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The Development of the Digital Economy and the Improvement of Manufacturing Efficiency

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Abstract: *The manufacturing industry is the main battlefield for China's development of digital economy, the digital economy is an important driving force for the transformation of China's manufacturing industry from rigid processing to flexible manufacturing and intelligent manufacturing, and China's manufacturing industry has good development opportunities under the current digital economy background. This paper constructs a panel dataset based on the data of 1334 manufacturing listed companies and the development of digital economy at the prefecture-level cities in China from 2011 to 2019, with a total of 12,006 observations, to explore the relationship between the development of the digital economy and the efficiency improvement of the manufacturing industry. The research results show that the vigorous development of the digital economy has a positive role in promoting the efficiency improvement of the manufacturing industry.*

Keywords: *Digital economy, Manufacturing efficiency, Total factor productivity, Enterprise heterogeneity*

1. Introduction

Human society has gradually entered the era of digital economy, and the digital economy characterized by big data and cloud computing has gradually penetrated into people's production and life. At present, many scholars have explored the problem of how to transform and upgrade manufacturing enterprises in the digital economy, on the basis of the previous research, this paper uses the available data to construct digital economic development indicators, learn from the practices of predecessors, measure the efficiency of the manufacturing industry by the total factor productivity of the manufacturing industry, explore the impact of the development of the digital economy on the efficiency of the manufacturing industry, and finally make suggestions for the development of traditional manufacturing enterprises in China.

2. Research design

2.1 Econometric model settings

Based on the practice of LiZhiGuo's article (2021) [1], this paper tests the impact of the development of digital economy on the efficiency improvement of manufacturing industry from the enterprise level. The benchmark model is as follows:

$$TFP_{it}=a_1+a_2IE_{it}+a_3ROA_{it}+a_4Size_{it}+a_5TL_{it}+a_6Age_{it}+v_t+\varepsilon_{it},$$

where i represents individual manufacturing enterprises and t represents time; a_1 represents a constant term; TFP_{it} stands for total factor productivity of manufacturing firms and is used to measure manufacturing efficiency; IE_{it} indicates the level of development of the digital economy; v_t denotes the time fixation effect; ε_{it} represents random perturbation terms; ROA_{it}, $Size_{it}$, $TL_{it,}$ Age_{it} represent control variables.

2.2 Data sources

By matching the level of digital economy development in prefecture-level cities with the data of listed

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companies in the manufacturing industry, a panel dataset with a research period of 2011-2019 is established. Among them, after excluding the samples with more missing values, a total of 1334 manufacturing listed enterprises were retained, covering more than 200 prefecture-level cities across the country, including pharmaceutical manufacturing, automobile manufacturing and special equipment manufacturing and other manufacturing sub-sectors. The relevant data is mainly selected from the CSMAR database, the annual report of listed companies, the Mark data network, etc.

2.3 Variables selection

2.3.1 Interpreted variable

Total Factor Productivity (TFP) of manufacturing at the enterprise level: Based on the existing literature practice, this paper identifies the listed company code, registered address, etc., confirms the continuous operation status of the listed company [1], and then constructs the panel dataset for 2011-2019 based on the 2011 base period. Compared with the OLS method, the LP method can effectively overcome the problems of potential endogeneity and loss of effective information, so the LP method is selected to estimate the total factor productivity of listed companies.

2.3.2 Core explanatory variable

This article refers to the existing literature, and uses the entropy method and STATA software to obtain the digital economy development index of each prefecture-level city according to the number of Internet users in each region, the proportion of computer services and software practitioners, the total amount of telecommunications services per capita, the number of postal services per capita, the number of mobile phone users, the digital inclusive financial index, etc.

2.3.3 Control variables

Manufacturing enterprise-level control variables include: corporate profitability (ROA, corporate net profit/total average assets of the enterprise), enterprise size (Size, the logarithmic value of the total assets of the enterprise), financial status (TL, the ratio of total liabilities to total assets), and age of the enterprise (Age, year of the current year - year of establishment +1).

3. Empirical analysis

3.1 Descriptive statistics

Descriptive statistics are first described in this article [2]. From the following Table 1, it can be seen that in the period from 2011 to 2019, the maximum value of the profitability index ROA of each manufacturing enterprise was 22.01, the minimum value was -30.85, and the standard deviation was 0.432, indicating that there were large differences among manufacturing enterprises. The maximum value of the digital development level indicator IE is 0.820, the minimum value is 0.0178, and the standard deviation is 0.118, which also indicates that the development of digital technology among manufacturing enterprises is unbalanced.

