An Empirical Study on the Promotion of "Internet +" in China's Industrial Structure Upgrade

Lei Yu

652050848@qq.com

Department of Economic Management, Shandong Vocational College of Science and Technology, Weifang, China

Abstract. This paper uses China's provincial panel data from 2009 to 2019 to conduct a policy evaluation of China's "Internet +" action plan through the double-difference method. At the same time, this paper also discusses the heterogeneity of "Internet +" to the upgrading of China's industrial structure. The research found that: (1) The "Internet +" action has significantly promoted the upgrading of China's industrial structure. (2) Under different external conditions such as economic level and government efficiency, the promotion effect of "Internet +" on the upgrading of industrial structure shows obvious heterogeneity. (3) The role of "Internet +" in promoting the upgrading of China's industrial structure can be achieved through resource allocation and technological innovation. Finally, this paper puts forward suggestions to deepen the integration of the Internet and the real economy, deepen the market-oriented reform of data elements, and promote economic growth.

Keywords: "Internet +"; Industrial Structure; Resource Allocation; Mechanism Innovation

1 Introduction

In the era of digital economy, ict and industrial development are more closely linked. The deep integration of the Internet and traditional industries makes the industrial structure continue to develop in the direction of advanced and rationalization. Exploring how to make effective use of this new development model is of great significance for China's high-quality economic development [1].

Literature has pointed out that the Internet has a significant positive impact on supporting financial development, promoting manufacturing transformation, improving employment structure, promoting consumption upgrading and enhancing enterprise innovation performance. As an important force to promote high-quality economic development, the upgrading of industrial structure will be affected by many factors, such as foreign direct investment, infrastructure construction, economic system reform and scientific and technological innovation.

As for the influence of Internet development on the upgrading of industrial structure, there is no unanimous conclusion in the academic circle [2]. Most people believe that "Internet +" is a huge new driving force for digital information, which is conducive to the transformation and upgrading of industrial structure. Zhao Xuemei and Hou Jingchuan (2020) use SCP model to

ICIDC 2022, June 17-19, Qingdao, People's Republic of China

DOI 10.4108/eai.17-6-2022.2322813

discuss the impact of "Internet +" on the upgrading of industrial structure [3]. The results show that "Internet +" can not only change market behavior, structure and performance directly promote industrial structure upgrading, but also indirectly promote industrial structure upgrading by triggering institutional change. However, some scholars believe that "Internet +" may hinder the upgrading of industrial structure. This paper studies the policy effect and heterogeneity impact of "Internet +" on industrial structure upgrading from both theoretical and empirical perspectives.

2 Research hypothesis

From the perspective of industrial agglomeration effect, the development of Internet accelerates the change of market demand significantly. Many businesses have established online industrial clusters on e-commerce platforms and distribution platforms, effectively reducing costs. From the perspective of industrial convergence effect, "Internet +" can promote industrial convergence through the mechanism of" business → market → industry ".

Based on the above analysis, hypothesis 1 is proposed: "Internet +" can promote the upgrading of China's industrial structure.

"Internet +" can indirectly affect the upgrading of industrial structure by influencing resource allocation. Different economic entities can use e-commerce platforms for outsourcing and other forms of cooperation. In addition, the information interaction effect brought by "Internet +" helps to break down the information island and reduce the time inconsistency of enterprise behavior caused by information asymmetry, so as to realize the cross-temporal integration of resource elements. On the basis of integrating existing resource factors, "Internet +" will also guide incremental resource factors to invest more in the secondary and tertiary industries with high competitiveness and high added value. Therefore, not only will the flow of existing resource factors enhance the competitiveness of high-productivity industries, but the new resource factors will also re-strengthen the dominant position of these industries.

Based on the above analysis, hypothesis 2 is proposed: "Internet +" can promote the transformation and upgrading of industrial structure by optimizing resource allocation.

"Internet +" can indirectly affect the upgrading of industrial structure by influencing technological innovation. "Internet +" promotes the technological innovation capacity of traditional enterprises or industries through scale effect, competition effect and forced mechanism. From the supply side, it can improve labor productivity and input-output efficiency, thus becoming an important driving force of industrial structure upgrading. From the demand side, technological innovation can accelerate the upgrading of products, promote the self-innovation of traditional industries, and finally realize the transformation and upgrading of industrial structure (figure 1).

Based on the above analysis, hypothesis 3 is proposed: "Internet +" can promote the transformation and upgrading of industrial structure by promoting technological innovation.

