Modeling Analysis of the Impact of Economic Growth Fluctuation on Enterprise Industrial Structure

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Abstract: At present, there is a lack of literature on the impact of economic growth fluctuations on the industrial structure of enterprises. Combined with the needs of national development strategy, this paper puts forward the modeling and analysis of the impact of economic growth fluctuations on the industrial structure of enterprises. Firstly, the influencing factors of economic growth fluctuation and industrial structure change of enterprises are determined, and the estimation methods are selected scientifically. According to the above-mentioned factors affecting the fluctuation of economic growth and the change of enterprise industrial structure, combined with Selkun and Chenery model, the influence of economic growth fluctuation on the industrial structure of enterprises is analyzed. The analysis results show that if the income elasticity of economic growth is positive, the proportion of corresponding industries will increase, otherwise, the proportion will decrease, so as to realize the impact of economic growth fluctuation on the industrial structure of enterprises Impact analysis. The empirical results show that the average income elasticity error of the model is 0.144,so it meets the needs of enterprises and national economic development, and it fully shows that the model is feasible.

1. Introduction

From the perspective of the world, with the advancement of industrial informatization, economic knowledge and economic globalization, as well as the emergence of the world financial crisis, the economic growth rate has gradually slowed down, which has brought great challenges to developed countries, developing countries and emerging economies [1]. Various countries and economies are faced with multiple difficulties, such as supply dislocation, insufficient demand, weak economic growth and so on. As a result, they turn their attention to the research on the mode of economic development and the adjustment and transformation of enterprise industrial structure, hoping to solve the current problems and improve the speed of national economic growth. Aiming at the goal of doubling the economic growth and upgrading the industrial structure of enterprises, combined with the accumulated problems in China's existing economy and industrial structure, based on the theory of interaction between economic growth fluctuation and enterprise industrial structure, this paper puts forward the modeling analysis of the impact of economic growth fluctuation on enterprise industrial structure. By establishing the impact model of economic growth fluctuation and enterprise industrial structure, this paper systematically analyzes the influencing factors of economic growth fluctuation and enterprise industrial structure, and explores the mechanism between economic growth fluctuation and enterprise industrial structure, and clarifies the influence of economic growth fluctuation on enterprise industrial structure [2].

The interaction between the fluctuation of economic growth and the industrial structure of enterprises is mainly reflected in two aspects. One is the effect and influence of economic growth fluctuation on the industrial structure of enterprises; the other is the effect and influence of the change of industrial structure of enterprises on the fluctuation of economic growth. In view of the second aspect (i.e. the effect and influence of the change of industrial structure on economic growth fluctuation), the relevant research literature is relatively rich, but their views are also quite different. Among them, the classical growth theory thinks that the industrial structure of enterprises is the natural product of economic growth, and does not take it as the variable of economic growth model; the structuralist non-equilibrium development theory takes the optimal allocation of resources as the

assumption condition, which holds that in the real world, there are great differences in the utility of production factors in different sectors, and the economic growth is unbalanced, resulting in economic implication It has great growth potential [3]. Therefore, the theory holds that the change of enterprise's industrial structure is the precondition of promoting the fluctuation of economic growth; classical economics holds that the industrial structure of enterprise is the product of social production refinement. Through the market, the trade-off between income and cost is carried out until the market main body reaches equilibrium, thus promoting the change of enterprise industrial structure. However, for the first aspect (i.e. the role and impact of economic growth fluctuation on the industrial structure of enterprises), the relevant research literature is relatively scarce. The existing references only study the influence relationship between economic growth fluctuation and the three changes of enterprise industrial structure, and each reference document has a big difference.

According to the above literature review, this study on the impact of economic growth fluctuations on the industrial structure of enterprises has very important practical significance, which can supplement the lack of existing literature, and also provide certain reference value for China's economic growth and enterprise industrial structure change. This study takes the fluctuation of economic growth and the change of enterprise industrial structure as the research object, and analyzes their respective influencing factors respectively, and analyzes the influence of economic growth fluctuation on enterprise industrial structure by using Selkun and Chenery model, which provides certain reference value for the research on the influence of economic growth fluctuation on Enterprise industrial structure [4].

