Digital Economy, Inclusive Finance and High-Quality Development of Manufacturing

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Abstract: Traditional manufacturing companies are integrating with the digital economy, and have set off a digital revolution in the manufacturing industry, triggering a wave of intelligent industrialization. Using the data of 16 prefecture-level regions in Shandong province in the period of 2011-2019, this paper discusses the transmission path of digital economy development level-inclusive finance-manufacturing high-quality development. It is concluded that the digital economy can significantly boost the high-quality development of the manufacturing, but the boosting effect is not strong. Inclusive finance has played a complete intermediary effect in the impact of the digital economy on the high-quality development of the manufacturing in local-level cities in Shandong province.

Keywords: Digital economy, Inclusive finance, Manufacturing, Mediation effect

1 Introduction

The report of the 19th National Congress of the Communist Party of China made a major historical judgment that China's economic development has shifted from a high-speed development stage to a high-quality development stage. With the innovation and breakthrough of information and communication technology, the deep integration of the digital economy and the tangible economy has become a significant driving force for the transformation of China's economic kinetic energy and high-quality development in the new era. The 14th Five-Year Plan for National Economic and Social Development of the People's Republic of China and the Outline of Vision 2035 mentioned that quickening digital development and building a digital China, giving full play to the advantages of Huge amounts of data and rich application scenarios, promoting the in-depth integration of digital technology and the tangible economy, and empowering the transformation and upgrading of traditional industries, give birth to new

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industries, new formats and new models, and strengthen new engines for economic development. As a new factor of production, data represents advanced productivity and new development direction. The integration of digital technology and manufacturing is not only the internal logic of the development of data as a factor of production, but also an unavoidable option for the high-quality development of manufacturing.

As the most vibrant field in China's economic development, the digital economy has continuously expanded in breadth and depth of integration with various economic and social fields, and has played a significant role in stimulating consumption, stimulating investment, and creating employment. Seizing the opportunity of digital development and enjoying the bonus of digital transformation has become the primary goal of the future strategic planning of the traditional manufacturing industry. At present, Beijing-Tianjin-Hebei, Yangtze River Delta, Pearl River Delta and other regions are actively deploying and constructing digital infrastructure, building a pioneer position for big data talents and industry agglomeration, accelerating the development of big data industry, and regional competition is intensifying. Shandong province has all 41 major industrial categories, 197 of 207 medium-sized industries, and 526 of 666 small-scale industries. It is the country with the most complete industrial categories, the most solid foundation, the most complete structure, and the most complete supporting facilities. One of the most complete provinces. However, Shandong's manufacturing industry has long faced the dilemma of complete but not strong, and it is urgent to be aware of the transformation from a large manufacturing province to a strong manufacturing province. How to integrate the integration and penetration of digital technology with traditional industries such as manufacturing, and help traditional industrial clusters to explore collaborative innovation mechanisms and shift and upgrading in the digital economy environment has become a key issue that needs to be solved imminently to elevate the integration of the digital economy and the real economy.

2 Literature review

In the research of digital economy, He Xiao yin et al. (2021) confirmed that the digital economy has five characteristics of big data, high efficiency, strong integration, positive externalities and broad benefits, and recapitulated the digital economy and traditional industry and agriculture. The difference between the two, and an in-depth analysis of the fit between the digital economy and high-quality economic development, proposes that the digital economy is a tactical choice to promote high-quality economic development [2]; Li et al. (2020) proposed that the digital economy of Asian countries includes the use of technology innovation, government growth policies and digital entrepreneurship to improve business processes [4]. Ding Zhifan (2020) based on a systematic summary of the conceptual relation and core feature of the digital economy, discussed the inner mechanism of the digital economy driving high-quality economic development based on the micro-meso-macro analysis framework [1]. Xu Xianchun and Zhang Meihui (2020) systematically reviewed the evolution of the information economy, the internet economy, and the digital economy, refined the connotation and forming elements of the digital economy, built a scale accounting frame for the digital economy, defined the scope of digital economy accounting, determined digital economy products, and screened digital economy industry [11].

In terms of the impact approach of the digital economy on the high-quality evolution of the manufacturing, Liu Xinxin and Hui Ning (2021) believed that the digital economy has a nonlinear dynamic impact on the evolution of the manufacturing [3]. Wei Zhuang yu et al. (2021) verified that the positive effect of the digital economy on the evolution of the manufacturing industry had location heterogeneity [10]. Shen Yunhong and Huang Qiang (2020) concluded the level of digital economy into three aspects: digital infrastructure, digital industry development, and digital innovation and scientific study. The specific impact of optimization and upgrading of industrial structure [8].