Table 1: Descriptive statistics of variables.

Variables	Obs	Mean	Std.Dev.	Min	Max
TFP	12,006	6.696	2.145	2.916	10.47
IE	12,006	0.166	0.118	0.0178	0.820
ROA	12,006	0.025	0.432	-30.85	22.01
Size	12,006	22.10	1.226	17.02	27.47
TL	12,006	0.440	0.463	0.00708	30.68
Age	12,006	17.66	5.740	3	45

3.2 Benchmark regression analysis

Before doing the benchmark regression, this paper makes Hausman test on the data and the results of the test show that a fixed-effects model should be used for regression in this paper, as shown in Table 2. Model 1 and Model 2 are based on the addition of enterprise control variables, whether to consider the regression of time fixed effects.

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Model 1 is the regression result of adding control variables, and it can be seen from Table 2 that the development of the digital economy has a significant positive effect on the total factor productivity of the manufacturing industry, reflecting that the development of the digital economy has a positive role in promoting the efficiency of the manufacturing industry. Model 2 considers the regression results of the fixed effect of time on the basis of adding control variables, from which it can be found that there is a time difference in the promotion of total factor productivity in the manufacturing industry by the development of the digital economy, and then there is a certain time difference in the improvement of manufacturing efficiency. By observing the regression results of the control variables, it can be found that the degree of debt (TL) of enterprises plays a significant role in inhibiting the total factor productivity of manufacturing enterprises, while the profitability and scale of enterprises will promote the improvement of total factor productivity of manufacturing.

Table 2: Benchmark regression results

	Model 1	Model 2
Variables	TFP	TFP
IE	0.340** (2.55)	0.556*** (3.74)
ROA	0.373*** (8.08)	0.353*** (7.63)
Size	1.055*** (80.98)	1.061*** (80.28)
TL	-0.229*** (-5.26)	-0.245*** (-5.63)
Age	-0.007** (-2.41)	-0.003 (-0.93)
Year.FE	NO	YES
N	12006	12006
R^2	0.373	0.378

t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

3.3 Robustness testing

In order to ensure the robustness of the model and the reliability of the empirical results, this paper conducts a robustness test for the lag phase I of the core explanatory variables [3], and the results are shown in Table 3, model 3 and model 4 are regression based on whether to consider the time fixed effect on the basis of adding enterprise control variables. It can be seen from the table that the indicators of digital economy are exogenous and have a significant effect on the total factor productivity of the manufacturing industry. Therefore, the development of digital economy is conducive to the improvement of the efficiency of manufacturing enterprises.

Table 3: Robustness test results

	Model 3	Model 4
Variables	TFP	TFP
L.IE	0.629*** (4.00)	0.681*** (3.96)
ROA	0.265*** (4.12)	0.261*** (4.04)
Size	1.060*** (74.20)	1.058*** (72.96)
TL	-0.319*** (-5.56)	-0.320*** (-5.56)
Age	-0.001 (-0.19)	-0.001 (-0.22)
Year.FE	NO	YES
N	10672	10672
R^2	0.367	0.369

t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

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3.3 Heterogeneity analysis

Based on the characteristics of the micro nature of enterprises, the sample was divided into state-owned enterprises and non-state-owned enterprises according to the nature of enterprise ownership, and the heterogeneity analysis was analyzed [4] [5], and the results were shown in Table 4 (the sum of the sample sizes of state-owned enterprises and non-state-owned enterprises was different from the basic regression sample size because some enterprises switched from state-owned to non-state-owned or from non-state-owned to state-owned during the study year). It can be seen from the table that the development of digital economy has a significant positive role in promoting the total factor productivity of both state-owned enterprises and non-state-owned enterprises, and has a greater role in promoting the total factor productivity of state-owned enterprises. The possible reasons for this result are: the digital transformation of enterprises requires a wide range of application of digital technology, large-scale investment in intelligent manufacturing and the construction of modern information systems. State owned enterprises with capital, scale, scientific research and policy advantages can make full use of their own characteristics, realize the organic combination of digital strategy and enterprise comparative advantages, and effectively make up for the efficiency loss of state-owned enterprises, promote the high-quality development of state-owned enterprises, which also provides an important reference for the future reform of state-owned enterprises [6].=