2. An analysis of the influencing factors of economic growth fluctuation

2.1 Determination of influencing factors

The fluctuation of economic growth has different characteristics with the change of development stage, which is mainly reflected in the way of supporting economic growth fluctuation. Generally speaking, what kind of factors should be used as the main driving force to support economic development. This study holds that the fluctuation of economic growth is not only related to the input factors, but also directly related to the input efficiency and mode, and the industrial structure of enterprises. Therefore, before analyzing the impact of economic growth fluctuations on the industrial structure of enterprises, we should explore the influencing factors of economic growth fluctuations, so as to lay a solid foundation for the subsequent modeling analysis [5].

Under normal circumstances, the "source" of the fluctuation of national economic growth is the input of production factors and the use efficiency of production factors, so it is the labor force, capital and total factor productivity. This study takes total factor productivity as the "source" of economic growth fluctuation, and analyzes the influencing factors of economic growth fluctuation.

Total factor productivity was put forward by the economist Dingbergen, which refers to the ratio of output to input. In the dynamic contribution analysis, the influencing factors of economic growth fluctuation are output growth rate, capital input growth rate, labor input growth rate, total factor productivity growth rate, capital input growth rate, labor input growth contribution rate and total factor productivity growth contribution rate, and they are marked as $\{GY, GK, GL, GA, EK, EL, EA\}$.

2.2 Estimation of influencing factors

The estimation methods of influencing factors of economic growth fluctuation can be divided into two categories: econometric method and growth accounting method. Among them, the econometric method estimates the influencing factors through the econometric model, and the factors are more comprehensive, but the estimation process of the influencing factors is more complex; the growth accounting method estimates the influencing factors based on the neoclassical growth theory, and the estimation process is simple, but there are too many assumptions and strong constraints [6].

According to the research needs, Solow residual method is selected to estimate the influencing factors of economic growth fluctuation. The specific process of influencing factors estimation is as follows:

Set the neoclassical production function to

$$Y = A_t F(K, L, t) \quad (1)$$

In formula (1), Y represents output; $A_t F(\cdot)$ is a new classical production function; K means capital investment; L means labor input; t means time.

The two sides of formula (1) are obtained by total differentiation and transform to

$$\frac{dY/dt}{Y} = \alpha \frac{dK/dt}{K} + \beta \frac{dL/dt}{L} + \frac{dA/dt}{Y} \quad (2)$$

In formula (2), α means the elasticity of capital investment, and the calculation formula is $\alpha = \frac{\partial F}{\partial K} \cdot \frac{K}{Y}$; β means the output elasticity of labor, and the calculation formula is $\beta = \frac{\partial F}{\partial L} \cdot \frac{L}{Y}$.

The variable in formula (2) is defined as

$$\begin{cases} GY = \dfrac{dY/dt}{Y} \\ GK = \dfrac{dK/dt}{K} \\ GL = \dfrac{dL/dt}{L} \\ GA = \dfrac{dA/dt}{Y} \end{cases} \quad (3)$$

In formula (3), GY represents the growth rate of output; GK represents the growth rate of capital investment; GL represents the growth rate of labor input; GA represents the growth rate of total factor productivity.

In the actual analysis process, GY as output growth rate, GK as capital input growth rate and GL as labor input growth rate are calculated according to the level method, GA as total factor productivity growth rate is calculated by the above three factors affecting economic growth fluctuation, and the calculation formula is as follows

$$\begin{cases} GY = \sqrt[t]{Y_t / Y_0} \times 100 - 100 \\ GK = \sqrt[t]{K_t / K_0} \times 100 - 100 \\ GL = \sqrt[t]{L_t / L_0} \times 100 - 100 \\ GA = GY - \alpha GK - \beta GL \end{cases} \quad (4)$$

The calculation formula of contribution rate of capital investment growth, labor input growth contribution rate and total factor productivity growth contribution rate is as follows

$$\begin{cases} EA = \dfrac{GA}{GY} \times 100\% \\ EK = \dfrac{\alpha GK}{GY} \times 100\% \\ EL = \dfrac{\beta GL}{GY} \times 100\% \end{cases} \quad (5)$$

In formula (5), EA represents the contribution rate of capital investment growth; EK represents the contribution rate of labor input growth; EL represents the contribution rate of total factor productivity growth.

