ISSN:2790-1661 Volume-5-(2023)

The Impact of Digital Economy on the High-Quality Development of Manufacturing Industry -- An Empirical Study Based on 277 Cities in China

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Abstract. The digital economy has contributed to new growth points in the high-quality development of industrial manufacturing in the context of the swift advancement of information technology. It has emerged as the primary force behind contemporary high-quality economic development. This study builds a mediation effect model for regression analysis using panel data from 277 prefecture-level cities in the nation from 2006 to 2019. It uses the urbanization rate as the mediating variable. It then examines the path mechanism for the impact on developing the digital economy and high-quality manufacturing. The empirical results show that the digital economy significantly promotes the high-quality development of China's manufacturing industry. At the same time, the digital economy can promote the high-quality development of China's manufacturing industry by increasing the urbanization rate. For different levels of cities in China, the urbanization rate has different effects on the high-quality development of the manufacturing industry. Therefore, government departments and manufacturing enterprises need to increase their investment in science and technology to enhance the digital level of intelligent manufacturing in the manufacturing service industry to form a two-way integration and coordinated development of science and technology and the real economy.

Keywords: digital economy, urbanization, manufacturing, high-quality development, mesomeric effect.

1. Introduction

At present, the digital economy, as a significant strategic development direction of the country, is an essential link in promoting the development of China's industrial economy from "quantity" to "quality." It has achieved initial results in empowering China's economic and social development. Thanks to the accelerated changes in information technology, big data, cloud computing, and artificial intelligence in recent years, the added value of the digital economy reached 45.5 trillion yuan in 2021, accounting for 39.8% of GDP, a record-high1. It is objectively proved that the digital economy, as an essential part of the economic development in the new era, is developing rapidly and has strong staying power. As a green, innovative, and sustainable high-quality economic paradigm, the digital economy continuously promotes the flow of resource elements, the integration of market players, and the restructuring of the organizational model, and solidly promotes the quality improvement and efficiency enhancement of the manufacturing industry.

The advanced manufacturing industry is the pillar of building a modern economic system. China's manufacturing value added ranked first worldwide for 12 consecutive years. The industrial system is highly improved, and the advantages of market backwardness are apparent2. However, it cannot be denied that if China wants to successfully realize the transformation from a "manufacturing power" to a "manufacturing power, "3 there is still considerable room for improvement in manufacturing quality. The report of the 19th Party Congress pointed out that if the industrial manufacturing industry wants to achieve the goal of high-quality development, it needs to accelerate the transformation from "manufacturing" to "manufacturing." The development of the digital economy is crucial in pushing global industrial technology to a new round of change. Domestic industrial robots and 3D printers are continuously applied in the core field of industrial manufacturing. New supporting technologies and production methods such as big data, cloud computing, and the Internet of Things have been widely applied in the production field, triggering a

new round of changes in manufacturing. China must thus take this chance to finish the manufacturing sector's transition and achieve the high-quality development of the sector as soon as feasible. At present, many scholars have explored the impact path between the digital economy and the high-quality development of the manufacturing industry and tried to conduct research from different levels: at the micro level, the digital economy enables the manufacturing industry to change from three levels of product quality, technical efficiency and organization management, in order to achieve its high-quality development and increase wages4; At the macro level, the digital economy will not only increase the current economic growth, but also leverage the domestic economic transformation, turning the manufacturing industry from the pursuit of a quantity to high-quality development, and completing the reform of China's manufacturing industry5.

China's urbanization path has also entered a strategic transition period from scale expansion to the overall efficiency and quality improvement. At this stage, the driving force of urbanization is still strong, which contains substantial domestic demand potential and strong development momentum. Therefore, it is a broad concern by economists. The available literature is mostly split into two schools of thought about the link between the digital economy and urbanization. One school of thought holds that these two phenomena mutually support and exhibit a tendency toward integration and growth. Wang Changjun (2021) believes that the digital economy has contributed to the continuous improvement of the quality of the current new type of urbanization and the implementation of the urbanization development strategy. In addition, the creation of digital economic formats cannot be separated from the development of new urbanization, which also lays a solid foundation for the construction of digital cities and the arrival of the intellectual alliance society5. Hong Zheng and others (2022) believe that cities and towns, as carriers of the Internet, are moving to cities and towns with the non-agricultural transfer of rural population and the continuous improvement of human capital. As a result, the opportunities and costs of Internet technology access are continuously decreasing, and the marginal effect and scale effect of information technology investment is gradually expanding, thus improving the overall informatization level of the whole people6. The second is to study the relationship between the digital economy and other economic variables by taking urbanization as an intermediate variable. Zuo Pengfei and others (2020) believe that the interactive integration of Internet technology and urbanization significantly affects the transformation of industrial structure and the promotion of industrial upgrading. At the same time, the urbanization threshold effect exists significantly in the promotion effect of the Internet on the transformation and upgrading of industrial structures7. The existing research shows that the new urbanization plays a very prominent role in the high-quality development of the service industry. Through the improvement of the investment environment and research and development conditions, many factors such as technology, innovation, and capital will be brought together to expand the coverage of the service industry and promote the high-quality development of the service industry8. Based on the panel data of 277 prefecture-level cities from 2006 to 2019, this paper scientifically constructs the index system of the digital economy and high-quality development of the manufacturing industry, measures its development level, profoundly studies the effect evaluation and action mechanism of the digital economy on high-quality development of manufacturing industry.

Based on this, this paper analyzes the impact of digital economy development and urbanization on the high-end and high-quality development of the manufacturing industry from the urban level. The marginal contribution of this paper lies in: (1) bringing digital economy, urbanization, and high-quality development of the manufacturing industry into the same research framework, analyzing the mechanism of urbanization, enriching the research on digital economy and manufacturing industry, and providing new evidence for the impact path of the digital economy on manufacturing industry development; (2) Taking 277 cities in China as an example, the index system of the development level of the digital economy in the national region is constructed and calculated, which provides a reference for the country to formulate relevant policies for the construction of digital economy and the high-end development of manufacturing industry.

2. Analysis Of Assumptions

2.1 Analysis of the Relationship between the Digital Economy and High-Quality Development of the Manufacturing Industry

The relationship between the digital economy and the high-quality development of the manufacturing industry has attracted the attention of a large number of scholars. Research has proved that the digital economy is essential in promoting the manufacturing industry's high-quality development. The digital economy promotes the manufacturing industry's high-quality development through innovation and labor productivity improvement9. As three indicators to measure the digital economy, digital industrialization, industry digitalization, and digital coupling are all conducive to promoting high-quality development of the manufacturing industry; In addition, the digital economy will also promote the high-quality development of the manufacturing industry by increasing investment in innovation and promoting per capita profit creation10. The digital economy has become an important driving force in promoting the high-quality development of the manufacturing industry in China11. In addition, through the accumulation of human capital, the deepening of capital, and the stimulation of entrepreneurial vitality, the digital economy has played a significant driving effect on the high-quality development of the manufacturing industry and further optimized the industrial structure 12.

Therefore, this paper puts forward hypothesis 1:

H1: Digital economy can promote high-quality development of the manufacturing industry at the macro level.

2.2 The Impact Mechanism of the Digital Economy on the High-Quality Development of the Manufacturing Industry

Currently, most studies show an interaction between the digital economy and urbanization, especially the interaction between the digital economy and economic urbanization. The digital economy directly drives economic urbanization and indirectly promotes social and ecological urbanization, thus improving the overall quality of urbanization13. Urbanization will also positively impact the digital economy regarding factor supply, high industrial structure, external production, and government support14. The improvement of the quality of various elements in the urbanization process has significantly promoted industrial agglomeration, labor quality, and resource allocation efficiency, which has played a positive role in promoting the high-quality development of the manufacturing industry15.

Therefore, this paper proposes hypothesis 2:

H2: Digital economy promotes high-quality development of the manufacturing industry by increasing the urbanization rate.

According to the literature review, most literature chooses urbanization as the control variable to study the impact path of high-quality development in the manufacturing industry. However, there are still few pieces of research on urbanization and high-quality development of the manufacturing industry. Some literature only theoretically analyzes the mechanism of urbanization and high-quality development of the manufacturing industry. The systematic path description is not comprehensive. Therefore, this paper attempts to supplement the relationship and impact path between urbanization and high-quality development of the manufacturing industry by an empirical test based on existing theories. With the continuous implementation and deepening of the "Made in China 2025" strategy, it has significant practical significance to explore the specific path of the digital economy affecting the high-quality development of the manufacturing industry. Concerning the existing literature, this paper sets urbanization as an intermediate variable. It takes it into the impact mechanism of the digital economy on the high-quality development of the manufacturing industry for the empirical test in order to enrich the relevant content of the impact path of China's manufacturing industry development, further explore the research results, and also provide a reference for finding manufacturing policies that conform to the reality of our country.

3. Index Selection And Model Design

3.1 Selection of Indicators

3.1.1Interpreted variable

Manufacturing High-Quality Development Index (MHI). The existing methods to measure the high-quality development level of the manufacturing industry can be divided into the single index method and the index system method. In contrast, using a single indicator measure often fails to simultaneously account for part of the critical information. The indicator system measure is more comprehensive and in line with the profound connotation of healthy and high-quality development of the manufacturing industry. Therefore, this section selects the indicator system measurement method, referring to the practices of Zhao Qing and other15 scholars, starting from the three dimensions of economic benefits, innovative development, and green sustainability, and centering on the five development concepts, construct a manufacturing high-quality development indicator system with seven indicators, to comprehensively and accurately measuring the level of manufacturing high-quality development. In terms of processing method, this section uses the entropy weight method to assign weights to various manufacturing indicators in turn. Finally, we calculate the level of high-quality development of the manufacturing industry based on the weighted summation of the required weights. The entropy method results in calculating the manufacturing industry's high-quality index system are shown in Table 1.

Table 1. Evaluation Index System for High-quality Development of the Manufacturing Industry

Level 1 indicators	Secondary indicators	Level 3 indicators	Calculation method	Weight
The high-quality development level of the manufacturing industry	economic benefits	Labor productivity/(yuan per person)	Main business income/number of employees	0.0015
		Total profit/(ten thousand yuan)	Total profit of industrial enterprises	0.0927
	Innovation-driven	The investment level in education and technology/(ten thousand yuan)	Investment in education and technology	0.0498
		Number of inventions/(pieces) of valid patents	Number of invention green patents	0.7699
	Green Manufacturing	Electricity consumption /(kWh)	Industrial electricity consumption	0.0299
		Wastewater discharge /(t)	Industrial wastewater discharge	0.0269
		Exhaust emissions /(t)	Industrial sulfur dioxide emissions	0.0293

3.1.2Interpretive variable

Digital Economic Development Index (Dige). Based on the consideration of the feasibility of the study, reference is made to the practice of Yang Rui et al. (2022), focusing on the development of the Internet and including digital transactions16. The evaluation system of the development level of the digital economy is constructed from five aspects: Internet penetration rate, number of Internet-related employees, Internet-related output, number of mobile Internet users, and development of digital financial inclusion (Table 2). Secondly, principal component analysis (PCA) is used to analyze the above indicators. The results show that the KMO test value is 0.502, indicating that the above indicators meet the primary conditions for principal component analysis. Therefore, dimensionless data are processed to reduce dimensions, and the digital economic development index is obtained through calculation.

Table 2. Index System of Digital Economic Evaluation

Level 1 indicators	Secondary indicators	Calculation method	Influence
Digital Economic Development Index	Internet penetration	Number of internet broadband access users per 100 population	+
	Number of Internet-related employees	Number of employees in information transmission, computer services, and software industry	+
	Internet-related outputs	Total telecom business per capita	+
	Number of mobile internet users	Number of mobile phone subscribers at the end of the year	+
	Inclusive development of digital finance	Digital inclusive finance Index	+

3.1.3Intermediary variable

Urbanization rate (U). The urban population is the primary indicator to measure a city's urbanization level. The dynamic process of the non-urban population's continuous transformation and concentration into a city is a fundamental reason for the gradual increase in the urbanization rate. Population urbanization affects the centralized production of the manufacturing industry to a certain extent. In this paper, the urbanization rate is selected as an intermediate variable, considering the practical meaning and availability of the data. The method of "urban population/resident population at the end of the year" is adopted to calculate the urbanization rate of each city.

3.1.4Control variables.

In order to ensure that the high-quality development of the digital economy, urbanization, and manufacturing INDUSTRY is not affected by the characteristics of urban heterogeneity, this section refers to the research of Ye Dezhu et al. (2020) and Guo Han et al. (2021)17. It selects industrial structure (industry, the ratio of output value of the tertiary industry to the secondary industry), financial development (FINDEV, the proportion of loan balance to GDP), degree of economic development (LNGDP, the relative value of GDP) and fixed investment (INV) as control variables.

3.2 Model Building

Based on the theoretical hypothesis proposed above, this paper constructs the following model to test H1: whether the digital economy promotes the high-quality development of the manufacturing industry.

$$MHIit = a0 + a1Digeit + \lambda Xit + \mu i + \delta t + \varepsilon it \quad (1)$$

In Formula (1), i and t represent a city and a year, respectively. Uit and Digeit respectively represent the urbanization level and digital economy development level of the ith city in the tth year, and Xit is the set of control variables, including industrial structure, financial development, economic development level, and fixed investment. In addition, μi and δt represent the fixed effects of city and time, respectively, and εit is the residual term.

In order to test H2, that is, to analyze whether urbanization impacts the manufacturing industry's high-quality development through the digital economy, this paper introduces an intermediate effect regression model.

$$Uit = \beta 0 + \beta 1 Digeit + \phi Xit + \mu i + \delta t + \varepsilon it \quad (2)$$

$$MHIit = \gamma 0 + \gamma 1 Digeit + \gamma 2 Uit + \vartheta Xit + \mu i + \delta t + \upsilon it \quad (3)$$

Specifically, the first step is to test whether the digital economy can significantly promote the high-quality development of the manufacturing industry. The second step is to test whether the digital economy has improved the urbanization rate. The third step is to test the impact path of the digital economy and urbanization on the high-quality development of the manufacturing industry. If the regression coefficients of β1 and γ2 are +, -, respectively, and significant simultaneously, it indicates an intermediate effect, i.e., H2 holds.

Table 3. Specific meanings of variables and descriptive statistics

Variable name	Symbol number	Contain meaning	average value	standard error	minimum value	maximum
Manufacturing High-Quality Development Index	MHI	Using the entropy method to calculate the high-quality development index of the manufacturing industry	0.057	0.039	0.023	0.837
Digital Economic Development Index	Dige	Using the principal component analysis method to calculate the digital economic indicators	4.000	0.716	0.047	10.449
Urbanization rate	U	Urbanization rate of resident population	0.517	0.160	0.153	1.000
industrial structure	INDUSTRY	The ratio of the output value of the tertiary industry to the secondary industry	0.911	0.505	0.000	5.169
Financial development	FINDEV	Loan balance as a proportion of GDP	0.879	0.556	0.075	9.622
Degree of economic development	LNGDP	Comparative value of GDP	16.294	1.007	13.160	19.760
fixed investment	INV	Total investment in fixed assets	1.37E+07	1.70E+07	-9.45E+07	2.29E+08

3.3 Data Sources and Descriptive Statistics

The original data of this article are all from the Peking University Digital Financial Inclusion Development Index Database, China Urban Statistical Yearbook, the work reports of each city government, the statistical yearbook of each province and city, the National Economic and Social Development Statistical Bulletin, and the website of the Bureau of Statistics. Out of consideration for data availability, the article finally selects the panel data of 277 prefecture-level cities in China from 2006 to 2019 and uses Stata17.0 software for analysis. Missing data were filled by linear interpolation; the data after filling are shown in Table 3.

Observing the data in the table is not difficult to find that the minimum and maximum values of each variable are pretty different. It is preliminarily inferred that the panel data may have substantial regional heterogeneity.

4. Empirical Analysis

4.1 Benchmark Regression Analysis

In order to test whether the digital economy significantly promotes the high-quality development of the manufacturing industry, this section conducts four types of regression processing on the explanatory variables and the explained variables in turn. The regression results are shown in Table 4. Among them, (1)~(4) represent the individual fixed effect model, OLS model, two-way fixed effect model, and random effect model, respectively. The results of the four models all show that the digital economy has a significant positive impact on the high-quality development of the manufacturing industry, and all passed the 1% significance level test. The regression results have a high degree of robustness, indicating that the digital economy has significantly promoted the manufacturing industry's high-quality development.

Table 4. Benchmark Regression Results (N=277)

variable	（1）	（2）	（3）	（4）
Dige	0.004***(3.14)	0.003***(3.47)	0.004***(3.03)	0.004***(4.00)
INDUSTRY	-0.001(-0.51)	0.002**(2.03)	-0.008***(-4.11)	-0.000(-0.15)
FINDEV	0.002(1.54)	-0.000(-0.19)	0.001(0.41)	0.002(1.34)
LNGDP	-0.001(-0.53)	-0.002***(-3.84)	-0.004(-1.25)	-0.002(-1.50)
INV	0.000***(24.25)	0.000***(35.05)	0.000***(22.86)	0.000***(27.39)
_cons	0.039*(1.69)	0.066***(7.24)	0.093*(1.91)	0.052***(3.09)
Urban fixed effect	YES	NO	NO	YES
Year fixed effect	NO	NO	YES	YES
R2	0.249	0.26	0.264	0.2655

Note: * * *, * *, * indicate that the regression results are significant at 1%, 5% and 10% significance levels respectively. The value in () is the corresponding T statistic.

For static short panel data, the Hausman test is performed first, and the difference between cluster robust standard error and common standard error is significant (in this section, the former is about twice the latter), so the Hausman test is not applicable. Therefore, the fixed effect model is selected. In combination with the actual situation and the test, the individual fixed model is finally selected in this paper. As shown in Table 4 (1), under the significance level of 1%, the high-quality development level of the manufacturing industry will increase by 0.004 units per unit as the development level of the digital economy increases. The digital economy has significantly and positively promoted the high-quality development of the manufacturing industry, thus verifying hypothesis 1.

At the same time, to analyze the digital economy's transmission mechanism to the manufacturing industry's high-quality development, this section uses the Bootstrap method to test the mediation effect with 500 repeated sampling times. The test results are shown in Table 5.

Table 5 Intermediary Effect Test

mediator variable	coefficient of regression	Bootstrap standard error	Z value	95% confidence interval	
U	0.001***	0.0000378	15.19	0.0004998	0.000648

Note: The latter * * *, * *, * *, indicate the significance level of 1%, 5% and 10% respectively corresponding to the regression results.

The results in the above table show that urbanization does not include 0 in the 95% confidence interval, the P value corresponding to the Bootstrap test is less than 0.01, and the intermediate variable is significant at the level of 99%. Therefore, the intermediate effect is significant, and Hypothesis 2 holds.

4.2 Robustness Test

4.2.1Replace the core explanatory variable

In order to ensure the reliability of the conclusions, the core explanatory variable index is replaced with further testing of the model's robustness. Referring to the research of Huining et al. (2022)11, based on the original index system of the development level of the digital economy, the entropy method is adopted to recalculate and form the digital economy composite index Dige2, which is regarded as the core explanatory variable in this section, and the regression operation is repeated. Table 6 (1) reports the estimation result. The results show that: compared with the original explanatory variables, the regression coefficient of the explanatory variables acting on the explained variables after the replacement is significantly positive, and the direction of action has not changed, indicating that the digital economy comprehensive index Dige2 plays a positive role in promoting the high-quality development of the manufacturing industry. Furthermore, the significance test at the 1% level is consistent with the primary regression results, proving that the conclusion has high robustness.

4.2.2Regional heterogeneity test

China's regional economic development is quite different. In order to test whether the construction of a digital economy has a regional impact on the development quality of the manufacturing industry, this section further divides 277 cities into four levels according to the number of permanent residents in cities in 2006 for comparative analysis. The study found that the development level of the digital economy and the degree of high-quality development of the manufacturing industry in different regions are different, and the direction and degree of the former's influence on the latter are also somewhat different. As shown in Figure 1, the quality of manufacturing development in mega-cities, large cities, and small and medium-sized cities was generally high from 2006 to 2019, showing a continuous upward trend. The increase in the horizontal index is most significant in mega-cities. After 2007, it had a large gap in absolute value compared with other three-level cities, with the growth rate ranking first among the four, followed by mega-cities development. As shown in Figure 2, the level of the digital economy in cities at all levels has been increasing yearly. The development level of the digital economy in small and medium-sized cities, large cities, and mega-cities is relatively close to and kept at a relatively high level. The digital economic development index of mega-cities is at the lowest level among the four-level cities. However, it is not significantly different from the first three in absolute terms. From this, it can be preliminarily inferred that the same level of development of the digital economy will be affected by the factors of regional heterogeneity in different levels of cities, which will lead to different degrees of deviation in the direction of high-quality development level of the manufacturing industry.

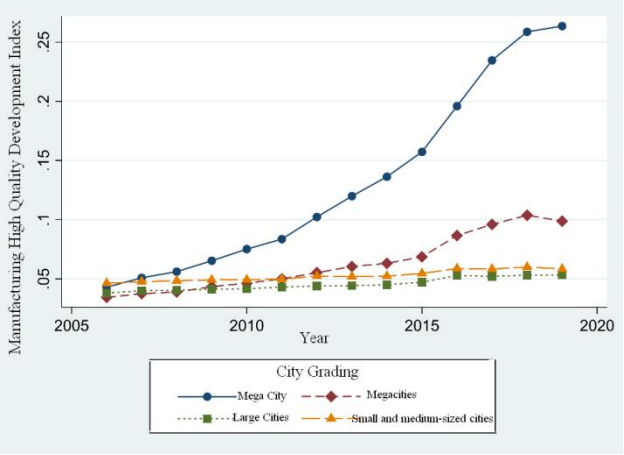

Figure 1. High-quality Development Index of City Manufacturing Industry in Level 4

Table 6 Robustness Test					
variable	（1）	（2）	（3）	（4）	（5）
Dige		0.109***(4.19)	-0.014***(-2.79)	0.002**(2.16)	-0.001***(-3.02)
Dige2	0.060***(4.61)				
INDUSTRY	0.003**(2.21)	-0.180***(-6.14)	0.010(0.34)	-0.001(-0.56)	-0.000(-0.76)
FINDEV	0.000(0.42)	0.055(1.45)	0.006*(1.73)	0.000(0.10)	0.000(0.80)
LNGDP	-0.002***(-3.17)	0.158***(3.85)	-0.036**(-2.04)	-0.002(-0.85)	-0.002(-1.26)
INV	0.000***(35.99)	-0.000(-1.50)	0.000***(4.60)	0.000***(9.33)	0.000***(7.31)
_cons	0.065***(7.24)	-2.124***(-3.51)	0.536**(1.97)	0.056*(1.83)	0.068***(3.23)
Urban fixed effect	NO	YES	YES	YES	YES
Year fixed effect	NO	YES	YES	YES	YES
Observations	3878	168	476	462	2772
R2	0.262	0.878	0.717	0.800	0.708
Note: The latter * * *, * *, * *, indicate the significance level of 1%, 5% and 10% respectively corresponding to the regression results. The value in () is the corresponding T statistic.					

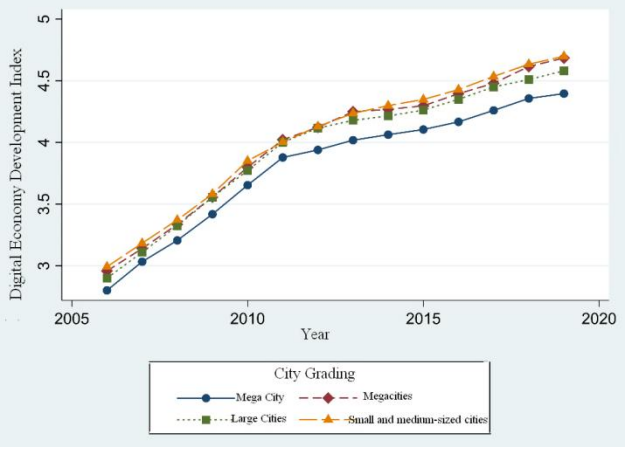

Figure 2. Digital Economic Development Index of Four Cities

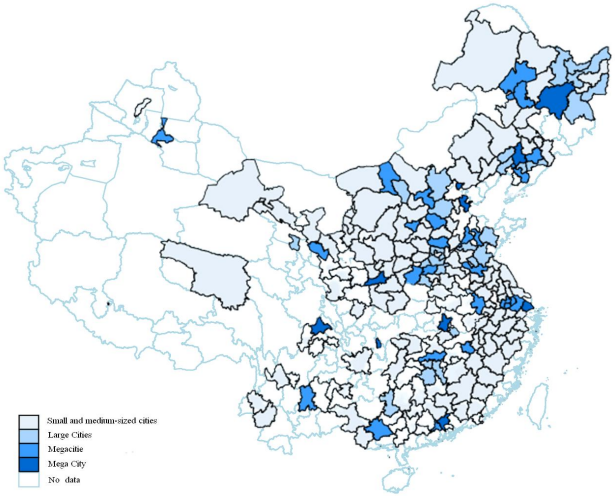

Figure 3. 277 city geographical location overview

In order to verify empirically whether the development level of the digital economy has the effect of regional heterogeneity on the high-quality development of the manufacturing industry, as shown in Figure 1 and Figure 2, this section carries out hierarchical regression on the above-mentioned four-level cities, and the regression results are shown in Table 6. Models (2) to (5) represent regression results of mega-cities, large cities, and small and medium-sized cities, respectively. The regression results show that the digital economy of megacities, large cities, and small and medium-sized cities significantly affects the quality of manufacturing development in each region. Model (2) (4) regression coefficients are positive, while model (3) (5) regression coefficients are negative. That is to say, the digital economy of megacities and large cities is positively promoting the high-quality development of the manufacturing industry. In contrast, the development of the digital economy in megacities and 198 small and medium-sized cities has hindered the high-quality development of the manufacturing industry. This may be because the 12 mega-cities are all municipalities directly under the central government or provincial capital cities with muscular economic strength and digital economic foundation. Looking at Figure 3, it is not difficult to find that 33 large cities are concentrated in China's eastern and northeastern regions. The demand-oriented digital economy in the eastern region based on basic industrial capabilities and development started earlier16, with a higher level of development. Besides, the Yangtze River Delta, the Pearl River Delta, and the Beijing-Tianjin-Hebei economic belt have an ideal economic environment and strong agglomeration effect, which promotes the in-depth integration and development of digital technology and the real economy and will have a noticeable incentive effect on the high-quality development of manufacturing industry. However, the development of the digital economy in small and medium-sized cities started relatively late. The overall situation of regional development is not in harmony with the development speed of the digital economy.

The manufacturing industry is under the pressure of the rapid increase in the cost of labor, land, capital, resources, environment, and other factors, which results in the problem of profit squeeze18. This may cause the manufacturing industry to be hindered not only in terms of economic benefits but also in terms of green sustainability. Similarly, the 34 mega-cities are distributed in and around the mega-cities, and the mega-cities strongly siphon off their production factors. In this case, the regional economic development will produce the "Matthew effect" of "the stronger, the stronger, the weaker, the weaker," thus aggravating the distortion of factor allocation19, making it more difficult for the mega-cities to maintain green manufacturing in the process of manufacturing development, thus hindering the development process of high-quality regional manufacturing. Judging from the absolute value of the coefficient, the degree of influence of the digital economy on the high-quality development of the manufacturing industry in four cities has apparent regional heterogeneity: from mega-cities to small and medium-sized cities, the degree of influence of the digital economy on the development quality of manufacturing industry is gradually weakening. This

may be because nearly 70% of China's manufacturing enterprises are still at level 1 or below, and less than 10% have reached level 4 or above. The positive impact of a slightly higher digital economic development index on the development of the manufacturing industry cannot make up for the negative impact on the quality of the development of the manufacturing industry caused by the insufficient number of manufacturing employees in cities.

