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Research on the Impact of Production Digitization on the Upgrading of Industrial Structure

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Abstract

The rapid development of digitalization has become one of the main driving forces for the upgrading of industrial structure. This paper constructs an index based on the dimension of production digitization, uses the equal-weighted summation method to calculate the production digitization index, builds an econometric model, and uses the feasible generalized least squares method to estimate the random effect model and analyze its impact on the upgrading of the industrial structure. The research results show that when the level of production digitalization increases by 1%, the industrial structure sophistication index will increase by 0.349%, and the industrial structure rationalization index will increase by 0.915%, which are significant at the levels of 5% and 1%, respectively. As a result, the digitalization of production has a significant role in promoting the advanced and rationalization of the industrial structure.

Keywords

Production Digitization; High-level Industrial Structure; Rationalization of Industrial Structure.

1. Introduction

The report of the 19th National Congress of the Communist Party of China proposed that it is necessary to accelerate the construction of a manufacturing power, a network power, and a digital China, promote the deep integration of the Internet, big data, artificial intelligence and the real economy, and drive the transformation and upgrading of the industrial structure through digitalization.

The development of digitalization can promote the transformation of my country from the traditional development model of high input, high output, high energy consumption and high pollution to a low-carbon, energy-saving and high-efficiency development model, and realize industrial upgrading and structural optimization [1]. This is because the essence of the transformation and upgrading of the industrial structure driven by digitalization is to rely on the new generation of digital technologies such as the Internet, big data and artificial intelligence and the reshaping of traditional industrial production methods to drive the upgrading of the industrial structure. The impact of digitalization on the upgrading of the industrial structure is mainly reflected in two aspects: one is the heightening of the industrial structure, which reflects the evolution of the industrial structure to a higher level of comprehensive productivity and technical structure within the industry [2]; the other is the rationalization of the industrial structure, it reflects the quality of aggregation between industries in various regions [3].

Can production digitization promote the upgrading of industrial structure? Is there a causal relationship between the two? This paper will build a comprehensive indicator system for the development level of production digitalization based on China's provincial panel data from 2013 to 2017, and use the feasible generalized least squares model to analyze the impact of

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production digitalization on the upgrading of industrial structure, so as to provide theoretical support and experience for realizing the upgrading of industrial structure. in accordance with.

2. The Influence Mechanism of Production Digitalization on Industrial Structure Upgrade

This paper studies its influence mechanism on the upgrading of industrial structure from the perspective of production digitization, and mainly measures the level of production digitization from the application level of digital technology. The higher application level of digital technology provides support and guarantee for the expansion of the production scale of enterprises and the reduction of production costs. On the one hand, the innovation of production technology and the digital transformation of production equipment can visualize production data, supervise and control production in real time, and use digital means to improve scarce resources such as land, labor, and capital, as well as new production such as information and data under existing technical conditions. The output of factors, the optimal utilization of factors, and the improvement of production efficiency and production output value. On the other hand, the digital transformation of traditional industries relying on the application of digital technology and the rise of emerging digital industries indicate that my country's industries will be upgraded from heavy industries to relatively advanced and reasonable industries, and their development direction is high-tech and high-intensity. Therefore, as a general technology, digital technology will disappear the spatial distance of interpersonal communication. Through the two mechanisms of expanding production scale and reducing production costs, it will deepen the division of labor and specialization, improve labor productivity, drive industrial technological innovation, and stimulate industrial structure. upgrade.

3. Empirical Test of Production Digitization on the Upgrading of Industrial Structure

3.1. Model Construction

According to the mechanism analysis of the impact of digital development on the quality of economic growth, in order to examine the impact of the level of digital development on the quality of economic growth, the following basic model is established:

$$LNINDH_{i,t} = \beta_0 + \beta_1 lndigit_{i,t} + \beta x_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$LNINDR_{i,t} = \beta_0 + \beta_1 lndigit_{i,t} + \beta x_{i,t} + \varepsilon_{i,t} \quad (2)$$

In the formula, i represents the province, t represents the year, $INDH$ is the heightened industrial structure, $INDR$ is the rationalization of the industrial structure, digit is the comprehensive index of digitalization level, x is a series of control variables, β_0 represents the constant term, and β_1 represents the effect of digitization on the industrial structure. effect,ε is a random disturbance term.

