Empirical Testing of the Impact of Manufacturing Digitalization on Industrial Upgrading

XueYang Zhang(✉)

School of Economics, Harbin University of Commerce, Harbin150028, China

18846126539@163.com

Abstract. In order to explore the impact of manufacturing digitization on industrial upgrading and realize green development. This paper first analyzes the impact of manufacturing digitization on industrial upgrading from both supply and demand aspects, and empirically tests the impact of manufacturing digitization on industrial upgrading by using the panel data of Chinese provinces and cities from 2003 to 2021. It is found that manufacturing digitization has a positive promotion effect on manufacturing upgrading, and the results are still valid after the robustness test.

Keywords: manufacturing industry; digitization; industrial upgrading;

1 Introduction

With the rapid development of information and communication technology, the digital economy has become an important driving force for economic and social development. It not only brings new industries and models, promotes the development of industries towards mid to high end, but also facilitates the green transformation of industries. The report of the 20th National Congress of the Communist Party of China emphasizes "accelerating the development of the digital economy and promoting the deep integration of the digital economy and the real economy". The real economy is the capital for China's development, and manufacturing is the foundation of the real economy. At present, the manufacturing industry has become the main battlefield of the digital economy, and the digital economy is also the main driving force for the rapid development of the manufacturing industry. Li Keqiang pointed out at the first session of the 14th National People's Congress that we should deeply implement the innovation driven development strategy and promote the optimization and upgrading of the industrial structure. The core of economic development is advanced industrial structure. What impact will the development of the digital economy have on the industrial structure? Therefore, this paper uses the Panel data of provinces and cities in China from 2003 to 2021 to study the impact of manufacturing digitalization on the upgrading of industrial structure, providing theoretical and decision-making reference for the development of manufacturing industry.

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2 Literature review

In recent years, the industrial internet has played a significant driving role in the development of China's digital economy. The scale of industrial digitization has reached 37.2 billion, accounting for 81.7% of the digital economy. It has become an important indicator for measuring the digital economy[10]. Digitalization can promote the green transformation of the manufacturing industry, improve the capacity utilization rate of enterprises, reduce pollution intensity, accelerate the green transformation of enterprises by expanding their own scale and improving their technological level, and drive upstream and downstream enterprises to undergo green transformation through the industrial chain[2]. While improving the environment, it can also promote rapid economic development and achieve a win-win situation[1]. Digitalization is also beneficial for improving the efficiency of resource allocation and innovation in the manufacturing industry, improving social efficiency, creating more personal and social welfare, and promoting high-quality development of the manufacturing industry[3].

With the development of the economy, the industrial structure has gradually shifted from being unreasonable to being reasonable. Human capital is an important factor affecting the upgrading of the manufacturing industry, but the externality of human capital consumption will have a negative impact on the low-end manufacturing industry, resulting in a decline in its business performance, prompting enterprises to use machines instead of labor to increase their capital intensity[5]. Foreign direct investment can also effectively promote the upgrading of the manufacturing industry structure, but environmental regulations have a certain inhibitory effect on the upgrading of the manufacturing industry structure[7].

The development of the digital economy has brought new development impetus to traditional industries and promoted industrial upgrading. Manufacturing digitalization can drive the upgrading of manufacturing in surrounding areas[6].

In summary, many scholars have studied the relationship between the digital economy and industrial development, and the effect of digitalization on industrial development is becoming increasingly evident. Therefore, this paper first analyzes the impact of manufacturing digitalization on manufacturing upgrading theoretically and empirically tests.

3 Theoretical Assumptions

The industrial upgrading in this article mainly refers to the process of continuously increasing high-tech and efficient industrial sectors and transitioning to a green manufacturing model to achieve sustainable development.

From the perspective of supply, resources are the basic factor of a country's economic development, and digital technology has a strong ability to integrate resources, alleviate the contradiction between supply and demand of factors, and promote industrial upgrading. Emerging digital elements can optimize the entire production process and drive a shift in production methods8. Human resources are also an important factor affecting the upgrading of industrial structure. Technological progress can promote the

transformation of various industrial sectors and promote the advanced evolution of related industrial sectors[9]. Moreover, the digitalization of manufacturing can also promote the integration of industries and accelerate industrial upgrading[4].

