Research on the Influencing Factors of the Efficiency of Industry Sector Driving Economic Growth—Based on 29 Provinces Dates of China

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Abstract

The industrial efficiency is enhanced by the upgrading of industry factor endowment structure and the change of industrial structure, and the latter drives economic growth. This paper selected four independent variables such as employment of the population, capital formation, industrial coordination and urbanization. It analyzed the relationship of the four independent variables and the labor productivity by regression analysis on panel data. This article think that the industry sector efficiency is influenced by many factors except for the industry coordination. The paper puts forward that we must pay attention to the coordinated development of the industry, increase the professional division of service sector, investment and urbanization, thereby enhancing the efficiency of the industry sector and ultimately drive economic growth.

Keywords: Industry sector, Industrial efficiency, Economic growth, Influence factors.

1. INTRODUCTION

The studies on the relationship between the industrial efficiency and the economic growth think that the improved industrial efficiency has been achieved through the upgrading of the intra-industry factor endowments and the change of industrial structure to further drive the economic growth. There are a lot of factors affecting the industry efficiency, including the size of the market, the factor of the intra-industry, industry policy and the outer environment and so on. Chenery has analyzed the industrial development stage, thinks that industrial service has improved the industrial efficiency and drive the economic growth (Chenery, 1970; Echevarria, 1997; Qu et al 2011; William, 1967). Jiangjing had studied the relationship between the producer service sector and the industry efficiency, thought that the enlarging of the producer service sector promote the higher industry efficiency (Jiang et al, 2007).

When studying the industrial efficiency, the indexes and the aspects that each scholar chose are different. The efficiency indexes mainly include outputs rate, efficiency index, total labor efficiency, comparative labor productive efficiency, and market share at present and so on. When choosing the industrial efficiency indexes, Chenchooses labor productive efficiency and market share to indicate the competitiveness of the industry (Chen et al, 2004). Gu chooses comparative labor productive efficiency and industry profit rate to study the competitiveness of industry (Gu et al, 2006). Jiangchooses the total labor productive efficiency of the all state-owned and non-state-owned industrial enterprises above designated size to measure the industry efficiency (Jiang et al,2007). Zhang chooses the input factors to study the promotion of the industry efficiency (Zhang et al, 2010). When choosing the aspect of studying the industrial efficiency, Hastudies the industrial efficiency on the aspects of international trade and FDI, and the relationship between the industrial efficiency and the TFP (Hu and Qiao,2006; Aleksandra,2010). Yu et al had analyzed the effects of industrial efficiency caused by the changes of resource allocation efficiency based on the government industrial policies (Yu, 2008; Wang and Liang, 2014). Battese et al choose the point of industry performance studies the improvement of the productive efficiency form the perspective of the sector performance (Battese and Coelli, 1992).

The improved industrial efficiency will promote the flow among the productive factors and therefore drive the economic growth. At this point, the question of how the changes of the industry efficiency will promote the flow of the productive factors, and how these factors drive the economic growth should be answered.
In view of the complication of the economic social behaviors, the development of the industry is affected by many factors and different places. Therefore, when choosing the indexes, in order to examine the industry efficiency more completely, we will study both the total labor efficiency and the comparative labor efficiency. When choosing the effects of the industrial efficiency improvement, both the intra-industry effects and the inter-industry effects will be taken into consideration. The intra-industry factors include the labor input and fixed capital formation of the industry, while the service industry’s labor input, level of industry coordination and urbanization are the inter-industry factors.

2. MODEL

To study the relationship between the industrial efficiency and the economic growth, we try to build a theoretical model by setting the input of the service industry as another input to enlarge the Cobb-Douglas production function.

The Cobb-Douglas production function is shown in the following equation:

\[ Y = A(t)L^\alpha K^\beta \]  

(1)

In this equation, \( Y \) is the total output of the industry, \( A(t) \) is the comprehensive technology level affecting the industry efficiency. \( L \) is the number of labor force (unit: ten thousands persons or person), \( K \) is the capital. \( \alpha \) is the elasticity of the labor output, \( \beta \) is the elastic coefficient of the capital output, \( \mu \) is the random term , \( \mu \leq 1 \).

If the service industry is put as an intermediate input of the industry output, given the assumption that the industry sector is constant to scales and stating that the productive efficiency will not change with the changing of the productive scales, only the change of the technology will improve the productive efficiency, where \( \alpha + \beta = 1 \), the new productive function will be shown:

\[ Y = A(t)(L^{\alpha}S^{1-\alpha})K^\beta \mu \]  

(2)

In the function, \( S \) is the intermediate input of the industry output.