3.2. Variable Selection

1. The explained variable.

In this paper, the high-level industrial structure and the rationalization of the industrial structure are used as explained variables. The high level of industrial structure is the evolution of the industrial structure to a higher level of comprehensive productivity and technical

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structure within the industry. In general literature, the proportion of non-agricultural output value is used to measure the upgrading of industrial structure according to Clark's Law. This paper refers to the research of Qian Chunhui [2] and uses the ratio of the output value of the tertiary industry to the output value of the secondary industry as a measure of the advanced industrial structure.

$$INDH = \frac{INDOV_{d=3}}{INDOV_{d=2}} \tag{3}$$

Rationalization of industrial structure refers to the quality of aggregation among industries in various regions. This indicator can not only reflect the degree of coordination between different industries, but also the degree of effective utilization of labor resources. This paper draws on the practice of Zuo Pengfei [3] et al. (2020), and uses the improved Theil index to measure the rationalization of the regional industrial structure, and then the coordination of the quality of economic growth. The formula is as follows:

$$INDR = \sum_{d=1}^{3} \frac{Y_{i,d,t}}{Y_{i,t}} ln\left(\frac{Y_{i,d,t}}{Y_{i,t}} / \frac{L_{i,d,t}}{L_{i,t}}\right) \qquad d = 1,2,3 \tag{4}$$

Among them, $Y_{i,d,t}$represents the industrial added value of the dth industry in the i region in the period t, $Y_{i,t}$ represents the regional GDP, and $L_{i,d,t}$ represents the dth industry in the i region, The number of employees in period t, $L_{i,t}$ represents the total number of employees in the region, $Y_{i,d,t} / Y_{i,t}$ represents the proportion of the dth industry in the total output value, $L_{i,d,t} / L_{i,t}$ represents the proportion of employment in the dth industry in the total employment. $INDR$ reflects the degree to which the industrial structure deviates from the equilibrium state, and the closer it is to zero, the higher the degree of rationality of the industrial structure.

2. Core explanatory variables

The explanatory variable in this paper is the development of digitalization of production. On the basis of referring to relevant literature (Qun Yin and Yuxiu Tian [4], Hejun Fan and Ting Wu [5], Yanling Wang [6]), the production digitization is divided into four dimensions, using the number of websites per 100 enterprises, the number of enterprises The ERP penetration rate, enterprise MES penetration rate, and enterprise equipment numerical control rate are measured and expressed, and the production digitization level index is obtained through equal weighted calculation.

3. Other explanatory variables

Since the factors affecting the upgrading of the industrial structure are not only the digitalization of production, therefore, on the basis of referring to relevant literature (Pengfei Zuo and Qiping Jiang [3], Xiaojun Zhao and Xiaoying Liu [7]), the level of scientific and technological innovation ($inno$), the level of education (edu), institutional level (ins), degree of openness ($open$), and urbanization rate (ur) as other explanatory variables. Among them, the level of scientific and technological innovation in the region is measured by the number of domestic patent applications and authorizations, the education level of the region is measured by the per capita years of education, the proportion of non-state-owned fixed asset investment in the total fixed asset investment in the whole society measures the level of regional institutions, and the proportion of total imports and exports in GDP measures the opening of the region to the outside world. The urban population ratio measures the regional urbanization rate.

4. Data sources

The gross domestic product of each industry, general public budget expenditure, regional gross domestic product, number of websites per 100 enterprises, number of domestic patent

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applications and authorizations, years of education per capita, and investment in fixed assets are from "China Statistical Yearbook"; enterprise ERP penetration rate The index, enterprise MES penetration rate index, and enterprise equipment numerical control rate index come from the Ministry of Industry and Information Technology.

3.3. Basic Estimation Results

In the benchmark model, this paper uses different methods to estimate the impact of the development of production digitalization on the upgrading of industrial structure. First, the corresponding models were selected among mixed regression models (PL), fixed effects models (FE) and random effects models (RE) by Brusch-Pagan test and Hausman test. In addition, since the panel dataset used in this paper is a "short panel", T≪N, the unit root problem of the data is not considered in the empirical analysis. Since the estimation of the panel data model is easily affected by residual autocorrelation and inter-group heteroscedasticity, in order to control the influence of residual autocorrelation and inter-group heteroscedasticity on parameter estimation, multicollinearity test, residual autocorrelation test, and residual autocorrelation were carried out in this paper. and heteroscedasticity test. The fixed-effects model was then estimated using the Xtscc command in the Stata15 software, and the feasible generalized least squares (FGLS) method was used for the random-effects model.

