Jie Duan, Hai-Lin Bai and Lin Cheng

Research on the Mechanism of Industry Integration between Shaanxi Advanced Manufacturing and Modern Service Industry

Abstract: With the continuous innovation of industrial development, industrial integration became a new form of industrial development. Based on the application of system theory, this paper discussed the mechanism of industrial integration with the corresponding mathematical model. And according to the Input-Output Table of Shaanxi Province, some indicators were selected to calculate the integration of Advanced Manufacturing Industry and Modern Service Industry, the result shows that the degree of integration of the two industries tends to balance, and Advanced Manufacturing Industry capacity of the integration is significantly stronger than the Modern Service Industry, but the two industries structure is still unreasonable. The innovation of this paper lies in using two perspectives - industrial coupling and industrial integration to explain coordinate development issues, interaction relationships, operational status, and the degree of integration of the two industries.

Keywords: Advanced Manufacturing Industry, Modern Service Industry, Industry Integration

1 Introduction

At present, the economic development trend of China is in the transition period with both opportunity and challenge and it is in the same period in Shaanxi Province, the western industrial province. In order to actively adapt to the new economic state, Shaanxi Province pay more attention to optimize the industrial structure, accelerate the changes in the way of development, promote coordinated development of regional economic, cultivate a new industrial structure, and actively develop new service industries, which aims to the industrial structure escalating, and lay the foundation for industrial development in the thirteen five plan. In order to promote the industrial integration, in 2016, an opinion was pointed out by government of...
Shaanxi Province that they would accelerate the development of service-oriented manufacturing and promote the deep integration of both manufacturing and service industries in the “Made in China 2025” Shaanxi implementation opinion. In 2017, it was also pointed out that would follow the ideas of “stable energy, promote chemical industry, rise electronics, enhance manufacturing, expand the new industries, optimize the tradition” to promote industrial development, strengthen the manufacturing industry restructuring, and simultaneously promote the quality and efficiency of modern service industry. In this context, the promotion of Shaanxi advanced manufacturing and modern service industry integration, has become the main trend of economic development in Shaanxi Province. In this context, the integration of both the advanced manufacturing and modern service industry has become the main trend of economic development in Shaanxi Province.

2 Integration and Interaction between Advanced Manufacturing and Modern Service Industry

In this paper, the integrated industry of Advanced Manufacturing and Modern Service Industry is regarded as an industrial system. And the system is made up of two subsystems: Advanced Manufacturing Industry and Modern Service Industry. According to the existing model and theory, the C-D production function can be used to explain the mechanism of the integration. We assume that the total output of the product in this industry system is, according to the C-D function

\[ Q_T = A L^K \eta \]

Assuming Advanced Manufacturing Industry \( Q_m = \sigma Q \) (0<\( \sigma \)<1),

So the Modern Service Industry and Advanced Manufacturing Industry production relationship is that: which means that. Setting up total factor production, the residual term is, is constant, we can see, industry scale pay the same or scale returns, the two industries have the necessary integration, otherwise it will produce a waste of economic resources. From this we can obtain equations:

\[
\begin{align*}
Q_T &= A_m L_m^\alpha K_m^\beta \eta_m Q_s \\
Q_s &= A_s L_s^\alpha K_s^\beta \eta_s = \frac{1-\sigma}{\sigma} A_m L_m^\alpha K_m^\beta \eta_m
\end{align*}
\]

In the above formula are output elasticity coefficients of advanced manufacturing and modern service industries respectively. Therefore, the elastic coefficient of the integration industry is linked equations by yield, elaborating the relationship between the total output of industry, the output of Advanced Manufacturing and the
output of Modern Service Industry. It reflects the interaction and integration between the Advanced Manufacturing Industry and Modern Service Industry.

3 Empirical Analysis

Based on the input-output method, this paper uses the Input-Output Table of Shaanxi Province in 2007 and 2012 measured the degree of integration between Advanced Manufacturing Industry and Modern Service Industry in Shaanxi Province. This paper chooses four indicators to measure the degree of integration of the two industries, namely: Advanced Manufacturing Industry input rate and demand rate, Modern Service Industry input rate and demand rate. The higher rate of investment in Advanced Manufacturing Industry, indicating that the Modern Service Industry is more reliance on the Advanced Manufacturing Industry and the stronger ability of Advanced Manufacturing Industry fuse into the Modern Service Industry; the higher demand rate of the Advanced Manufacturing Industry, indicating that the Advanced Manufacturing Industry more depend on Modern Service Industry about the intermediate consumption. And the Advanced Manufacturing Industry has stronger power fuses to the Modern Service Industry. This is also true for modern service industries.