Using Log function on both sides of the productive function will get function:

\[ \ln Y = \ln A(t) + \alpha \ln L + \beta \ln K + \ln \mu \]  

(3)

We chose total labor productive efficiency and comparative labor productive efficiency to study the industry efficiency. Considering \( A(t) \) is the comprehensive technology level, the technology progress will promote the improvement of the industry efficiency. Then it will lead to the flow of productive factors between the industries and the changes of the industrial structures. Here we choose the degree of the industry coordination as a variable and in view of the impacts of the urbanization on the comprehensive technology, the urbanization level will be introduced as a controlled variable, we can get the function:

\[ \ln pro_{it} = C_0 + C_1 \ln manu_{it} + C_2 \ln ser_{it} + C_3 \ln fix_{it} + C_4 \ln negdp_{it} + C_5 \ln city_{it} + \epsilon \]  

(4)

\[ \ln clp_{it} = C_0 + C_1 \ln manu_{it} + C_2 \ln ser_{it} + C_3 \ln fix_{it} + C_4 \ln negdp_{it} + C_5 \ln city_{it} + \epsilon \]  

(5)

So the econometric model of the industry efficiency is: \( \ln pro_{it} \) is the natural logarithm of the total labor productive efficiency in Year \( t \) in area \( t \).\( \ln clp_{it} \) is the natural logarithm of the comparative labor productive efficiency in Year \( t \) in area \( t \). \( \ln manu_{it} \) is the natural logarithm of the rate of the employed persons in the industry to the total employed persons in Year \( t \) in Area \( t \). \( \ln ser_{it} \) is the natural logarithm of the rate of the
employed persons to the total employed persons in the service industry in Year $t$ in Area $t$. $\ln \text{fix}_{it}$ is the natural logarithm of the annual capital formation amount per capita in Year $t$ in Area $t$. $\ln \text{egdp}_{it}$ is the natural logarithm of the industry coordination level in Year $t$ in Area $t$. $\ln \text{city}_{it}$ is the natural logarithm of the urbanization level in Year $t$ in Area $t$.

3. METHODOLOGY

In the construction of industrial efficiency model, Stata12.0 is used in regression tests. Fixed-effects model and random-effects model are used for testing respectively. We use the Hausman test to determine the Whether we apply the fixed effects model or random effects model in this study. OLS regression analysis method will be used if these two models have to be abandoned (See Table1 for details). The Panel data collected between 2001 and 2014 from 29 provinces are studied in this paper.

Table 1 Variables description

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ln \text{pro}$</td>
<td>natural logarithm of industrial labor productivity</td>
</tr>
<tr>
<td>$\ln \text{clp}$</td>
<td>natural logarithm of Industrial comparative labor productivity</td>
</tr>
<tr>
<td>$\ln \text{manu}$</td>
<td>natural logarithm of the proportion of employed persons in industry</td>
</tr>
<tr>
<td>$\ln \text{ser}$</td>
<td>natural logarithm of the proportion of employed persons in service</td>
</tr>
<tr>
<td>$\ln \text{fix}$</td>
<td>natural logarithm of per capita annual capital formation</td>
</tr>
<tr>
<td>$\ln \text{egdp}$</td>
<td>natural logarithm of Industrial coordination degree</td>
</tr>
<tr>
<td>$\ln \text{city}$</td>
<td>natural logarithm of urbanization level</td>
</tr>
</tbody>
</table>

3.1 ADF test

Stability test of related variables are conducted. We find that natural logarithm value of industrial productivity and natural logarithm value of annual gross capital formation per capita do not pass the test, but in the first order differential, all variables can pass the test (See Table 2 for details).

Table 2 ADF test of panel data

<table>
<thead>
<tr>
<th></th>
<th>Total labor productivity</th>
<th>Comparative labor productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ln \text{pro}$</td>
<td>$-3.016$ ***</td>
<td>$-12.25$ ***</td>
</tr>
<tr>
<td>$\ln \text{clp}$</td>
<td>$-5.271$ **</td>
<td>$-14.563$ ***</td>
</tr>
<tr>
<td>$\ln \text{manu}$</td>
<td>$-7.787$ **</td>
<td>$-15.639$ ***</td>
</tr>
<tr>
<td>$\ln \text{fix}$</td>
<td>$-3.460$</td>
<td>$-15.358$ ***</td>
</tr>
<tr>
<td>$\ln \text{egdp}$</td>
<td>$-6.410$ ***</td>
<td>$-13.759$ ***</td>
</tr>
<tr>
<td>$\ln \text{city}$</td>
<td>$-7.626$ ***</td>
<td>$-15.665$ ***</td>
</tr>
</tbody>
</table>

***<.001, **<0.01, *<.05.

3.2 Regression analysis

The regression results of industrial labor productivity and comparative productivity are shown (See Table 3 and Table 4 for details).