Table 1. The impact of production digitization on the heightening of industrial structure

Explanatory variables	Explained variable					
	LNINDH					
	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS
	Model1	Model2	Model3	Model4	Model5	Model6
lndigit	0.333** (0.168)	0.551*** (0.206)	0.286* (0.167)	0.386** (0.166)	0.417** (0.166)	0.349** (0.165)
lninno		-0.0484* (0.0271)	-0.0816*** (0.0219)	-0.0581** (0.0229)	-0.0771*** (0.0252)	-0.084*** (0.0250)
lnedu			2.665*** (0.290)	2.938*** (0.298)	2.634*** (0.345)	1.741*** (0.505)
lnins				-0.577*** (0.200)	-0.545*** (0.199)	-0.529*** (0.196)
lnopen					0.0501* (0.0296)	0.0363 (0.0296)
lnur						0.581** (0.244)
cons	-1.275* (0.678)	-1.709** (0.713)	-6.243*** (0.754)	-7.645*** (0.881)	-6.945*** (0.966))	-6.957*** (0.948)
Wald	3.94	7.23	95.77	109.35	114.3	124.31
N	150	150	150	150	150	150

Note: Robust standard errors are in parentheses. *, **, *** indicate passing the test at the 10%, 5% and 1% significance levels, respectively.

This paper uses the panel data of 30 provinces in my country from 2013 to 2017 to estimate equations (1) and (2). Since the Wald test shows that the random disturbance term has heteroscedasticity between groups, and the Wooldridge test shows that the disturbance term has first-order autocorrelation within the group, this paper uses feasible generalized least squares (FGLS) for parameter estimation to overcome heteroscedasticity and autocorrelation. The impact of the problem is estimated as shown in the table. The estimated results are shown

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in Table 1 Model 1. Its coefficient is significantly positive, which indicates that the development of production digitalization can indeed significantly improve the industrial structure. Secondly, Model 2 to Model 6 in Table 1 add other explanatory variables in turn. The estimated coefficients of the core explanatory variables have declined, which means that the setting of the regression model without considering other explanatory variables is too simple, ignoring the impact of other possible factors on the heightened industrial structure, that is, there is a regression model that does not consider other explanatory variables. The problem of missing important explanatory variables; on the other hand, when other explanatory variables are added one by one, the regression coefficient of the core variable of production digitalization level is still positive and passed the significance test, which means that the core conclusion of this paper is controlling for other explanatory variables. The possible influencing factors are also established, which also shows that the conclusions of this paper are relatively stable and reliable. Table 2 is the same.

Table 2. The impact of production digitalization on the rationalization of industrial structure

Explanatory variables	Explained variable					
	LNINDR					
	FGLS	FGLS	FGLS	FGLS	FGLS	FGLS
	Model7	Model8	Model9	Model10	Model11	Model12
lndigit	-2.327** (0.284)	-1.604*** (0.337)	-1.132*** (0.259)	-1.061*** (0.263)	-1.187*** (0.248)	-0.915*** (0.217)
lninno		-0.161*** (0.0443)	-0.102*** (0.0340)	-0.0853** (0.0362)	-0.00931 (0.0378)	0.0210 (0.0328)
lnedu			-4.751*** (0.449)	-4.555*** (0.471)	-3.332*** (0.518)	0.254 (0.663)
lnins				-0.414 (0.317)	-0.541* (0.299)	-0.607** (0.257)
lnopen					-0.201*** (0.0443)	-0.146*** (0.0388)
lnur						-2.335*** (0.320)
Constant term	7.572*** (1.146)	6.129*** (1.168)	14.21*** (1.169)	13.21*** (1.395)	10.40*** (1.447)	10.44*** (1.243)
Wald	67.27	86.44	262.6	267.28	324.61	493.13
N	150	150	150	150	150	150

Note: Robust standard errors are in parentheses. *, **, *** indicate passing the test at the 10%, 5% and 1% significance levels, respectively.

4. Conclusion and Suggestion

Based on the dimension of production digitization, this study discusses its impact on the upgrading of industrial structure, and uses the econometric regression model to empirically test the mechanism of production digitization in promoting industrial structure upgrading, and draws the following conclusions: (1) Production digitization promotes industrial structure by promoting The level of sophistication and the level of rationalization of the industrial structure can improve the upgrading of the industrial structure;(2) After adding other explanatory variables, the regression results can be output. When the level of production digitalization increases by 1%, the index of industrial structure sophistication will increase by 0.349%, and it is significant at the level of 5%, while the industrial structure rationalization index will decrease by 0.915%, which is significant at the level of 1%.

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Based on the above conclusions, this study puts forward the following suggestions: (1) Accelerate the digital transformation of production. Seize the window of opportunity of the new generation of industrial revolution, improve supporting policies, focus on the development of new generation digital technologies such as the Internet, big data, and artificial intelligence, and rely on digital technology innovation to drive new industries, new business forms, and new models.(2) Strengthen the upgrading of industrial structure, and give full play to the positive role of production digitization in the advancement and rationalization of industrial structure.

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