In the research on the impact of financial inclusion on the manufacturing industry, Tu Qiang nan and He Yiqing (2021) divided the manufacturing industry into three categories: low, medium and high, and explained the impact of digital financial inclusion on the low-end manufacturing industry through the intermediary and threshold models. Development has a promoting effect and inhibits the development of high-end manufacturing [9]. Xi Mingming et al. (2021) comfirmed the impact of inclusive finance on manufacturing employment. Inclusive finance can not only reduce manufacturing financing costs and ease financing constraints, and directly promote manufacturing employment, but also indirectly create manufacturing jobs by promoting manufacturing transition and upgrading [12].

Through the analysis of existing research, we can see that the impact of the evolution of the digital economy on the development of the manufacturing industry is multi-dimensional and complex. At the micro level, emerging technologies such as the internet can form an economic condition with economies of scale, scope economies and long tail effects, better match supply and demand, form a more complete price mechanism, and facilitate the equilibrium level of the economy. At the macro level, through new input elements, new resource distribution efficiency and new total element productivity to promote high-quality evolution. However, existing research does not provide a unified framework to answer the question about what mechanism the digital economy uses to improve the high-quality evolution of manufacturing. Therefore, this paper will focus on clarifying the role mechanism of the digital economy on the high-quality evolution of the manufacturing, and clarifying the role of inclusive finance in the process of the digital economy on the high-quality evolution of the manufacturing. Green and high-quality development is of great significance.

3 Research content

3.1 Mechanism research

The core meaning of the high-quality evolution of the manufacturing is a new development notion consisting of innovation, coordination, greenness, openness and sharing, involving all social and economic fields. The digital economy has inherent advantages such as information dissemination across time and space, data sharing and openness, and low transaction costs. It can effectively solve problems such as the conflict between supply and demand of factors for high-quality economic evolution, the limitation of economic activity space, and the difficulty in taking into account fairness and efficiency. Moreover, the digital economy can also affect the development of inclusive finance, thereby indirectly affecting the development of industries such as manufacturing. Through theoretical deduction and case studies, this paper will use inclusive finance as an intermediary variable to study the transmission path of digital economy

evolution level-inclusive finance-manufacturing high-quality development through theoretical deduction. This hypothesis is that financial inclusion plays an intermediary effect in the impact of the development level of the digital economy on the evolution of the manufacturing.

3.2 Model

This study measures the evolution of digital economy and manufacturing in 16 prefecture-level regions in Shandong province from 2011 to 2019, and matches the financial inclusion index with other variables. In order to test the relationship between the evolution of the digital economy and the development of the manufacturing, this paper constructs the following model based on the control variables. In order to lower the heteroskedasticity between variables, the relevant data will be logarithmically processed:

$$\mathrm{DM_{i,t}} = \alpha_0 + \alpha_1 \mathrm{Lndig_{i,t}} + \alpha_2 \mathrm{W_{i,t}} + \varepsilon_{\mathrm{i,t}} \tag{1}$$

In order to further study whether the digital economy has an impact on the evolution of manufacturing through the mediating variable of financial inclusion, model (1) is extended to models (2)-(4):

$$\mathrm{DM_{i,t}} = \alpha_0 + \alpha_1 \mathrm{Lndig_{i,t}} + \alpha_2 \mathrm{W_{i,t}} + \varepsilon_{1\mathrm{i,t}} \tag{2}$$

$$\mathrm{Lnif_{i,t}} = \beta_0 + \beta_1 \mathrm{Lndig_{i,t}} + \beta_3 \mathrm{W_{i,t}} + \varepsilon_{2\mathrm{i,t}} \tag{3}$$

$$\mathrm{DM_{i,t}} = \gamma_0 + \gamma_1 \mathrm{Lndig_{i,t}} + \gamma_2 \mathrm{Lnif_{i,t}} + \gamma_3 \mathrm{W_{i,t}} + \varepsilon_{3\mathrm{i,t}} \tag{4}$$

where $DM_{i,t}$, $Lndig_{i,t}$ and Lnif are the manufacturing development level, digital economy development level index and inclusive finance development index of region i in period t, respectively, the vector $W_{i,t}$ represents the control variable, $\varepsilon_{3i,t}$ represents the random disturbance item.

