Empirical Analysis of Global Value Chain Upgrading Model of Chinese Manufacturing Enterprises

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Abstract
The new scientific and technological revolution has brought about great changes in the world economic structure, and also brought about a fundamental change in the paradigm of global production organization. The mode of division of labor characterized by the global value chain is gradually dominating the process and pattern of the current economic globalization. China's economy, as an important part of the global value chain, has evolved from the original equipment manufacturer to today's direct foreign investment. China's manufacturing industry has been integrated into the world production network through international production. The sharing of interests in the global value chain also occupies an important place. Yet China produces 60% of the world's manufacturing output, but gains only 20% of the global value chain. Therefore, the study on the global value chain upgrade of manufacturing industry has important theoretical and practical significance. Based on the brief introduction of the mechanism of industrial upgrading of China's manufacturing industry under the global value chain, this paper analyzes the main influencing factors of China's manufacturing industry upgrading, and constructs the global value chain upgrade model of manufacturing enterprises. It is hoped that the discussion of this paper can be used for reference.

Keywords: Manufacturing; Global value chain; Industrial upgrading; Model

1. Introduction

Since the beginning of the new century, the mode of resource integration and international division of labor in the world has undergone tremendous changes, from the initial international division of labor between industries to the international division of labor within the product. Transnational capital, which is driven by the pursuit of the highest interest, has organized economic activities around the world, and the cross-border economic transfer has become more and more frequent. In this globalized context, global trade with the integration of markets and the fragment of production links developed countries with developing countries. Fundamental changes have been made in the nature, flow direction and flow rate of world trade. In order to revitalize the economy of this region, the economic regions are increasingly dependent on embedding local economic activity into the global value chain to gain more value. The competition for high value added strategic links has also become the focus of the global competition for mobile space. In this context the competition between enterprises has been transformed from the initial product competition to the global value chain embedded in the enterprise. At the global value chain, enterprises are engaged in various value-added activities such as design, product research and development, production and manufacturing, and sales. The position of enterprises in global value chain plays an important role in the competitiveness of enterprises. China's manufacturing industry entered a period of rapid development in the 1990s after the starting stage with external closure and import substitution as a feature in the 1970s. The level of international division of labor in the manufacturing sector is deepening. The regions, especially the southeast coastal cities, rely on the advantages of status, labor and natural resources to participate in the global value chain. The investment of international transnational capital and the large absorption of outsourcing orders have resulted in rapid growth in the processing trade industry characterized by labor-intensive labor force. Therefore, it is particularly important to understand the position and role of our manufacturing industry in the global value chain and the mechanism and path of manufacturing upgrading.

2. Upgrading mechanism of China's manufacturing industry under the global value chain

Gereffi (1999) and Ernst (2002) argue that developing countries, when participating in the division of labor in the global value chain, can transcend the stage of industrial growth through technology transfer to achieve cross-industry industrial upgrading. This paper argues that the mechanism of global value chain division for industrial upgrading in developing countries can be represented by Figure 1:
2.1. Foreign direct investment provides capital supplement for industrial upgrading of manufacturing industry

In the global value chain, foreign direct investment has the function of capital supplement and guidance for the development of China's manufacturing industry upgrading. Developing countries are generally in the initial stage of development, and there are generally problems of insufficient investment and "savings gap". In the context of global value chain division of labor, foreign investment can directly make up for this gap, thereby improving the level of domestic investment and promoting the development of some domestic manufacturing industries.

2.2. Technology learning effect promotes internal upgrading of manufacturing industry

In the global value chain environment, developing countries can accumulate technological resources and power needed by the internal upgrading of manufacturing industry by learning advanced technology. In the division of value chain, developing countries through a large number of high-tech imports of intermediate products, production equipment, etc., could further broaden the enterprise vision, thereby enhancing the enterprise's technology use and innovation. With the deepening of the value chain division of labor, due to the technical spillover effect, the technical level and human resource of domestic related industries has been greatly improved, so as to promote foreign companies to transfer their R&D center and aftermarket and other high value-added links gradually to the developing countries. In order to pursue the greatest economic benefits, the domestic enterprises are also willing to transfer OEM way of processing and assembly into ODM way of self-design and processing, or to OBM way of self-brand processing and sales.