Table 3 Total labor productivity model comparison

<table>
<thead>
<tr>
<th>Variables</th>
<th>Parameters</th>
<th>Fixed effect model</th>
<th>Random effect model</th>
<th>Driscoll&amp;Kraay Standard error estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cons</td>
<td>$C_0$</td>
<td>0.0543 ***</td>
<td>0.0521</td>
<td>0.0544 *** (0.011)</td>
</tr>
<tr>
<td>$\ln \text{manu}$</td>
<td>$C_1$</td>
<td>-0.8555 ***</td>
<td>-0.8540</td>
<td>-0.8555 *** (0.0522)</td>
</tr>
</tbody>
</table>
Table 3 shows the fixed effects and random effects models results, and Hausman tests are performed to determine the coefficients of fixed effects and random effects models are significantly different. The hypothesis of Hausman test is no significant difference exists. Empirical results show that p-value is 0.0009, the fixed effects is accepted in the level of 1%. R2 is 0.7631 shows better goodness of fit. After applying the XTSCC command to control heteroskedasticity and cross sectional dependence, we select the model which Driscoll & Kraay standard error is estimated.

Table 4. Comparative labor productivity model comparison

<table>
<thead>
<tr>
<th>Variables</th>
<th>Parameters</th>
<th>Fixed effect model</th>
<th>Random effect model</th>
<th>Driscoll &amp; Kraay Standard error estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cons</td>
<td>C₀</td>
<td>-0.0118*** 0.005</td>
<td>-0.01608*** 0.005</td>
<td>-0.0118*** (0.0077)</td>
</tr>
<tr>
<td>lnmanu</td>
<td>C₁</td>
<td>-0.9991*** 0.0283</td>
<td>-0.9817*** 0.0278</td>
<td>-0.9991*** (0.0231)</td>
</tr>
<tr>
<td>lnser</td>
<td>C₂</td>
<td>0.0928* 0.0502</td>
<td>0.0706 0.0489</td>
<td>0.0928* 0.0276409</td>
</tr>
<tr>
<td>lnfix</td>
<td>C₃</td>
<td>0.0472*** 0.0225</td>
<td>0.0790*** 0.0217</td>
<td>0.0472*** (0.0281)</td>
</tr>
<tr>
<td>lnegdp</td>
<td>C₄</td>
<td>-1.407*** 0.1632</td>
<td>-1.3389*** 0.1613</td>
<td>-1.407*** (0.1982)</td>
</tr>
<tr>
<td>lncity</td>
<td>C₅</td>
<td>0.13026*** 0.0588</td>
<td>0.115*** 0.0565</td>
<td>0.1303*** (0.0856)</td>
</tr>
<tr>
<td>Adj-RP2</td>
<td></td>
<td>0.8213</td>
<td>0.8195</td>
<td>0.8213</td>
</tr>
<tr>
<td>P value</td>
<td></td>
<td>0.0002</td>
<td>0.0002</td>
<td>0.0002</td>
</tr>
<tr>
<td>Sample</td>
<td></td>
<td>377</td>
<td>377</td>
<td>377</td>
</tr>
</tbody>
</table>

Table 4 shows the fixed effects and random effects models results, and Hausman tests are performed to determine the coefficients of fixed effects and random effects models are significantly different. The hypothesis of Hausman test is no significant difference exists. Empirical results show that p-value is 0.0001, the fixed effects is accepted in the level of 1%. R2 is 0.8213 shows better goodness of fit. After applying the XTSCC command to control heteroskedasticity and cross sectional dependence, we select the model which Driscoll & Kraay standard error is estimated.

3.3 Explanations of Industrial efficiency model

According to the calculated results of measurement, formula 6 represents linear relationship between the labour productivity of service sector and related factors, and formula 7 represents linear relationship between comparative labour productivity and related factors.

\[
\lnpro_p = 0.0544 - 0.8555\lnmanu_p + 0.1253\lnser_p + 0.4029\lnfix_p - 2.0818\lnegdp_p + 0.3736\lncity_p + \varepsilon
\] (6)

\[
\lnclp_p = -0.0118 - 0.9991\lnmanu_p + 0.0928\lnser_p + 0.0472\lnfix_p - 1.4071\lnegdp_p + 0.1303\lncity_p + \varepsilon
\] (7)
From the empirical results, formula 6 represents linear relationship between industrial labour productivity and related factors, and formula 7 represents linear relationship between comparative labour productivity and related factors. Empirical results show that the two models will accept fixed effects in the level of 1%. R² are 0.7631 and 0.8213 respectively, which means both models have good goodness of fit. For the fixed effects model, the following conclusions can be drawn:

(1) Evidence shows a negative correlation between industrial labor input, industrial productivity and comparative labor productivity. According to the Cobb-Douglas production function, the increase in industrial labor investment has contributed to the increase of total output, which has led to the overall economic growth. However, due to the lack of improvements in the comprehensive technical level, the increase in labor input has led to a downward trend in industrial efficiency, indicating that China's industrial industry, especially the level of development is relatively low. This is also consistent with current China's industrialization level. Since Chinese industrial efficiency is relatively low, it needs to be improved through the intelligent workshops, the application of intelligent equipment and advanced industrial technology, thereby driving economic growth.