4 Data and variable

The original data of this article comes from the Shandong Statistical Yearbook, China Urban Statistical Yearbook, the National Bureau of Statistics and the statistical yearbook of prefecture-level cities in Shandong province. The specific variables are set as follows:

4.1 Dependent variable

The dependent variable in this research is the level of manufacturing development (DM). At present, the common manufacturing development evaluation methods include total factor productivity method (Shangguan Xuming, 2021; Wei Zhuangyu et al., 2021) [6],[10], comprehensive evaluation index system method (Su Yongwei, 2021) [7]. Since the high-quality development of the manufacturing is mainly manifested in efficiency improvement and green development, this paper uses green total factor productivity to measure the development level of the manufacturing. Drawing on the Global Malmquist index proposed by Pastor and Lovell

(2005) [5], under the framework of data envelopment analysis of global reference, the super-efficiency SBM (Slacks Based Measure) model of undesired output and the Malmquist productivity index are comprehensively considered to the urban total factor productivity.

4.2 Independent variable

The core explanatory variable of this study is the evolution of digital economy (Lndig). According to the data availability and estimated consistency, from the digital infrastructure (telecom business income, the number of information services), digital equipment application (Internet, mobile phone users, broadband Internet users), digital technology innovation (spending on research and experiment, the patent grant) three directions for a total of six Angle measure digital economy, as shown in Table 1.

Table 1. Indicator system of digital economy development.

Level 1 Index	Level 2 Index	Level 3 Index
Digital economy development level	Digital infrastructure	Telecom business revenue
		Number of people in the information service industry
	Digital device applications	Number of Internet Broadband Access Users
		Number of mobile phone users
	Digital technology innovation	Research and experimental expenses
		Number of patents granted

Using the evaluation method of Zhang Xueling et al. (2017) [13] to measure the development of the digital economy, the certain steps are as follows:

Convert the original data to a sequence of comparable initialization values:

$$X_{ij}^{'} = \frac{x_{ij}}{x_{i1}} \tag{5}$$

Among them, $X_{ij}^{'}$ represents the initialized data of the i indicator in the j year, X_{ij} represents the original data, and X_{i1} represents the value of the i indicator in the first year (with 2011 as the base year). According to formula (5), the initialization change matrix A of each index can be obtained, see equation (6) for an example:

$$A = \begin{bmatrix} X_{11}^{'} & \cdots & X_{19}^{'} \\ \vdots & \ddots & \vdots \\ X_{61}^{'} & \cdots & X_{69}^{'} \end{bmatrix} \tag{6}$$

Use the entropy method to estimate the weight of each index. Firstly, the information entropy of $X_{IJ}^{'}$ of each index is calculated according to formula (7) and formula (8).

$$P_{ij} = \frac{x_{ij}'}{\sum_{j=1}^{9} x_{ij}'} \quad (7)$$

$$H_i = -k \cdot \sum_{j=1}^{9} P_{ij} \cdot \ln P_{ij} \quad (8)$$

Among them, P_{ij} represents the ratio of the value of the i indicator in the j year in the total value of the indicator, and H_i represents the information entropy of the i indicator. Equation (9) calculates the value of k.

$$k = \frac{1}{\ln 9} \approx 0.4551 \quad (9)$$

Second, calculate the weight of each index according to formula (10).

$$w_i = \frac{g_i}{\sum_{i=1}^{6} g_i} \quad (10)$$

Where w_i represents the entropy weight of the i indicator, $g_i = 1 - H_i$, represents the difference coefficient of the i indicator.

4.3 Intermediate variable

The study uses financial inclusion (Lnif) as an intermediate variable to test the mediating effect of financial inclusion in the impact of digital economy development on manufacturing development. The data comes from the Peking University Digital Financial Inclusion Index report released by the Digital Finance Research Center of Peking University.

4.4 Control variables

In order to reduce the possible omitted-variable bias problem in the econometric model, the research considers factors that may have a substantial influence on the evolution of the manufacturing.

Economic development level (Lned): A higher level of economic development is the basis for the development of the manufacturing. In the study, the per capita GDP of prefecture-level cities is selected to represent the level of economic development.