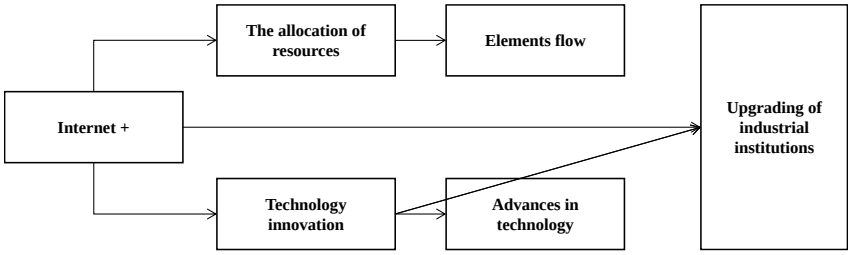

Figure 1 The mechanism of "Internet +" promoting the upgrading of industrial structure

3 Empirical research

3.1 Model settings

This paper uses the difference-in-difference method to evaluate the policy effect of the "Internet +" action on the upgrading of China's industrial structure. The econometric model constructed in this paper is as follows:

$$IND_{c,t} = u_0 + u_1 IP * Post_t + \lambda Z_{c,t} + D_c + D_t + \varepsilon_{c,t} \quad (1)$$

Among them, c and t represent the province and time, respectively. IP is the core explanatory variable of this paper, which is used to reflect the comprehensive development level of the Internet in various regions before and after the implementation of the policy. Post is used to identify the year the policy was implemented. If t is before 2015, it is assigned a value of 0. If t is after 2015, assign the value 1. Dc and Dt are regional fixed effects and time fixed effects, respectively. Zc and ε are the control variable and random disturbance term, respectively. μ is the regression coefficient. If μ is significantly greater than 0, it indicates that the "Internet +" action has promoted the upgrading of China's industrial structure. If μ is significantly less than 0, it means that the "Internet +" action is not conducive to the upgrading of China's industrial structure.

3.2 Variable description and data source

The explained variable is IND. Referring to the practice of Zhou Changlin et al. (2007) and Li Fengchun (2012), from the perspective of division of labor and specialization, the labor productivity of the three industries (Li) and the proportion of the output value of the three industries to the total production value (Pi) were used to represent the industrial structure. evolution and upgrade [4-5]. Among them, labor productivity is expressed by dividing the added value of each industry by the number of people employed in each industry. Since there may be large differences in labor productivity in various industries, it is squared in the actual calculation, and the formula is as follows:

$$IND = \sum_{i=1}^{3} \sqrt{L_i} * P_i \quad (2)$$

Note: In order to eliminate the color noise caused by different dimensions, the original indicator data is standardized here. All data passed the Bartlett sphericity test and KMO test (KMO value was 0.867), indicating that the data observed in this paper are suitable for principal component analysis. For the selection of the number of factors, the method that the cumulative variance contribution rate of the first k principal components reaches 80% is used to determine.

The core explanatory variable is the comprehensive level of Internet development (IP). Considering that the implementation of the "Internet +" action will bring about the improvement of the comprehensive development level of the Internet in the region, this paper is based on the evaluation index system established by Han Xianfeng et al. (2019) and Zeng Fanhuan et al [6-7]. According to the availability, 10 relevant indicators were selected to construct an evaluation system for the comprehensive development level of the Internet using principal component analysis, as shown in Table 1.

Table 1 Index evaluation system of Internet comprehensive development level

	first-level indicator	Secondary indicators
Internet comprehensive development level	Internet Development Environment Indicators	Internet penetration rate (%)
		Average Bytes per Web Page (KB)
		GDP per capita (yuan)
		Per capita disposable income of urban residents (yuan)
	Internet Information Resource Indicators	Proportion of IPV4 addresses (%)
		Number of domain names (units/10,000 people)
		The average number of websites owned by a company (pieces)
	Internet Business Application Indicators	Number of Internet Access Ports (10,000)
		total express business
		Total telecom business

In order to exclude the influence of external factors on this experiment, combined with the existing literature, this paper also sets the level of government participation (GP), human capital stock (HR), level of opening to the outside world (OP), level of investment in fixed assets (INV) and level of financial development. (LOANV) as the control variable. The degree of government participation is expressed by the proportion of regional fiscal expenditure to the regional GDP; the human capital stock is expressed by the per capita education years in each region; the level of opening to the outside world is expressed by the proportion of the import and export volume of each region in the regional GDP; the level of investment in fixed assets It is represented by the ratio of the total investment in fixed assets of the whole society to the

regional GDP; the level of financial development is represented by the ratio of the loan balance of financial institutions to the regional GDP at the end of the year.

The research sample in this paper is panel data composed of 30 provincial-level administrative regions in China from 2009 to 2019 (the data of Tibet Autonomous Region and Hong Kong, Macao and Taiwan regions are seriously missing and will not be considered for the time being). The data comes from China Statistical Yearbook, China Science and Technology Statistical Yearbook and Statistical Report on China's Internet Development. The descriptive statistics of each variable are shown in Table 2.

Table 2 Descriptive statistics of main variables

variable	sample	average value	standard deviation	min	max
IND	330	3.248	0.682	1.693	5.036
IP	330	6.67e -05	0.285	-0.330	1.220
GP	330	0.241	0.100	0.0964	0.627
HR	330	9.016	0.937	6.764	12.56
OP	330	0.265	0.291	0.0115	1.457
INV	330	0.769	0.240	0.233	1.469
LOAN	330	2.035	0.564	1.056	3.831

4 Empirical analyses

4.1 Benchmark regression results

According to the results of the hausman test, the fixed effect model is used to estimate the parameters of formula (1), and the results are shown in Table 3.