2.3. Stimulating effect of service value chain on the internal upgrade of the manufacturing industry

The development of division of value chain in service industry has a significant pulling effect on the internal upgrading of manufacturing industry in developing countries. In the context of expanding the scope and depth of value chain division of labor, the development of service value chain is relatively rapid, which provides a powerful impetus for manufacturing industry upgrading in developing countries. As seen in Figure 2, from the perspective of enterprises, industrial upgrading in developing countries is basically changing from low value-added processing and assembly to high value-added R&D and aftermarket links. R&D and after-sales service is essentially a production service category. Producer services is a new industry that provides service products and labor for producers at different stages of the production process, such as logistics, warehousing, supporting production and financial services. There is an important industrial correlation effect between the production service industry and the upgrading of manufacturing industry. The specific performance is: first, the development of high-end manufacturing needs high-end manufacturing services to match. Second, productive
service enterprise is part of the original manufacturing. Due to its high technology, high value-added features, its development could promote manufacturing upgrade from the processing assembly part to high technology intensive industries links including research and development, design, brand building and maintenance, so as to make the manufacturing enterprises to realize upgrading and transformation from the traditional sound type to the core business including advanced technical services, information, financial services, etc.

![Image of U-type value-added curve of value chain division](image)

Figure 2. U-type value-added curve of value chain division

3. Main influencing factors of China's manufacturing upgrading

3.1. Supply of capital elements of senior talent

Senior talent production elements and advanced human capital have a significant driving effect on the economic growth of a country. According to minssell's theory, the addition of human capital can improve the marginal productivity of material capital, thus further improving the production efficiency of the production process. The advanced human capital that can play a role in the upgrading of a national industry is mainly embodied in the specialized human capital and entrepreneur human capital that the country possesses.

![Image of promotion of senior talents to industrial upgrading](image)

Figure 3. Promotion of senior talents to industrial upgrading

3.2. Technical ability

Technical ability refers to the collection of technology and knowledge. The technical capacity required for enterprise upgrading could be an endogenous capability, that is, the ability of an organization to increase its technology through its own accumulation, or an exogenous capacity, that is, the spillover effect of foreign investment and the technical capacity gained from the GVC relationship. The key factor of industrial upgrading in our country lies in improving the ability of absorbing and digesting technology.

3.3. Development of productive service industry

Producer service industry is a process industry that promotes the growth of other sectors of the national economy. It is the glue of economy and the main driving force for stimulating commodity production. After the reform and opening up, our government has made major adjustments to the past industrialization strategy, and put forward the development strategy of focusing on the market, demand orientation, and steadily developing the light industry, to promote the coordinated development of heavy industry and light industry.
The C-H index defined by Chinese scholar Huang Zhicong and Pan Junnan is an indicator of the degree of change in the structure of the manufacturing industry. The mathematical expression is: \( C-H = \frac{\text{total output value of capital products}}{\text{total output value of consumer products}} \). The higher the C-H value, the faster the manufacturing sector is moving to the heavy industry, and vice versa, the faster to the light industry. Taking into account the availability of data, this paper uses the gross output value of heavy industry instead of the total output value of capital products, with light industrial output value instead of total output value of consumer goods.

<table>
<thead>
<tr>
<th>Countrywide</th>
<th>Total output value of light industry</th>
<th>Gross output value of heavy industry</th>
<th>C-H value</th>
<th>Growth value of service industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>22034</td>
<td>23455</td>
<td>1.034556</td>
<td>7.7</td>
</tr>
<tr>
<td>2009</td>
<td>26897</td>
<td>29077</td>
<td>1.047863</td>
<td>5.3</td>
</tr>
<tr>
<td>2010</td>
<td>32344</td>
<td>33976</td>
<td>1.113456</td>
<td>9.2</td>
</tr>
<tr>
<td>2011</td>
<td>37489</td>
<td>39567</td>
<td>1.153936</td>
<td>9.4</td>
</tr>
<tr>
<td>2012</td>
<td>41368</td>
<td>42894</td>
<td>1.193456</td>
<td>8.6</td>
</tr>
<tr>
<td>2013</td>
<td>45286</td>
<td>47889</td>
<td>1.289789</td>
<td>8</td>
</tr>
<tr>
<td>2014</td>
<td>51356</td>
<td>55457</td>
<td>1.345768</td>
<td>8</td>
</tr>
<tr>
<td>2015</td>
<td>76893</td>
<td>79567</td>
<td>1.645785</td>
<td>9.9</td>
</tr>
<tr>
<td>2016</td>
<td>99789</td>
<td>104562</td>
<td>1.876590</td>
<td>11.8</td>
</tr>
</tbody>
</table>


