

Motivation of the Structural Transformation of Manufacturing Industry in Northeast China

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Abstract. This paper mainly analyzes a large number of relevant theories of domestic industry transformation motives in China, and combines the basic conditions of the northeast region, using qualitative analysis methods to identify the current motives that affect the industrial restructuring of Northeast manufacturing industry. Among them, government factors, technical factors and market factors play the most important role.

1. Introduction

Since the 21st century, although there have been more studies on industrial transformation in China, most of them are limited to theory, and there are not many methods that can be applied to practice. One of the reasons may be that the policy of northeast revitalization has encountered a bottleneck, and the complicated political and economic environment has hindered the reform process. This article makes a reasonable analysis of the status quo, problems, and causes of the current northeast old industrial base, and propose reasonable suggestions for the existing problems. This has great practical significance for the structural transformation of the manufacturing industry in the Northeast.

2. Identification of Causes of Manufacturing Industry Structure Transformation in Northeast China

The earliest domestic literature on the causes of economic structural transformation can be traced back to the early 21st century. From a single internal environmental factor to China's accession to the WTO, domestic factors and foreign factors complement each other. The study of these theories always conforms to the economic development. Among them, the more representative ones such as Ma Jinping's (2002) sustainable development theory, which analyzes the development history of resource-extraction companies at home and abroad, prove that companies will inevitably decline with the depletion of local resources. Therefore, for resource-extraction enterprises to achieve sustainable development, structural adjustment and organizational transformation are needed. Wang Hengwei (2003) believes that due to the low labor price in China, in the labor-intensive industries such as cotton textile industry, there is no need for technological innovation to significantly reduce costs, thus making cotton textile prices much lower than the world market.

In recent years, domestic scholars have increasingly diversified their perspectives on the causes of industrial transformation. In the literature where citation rates are at the forefront, some domestic scholars have successively proposed new theories. As Li Bing (2009) stated, the government is the maker of macroeconomic policies and shoulders the responsibility of formulating industrial policies based on economic development, adjusting industrial institutions, and increasing the level of resource utilization. Therefore, the industrial policy formulated by the government will directly affect the development of the industry, thereby affecting the investment in industrial technological innovation resources and affecting the expectations of relevant organizations for the industrial outlook. Sun Hanjie (2016) believes that the Central Government twice blew the clarion call of the Northeast revitalization in 2003 and August 2014, and promulgated the "State Council's Opinions on Recent Major Policies Initiatives in Supporting Northeast Revitalization". The implementation of these

policies has played an important role in policy development for the economic development of the Northeast and has achieved initial results. Yu Fanxiu (2017) proposed that the government should only improve the laws and regulations, scientifically formulate policies, and clarify government responsibilities in order to truly achieve the government service market and play a key role in the transformation of the industrial structure. Zhao Longshuang (2014) believes that technological innovation is an important factor in promoting industrial restructuring in Northeast China. Producer services and equipment manufacturing industries have penetrated and spread to each other to provide the impetus for the integration of industries. Li Bing (2009) summarized the internal science and technology motives and stated that scientific research and development capability is an important factor affecting the successful localization and reinvention of Heilongjiang Province's equipment manufacturing industry. The ability to obtain technology and information from the outside determines the degree of influence of the technological environment on technological innovation activities and the degree of adaptation to the technological environment. It also determines the advanced nature and adaptability of the technology.

Table 1. Frequency and proportion of each transitional factor

skill improved	16	31.4%
government policy	13	25.5%
Market factors	10	19.6%
Natural endowment	4	7.8%
Organization transformation	3	5.9%
Population factors	2	3.9%
Industrial Division	2	3.9%
Environmental factor	1	2.0%

From the types of motivation in the statistical literature, it can be seen that the above eight kinds of motivation categories are mentioned in the relevant literature. Among them, technological progress, government policies, and market factors were cited the most times, including 16 technological advances, 13 government policies, and 10 market factors. Their proportions in the causes of the transition are 31.4%, 25.5%, and 19.6%, respectively, and they have drastically changed other drivers.