3.1 Measurement The Degree of Integration

Intermediate input rate (F): Intermediate investment rate refers to the proportion of other industries in the middle of investment in the total investment in an industry. The formula is:

\[ F_{i,j} = \frac{\sum_{i=1}^{n} x_{ij}}{\sum_{i=1}^{n} x_{ij} + N_j} \quad (j = 1, 2, \cdots, n) \]  

Among them, \( x_{ij} \) represents the intermediate input of the j industrial sector, \( N_j \) represents the value created by the j industry sector.

(1) Intermediate demand rate (G): The intermediate demand rate refers to the proportion of other industries' demand for intermediate products of an industry in the output of this industry. The formula is:
Among them, $\sum_{j=1}^{n} x_{ij}$ represents other industries demand for intermediate products in the $i$ industry, $Y_{i}$ represents the final demand segment in the $i$ industry sector product.

Investment rate of advanced manufacturing industry (Fe-s): Fe-s = the part of investment in Modern Service Industry form the Advanced Manufacturing Industry / total investment in Modern Service Industry

Demand rate of Modern Service Industry (Ge-s): Ge-s = the output of the modern service industry was consumed by the advanced manufacturing industry used in the middle part / the total output of the modern service industry.

Investment rate of Modern Service Industry (Fs-e): Fs-e = The part of investment in Advanced Manufacturing Industry form Modern Service Industry / Total Investment in Advanced Manufacturing Industry

Demand rate of Advanced Manufacturing Industry (Gs-e): Gs-e = the output of the Advanced Manufacturing Industry was consumed by the Modern Service Industry used in the middle part / the total output of the Advanced Manufacturing Industry.

Based on the above four indicators, according to the relevant data in the Input-Output Table, we calculated the corresponding indicators value and analysed the data results.

Tab. 1: Data about Advanced Manufacturing Industry and Modern Service Industry

<table>
<thead>
<tr>
<th>Name of Modern Service Industry</th>
<th>Fe-s</th>
<th>Ge-s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Transmission, Computer, Services and Software</td>
<td>0.1483</td>
<td>0.1499</td>
</tr>
<tr>
<td>Financial Intermediation</td>
<td>0.0222</td>
<td>0.0119</td>
</tr>
<tr>
<td>Real Estate</td>
<td>0.0035</td>
<td>0.0029</td>
</tr>
<tr>
<td>Leasing and Business Services</td>
<td>0.0781</td>
<td>0.3704</td>
</tr>
<tr>
<td>Research and Experimental Development</td>
<td>0.3432</td>
<td>0.1270</td>
</tr>
<tr>
<td>Education</td>
<td>0.0753</td>
<td>0.0033</td>
</tr>
<tr>
<td>Culture, Sports and Entertainment</td>
<td>0.0129</td>
<td>0.0274</td>
</tr>
<tr>
<td>Modern Service Industry</td>
<td>0.0976</td>
<td>0.0982</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of Advanced Manufacturing Industry</th>
<th>Fs-e</th>
<th>Gs-e</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</table>
From the perspective of investment rate, the investment rate of advanced manufacturing industry fluctuation less in 2007 and 2012. The Modern Service Industry investment rate of 2012 is 0.0425 compared with 2007 increased 1.4 percentages. But overall, the Advanced Manufacturing Industry Investment rate is significantly higher than the Modern Service Industry. This indicating that the degree of dependence on investment Modern Service Industry on the Advanced Manufacturing Investment is significantly higher than the advanced manufacturing industry on the modern service industry. And Advanced Manufacturing Industry has stronger power fuses to Modern Service Industry. From the perspective of demand rate, the demand rate of Modern Service Industry is only about 0.04, and it decreased 0.5 percentage points in 2012 compared with 2007. The Modern Service Industry has a lower dependence on the intermediate consumption of the Advanced Manufacturing Industry. The demand rate of Advanced Manufacturing Industry is high, the rate in 2007 is 0.1589 and 2012 is 0.1937. Between 5 years, there is a larger increase. That shows the Advanced Manufacturing Industry more depend on the Modern Service Industry about the intermediate consumption. And the advanced manufacturing industry has stronger power fuses to the modern service industry. The analysis of the input rate and demand rate shows that the Advanced Manufacturing Industry have stronger ability fuse into the modern service industry, and the integrate power is insufficient.