As can be seen from the table above, China's service industry and manufacturing industry interact, influence each other and develop together. The growth of service industry plays an important role in upgrading the industrial structure of manufacturing industry. The coordinated development of service industry and manufacturing industry is an important guarantee to enhance the competitiveness of the manufacturing market and to promote the upgrading of its industrial structure. At present, the development of most producer service enterprises in China is still relatively backward compared with developed countries, and is in a period of rapid development. Due to the constraints of resources, environment and other factors, it is not possible to follow the old path of traditional industrial structure upgrade mode, namely, the living manufacturing industry is disconnected from the service industry.

3.4. Export trade

As the process of production socialization has accelerated, the links between the world's economies have become ever closer. The change of industrial structure in a country is increasingly influenced by the structure of foreign trade. In today's economic globalization, the impact of export demand and import supply on the industrial structure adjustment of China's manufacturing industry has been fully reflected. The adjustment of import structure has caused the adjustment of the production structure of our country's manufacturing industry. For example, in 2008 the proportion of the textile industry in China's manufacturing industry is up to 11.98%, but in 2014 the proportion of communication equipment, computer and other electronic equipment in manufacturing output is highest, up to 22.6%, and the proportion of the textile industry is down to 4%. The influence of import supply on industrial structure adjustment is mainly manifested in the accumulation of capital and technical elements brought by import. Generally speaking, imported products can be divided into capital products, intermediate products and consumer products according to their final use. The main characteristics of developing countries are insufficient capital products at home, so it is of great significance to develop capital products for capital accumulation and industrial restructuring in developing countries.

4. Construction of global value chain upgrading model for Chinese manufacturing enterprises

4.1. Selection of variables

In order to improve the revealing ability of the calculation model, this paper increases the sample size. The panel data of 8 years are selected from 30 provinces in China. The sample size is 249.

Variable declaration:

The explanatory variable of the model is the manufacturing upgrading, and the per capita tax is used to express the development of the manufacturing industry. The qualitative changes represented by the variables of technological innovation are: (1) the amount of patent applications (Isper); (2) R & D expenditure (zl); (3) the proportion of local financial appropriation to the total local finance (bk). Based on the previous experience, this paper takes the degree of dependence on foreign trade (wm) and the degree of marketization (gz) as the institutional innovation variables.

SPSS is used for descriptive statistical analysis of the above variables, the structure is as follows:

Table 2. Descriptive statistics analysis results of each variable
### 4.2. Correlation analysis of single variables

Through coefficient matrix shown in Table 3, it can be found that the variables are positively correlated. That is to say, the development of China’s manufacturing industry has a correlation relationship in the same direction respectively with the amount of patent applications, R&D expenditure, local finance and technology funding accounted for the percentage of total local financial expenditure, foreign trade dependence, local non-state fixed assets accounted for the proportion of local total fixed assets investment, and the level of confidence is significant at 10%.

#### Table 3. Correlation coefficient matrix of single variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isper</td>
<td>245</td>
<td>176.55</td>
<td>303.26</td>
<td>2.4</td>
<td>1754.0</td>
</tr>
<tr>
<td>zl</td>
<td>230</td>
<td>459.23</td>
<td>1810.24</td>
<td>1.0</td>
<td>20887.0</td>
</tr>
<tr>
<td>yf</td>
<td>247</td>
<td>63.24</td>
<td>86.10</td>
<td>0.2</td>
<td>504.4</td>
</tr>
<tr>
<td>bk</td>
<td>247</td>
<td>1.60</td>
<td>0.94</td>
<td>0.3</td>
<td>5.5</td>
</tr>
<tr>
<td>wm</td>
<td>247</td>
<td>0.17</td>
<td>0.22</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>gz</td>
<td>247</td>
<td>0.55678</td>
<td>0.136787</td>
<td>0</td>
<td>0.9</td>
</tr>
</tbody>
</table>