Based on the content analysis method, the motivation analysis part of the existing domestic literature is classified and summarized, and the following conclusions about the structural transformation cause of Northeast manufacturing are drawn.

First of all, technological advancement in the promotion of industrial transformation in northeast China is dominated by technological progress, followed by government factors and market factors. The importance of technological progress need not be repeated, and the formulation of relevant policies has played a role in macro-control. Experience has shown that the transformation of the industrial structure cannot be achieved solely through the operation of the market. At the same time, the “visible hand” of national policy is needed to make overall plans, optimize the allocation of resources, and increase the efficiency of transformation. The transformation of the industrial structure at the same time affects the way the market operates. It is also inseparable from the market factors. Therefore, this project will analyze the drivers from these three aspects, and qualitatively conclude that the above conclusions will also apply to the industrial restructuring of the manufacturing industry in the Northeast.

3. Assumed Role of the Industrial Restructuring of the Manufacturing Industry in Northeast

3.1 Government Policy Factors.

Han Jingyi and Liu Chang (2017) believe that in order to ensure the effective implementation of the transformation work, higher level policies and financial support can be obtained. Capital investment plays a huge role in the transformation of industrial structure. We must expand funding sources and actively guide social capital. Increase the financial transfer payment and play a role in

taxation. Priority will be given to the transformation and development of industrial structures. The relevant aspects of the transformation and development of the industrial structure must also maintain reasonable capital input and start from various aspects to form a joint force. Zhang Tao (2012) also wrote that government promotion is the most important and most powerful driving force in the external factors of breakthrough innovation. Not only is it a breakthrough innovation, all business activities of the company must be rooted in the economic environment, market system, and legal environment. The stable macroeconomic operating situation is the guarantee for the stable development of innovation. Therefore, government promotion is an important driving factor for breakthrough innovation. In addition, government support policies such as tax incentives and financial support for breakthrough innovation are also important driving forces for breakthrough innovation.

In China, the government occupies a major position in the formulation of regional industrial policies. Therefore, considering the transformation of industrial structure, the role of the government cannot be ignored. As the main body of institutional supply, the government can provide a large amount of financial support through the system, creating a greater space for development for market players and prompting market players to make decisions that are most conducive to resource allocation. The government regulates the regional industrial structure through financial means. Under the new normal, market players have higher requirements for a sound market mechanism. The government's role in better performing its functions will directly affect the overall effectiveness of China's economic restructuring.

As a result, Hypothesis 1: Government support significantly influences the industrial restructuring.

3.2 Market Factors.

Regarding labor costs, Sun Yulei (2014) believes that within the manufacturing industry, wages in labor-intensive industries are low, and wages in capital and technology industries are relatively high. The labor force will gradually shift from labor-intensive industries to capital- and technology-intensive industries, indirectly promoting the shift of manufacturing focus from labor-intensive industries to capital- and technology-intensive industries, and the phenomenon of shifting and upgrading of the industrial structure.

China's long-term low wage levels and low labor costs have impeded technological advancement and advanced industrial structure. Earnings from industry and companies rely on low wages, resulting in insufficient investment in R&D and insufficient innovation. The more development of labor-intensive economic activities has weakened the development of China's high-tech industries, leaving most industries in China at the low end of the international division of labor. Therefore, raising the wages and welfare of the labor force in the relevant industries will have a certain degree of influence on the optimization and heightening of the industry.

As a result, Hypothesis 2: The increase in labor costs has a positive effect on the industrial restructuring.

3.3 Technical Factors.

Zhang Junfeng (2016) believes that science and technology are the basis for a country's prosperity and that science and technology are the driving force for industrial upgrading. Under the background of the new normal, the development of science and technology has become the main driving force for the transformation of China's industrial structure. Zhou Mi and Liu Xiaoming (2008) also stated that in today's society, technical resources have become the most important strategic resource in the current international market. Any kind of industry, through technological development and innovation, the use of new technologies, the creation of new production tools and production processes, can increase production efficiency, enhance industrial competitiveness and accelerate the development of the industry.