Development level of the secondary industry (Lnsi): Manufacturing is a significant component of the secondary industry, and its high-quality development is closely related to the overall development of the secondary industry. The paper selects the proportion of the secondary industry to gross domestic product to measure the development level of the secondary industry.

Urbanization level (Lnurban): With the constant improvement of urbanization, the regional industrial structure will also change accordingly. This research selects the population density of various cities in Shandong province to measure the level of urbanization.

5 Empirical analysis

5.1 Empirical results

This research tests the influence of the digital economy on the development of manufacturing in Shandong province in the period of 2011-2019. Table 2 shows the descriptive statistics of variables. It can be obvious that the maximum of the manufacturing evolution is 2.065, the minimum is 0.961, and the standard error is 0.2482, which indicates the manufacturing development level of different cities in Shandong province in different years from the side. The variance is small. The maximum value of the digital economy development level is 13.490, the minimum value is 10.725, and the standard error is 0.624, indicating that the differences in the digital economy evolution level in Shandong province are relatively obvious. The gap between the development of the secondary industry and urbanization is relatively small, and both show a trend of steady growth.

Table 2. Descriptive statistics.

Variable	Sample	Mean	St. Dev.	Min	Max
DM	144	1.1	0.3	0.9	2.1
Lndig	144	11.9	0.6	10.7	13.5
Lnif	144	5.0	0.5	3.5	5.7
Lned	144	11.1	0.5	9.8	12.2
Lnsi	144	3.9	0.1	3.5	4.3
Lnurban	144	6.2	0.4	5.4	6.8

In order to test the impact of the digital economy on the evolution of the manufacturing in local-level cities and ensure the robustness of the regression results, we use inclusive finance as an intermediary variable to test the mediating effect of inclusive finance in the process of digital economy affecting the development of manufacturing industries. Since the number of sections is much greater than the number of times, the study selects the panel least squares method for regression analysis of the model, and the specific results are shown in Table 3.

Table 3. Regression analysis.

Variable	Model (2)	Model (3)	Model (4)
Lndig	0.0747^{*} (1.8398)	0.1395^{*} (-1.9540)	0.045 (1.1753)
Lnif			-0.2129^{***} (-4.7393)
Lned	0.0731 (1.2690)	0.5821^{***} (5.7528)	0.1969^{***} (3.3036)
Lnsi	-0.6037^{***} (0.0002)	-2.0965^{***} (-7.4905)	-1.0499^{***} (-5.9798)
Lnurban	0.0812 (1.0083)	0.0352 (0.2487)	0.0887 (1.1831)
Constant	1.2066	8.2045	2.9529

R^2	0.2851	0.4679	0.3852
F-statistic	13.8585	30.5626	17.2907
Pro(F-statistic)	0.0000	0.0000	0.0000
Sample	144	144	144

Note: t values in parentheses, *, **, and ***are significant at 10%, 5%, and 1% levels, respectively.

Since the model (2) does not include mediating variables, we only examine the influence of the digital economy on the evolution of manufacturing in various regions in Shandong province. The influence coefficient of the digital economy on the evolution of the manufacturing is 0.0747, and it has passed the 10% significance level test, indicating that the digital economy has a remarkable promoting influence on the development of the manufacturing. The regression results of model (3) indicate that the estimated value of the digital economy coefficient is 0.1395, that is, at the 10% significance level, the digital economy significantly improves the development of inclusive finance. The regression results of model (4) show that the influence of the digital economy on the development of the manufacturing in all cities in Shandong province is not significant, while the influence of the evolution of inclusive finance on the development of the manufacturing in all regions in Shandong province is significant at the 1% significance level. It shows that financial inclusion as an intermediary variable has a complete intermediary effect. However, its regression coefficient is -0.2129, indicating that financial inclusion cannot improve the high-quality development of manufacturing at this stage, but will instead bring about an inhibitory effect. In addition, the coefficients of each model are relatively small, which may be because of the fact that the digital economy and inclusive finance as a whole are still in the early stage of development, and the manufacturing in various cities in Shandong province is still in the initial phase of digital transformation. The depth and breadth of the integration with the manufacturing industry is not enough, so although the overall positive promotion effect, but the boost is not strong. As far as control variables are concerned, the level of economic development has a significant positive influence on the evolution of the manufacturing, the level of secondary industry development has an observably negative influence on the evolution of the manufacturing, and the level of urbanization has a weak influence on the evolution of the manufacturing.

