. *Journal of Financial Compliance*, 2022, 6(1).

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