As many scholars have found during the study, the impact of technological progress on economic growth and industrial transformation has become more pronounced and has gradually become the dominant factor. If we want to speed up modern production, we must rely on technological progress to increase labor productivity and use of stock resources, increase technological progress, and

increase research funding. It will not only enhance and transform the traditional industries, but also improve the overall quality of the workers. It will maximize the effectiveness of production factors, effectively promote the transformation and upgrading of the industrial structure, and accelerate the growth of the regional economy.

As a result, Hypothesis 3: Technology R&D investment has a significant positive impact on industrial restructuring.

4. Model Construction and Variable Selection

4.1 Construction of Model.

Based on the above assumptions, the structural transformation is the result of the joint action of three core variables: government policy, market factors, and technology. When the three elements are in a given state, the difference in each factor variable will trigger the difference in the economic growth industrial structure transformation efficiency. Based on this, a multiple regression linear model will be constructed. Assume that the construction function is:

$$Y = (X_1, X_2, X_3, \mu_i) \tag{1}$$

Among them, Y represents the explanatory variable, that is, the ratio of manufacturing to total industrial output. X_i ($i=1, 2, 3,$) represents the implementation of government policies, the average salary of employees in the manufacturing industry, and the R&D expenditure of industrial enterprises, μ_i is the random interference term, and Y is a multivariate regression model of each explanatory variable. This is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \mu_i \tag{2}$$

In order to reduce the heteroscedasticity of the data as much as possible, we take the logarithm and get it:

$$\log Y = \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 + \log \mu_i \tag{3}$$

As a multivariate regression model in this section, we select the relevant data from 2007 to 2015 to do time series regression analysis to verify the results of the above three hypotheses.

4.2 Explanation of Variables.

(1) The proportion of manufacturing output value Y. The second part of this paper proposes that the optimization and heightening of the manufacturing industry can promote the improvement of manufacturing technology and productivity. The greater the proportion of output value, the higher the utilization rate of resources under the condition of constant supply, the better the effect of industrial transformation. (2) Implementation of government policies X_1 . In the structural reforms, the government must plan and guide new industries, advocate scientific and technological progress, encourage innovation and development, and vigorously promote ecological civilization construction. It is necessary to provide financial support for the transformation and upgrading of industries. Therefore, this paper will use the variables of each province's fiscal expenditure to reflect the strength of government support. The more the government invests in funds, the higher the degree of support. (3) Average wages X_2 of employees in manufacturing industry by industry. With regard to wages of employees, some scholars have confirmed that it is a function of production efficiency. It directly affects the production enthusiasm of labor production personnel, and thus accelerates the degree of industrial transformation. (4) R&D expenditures of industrial enterprises X_3 . Technological innovation and technological advancement are the most important sources of economic growth and efficiency improvement. R&D activities are the most innovative part of science and technology activities and an important subject of technological innovation. Strengthen R&D activities and enhance the ability of industrial enterprises to innovate in science and technology. The more adequate R&D funds for industrial companies, the stronger the incentive for companies to conduct technological innovation.

5. Variable Interpretation and Descriptive Analysis

By sorting out sample data, it is not difficult to find that from 2007 to 2015, the implementation of government policies by provinces, the average wage of manufacturing workers, and the R&D expenditures of industrial enterprises have continued to rise. Although the change trend of the explanatory variables is different, overall, it has gradually increased from 0.8550, 0.8621, 0.5710 in 2007 to 0.8113, 0.8931, and 0.7608 in 2015, and the overall trend is still showing an upward trend. In terms of horizontal comparison, X_1 , X_3 in Liaoning province are much higher than those in the other two provinces, and the X_2 levels in the three provinces are basically the same.

The sources of data in this article mainly come from the Statistical Yearbook of China, the compilation of statistical data on New China for the past 60 years, the Statistical Yearbook of each province, and the Statistical Yearbook of some cities. The data in Liaoning Province are not continuous, and the data on the average wages of employees in the industry from 2007 to 2009 are missing. This missing item has been replaced by the moving average method. Due to the different project names in the yearbooks of different provinces, the types of projects between different years are not uniform. Therefore, this project only selected the sample data from 2007 to 2015. The sample size is not large, but it is sufficient to analyze the time series model.