Table 4: Heterogeneity analysis results

	State-owned enterprises	Non-state-owned enterprises
Variables	TFP	TFP
IE	1.047** (2.19)	0.415*** (2.72)
ROA	15.923*** (21.07)	0.355*** (7.74)
Size	0.993*** (27.26)	1.097*** (76.99)
TL	-1.240*** (-4.82)	-0.179*** (-4.11)
Age	0.012 (1.25)	0.000 (0.08)
Year.FE	YES	YES
N	1274	10732
R^2	0.576	0.384

t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

4. Conclusions and policy recommendations

This paper constructs a panel dataset based on the data of listed companies in China's manufacturing enterprises and the development of digital economy at the prefecture-level cities in China from 2011 to 2019, measures the efficiency of manufacturing industry by the total factor productivity of manufacturing enterprises, considers the time difference, and empirically analyzes the role of digital economy development on improving manufacturing efficiency. The empirical results show that: (1) Overall, the development of the digital economy can significantly increase the total factor productivity of manufacturing enterprises, thereby improving the efficiency of manufacturing. (2) From the perspective of control variables, manufacturing enterprises can improve total factor productivity and manufacturing efficiency by reducing asset liability ratio, improving profitability, and promoting digital development through innovation and optimization.. (3) From the heterogeneity analysis results, for state-owned manufacturing enterprises, the digital economy plays a greater role in promoting their total factor productivity, so the development of the digital economy has a more significant effect on the efficiency of state-owned manufacturing. Based on the above research results, the following policy recommendations are proposed in this paper.

First, improve the service system for the development of the digital economy and strengthen the deep integration and development of the digital economy and the traditional manufacturing industry. On the one hand, vigorously promote the construction of "new infrastructure" projects such as 5G technology, intelligence and big data platforms, improve the construction of network infrastructure, and effectively drive the development level of digital economy. On the other hand, the government should build a

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communication platform between the digital economy industry and the manufacturing industry, reshape the manufacturing division of labor model and innovation model with the digital economy as the carrier, and promote the networked, intelligent and digital transformation of the manufacturing industry with digital technology as the guide.

Second, manufacturing enterprises should pay attention to the powerful role of the development of the digital economy in promoting their efficiency. On the one hand, manufacturing enterprises should make full use of digital new technologies to upgrade the traditional business chain in an all-round way. On the other hand, manufacturing enterprises should try to use Internet thinking for organizational innovation and system innovation, and strive to mobilize the innovation enthusiasm of various entities and continue to stimulate the innovation vitality within the company.

Third, improve relevant laws and regulations to provide a good external environment for the digital development of manufacturing enterprises [7]. On the one hand, in view of the new characteristics of infringement in the era of digital economy, the government should accelerate the formulation of relevant systems for confirming, opening, circulating and trading data resources, and increase the protection of intellectual property rights for digital technologies and data assets. On the other hand, the government should introduce corresponding subsidy policies to help manufacturing enterprises better complete digital transformation, so as to achieve a steady increase in manufacturing efficiency.

References

[1] LI Zhiguo,Wang Jie. Digital Economy Development, Data Factor Allocation and Manufacturing Productivity Improvement[J]. Economist, 2021(10):41-50.
[2] Fiona Fan Yang,Anthony G.O. Yeh,Jiejing Wang. Regional effects of producer services on manufacturing productivity in China[J]. Applied Geography,2018,97.
[3] Qiu Xiaofeng. Digital Economy and Total Factor Productivity of Enterprises[J]. Hebei Enterprises, 2020(08):51-52.
[4] Wang Guiduo,Cui Lusha,Zhang Jianfei,Wang Chunzhi. Digital Economy Empowers Manufacturing Transformation and Upgrading: Heterogeneity Influence Mechanism and Effect[J]. Journal of Statistics,2021,2(05):9-23.
[5] Yu Shihai,Xu Huixin,Kong Lingqian. Research on the Impact of Digital Economy Level on Resource Allocation Efficiency of China's Manufacturing Industry[J/OL].Finance and Trade Research:1-22[2022-06-20].
[6] Zhao Chenyu,Wang Wenchun,Li Xuesong. How Digital Transformation Affects Firms' Total Factor Productivity[J]. Journal of Finance and Trade Economics,2021,42(07):114-129.
[7] Cai Tingting,Wu Songqiang. Digital Economy Empowers China's Advanced Manufacturing Industry: International Experience and Reference[J]. Decision-making and Information, 2021(12):72-79.