3. Analysis of the factors influencing the change of enterprise industrial structure

3.1 Construction of industrial structure change model

In the research on the influencing factors of enterprise industrial structure change, it is believed that with the change of demand structure and consumption structure, the increase of productivity and the expansion of international trade scope, the industrial structure will also change. In the process of actual economic development, the change of enterprise industrial structure is the result of a variety of influencing factors. Therefore, this study constructs the enterprise industrial structure change model and selects the influencing factors of enterprise industrial structure change.

Suppose the industry vector is $Y=\{Y_1,Y_2,\cdots,Y_n\}$, Y_n means the nth industry; the feature vector is $X=\{X_1,X_2,\cdots,X_n\}$, X_n refers to the nth supply factor affecting industrial development; the factor vector of industry restriction is $Z=\{Z_1,Z_2,\cdots,Z_n\}$, Z_n represents the nth restrictive factor affecting industrial development; the vector of industrial policy is $P=\{P_1,P_2,\cdots,P_n\}$, P_n represents the nth policy element affecting industrial development [8].

From the perspective of supply, this paper selects the influencing factors of industrial structure change as capital input, labor input and resource input, which are recorded as K, L and R, so $X=(K,L,R)$. The enterprise industry is mainly divided into three categories, namely the first industry, the second industry and the third industry, which are respectively recorded as Y_1、Y_2 and Y_3, so $Y=(Y_1,Y_2,Y_3)$; From the perspective of demand and supply, the restrictive factors of industrial development include technological level and innovation ability, consumption level and structure, investment demand, economic development level and industrial structure reflecting the elasticity of supply and demand and industrial correlation, and they are recorded as T, C, I, Q and H, so $Z=(T,C,I,Q,H)$;Industrial policies are mainly aimed at supporting and encouraging development and not hindering development, and they are recorded as P_1 and P_2, so $P=(P_1,P_2)$ [9]。

Therefore, according to the above analysis results, the model of enterprise industrial structure change is

$$Y=\left\{(Y_1,Y_2,Y_3)\middle|Y_i=F\left[X=(K,L,R),Z=(T,C,I,Q,H),P=(P_1,P_2),Y=(Y_1,Y_2,Y_3)\right]\right\} \quad (6)$$

3.2 Determination of influencing factors of industrial structure change

According to the above-mentioned enterprise industrial structure change model, based on the data relevance and availability, and select a number of typical indicators for comprehensive analysis, and find out the influencing factors of enterprise industrial structure change, and prepare for the analysis of the impact of economic growth fluctuation on enterprise industrial structure change [10].

The influencing factors of enterprise industrial structure change are shown in Table 1.

Table 1 Influencing factors of enterprise industrial structure change

variable	influence factor	variable	influence factor
X_1	Per capita GDP(Yuan / person)	X_9	Proportion of added value of tertiary industry(%)
X_2	GDP growth rate(%)	X_{10}	Proportion of secondary industry employment(%)
X_3	Consumption level of residents (Yuan / person)	X_{11}	Proportion of tertiary industry employment(%)
X_4	Disposable income of urban residents(Yuan / person)	X_{12}	Investment rate(%)
X_5	Per capita net income of peasant households(Yuan / person)	X_{13}	Export proportion(%)
X_6	Engel coefficient of Urban Households(%)	X_{14}	Full labor production(Yuan / person)
X_7	Engel coefficient of rural households(%)	X_{15}	Number of college students per 10000 population(People / 10000 people)
X_8	Proportion of added value of secondary industry(%)	X_{16}	Urbanization rate(%)

4. The impact of economic growth fluctuation on the industrial structure of enterprises

Based on the above-mentioned factors affecting the fluctuation of economic growth and the change of industrial structure of enterprises, the influence of economic growth fluctuation on the industrial structure of enterprises is analyzed by combining Selkun and Chenery models, and the specific analysis process is as follows:

4.1 Introduction of Serquin and Chenery model

As for the impact of economic growth fluctuation on the industrial structure of enterprises, Serquin and Chenery have conducted in-depth research on it, and have achieved certain results, namely the model of Serquin and Chenery [11]. Serquin and Chenery think that the fluctuation of economic growth is the process of the change of national economic structure, which is closely related to the change of enterprise industrial structure.