5.2 Robustness test

In order to ensure the reliability of the empirical results (Shen Yunhong et al., 2020) [8], the study repeats the empirical part with the data from 2016 to 2019, and tests the robustness of model (2), model (3) and model (4) respectively, as shown in Table 4. The test results show that the influence direction and significance level of the independent variables on the explained variables have not changed, and the mediating variables also play a complete mediating effect, which is consistent with the above test results, and thus proves that the above empirical results are more reliable.

Table 4. Robustness test.

Variable	Model (2)	Model (3)	Model (4)
Lndig	0.0567* (1.7869)	0.0549* (-1.8739)	0.0620 (0.9692)
Lnif			−0.3496* (-1.8425)
Lned	0.1346 (0.1429)	0.1523*** (3.7108)	0.1879* (1.8739)
Lnsi	−0.6993** (0.0076)	−0.5687*** (-4.9642)	−0.8982*** (-2.9946)
Lnurban	0.1269 (0.2736)	-0.0322 (-0.6195)	0.1156 (0.3177)
Constant	0.4994	6.6377	2.8200
R^2	0.3513	0.4152	0.3676
F-statistic	7.9885	10.4714	6.7424
Pro (F-statistic)	0.0000	0.0000	0.0000
Sample	64	64	64

Note: t values in parentheses, *, **, and ***are significant at 10%, 5%, and 1% levels, respectively.

6 Conclusions

The research focuses on the high-quality development of the digital economy and manufacturing, and introduces the intermediary variable of inclusive finance. In theory, this study analyzes the connotation requirements and dynamic mechanism of the digital economy and inclusive finance boosting the high-quality development of the manufacturing, and empirically takes the development of digital economy and manufacturing in various regions in Shandong province in the period of 2011-2019 as the research object. The evaluation for the development level of digital economy is established and the variables are measured by the entropy method. The panel least squares method is used to empirically analyze the construction of digital infrastructure, the application of digital equipment and the impact of digital technology innovation level on the development of manufacturing. The following conclusions are drawn: the digital economy can significantly boost the development of the manufacturing, but the boosting effect is not strong. Inclusive finance has played a complete intermediary effect in the influence of the digital economy on the development of the manufacturing in various cities in Shandong province. Through empirical analysis, it is found that the digital economy can significantly boost the high-quality evolution of the manufacturing, but it may be because the digital economy is still in the early stage of development, the digital development in various

regions is uneven, and the depth and breadth of the integration between the digital economy and manufacturing is not enough. Therefore, although there is a positive facilitation effect on the whole, the boosting force is not large. As far as the control variables are concerned, the regional economic development and urbanization have a remarkable positive influence on the progress of the manufacturing, while the development of the secondary industry has a negative influence on the evolution of the manufacturing, which indicates that the development of the secondary industry cannot promote the high-quality development of the manufacturing.

7 Policy suggestion

Based on the empirical analysis results, in order to accelerate the integration of the digital economy and the real economy and promote the high-quality development of the manufacturing, the research proposes the following policy proposal.

Improve the digital economy infrastructure construction. According to the actual development of the digital economy in the area, strengthen investment in information infrastructure such as 5G base stations and data centers, vigorously develop new-generation information technologies such as artificial intelligence, cloud computing, and big data, and improve the software and hardware infrastructure of the digital economy. Pay attention to the digital transformation of traditional industry infrastructure, drive the upgrading and transformation of infrastructure in transportation, electricity, energy and other industries, and enhance its intelligence and digitalization level. By optimizing the construction process, unblocking investment and financing channels, simplifying administrative approval procedures, increasing the enthusiasm of various market players, and building a systematic, large-scale and forward-looking national digital infrastructure network pattern, and laying a solid foundation for the evolution of the digital economy.

Deepen the depth and breadth of the integration of the digital economy and manufacturing, and stimulate the network effect of the digital economy. The first is to strengthen talent training in emerging digital technologies, innovate digital talent training models, set up digital economy-related majors in colleges and universities at all levels, attach important to the training of teachers related to the development of digital economy, and expand academic and skilled talents in the field of digital technology. Second, the government should formulate relevant policies to increase support for the integration of the digital economy and manufacturing, fully use the intervention character of local governments in the course of digital transformation, formulate manufacturing development policies in differentiated regions, and optimize the way the digital economy is embedded to achieve personalization.

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