From the perspective of demand, demand structure is one of the most important factors affecting industrial structure. With the increase of per capita income, the focus of demand gradually shifts to a high level, which is consistent with the evolution direction of industrial structure premiumization, so it is believed that changes in demand structure can affect changes in industrial structure. Manufacturing digitalization can separate production and consumption in time and space, reduce transaction costs, create new demand, and promote industrial upgrading. The deep integration of manufacturing and digital technology is also conducive to increasing product output value, meeting consumer needs to the greatest extent, and promoting industrial upgrading. Therefore, changes in consumption structure will promote changes in the structure of the manufacturing industry[8].

Therefore, this article believes that manufacturing digitalization contributes to industrial upgrading.

4 Study Design and Statistical Analysis

4.1 Model settings and data sources

To verify the hypothesis of this article, a benchmark regression model was constructed for manufacturing digitalization and industrial upgrading:

$$ind_{it} = \alpha_0 + \alpha_1 dig_{it} + \alpha_2 controls_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Among them, dig represents manufacturing digitization, ind represents manufacturing upgrading, and controls are control variables, μ I λ T is the individual fixed effect and time fixed effect, ε is a random error term.

The original data comes from China Statistical Yearbook, China Industrial Statistical Yearbook, China Economic Network database and provincial statistical yearbooks from 2004 to 2022. For some missing data, interpolation method is chosen to supplement.

4.2 Statistical Analysis

In this paper, a fixed-effect model of fixed time and place is selected to examine the impact of manufacturing digitalization on industrial upgrading. The specific results are shown in Table 1. From the first column of Table 1, it can be seen that digitalization in manufacturing significantly promotes the upgrading of the manufacturing industry. The second column represents the impact of digitalization in manufacturing on the upgrading of the manufacturing industry when controlling for control variables. Specifically, the digitalization level in manufacturing increases by one unit level, while the upgrading level in industry increases by 0.967 units. This indicates that digitalization in manufacturing has a significant promoting effect on industrial upgrading. The third and

fourth column cities replaced the explanatory variables with the level of manufacturing digitization with lag 1 and lag 2, and the results were still significant. The digitalization of manufacturing industry has a significant promoting effect on industrial upgrading. Therefore, in future development, it is necessary to accelerate the digitization process of the manufacturing industry, promote the application of digital technology, promote industrial upgrading, and achieve high-quality economic development.

Table 1. Benchmark regression results

	(1)	(2)	(3)	(4)
	m1	m2	m3	m4
dig	1.3187**	0.9670*		
	(2.4480)	(1.9589)		
L.dig			1.2496**	
			(2.5305)	
L2.dig				1.4744***
				(2.9738)
controls	no	yes	yes	yes
_cons	1.4702***	10.5818**	10.0342**	9.0681***
	(14.0082)	(7.2709)	(6.6947)	(5.7433)
N	570	570	540	510
r2_a	0.8722	0.8970	0.2816	0.2861

The development status of different regions varies, and the corresponding level of digitalization in the manufacturing industry also varies, resulting in differences in the impact on the upgrading of the manufacturing industry. In order to analyze whether there is heterogeneity in the impact of manufacturing digitization on industrial upgrading in different regions, this article divides the data into three regions: East, Central, and West for analysis. The regression results are shown in Table 2. From Table 2, it can be seen that digitalization of manufacturing has a significant promoting effect on the upgrading of manufacturing industries in various regions. However, in different regions, the impact of digitalization of manufacturing on industrial upgrading varies, specifically manifested as the strongest in the central region, followed by the western region, and the weakest in the eastern region. In the eastern region, the digitalization of manufacturing industry has a positive promoting effect on industrial upgrading, but it is not significant. The possible reason is that the eastern region has a high level of economic development, complete infrastructure, high technological level, and a sound policy system. Compared to the central and western regions, the development has been very advanced, and the dividends for manufacturing upgrading may have been released in advance. Therefore, although the digitalization of manufacturing industry has a positive impact on industrial upgrading, But the effect is not as significant as in the central and western regions. In the central and western regions, digitalization of manufacturing

has a significant promoting effect on industrial upgrading. For the central region, digitalization of the manufacturing industry can effectively integrate information, improve resource allocation efficiency and production efficiency, reduce costs, increase product output value, improve the technological level of the industry, and promote the upgrading of industrial structure; For the western region, the development of digital manufacturing can better utilize the rich local material resources, and the application of digital technology may have a greater marginal impact on the upgrading of the manufacturing industry.