The basic form of Serquin and Chenery model is

$$\ln x = a + \beta_1 \ln y - \beta_2 (\ln y)^2 - \gamma \ln N + v_2 (\ln N)^2 + \sum \delta_i T_j \quad (7)$$

In formula (7), x represents the ratio of industry to GDP; a, β_1, β_2, γ, v_2 and δ_i represents the coefficients of the model; y means per capita income, the main function of the index is to measure the level of economic growth and output; N represents the total population of the country; T_j is a period, the value range of j is $[1,4]$.

In order to facilitate the analysis of subsequent impacts, the derivation of y and N in formula (7) is carried out, obtaining the income elasticity and population elasticity of the industrial structure of enterprises, and the expression is

$$\begin{cases} \dfrac{\partial x}{\partial y} \cdot \dfrac{y}{x} = \beta_1 + 2\beta_2 \ln y \\ \dfrac{\partial x}{\partial N} \cdot \dfrac{N}{x} = \gamma \end{cases} \quad (8)$$

In formula (8), the first equation is the income elasticity of enterprise industrial structure. If per capita income increases, then the estimated value of $\beta_1 + 2\beta_2 \ln y$ coefficient is positive, and it shows that the proportion of industrial added value of enterprises is increasing; if per capita income falls, then the estimated value of $\beta_1 + 2\beta_2 \ln y$ coefficient is negative, and it shows that the proportion of industrial added value of enterprises is decreasing [12]. The second equation is the population elasticity of industrial structure of enterprises, and the estimated value of γ represents the percentage points of increase or decrease in the proportion of industrial structure of enterprises for every 1% increase in population.

4.2 The impact of economic growth fluctuation on the industrial structure of enterprises

According to formula (7), the proportion of added value of China's three industries is taken as the explanatory variable, recording as x_1, x_2 x_3,and take China's per capita GDP as the explanatory variable, recording as y [13]. The regression structure of enterprise industrial structure is recorded as

$$\ln(x_1 / x_2 / x_3) = a + \beta_1 \ln y - \beta_2 (\ln y)^2 - \gamma \ln N \quad (9)$$

According to formula (9), the income elasticity of the proportion of industrial added value of enterprises is $\beta_1 + 2\beta_2 \ln y$. Taking the data of an enterprise from 2010 to 2019 as an example, the elasticity of the enterprise industry on the change of the real per capita GDP can be obtained by substituting the actual per capita GDP y into formula (9), as shown in Table 2.

Table 2 elasticity of real per capita GDP of enterprises and industries

Year (year)	primary industry	the secondary industry	The third industry
2010	-7.29	0.09	11.11
2011	-6.84	-1.40	10.83
2012	-6.32	-2.87	10.51
2013	-5.97	-3.88	10.30
2014	-5.63	-4.85	10.09
2015	-5.24	-5.96	9.85
2016	-4.90	-6.95	9.64
2017	-4.61	-7.76	9.46
2018	-4.33	-8.56	9.29
2019	-4.07	-9.32	9.12

As can be seen from the data in Table 2, the income elasticity of the proportion of added value of the primary industry is all negative, indicating that with the growth of per capita GDP (fluctuation of economic growth), and the proportion of added value of the primary industry shows a downward trend; the income elasticity of the proportion of added value of the secondary industry is only positive in 2010 and negative in other years, indicating that with the growth of per capita GDP (fluctuation of economic growth), and the proportion of added value of the secondary industry shows a trend of first rising and then decreasing; the income elasticity of the proportion of added value of the tertiary industry is all positive, indicating that with the growth of per capita GDP (fluctuation of economic growth), and the proportion of added value of the tertiary industry shows an upward trend [14].