The project uses Eviews7 software to perform empirical regression analysis at this stage. The goodness of fit of the three provinces models exceeds 0.8. The explanatory variables have a high degree of interpretation of the interpreted variables, and they have multiple linear relationships.

5.2. Empirical Results.

5.2.1 Influence of Explanatory Variables on the Industrial Structure Transformation in Jilin Province.

From the above regression results can be drawn regression equation:

$$\ln Y = -0.4447 + 0.0609 \ln X_1 - 0.0233 \ln X_2 - 0.0061 \ln X_3 \quad (4)$$

(0.0018) (0.0026) (0.0019).

Table 2. Empirical Results of Jilin Province

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	-0.444727	0.015669	-28.23289	0.0000
X1	0.060935	0.001783	34.17185	0.0000
X2	-0.023278	0.002553	-9.119433	0.0003
X3	-0.006082	0.001944	-3.128283	0.0260
Weighted Statistics				
R-squared	0.999688	Prob(F-statistic)	0.000000	
Adjusted R-squared	0.999501	Durbin-Watson stat	3.056967	

The regression coefficient of the above regression equation is $R^2=0.9997$, and the adjusted decision coefficient is $R^2(ad)=0.9995$. This shows that the implementation of government policies, the average wages of employees in the manufacturing industry, and the R&D expenditures of industrial enterprises explain the significance of the transformation of regional manufacturing industries. $Prob=0.0000$ corresponding to the F value is far less than 0.05, and passes the test and the corresponding coefficient is not significantly zero. The D-W statistic = 3.0570, which is close to 2, indicates that there is no autocorrelation in the residuals of the regression equations. Therefore, the parameter estimates of the equations are statistically significant.

Based on the above regression equation, we can make further judgments on the relationship between explanatory variables and industrial transition in Jilin Province.

First, the X_1 coefficient of the implementation of government policies is 0.0609, which means that with the other variables unchanged, the proportion of manufacturing output value will increase by 0.0609% for every 10,000 yuan increase in government policy implementation.

Second, the average wage X_2 coefficient of employees in the manufacturing industry is -0.0233. This shows that with other variables unchanged, the average wage per person in the manufacturing

industry will increase by 1 yuan, and the proportion of manufacturing output will increase by -0.0233%.

Third, the X3 coefficient of R&D expenditure of industrial enterprises is -0.0061 which means that with other variables unchanged, the R&D expenditure of industrial enterprises will increase by 10,000 yuan each, and the proportion of manufacturing output value will increase by -0.0061%.

5.2.2 Influence of Explanatory Variables on the Industrial Structure Transformation in Heilongjiang Province.

From the above regression results can be drawn regression equation:

$$\ln Y = -3.4419 + 0.2309 \ln X_1 + 0.2502 \ln X_2 - 0.1689 \ln X_3 \quad (5)$$

(0.0372) (0.01000) (0.0381).

Table 3. Empirical Results of Heilongjiang Province

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	-3.441930	0.046761	-73.60695	0.0000
X1	0.230885	0.037232	6.201295	0.0016
X2	0.250192	0.010004	25.00994	0.0000
X3	-0.168866	0.038128	-4.428879	0.0068
Weighted Statistics				
R-squared	0.999886	Prob(F-statistic)		0.000000
Adjusted R-squared	0.999817	Durbin-Watson stat		1.716790

The regression coefficient of the above regression equation is $R^2=0.9999$, and the adjusted decision coefficient is $R^2(ad)=0.9998$. This shows that the implementation of government policies, the average wages of employees in the manufacturing industry, and the R&D expenditures of industrial enterprises explain the significance of the transformation of regional manufacturing industries. Prob=0.0000 corresponding to the F value is far less than 0.05, and passes the test and the corresponding coefficient is not significantly zero. The D-W statistic = 1.7168, which is close to 2, indicates that there is no autocorrelation in the residuals of the regression equations. Therefore, the parameter estimates of the equations are statistically significant.