Table 2. Benchmark regression results

	(2)	(4)	(6)
	east	centre	west
dig	0.5711*	3.6873***	1.3866**
	(0.6238)	(4.1259)	(2.3500)
controls	yes	yes	yes
_cons	30.6939***	-3.0014	-0.5802
	(7.1214)	(-0.7070)	(-0.3430)
N	209	152	209
r2_a	0.8977	0.8881	0.9415

5 Conclusion and suggestions

This paper analyzes the impact of manufacturing digitalization on industrial upgrading from a theoretical level, and empirically tests the results. The research found that manufacturing digitalization can affect industrial upgrading by improving resource utilization, human capital structure, technological level, and demand structure, and positively promote industrial upgrading. Empirical results also prove that manufacturing digitalization significantly affects industrial upgrading. After conducting stability tests, the results still show that manufacturing digitization has a significant promoting effect on industrial upgrading. And the impact of manufacturing digitization on industrial upgrading varies in different regions, with the central region having the greatest impact, followed by the western region, and the eastern region having the weakest impact.

According to the research conclusions of this paper, the following enlightenment can be obtained: First, the digital level of manufacturing should be improved and its role in industrial upgrading should be fully exerted. To accelerate the construction of digital infrastructure, the manufacturing industry sector should increase investment in research and development of digital technology, strengthen the application of digital technology in manufacturing, and promote the integration of digital technology and manufacturing. Second, strengthen investment in education, improve the level of basic education, vigorously develop vocational education, increase the proportion of high-end talents and professional talents, and ensure the supply of basic talents; Improve the talent flow mechanism and rationally allocate existing digital talents; At the same time, it pays

attention to cultivating professional talents and compound talents, optimizing the structure of human capital, improving the talent service system, and innovating the talent incentive mechanism. Finally, the government formulates corresponding policies and systems according to the economic development of each region and the development of the manufacturing industry to promote the digital development of the manufacturing industry. The government can increase its support for technological innovation in the industrial sector, promote the development of green high-tech, and guide the rational allocation of production factors through policies. The government can also increase financial and tax support, and give tax incentives and certain financial support to Digital transformation enterprises.

References

1. ZHANG Qing,YU Jinping. Digitalization of manufacturing input and mid-to-high-end l eap in global value chain——Re-examination based on the difference of input sources [J].Journal of Finance and Economics,2021,47(09):93-107.
2. DAI Xiang,YANG Shuangzhi. Digital empowerment, digital input sources and green tr ansformation of manufacturing industry[J].China Industrial Economics,2022(09):83-101.
3. Shi Yanxin,Xiong Tianren. Digitalization, institutional environment and high-quality de velopment of manufacturing industry[J].Contemporary Finance and Economics,2022(1 1):113-124.
4. Chen Lin, Zhang Xiwen. Research on the Mechanism of Digital transformation and U pgrading of Manufacturing Industry [J]. Jinan Journal (Philosophy and Social Sciences Edition), 2023,45 (03): 99-110
5. Li Lei. Human Capital Spillovers and Manufacturing Upgrading -- From the Perspecti ve of Consumption Externality [J]. Economic Issues Exploration, 2023, No.488 (03): 1 26-142
6. HUANG Zhaolin,QIN Shuyue,ZHANG Yuhao. How does the digital economy drive th e upgrading of manufacturing industry[J].Economic Management,2022,44(04):80-97.
7. XU Xiaohui,LIAO Han. Environmental regulation, FDI and industrial structure upgradi ng of manufacturing industry——An empirical test based on panel data of the Yangtz e River Economic Belt[J].Hubei Social Sciences,2021(07):68-74.
8. Liu Yang. Digital Economy, Optimization of Consumption Structure and Upgrading of Industrial Structure [J]. Economics and Management, 2023,37 (02): 68-75
9. HAN Feng,YANG Ligao. How does the agglomeration of productive service industries affect the upgrading of manufacturing structure?—— a comprehensive framework of agglomeration economy and Schumpeter's endogenous growth theory[J].Management World,2020,36(02):72-94+219.
10. XU Xianchun,ZHANG Meihui. Research on scale measurement of China's digital econ omy——Based on the perspective of international comparison[J].China Industrial Econ omics,2020(05):23-41.