In addition, the speed of economic growth fluctuations also affect the rate and direction of enterprise industrial structure change, which requires a large amount of data to prove. Due to the limitation of space, this study does not elaborate on it in detail [15].

Through the above process, this paper introduces the Serquin and Chenery models to analyze the impact of economic growth fluctuations on the changes of enterprise industrial structure, which can not only provide accurate data support for enterprise development and structural upgrading, but also provide certain reference for the research on the interaction between economic growth and enterprise industrial structure.

5. Empirical analysis

In order to verify the performance of the model, the eastern region of China is selected for empirical analysis, and the specific process is as follows:

5.1 Data source and processing

The empirical analysis is based on the statistical yearbook data, and the time period is 2010-2019. According to the data changes in the time period, the missing data is replaced by moving average.

It is very likely that there is heteroscedasticity problem in the data acquisition, so the regional indicators are logarithmically processed. In addition, the time series also has non-stationary characteristics, which need to be processed by difference.

5.2 Selection and test of regression model

Regression model is the key to the analysis of the impact of economic growth fluctuation on the industrial structure of enterprises. The model has high requirements for variables, and the stability of variables must be ensured. Therefore, unit root test (ADF test) is used to test the input variables of the model, and the test results are shown in Table 3.

Table 3 ADF test results

variable	TS	TL	GDP
ADF value	-3.7578	-3.6247	-3.5376
Anaphase of stagnation	0	0	3
10% critical value	-2.6103	-2.6103	-3.2071
Is it stable	Yes***	Yes ***	Yes **

Note: ** represents a significance level of 5%;
*** represents a significance level of 1%;

Vector autoregressive model test is not only to test its stability, but also the basis of influence analysis. The stability test results are shown in Figure 1.

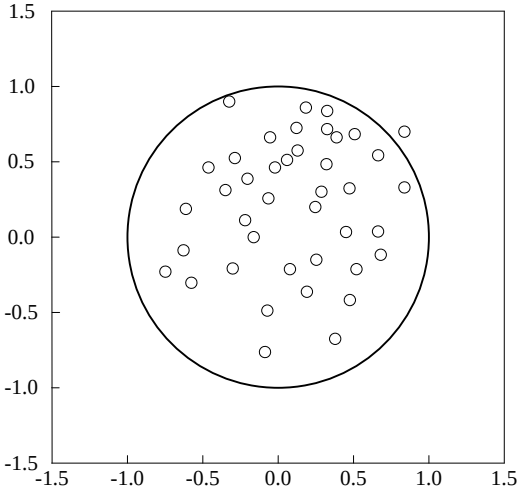

Figure 1 test results of model stability

According to the study, if all the AR roots fall in the unit circle, it shows that the regression model has good stability. As shown in Figure 1, almost all AR roots fall in the unit circle. Analysis shows that the AR roots outside the unit circle are caused by calculation errors, which indicates that the stability of vector autoregressive model is qualified.

5.3 Analysis of empirical results

According to the data obtained and the regression model selected, the performance of the model is reflected by the income elasticity error of the proportion of industrial added value, and the specific empirical results are as follows:

Through calculation, the income elasticity data of the proportion of added value of the enterprise industry are shown in Table 4.

Table 4 Income elasticity data of the proportion of industrial added value of enterprises

Year (year)	model data	Actual data	error
2010	-5.69	-5.49	0.20
2011	6.45	6.40	0.05
2012	6.29	6.29	0.00
2013	-4.59	-4.55	0.04
2014	10.25	10.26	0.01
2015	-9.58	2.13	11.71
2016	-4.26	-4.22	0.04
2017	6.59	6.96	0.40
2018	6.06	6.12	0.06
2019	11.59	10.95	0.64
average error	0.144		

As shown in Table 4, the error in 2015 is relatively large, which is easy to affect the authenticity of the empirical results. Therefore, it is not included in the calculation of the average error.

6. Empirical conclusion

Through the above experimental results, it can be found that the average value of income elasticity error is 0.144 by using the model to analyze the impact of economic growth fluctuation on the industrial structure of enterprises, which can meet the needs of enterprises and national economic development, which fully shows that the model is feasible.

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