From the specific sub-industry analysis, in terms of input rate, the investment rate of the Advanced Manufacturing Industry about the two service industries including information transmission, computer service software industry and research, experiment development service industry, has decreased in 2012 compared with 2007, but it was significantly higher than other service industries, which showed that there were a higher dependency for the two industries on the Advanced Manufacturing Investment. In addition, apart from the increased dependency on the Advanced Manufacturing investment in the leasing and business services and cultural, sports and entertainment industry, the investment rate of the Advanced Manufacturing Industry has declined about other Modern Service Industry. The investment rate of the Modern Service Industry about electrical machinery and equipment
manufacturing industry has declined slightly in 2012 than 2007, but there become increased in other service industries, such as, it was a largest increase in communications equipment manufacturing industry, which indicated that the capacity of Modern Service Industry into the Advanced Manufacturing Industry is increasing, but the overall integration capacity is still low. In the demand rate, the top two about the demand rate of modern service industries is leasing and business service industry and research and experimental development industry in 2007, the demand rate of the leasing industry was still the highest in 2012, but the demand rate of research and experimental development industry fell sharply from 0.09 to 0.0064. In addition, the lower demand rate of information transmission and computer service software industry indicated that the demand of the manufacturing sector about the knowledge-intensive service industry is low in Shaanxi Province, the knowledge innovation ability of the manufacturing sector is insufficient and the optimization of industrial structure is difficult. The higher intermediate consumption rate of the Modern Service Industry is the high-tech manufacturing, such as communications equipment manufacturing industry and instrumentation machinery manufacturing industry, which showed that the dependency of the high-tech manufacturing industry about the intermediate consumption of the modern service industry kept a higher degree. In the advanced manufacturing industry the ability of the high-tech manufacturing industry fusing into the modern service industry is stronger.

### 3.2 Integration Equilibrium Degree

This paper uses the ratio of the input rate of Advanced Manufacturing and Modern Service industry to represent two industries’ integration equilibrium degree of input. Using the ratio of demand ratio of Modern Service Industry and Advanced Manufacturing Industry indicates the integration equilibrium degree of the two industries in the relation of output and consumption. In theory, the higher the degree of integration, the stronger the fusion ability between the two industries. When the degree of integration equilibrium is close to 1, it shows that the two industries depend on each other to promote and develop together.

<table>
<thead>
<tr>
<th>Year</th>
<th>Fe-s</th>
<th>Fs-e</th>
<th>Ge-s</th>
<th>Gs-e</th>
<th>Integration equilibrium degree(input)</th>
<th>Integration equilibrium degree(consume)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>0.0976</td>
<td>0.0284</td>
<td>0.0455</td>
<td>0.1589</td>
<td>3.44</td>
<td>0.29</td>
</tr>
<tr>
<td>2012</td>
<td>0.0982</td>
<td>0.0425</td>
<td>0.0400</td>
<td>0.1937</td>
<td>2.31</td>
<td>0.21</td>
</tr>
</tbody>
</table>
In 2007 and 2012, the integration equilibrium degree in input relationship between the Modern Service Industry and the Advanced Manufacturing Industry in Shaanxi was significantly higher than that in the consumption relationship. This is mainly due to the Advanced Manufacturing Industry have stronger ability fuse into the modern service industry. The equilibrium degree of integration of the two industries in the input relationship has declined, but the fusion value is still greater than 1, which shows that the Advanced Manufacturing Industry have stronger integration ability. However, the level of integration has declined. The consumption of the relationship of integrate equilibrium degree decreased and the value is low, this may explain the Modern Service Industry lack power fuse into the Advanced Manufacturing Industry, and the development of Advanced Manufacturing Industry depend more on Modern Service Industry in consumption, which caused integration equilibrium degree in the consumption is low. In general[1][2], the current integrate situation between the Advanced Manufacturing Industry and the Modern Service Industry in Shaanxi Province is that the Advanced Manufacturing Industry has a strong ability to integrate into the Modern Service Industry, and the driving force of the Modern Service Industry to the Advanced Manufacturing Industry needs to be further improved. Overall, the two have been in the depth of integration stage.

4 Conclusion

This article regards the industry after the amalgamation of the two industries as a system. The Advanced Manufacturing Industry and the Modern Service Industry in Shaanxi are regarded as two subsystems, and on this basis, we researched the path of the integration of the two industries.

On this basis, according to the Input-Output Table data in 2007 and 2012, we calculated the integration between two industries in Shaanxi province. And the result shows that the Advanced Manufacturing Industry has a strong ability to integrate into the Modern Service Industry. But the integration between the two is becoming more balanced. Among them, Manufacture of Communication Equipment, Computers and Other Electronic Equipment the ability to integrate into the Modern Service Industry is strongest. The intermediate demand for the Modern Service Industry in the Advanced Manufacturing Industry is declining, and the demand is higher for traditional services such as Leasing and Business Services, while the demand for knowledge intensive industries is lower. The results show that there are unreasonable industrial structure in Advanced Manufacturing Industry and Modern Service Industry in Shaanxi Province. Promoting the optimization and upgrading of the industrial structure and speeding up industrial convergence are conducive to speeding up the economic development of Shaanxi province. In fact, the present situation of Advanced Manufacturing Industry in Shaanxi province is superior to
that of Modern Service Industry, which is consistent with the empirical results. So Shaanxi Province can give priority to the development of advanced manufacturing. Second, do a good job of integration and development with modern service industry. And then utilizing the high-tech content of advanced manufacturing industry to promote the upgrading and transformation of Traditional manufacturing Industry.

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