#### Note:
SPSS 1.0 is used for calculation

### 4.3. Model setting

This paper adopts panel data regression analysis to set the model as:

\[
y_{it} = \alpha_i + X_{it}\beta + \epsilon_{it}, \quad i = 1,...,N; t = 1,...,T
\]

Per capita industrial profit is expressed as \( y_{it} \), which is defined as The ratio of the local industrial profits tax in the t-th year of the i-th province to the local population of this province; \( X_{it} \) is a self variable vector, which represents the technological innovation and institutional innovation factors that affect the per capita tax. \( \epsilon_{it} \) is a random error. The intercept \( \alpha_i \) indicates the influence of the individual, i.e. the variables that reflect the individual differences that are ignored in the model.

In this paper, based on panel data, this paper adopts the bidirectional fixed effect model of province and year, which has the following advantages. First of all, there may be non-observable heterogeneity factors of different historical backgrounds or natural geographical conditions between different provinces and regions. These heterogeneity factors, once associated with the error term and the independent variable vector, will result in errors of regression results. The model will show endogenous problems caused by default variables. And these heterogeneity are all reduced by the order difference in the fixed effect model, which makes the regression results of this paper more robust. Secondly, based on the Chinese provincial fixed effect of panel data, the analysis can effectively expand the sample size, thus satisfying the gradual nature of large samples in statistics.

### 4.4. Result analysis

The fitting results obtained by SPASS 1.0 are shown in Table 4:

#### Table 4. Model regression results

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Fixed effect model</th>
<th>Fixed effect model</th>
<th>Stochastic effect model</th>
<th>Stochastic effect model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isper</td>
<td>0.013</td>
<td>0.013</td>
<td>(2.13)**</td>
<td>(1.98)**</td>
</tr>
<tr>
<td>zl</td>
<td>1.338</td>
<td>1.348</td>
<td>(7.64)**</td>
<td>(7.75)**</td>
</tr>
<tr>
<td>bk</td>
<td>8.792</td>
<td>27.375</td>
<td>(0.45)</td>
<td>(1.53)</td>
</tr>
<tr>
<td>wms</td>
<td>876.984</td>
<td>945.336</td>
<td>(7.26)**</td>
<td>(9.45)**</td>
</tr>
<tr>
<td>Proportion of non-fixed assets</td>
<td>242.784</td>
<td>934.356</td>
<td>(2.74)**</td>
<td>(2.45)**</td>
</tr>
</tbody>
</table>
Model fitting results show that the amount of patent applications, R&D expenditure, local finance and technology funding accounted for the percentage of total local financial expenditure, foreign trade dependence, local non-state fixed assets accounted for the proportion of local total fixed assets investment all have positive correlation relationships with development of manufacturing industry. But no matter in which model the number of patent applications, research and development expenditures, the estimated coefficient of foreign trade dependence are positive. The proportion of local science and technology appropriation to local fiscal expenditure is not significant in all equations. This can be explained by the fact that the impact of technology inputs on the economy is not "immediate" and there will be a time lag and a cumulative effect. In other words, the development of the manufacturing industry will not be immediately apparent to the development of the research funding, which will be seen in the years to come. There is also the possibility that our funding for science and technology is not fully invested in research and development, and there is room for improvement in the current technology funding system.

5. Conclusion

In the context of international division of labor, the external force driving effect of global value chain has great influence on industrial structure upgrading in developing countries. Since the 1990s, the global value chain network has been introduced in various provinces of China. Especially in the coastal developed cities, they absorbed the international capital, a large number of industrial transfer and outsourcing orders, which make the low value-added labor-intensive industry and manufacturing industry of the processing trade develop rapidly. But at present, China’s manufacturing industry is still in the middle level of competition, and is at the lower end of the global value chain. Therefore, through independent technology innovation to improve China's position in the global value chain, the government should create favorable environment for the transformation and upgrading of enterprises, through various channels to enhance the rationality of structure of human capital in our country. Through the above measures, the industrial upgrading of China’s manufacturing industry in the global value chain would be successfully realized.

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References: