ISSN: 2688-8653

Mechanism of Digital Economy Helping the Transformation and Upgrading of Manufacturing Industry in China's Yangtze River Delta

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Abstract

In recent years, along with the high-speed Internet development and the change of communication era, many countries have promoted the integration of digital economy and manufacturing industry as their main means to improve their competitiveness in the international arena. In the context of China's economy entering a new stage of development and the urgent need for the transformation and upgrading of the manufacturing industry with a large slope bottleneck, the Yangtze River Delta region, as one of the regions representing the most advanced manufacturing level in China, has likewise The Yangtze River Delta region, as one of the most advanced manufacturing regions in China, has also demonstrated a relatively strong international competitiveness in digital economy. This study will study the influence of digital economy on the upgrading of manufacturing industry in Yangtze River Delta, and provide theoretical reference suggestions for the upgrading development of manufacturing industry in Yangtze River Delta. First, this study will select indicators to establish the index system and model; secondly, this study will use multiple linear regression analysis to conduct an empirical study on the influence of digital economy on the upgrading of manufacturing industry in Yangtze River Delta; finally, the results will be analyzed to put forward corresponding suggestions.

Keywords

Digital Economy; Yangtze River Delta Region; Manufacturing Transformation and Upgrading; Multiple Linear Regression Analysis.

1. Introduction

Today China's manufacturing industry is the largest in the world, and goods produced in China are circulating around the world. The rapid development of China's manufacturing industry, with its huge population base and market, has rapidly attracted a large amount of foreign capital investment. However, what cannot be ignored is that China's huge manufacturing scale is mostly based on the middle and low-end manufacturing industries. In the link of "global division of labor", China often undertakes some tasks with low technology content and has been at the bottom of the "profit chain" for a long time. Under the dual challenges of lack of high-end manufacturing and overcapacity of some middle and low-end manufacturing industries, how China can contribute to the balanced, high-speed, effective and green development of manufacturing industry becomes the key to future development.

The further integration of digital economy and manufacturing industry is the inevitable trend of development. The Internet Development Report of China 2020 points out that the total scale and growth rate of China's digital economy are in the first position in the world. However, the development of China's digital economy is still in its initial stage, so how to accelerate the

ISSN: 2688-8653

integration of digital economy and manufacturing industry is the top priority during the 14th Five-Year Plan development.

The Yangtze River Delta region has a strong manufacturing base and occupies the geographical advantages of river transportation and sea transportation, so the foreign trade has always been growing rapidly, and it can also radiate the Yangtze River coastal area internally. In addition, the country's four comprehensive national science center cities in the Yangtze River Delta occupies two, respectively, Hefei and Shanghai. Jiangsu and Zhejiang provinces are also at the forefront of the development of domestic provinces. Therefore, to a certain extent, the level of manufacturing development in the Yangtze River Delta region also represents the highest level of manufacturing development in China at present.

This study aims to analyze the digital economy and manufacturing development in the Yangtze River Delta region through relevant data and scientific and effective analysis methods, explore the research on the influence of digital economy on the upgrading and development of the manufacturing industry in the Yangtze River Delta, provide guidance on the collaborative development and manufacturing innovation development in the Yangtze River Delta region by combining relevant data, and finally will propose specific measures for the integration and development of the digital economy and manufacturing industry in the Yangtze River Delta by combining the analysis and provide enterprises with informatization and digitalization to provide practical suggestions for China to better realize the development of informatization and industrialization and become a global development leader.

2. Current status of manufacturing upgrading and digital economy development in the Yangtze River Delta region

2.1. Status of manufacturing upgrade

Traditionally, the Yangtze River Delta region only included the area around Shanghai, but with the addition of Anhui Province, the Yangtze River Delta city cluster has gradually developed and expanded to include the entire Jiangsu Province, Zhejiang Province, Anhui Province and Shanghai. Located in the eastern part of China, the Yangtze River Delta urban agglomeration contributes about a quarter of the country's GDP and industrial value added with a total area of only 3.7% of the country and a population of more than 200 million people. As one of the most developed city clusters in China and the world, the Yangtze River Delta has advanced manufacturing industries, and the Yangtze River Delta region occupies 12 of the two batches of 25 advanced manufacturing cluster winners announced to the public by the Ministry of Industry and Information Technology in 2021. According to the newly released White Paper on High Quality Manufacturing in 2021, all three provinces and one city in the Yangtze River Delta are ranked among the top ten in high quality manufacturing development.

Although the development of manufacturing industry in the Yangtze River Delta has made some remarkable achievements, with the development of the times, the manufacturing industry in the Yangtze River Delta also faces problems such as rising labor costs, scarce resources, significant rise in land costs, insufficient regional coordination, etc. This study analyzes the current situation of manufacturing development in three provinces and one city with reference to the National Economic Classification of Industries released in 2017, which divides the manufacturing industry into three levels: low-end, mid-range and high-end.

2.2. Current status of digital economy development

In recent years, the total scale of the digital economy in the Yangtze River Delta region has exceeded RMB 8.5 trillion, accounting for nearly 30% of the total scale of the digital economy in China. Among them, Hangzhou and Shanghai are the two cities with the highest level of digital economy development in the Yangtze River Delta. This study will analyse the current situation

ISSN: 2688-8653

of digital economy development in each region of the Yangtze River Delta in five dimensions: digital infrastructure index, digital business index, digital industry index, digital government index and digital livelihood service index.

2.2.1. Digital Infrastructure

Digital infrastructure is the new digital infrastructure. Taking the construction of 5G base stations as an example, by the end of 2020, the cumulative number of 5G base stations built in the Yangtze River Delta exceeded 200,000. In addition to this, the three provinces and one city in the Yangtze River Delta are focusing on supporting the construction and development of 5G applications. Anhui Province plans to build 25,000 5G base stations in 2021. By the end of 2021, Jiangsu Province plans to achieve the annual target of "basic coverage of 5G networks in areas above the county level and some key towns". Zhejiang Province will strengthen 5G infrastructure construction during the next five-year plan to achieve full coverage of 5G applications within four to five years. Shanghai plans to achieve the target of reaching 100 billion yuan in 5G manufacturing, software and information services, and application industries this year, and to promote the collaborative innovation and cluster development of the 5G industry chain in a comprehensive manner.

2.2.2. Digital Business

The Yangtze River Delta has implemented a series of policies in recent years to stimulate consumption and promote digital business development. 2021 The 2021 Yangtze River Delta Eco-Green Integrated Development Demonstration Zone "May 5 Shopping Festival" was officially opened on 30 April 2021 in the first shopping district of Qingpu Lianmei, and during this shopping festival, which spans the entire second quarter, the Yangtze River Delta will During this shopping festival, which will span the entire second quarter, the Yangtze River Delta will pilot the application of digital RMB for cross-regional payments in the Yangtze River Delta Integrated Development Demonstration Zone and support the implementation of cross-province multi-domain consumption applications.

2.2.3. Digital Industry

The Digital Industry Index includes: the Enterprise Sales Index, which reflects the scale of sales of digital products and services by regional enterprises; the Regional Trade Index, which reflects the scale of inter-regional trade in digital goods; the Agricultural Digital Economy Development Index, which reflects the level and extent of application of digital information technology in the agricultural production process; and the Industrial Digital Economy Development Index, the Industrial Digital Economy Development Index reflects the degree of digitisation of regional industrial enterprises. The Digital Industry Index reflects the level of digital development of regional industries. Anhui Province has a relatively low urban digital industry index, mainly due to the lack of online business cluster centres of a certain scale compared to the other two provinces and one city, and the fact that Anhui Province started late in building a modern agricultural system and has a relatively low level of agricultural digitisation.

However, Hefei, the capital of Anhui Province, is ranked 6th in the Industrial Digital Economy Development Index because it has actively promoted the integration of informatisation and industrialisation in the last two years and more than half of the "smart factories" have been applied in collaboration with the industrial chain. Jiangsu and Zhejiang provinces are ranked higher in the Digital Industry Index because of their high level of industrial development and their early attempts to transform and upgrade their industries nationwide.

ISSN: 2688-8653

3. An Empirical Study on the Impact of Digital Economy on the Upgrading of Manufacturing Industry in Yangtze River Delta

3.1. Research hypothesis and variable selection

3.1.1. Research hypotheses

This study concludes that the level of development of the digital economy, the level of education and technology, the level of induced investment and the level of consumer demand all have a positive impact on the level of upgrading of the manufacturing industry. Firstly, with the integration and development of digital economy and manufacturing industry, the manufacturing industry can better allocate resources to increase efficiency and increase output; in addition, with the increasing investment of resources in education and science and technology, the production level and management level of the manufacturing industry will be greatly improved; secondly, with the increasing scale of investment attraction, it can produce industrial agglomeration effect, attract upstream and downstream enterprises of the manufacturing industry and promote the Once again, from the perspective of the demand side, the more demand there is, the more supply there will be, and the improvement of people's consumption level and the increasingly high-end and complex consumer demand will also promote the development of the manufacturing industry.

3.1.2. Selection of variables

In this study, we study the influence of the level of digital economy development on the level of manufacturing upgrading, so the dependent variable is set as the manufacturing upgrading level index, and the manufacturing upgrading level scores of different cities in different years have been analysed by principal component analysis before the experiment.

The core explanatory variable of this study is the digital economy development level index, and the digital economy development level scores of each city in each year have been analysed by principal component analysis before the experiment. In addition, six more control variables will be extracted from this study, namely the number of students enrolled in general higher education schools and the total number of patent applications granted in terms of the level of education and technology, where the number of students enrolled in general higher education schools reflects the importance attached to higher education and the scale of higher education in the region, and the total number of patent applications granted reflects the level of application of science and technology in the region; the introduction of investment level in terms of the actual The actual utilisation of foreign capital and the balance of financial deposits in local and foreign currencies, of which the actual utilisation of foreign capital in the current year reflects the region's ability to attract foreign investment and the degree of exchange between the region and foreign capital, while the balance of financial deposits in local and foreign currencies reflects the region's ability to attract capital and is a reflection of the region's financial development; the level of consumer demand includes disposable income per capita and the consumer price index, with disposable income per capita reflecting the amount of income that residents can use for discretionary purposes. Per capita disposable income reflects the amount of income that residents have at their disposal and, to a certain extent, how much money they have at their disposal for consumption, while the consumer price index reflects the fluctuations in the price level of goods and services consumed by residents.

3.2. Model construction

In order to test the above hypothesis, the econometric model constructed is:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \varepsilon \quad (1)$$

Where, the dependent variable Y is the manufacturing upgrading level index, the digital economy development level index, the intercept term, the financial local and foreign currency

ISSN: 2688-8653

deposit balance variable, the number of students enrolled in general higher education institutions variable, the actual utilization of foreign investment in the current year variable, the per capita disposable income variable, the total number of patent applications granted variable, and the random error

3.3. Empirical Analysis

3.3.1. Descriptive statistics for multiple linear regression

In this study, descriptive statistics of the raw data were performed by SPSS software and the following results were obtained.

Table 1 Descriptive statistics

	N	Minimum value	Maximum Value	Average value	Standard deviation
A	40	-1.784105	4.827003	0.00000000	1.843490763
B	40	-1.745372	3.668429	0.00000000	1.500007685
C	40	470346	3510348	1317780.60	850988.484
D	40	9.00	87.78	37.8843	25.91545
E	40	49343.000	274173.000	125435.0250	54744.99556
F	40	23.160	190.480	58.57050	48.781896
G	40	7833.490	121112.330	30354.89325	27168.20727
H	40	26605.000	69442.000	46369.05000	10349.73827
I	40	1.01	1.03	1.0299	0.00544

A:Manufacturing upgrade level index B:Digital Economy Development Level Index C:Number of employees in manufacturing industry D:Number of students in general higher education schools (10,000) E:Total number of patent applications and licenses (pieces) F:Actual utilization of foreign capital in the current year (USD billion) G:Balance of financial domestic and foreign currency deposits (RMB billion) H:Per capita disposable income (RMB) I:Consumer Price Index.

3.3.2. P-P diagram for multiple linear regression

In this study, after multiple linear regression of the dependent and independent variables, a normal distribution plot was obtained as shown below. The normal distribution plot of the standardised residuals from the regression shows that all the points are roughly distributed around a straight line, indicating that the residuals work well and the residuals can be considered to meet the requirements of a normal distribution.

ISSN: 2688-8653

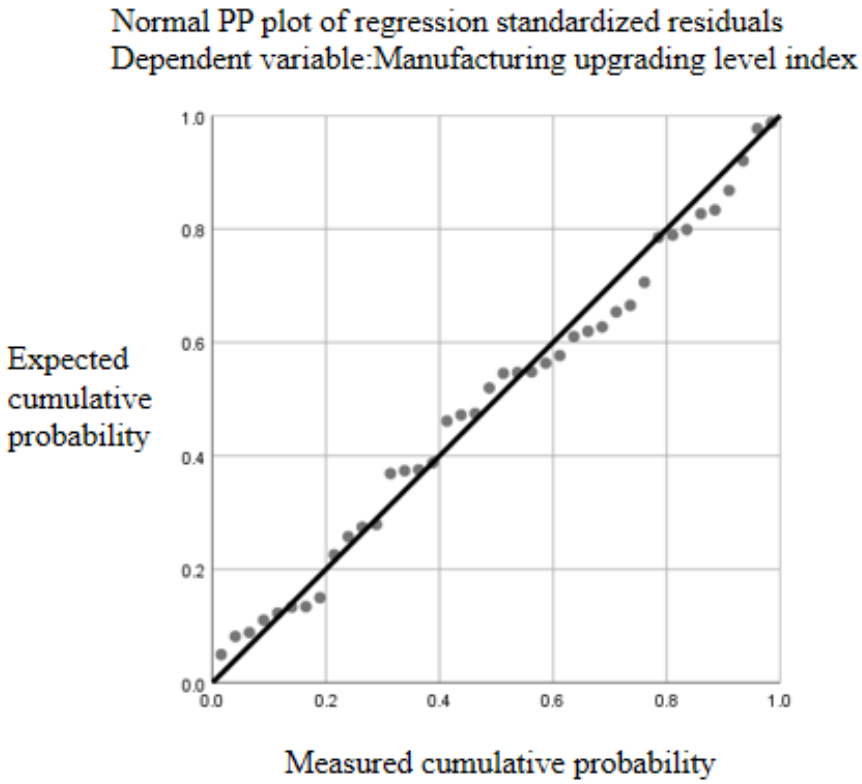

Figure 1 Multiple linear regression normal distribution

3.3.3. ANOVA table for multiple linear regression

ANOVA tables were used to test the statistical significance of the model, as shown below, the F-value of this multiple linear regression analysis equals 32.627 and the p-value is less than 0.05, indicating that the coefficients of the variables are significant and the variables selected in this regression analysis can be considered valid.

Table 2 Multiple linear regression ANOVA table

ANOVA[a]

Model		Sum of squares	Degree of Freedom	Mean Square	F	Significance
1	Regression	116.251	7	16.607	32.627	0.000b
	Residuals	16.288	32	0.509		
	Total	132.540	39			

a. Dependent variable: manufacturing upgrading level index

b. Predictor variables: (constant), consumer price index, actual utilization of foreign capital (USD billion), number of students in higher education (10,000), per capita disposable income (RMB), digital economy development level index, total number of patent applications and licenses (pieces), financial deposits in domestic and foreign currencies (RMB billion)

3.3.4. R-squared and DW test values for the multiple linear regression

In general, the better the fit of the model, the closer the R-squared will be to 1. The adjusted R-squared value for this regression analysis is 0.850 as shown below. In addition, the DW value is 1.684, which is between 1.5 and 2.5, and it can be assumed that the observations in this study are mutually independent.

ISSN: 2688-8653

Table 3 Multiple linear regression model summary

Model Summary[b]

Model	R	R2	Adjusted R2	Errors in standard estimation	Durbin-Watson
1	0.937a	0.877	0.850	0.713451732	1.684

a. Forecast variables: (constant). Consumer price index, actual utilization of foreign capital (USD billion), number of students in higher education (10,000), per capita disposable income (RMB), digital economy development level index, total number of patent applications and licenses (pieces), financial deposits in domestic and foreign currencies (RMB billion)

b. Dependent variable: manufacturing upgrading level index

3.3.5. Coefficients of the multiple linear regression

According to the table below it can be seen that the variance inflation number VIF values are also less than 15, and most of them are below 10, which can be considered that the multiple covariance of this regression analysis is light and the tolerance of the independent variables is greater.

Also according to the table below it can be concluded that the variables of the number of students enrolled in general higher education schools and the total number of patent applications granted in terms of education and technology level, the variable of actual foreign investment utilised in the current year in terms of the level of investment introduced are the main factors influencing the level of upgrading of the manufacturing industry, followed by the variables of financial local and foreign currency deposit balance, the variable of disposable income per capita and the variable of the level of development of the digital economy.

Table 4 Table of linear regression coefficients

Coefficienta

		Unstandardized coefficient		Standardization coefficient		Covariance statistics		
	Model	B	Standard error	Beta	t	Significance	Tolerance	VIF
1	(Constant)	4.765	24.717		0.194	0.847		
	K	-1.24	.211	-0.101	-0.587	0.561	0.130	7.685
	L	-0.014	0.005	-1.95	-2.746	0.010	0.761	1.313
	M	1.890E-5	0.000	0.561	2.932	0.006	0.105	9.537
	N	0.016	0.008	0.428	2.006	0.053	0.084	11.836
	O	1.634E-5	0.000	0.241	1.119	0.272	0.083	12.059
	P	-1.901E-5	0.000	-0.107	-0.849	0.402	0.243	4.113
	Q	-7.040	24.307	-0.021	-0.290	0.774	0.746	1.341

K:Digital economy development level index L:Number of students in general higher education institutions(10,000) M:Total number of patent applications and licenses (pieces) N:Actual utilization of foreign capital in the year (USD billion) O:Balance of financial domestic and foreign currency deposits (RMB billion) P: Per capita disposable income (RMB) Q:Consumer price index

a. Dependent variable:Manufacturing upgrading level index

ISSN: 2688-8653

3.3.6. Analysis of regression results

The results obtained from the multiple linear regression analysis of the original data show that the two indicators of education and technology have the most significant impact on the upgrading level of the manufacturing industry, indicating that "technology is the first productive force" and highlighting the importance of education and technology; followed by the two indicators of investment on the upgrading level of the manufacturing industry. In addition, the impact of disposable income per capita on the upgrading level of the manufacturing industry is also positively correlated, indicating that as people's income increases, consumption will increase and demand will increase, thus further stimulating the increase in supply and the development of the manufacturing industry from the demand side.

The significance of the digital economy development level index variable is 0.561, which may be due to the fact that the effect of the newly developed digital economy on the manufacturing industry is not yet significant, and with the rapid development of the digital economy and the bottleneck encountered in the development of the manufacturing industry, the degree of influence of the digital economy on the development of the manufacturing industry may further increase.

4. Policies and Recommendations for the Transformation and Upgrading of Manufacturing Industries in the Yangtze River Delta Region

4.1. Insisting on science and technology innovation as the first driving force

Promote the transformation and upgrading of the manufacturing industry with scientific and technological innovation as the driving force. The Yangtze River Delta can take the core industrial enterprises in the region as a carrier, gather key elements such as capital, technology and talents to import, strengthen the application of digital industry in R&D, design, manufacturing and sales services, and cultivate backbone enterprises with core competitiveness in the region (Hong Jia). In addition, the Yangtze River Delta region should focus on attracting research talents and increasing research funding, as well as attracting university students to start their own businesses by establishing incubation bases to attract young people and make the region "come alive".

4.2. Investing in improving the overall quality of the workforce

In the current context of manufacturing industry focusing less and less on quantitative accumulation and more on qualitative change, the only way to better promote the upgrading and transformation of manufacturing industry is to have high quality talents. The Yangtze River Delta region should focus on higher education as well as specialist education; we need good managers and leaders as well as good workers. In addition, the Yangtze River Delta region should also increase its support for education in emerging industries, for example by providing support to train professionals in areas such as integrated circuits and quantum information in collaboration with many universities in the Yangtze River Delta.

4.3. Promoting the trend towards regional harmonisation

Based on the analysis of this study, it can be seen that the Yangtze River Delta region has large differences in the level of development of both manufacturing and digital economy, which can lead to the Yangtze River Delta region not fully utilising its resources effectively to promote the upgrading and transformation of the manufacturing industry, and can consume a lot of resources for no good reason when coordination is not adequate. Therefore, if the Yangtze River Delta as a whole is to better promote the upgrading and development of the manufacturing industry, the regions must work in concert so as to maximise the use of available resources to achieve better results. By increasing financial investment, we promote the construction of an

efficient and convenient integrated infrastructure network, an integrated market ecosystem of industry, academia, research and marketing, and an open and cohesive integrated government collaboration platform.

4.4. Deepening and improving the supply-side reform of the industry chain

In the face of the impact of the epidemic and the international trend of reverse globalisation, we will expand the integrity of the upstream and downstream chains of industries with advantages in the Yangtze River Delta from the perspective of securing the security of the supply chain and improving the competitiveness of the industrial chain, accelerate the reforming role of the digital economy, e-commerce and platform models in industrial development, overcome "neck" technological difficulties with in-depth and integrated collaborative innovation capabilities, smooth and improve the industrial and innovation chains, insist on creating an enterprise ecological environment of "mass entrepreneurship and innovation", stimulate the innovative vitality of SMEs, and effectively play the role of SMEs in upgrading the basic capabilities of secondary and tertiary industries and the level of industrial chains.

Acknowledgements

This study was funded by the National Innovation and Entrepreneurship Training Program for Undergraduates of China (202110378217 and 202110378006).

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