Based on the above regression equation, we can make further judgments on the relationship between explanatory variables and industrial transition in Heilongjiang Province.

First, the X1 coefficient of the implementation of government policies is 0.2309 which means that with the other variables unchanged, the proportion of manufacturing output value will increase by 0.2309% for every 10,000 yuan increase in government policy implementation.

Second, the average wage X2 coefficient of employees in the manufacturing industry is 0.2502. This shows that with other variables unchanged, the average wage per person in the manufacturing industry will increase by 1 yuan, and the proportion of manufacturing output will increase by 0.2502%.

Third, the X3 coefficient of R&D expenditure of industrial enterprises is -0.1689, which means that with other variables unchanged, the R&D expenditure of industrial enterprises will increase by 10,000 yuan each, and the proportion of manufacturing output value will increase by -0.1689%.

5.2.3 Influence of Explanatory Variables on the Industrial Structure Transformation in Liaoning Province.

From the above regression results can be drawn regression equation:

$$\ln Y = 0.8299 - 0.0917 \ln X_1 + 0.1415 \ln X_2 - 0.0898 \ln X_3 \quad (6)$$

(0.0372) (0.0116) (0.0081).

The regression coefficient of the above regression equation is $R^2=0.9931$, and the adjusted decision coefficient is $R^2(ad)=0.9889$. This shows that the implementation of government policies, the average wages of employees in the manufacturing industry, and the R&D expenditures of industrial enterprises explain the significance of the transformation of regional manufacturing industries. Prob=0.0000 corresponding to the F value is far less than 0.05, and passes the test and the corresponding coefficient is not significantly zero. The D-W statistic = 1.3784, which is close to 2,

indicates that there is no autocorrelation in the residuals of the regression equations. Therefore, the parameter estimates of the equations are statistically significant.

Table 4. Empirical Results of Liaoning Province

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	0.829895	0.319673	2.596071	0.0485
X1	-0.091724	0.037245	2.462724	-0.0570
X2	0.141510	0.011594	12.20528	0.0001
X3	-0.089828	0.008131	11.04725	-0.0001
Weighted Statistics				
R-squared	0.993093	Prob(F-statistic)		0.000008
Adjusted R-squared	0.988949	Durbin-Watson stat		1.378444

Based on the above regression equation, we can make further judgments on the relationship between explanatory variables and industrial transition in Liaoning Province.

First, the X1 coefficient of the implementation of government policies is -0.0917, which means that with the other variables unchanged, the proportion of manufacturing output value will increase by -0.0917% for every 10,000 yuan increase in government policy implementation.

Second, the average wage X2 coefficient of employees in the manufacturing industry is 0.1415. This shows that with other variables unchanged, the average wage per person in the manufacturing industry will increase by 1 yuan, and the proportion of manufacturing output will increase by 0.1415%.

Third, the X3 coefficient of R&D expenditure of industrial enterprises is -0.0898, which means that with other variables unchanged, the R&D expenditure of industrial enterprises will increase by 10,000 yuan each, and the proportion of manufacturing output value will increase by -0.0898%.

6. Conclusion

Through the regression analysis above, we can find that (1) the implementation of the Jilin provincial government policy has a positive and significant effect on the manufacturing transformation of the three provinces. The wages of employees in the manufacturing industry and R&D expenditures in industrial enterprises have a significant positive effect on the manufacturing transformation. (2) The implementation of the Liaoning provincial government policy, the wages of the employees in the manufacturing industry and the R&D expenditure of the industrial enterprises have a positive and significant effect on the manufacturing transformation. (3) The implementation of the policies of the Heilongjiang provincial government, the wages of employees in the manufacturing industry, and the R&D expenditure of industrial enterprises also have positive and significant effects on the manufacturing transformation. It is consistent with the assumptions of this project in the previous section. We can promote the transformation of the economic structure in Northeast China by increasing government direct investment, raising the wage level of employees in the manufacturing industry, and increasing R&D expenditures, and realize the transition from an extensive economy to an intensive industrial economy.

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