(2) The further specialized division of labor in the service industry is significantly positively correlated with the industrial labor productivity and the comparative labor productivity. In measuring the labor productivity, it shows that the regression coefficient of labor investment is 0.1253, and the significant level is 1%. Because the natural logarithm is taken, the total labor productivity of the industry can increase by 0.1253% when the labor input of the service industry is increased by 1%. It also suggests that the further the division of labor services is, the higher the labor productivity of the industry will be.

In the comparison of labor productivity measurement test, it is found that the coefficient of labor investment is 0.0928, and it is significant at 1% level. As the natural logarithm is taken, for each increase of 1%, the comparative labor productivity of the industry can increase by 0.0928%. Therefore, the further the division of labor services is, the higher the labor productivity of the industry will be.

It also shows that the coordination of the service industry requires the in-depth professionalization of the division of labor industry, so as to improve the industrial efficiency and thus drive the economic growth.

(3) Empirical evidence shows positive correlation among the formation of per capita capital, labor productivity and the improvement of labor productivity. It can be found that in the econometric test of labor productivity, the personally-mean capital formation has a regression coefficient of 0.4029, and it is significant at 1% level. Since the natural logarithm is taken, each increase of 1% of the personally-mean capital formation can lead to an increase of labor productivity of industry by 0.4029%.

In the econometric test of comparative labor productivity, it can be found that the regression coefficient of the personally-mean capital formation is 0.0472, which is significant at 1% level. It means that each increase of 1% of the total personally-mean capital formation can lead to the industrial comparative labor productivity increasing by 0.0472%.

At the current stage of China's economic development, investments play an important role in the domestic growth; actions should be taken through the increase of investments and the improvement of equipment and technology. It will help improve the overall labor productivity and the comparative labor productivity, and thus drive the economic growth.

(4) The improvement of the coordinated development of the industry has promoted the industrial efficiency. The lower index of industrial information entropy indicates that the degree of coordinated development of tertiary industry is higher. Therefore, based on the empirical results, the degree of industrial coordination of the tertiary industry has a positive correlation with the industrial labor productivity.

From the measurement of labor productivity, we find that the regression coefficient of industrial information entropy index is -2.0818, and at 1% significant level. Since the natural logarithm is taken, the industrial information entropy index is reduced by 1% when the industrial full labor productivity is increased by 2.0818%, which is almost double time of the rate of increase.
In the comparison of labor productivity measurement, we find that the regression coefficient of industrial information entropy index is -1.407, at 1% significant level. Because the natural logarithm is taken, that is, the industrial information entropy index is reduced by 1%, Industrial comparative labor productivity is increased by 1.407%.

It shows that the coordinated development of tertiary industry has a critical impact on the improvement of industrial efficiency. The industrial labor productivity and comparative labor productivity can only be improved through ensuring the coordinated development of the tertiary industry in different stages of economic development, and this will ultimately improve the economic growth.

(5) The urbanization has promoted the improvement of industrial efficiency through the increase of market demand, the upgrade of technical level, and the improvement of the management level. The increase in urbanization results in the concentration of talent, capital, technology and other industrial factors. These factors will also help improve the industrial labor productivity. The empirical results show that the higher urbanization rate promotes the improvement of industrial efficiency.

In examining full labor productivity, the regression coefficient of urbanization rate is found to be 0.3736, and it is significant at 1% level. Because the natural logarithm is taken, for every 1% increase in urbanization rate, the total labor productivity will be increased by 0.374%.

From the comparison of labor productivity, the regression coefficient of urbanization rate is found to be 0.1303, and it is significant at 1% level. Because the natural logarithm is taken, every 1% increase in urbanization rate will lead to 1.407% higher of the industrial comparing labor productivity.

4. CONCLUSION

In general, the five indicators selected by the two models are all significant at the 1% level, and among them, the index coefficient of the industry coordination degree is the highest. It implies a close relationship between the coordinated development of the tertiary industry and the industrial productivity efficiency. To improve the industrial labor productivity and comparative labor productivity, more attentions should be paid to the coordinated development of the tertiary industry, in order to drive the economic growth.

Apart from the degree of coordination, the improvement of industrial efficiency is influenced by many other factors. The Empirical studies have shown that the professionalization of the service industry, the investment, and urbanization, etc., should also be considered in enhancing the industrial efficiency, and consequently driving the overall economic growth.

REFERENCES