4.3 Endogenous Test

The above tests show that the digital economy can significantly promote the high-quality development of the manufacturing industry. However, the realization process of this result does not mean that there is no endogenous problem caused by the mutual causality between the high-quality development of the manufacturing industry and the digital economy. The high-quality development of the manufacturing industry is included in economic development, and economic development will drive the sustainable development of the digital economy, which indicates that there are factors that promote the development of the digital economy at the macro-level of the manufacturing industry. In addition, the manufacturing industry's high-quality development and output will attract many digital service enterprises to settle down, further promoting social construction and improving the digital infrastructure. In order to test whether there is an endogenous problem between the digital economy and the development of the manufacturing industry, this paper refers to the practice of Liao Xinlin (2022)9. It introduces the slow Internet penetration rate as a tool variable for the endogenous test. The choice of instrument variables is based on the following two considerations: First, the correlation between the development level of the digital economy and Internet penetration rate is strong; Second, the Internet penetration rate lagging by one stage is a pre-determined variable, and the current level of development of manufacturing industry cannot affect it, thus effectively solving the model endogeneity problem caused by two-way causality. The regression test was performed after considering the endogenous problem, and the test results are represented by models (1) and (2) in Table 7. The results show that the digital economy can still significantly promote the high-end and high-quality development of the manufacturing industry. This further proves the reliability of the model.

Table 7 Endogeneity Test

variable	(1)	(2)
Dige	0.007***(7.18)	0.003***(2.75)
INDUSTRY		0.002*(1.70)
FINDEV		-0.000(-0.28)
LNGDP		-0.002***(-3.65)
INV		0.000***(29.68)
_cons	0.032***（8.71）	0.062***(6.14)
Observations	3601	3601
R2	0.014	0.261

Note: The latter * * *, * *, * *, indicate the significance level of 1%, 5% and 10% respectively corresponding to the regression results. The value in () is the corresponding T statistic.

5. Conclusion And Insights

Based on the panel data of 277 prefecture-level cities from 2006 to 2019, this article scientifically constructs an indicator system of the digital economy and high-quality development of the manufacturing industry, on which the digital economy development level is measured. The empirical analysis is conducted using economic statistical methods such as the fixed-effect model, least squares method, mediating effect model, and panel instrumental variable model. The article profoundly investigates the effect assessment and mechanism of the digital economy influencing the high-end quality development of the manufacturing industry. The results are robustly heterogeneous, and the following conclusions are drawn: Firstly, the impact of the digital economy directly acting

on the quality development of the manufacturing industry is significantly positive in general; secondly, the digital economy drives the development of urbanization, and this path positively acts on the quality development of the manufacturing industry; thirdly, the digital economy acts on the thirdly, the depth and direction of the digital economy's role in the high-quality development of manufacturing industry show some regional heterogeneity.

This study provides empirical evidence for China to adhere to innovation-driven development and promote the implementation of "Digital China" and "Made in China 2025". We propose considering the current digital economy construction and industrial manufacturing situation in the following three policy recommendations.

(1) Enhance the support for the digital industry and build a digital city. Advanced management technologies such as smart cities and digital twins need to be reasonably introduced at the digital technology level to accelerate the construction of digital cities. At the same time, it should increase investment in information network construction and application, accelerate the comprehensive coverage of digital infrastructure, fully exploit the new momentum of digital economic growth and play to the spillover effect of the regional digital economy. These give birth to new industries, business models, and modes and continuously make our digital economy bigger, better, and more robust.

(2) Find a balance between the urbanization rate and high-quality development of the manufacturing industry according to local conditions. Currently, China's urbanization has entered the middle stage of rapid growth. Still, the empirical results show that the higher the urbanization rate is, the better it is. But blindly increasing the urbanization rate will be at the expense of the quality of manufacturing development. Maintaining a balance between the urbanization rate and high-quality development of the manufacturing industry in each region has become an aspect of being considered by the central and local governments. By optimizing the allocation of labor factors, government departments can promote the upgrading of manufacturing development quality in megacities and small and medium-sized cities 16, reverse the "Matthew effect" of more developed economic regions on less developed and less developed areas at the macro level, and improve the distortion of labor allocation between regions.

(3) Continuously optimize the regional macroeconomic and financial environment and solidify the foundation for green and high-quality development. Support the developed eastern coastal provinces and regions to continue to play the "leading effect," take the lead in upgrading to the middle and high end of the industrial value chain, and continuously narrow the technology gap with developed economies, while " the rich lead the rich," thus driving the inland areas to realize transformation and upgrading of the digital economy and high-quality development of manufacturing industry.

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