Table 3 The impact of "Internet +" action on the upgrading of industrial structure

variable	(1)	(2)
IPX Post	0.360…	0.527…
	(3.38)	(5.75)
control variable	No control	control
Regional fixed effects	control	control
time fixed effects	control	control
R^2	0.928	0.944
Obs	330	330

Column (1) does not control the influencing factors at the regional level. The results show that the "Internet +" action has a significant positive effect on the upgrading of China's industrial structure. In column (2), the degree of government participation, human capital stock, after influencing factors such as the level of opening up, the level of fixed asset investment and the level of financial development, the cross-term coefficient is still positive and significant. The

above results show that after the implementation of the "Internet +" action, the comprehensive development level of the Internet in different regions is different in the degree of policy impact. To sum up, the "Internet +" action has effectively promoted the deep integration of Internet technology and traditional industries, and also played an important role in stimulating the development of emerging industries and reshaping the industrial structure, which in turn is conducive to promoting the transformation and upgrading of China's industrial structure. Therefore, Hypothesis 1 is verified.

4.2 Heterogeneity test

In order to explore the impact of "Internet +" on the upgrading of industrial structure under different endowment conditions, this paper investigates from three aspects: economic development level, local government efficiency and factor market development. The results are shown in Table 4.

Table 4 Industrial structure upgrading effect of "Internet +" under different endowment conditions

variable	The level of economic development		local government efficiency		Factor market development degree	
	High	low	High	low	High	low
	(1)	(2)	(3)	(4)	(5)	(6)
IPx	0.601***	0.425*	0.553***	0.382	0.656***	0.379*
Post	(4.70)	(2.12)	(6.29)	(1.60)	(3.56)	(1.85)
control variable	control	control	control	control	control	control
Regional fixed effects	control	control	control	control	control	control
time fixed effects	control	control	control	control	control	control
R^2	0.924	0.901	0.954	0.944	0.939	0.938
Obs	165	165	165	165	165	165

The data in columns (1) and (2) in Table 4 show that in regions with a higher level of economic development, the industrial structure upgrading effect of "Internet +" is stronger. This is because areas with a higher level of economic development have more advantages in terms of infrastructure, innovation and development potential, and capital supply, thus strengthening the role of "Internet +" in promoting the upgrading of industrial structures. The results in columns (3) and (4) of Table 4 illustrate that "Internet +" is more conducive to the upgrading of the industrial structure in areas with higher government operating efficiency.

Columns (5) and (6) of Table 4 show that the higher the development of the factor market, the more obvious the role of "Internet +" in promoting the upgrading of the industrial structure in the region. Existing studies have shown that distorted capital and labor markets will seriously hinder the process of industrial restructuring and upgrading, while a high degree of factor market development means a more complete market mechanism.

4.3 Robustness check

Parallel Trend Hypothesis Test: The premise of the difference-in-difference method is that the experimental group and the control group must be comparable. This paper compares three years before and after the policy impact to examine the dynamic impact of the comprehensive development level of the Internet on the upgrading of the industrial structure. The impact of the "Internet +" action plan on the upgrading of the industrial structure only became significant after 2015, which shows that the promoting effect of the "Internet +" action on the upgrading of the industrial structure began to appear after the implementation of the policy in 2015.

Fixed effects of region and time: This paper controls for the fixed effects of region and time in column (3) of Table 5. There is no substantial change in the regression coefficients compared to the benchmark regression results. This shows that the estimated results are robust and reliable.

Table 5 Robustness test

variable	expected effect	placebo test	region and time fixed effects
	(1)	(2)	(3)
IPc * Post	0.588***	-0.026	0.532***
	(5.65)	(-0.22)	(5.98)
IP*D04	0. 233		
	(1.70)		
control variable	control	control	control
Regional fixed effect	control	control	control
Time fixed effect	control	control	control
R^2	0.944	0.936	0.818
Obs	330	330	330

5 Conclusions

This paper uses the panel data of 30 provinces in China from 2009 to 2019 as a sample, and uses the double difference method to evaluate the policy effect of the "Internet +" action on China's industrial structure upgrading. The research conclusions are as follows: (1) The "Internet +" action has promoted the upgrading of China's industrial structure. Different policies will lead to differences in the effect of industrial structure upgrading. (2) In the case of different endowment conditions, the promotion effect of "Internet +" on the upgrading of industrial structure shows obvious heterogeneity. effect is more pronounced. (3) The impact of "Internet +" on the upgrading of industrial structure mainly comes from the optimization and re-allocation of resource elements between different industries in the same region. In addition, technological innovation also plays an important role in the process of "Internet +" promoting the upgrading of industrial structure.

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