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Value Chain Position Rising in Chinese High Technology Industry

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Abstract

From the view of R&D contribution, this paper studies how the positions of Chinese high technology industries rise in the global value chain. The indicators of embedding and position of Chinese industries in the global value chain are measured based on the bilateral trade data and noncompetitive input-output table covering 44 major economies from 2000 to 2014. The empirical analysis is also conducted in order to measure the effects of R&D contribution to high-tech industries' position and specialty in the global chain. The results show that R&D contribution improves Chinese industries embedding and position in the global chain. The research also finds lab capital and technology play key role in the process.

Keywords

High-tech industry, Value-added, Position in Global Value Chain.

1. Introduction

Koopman et al. (2014) suggest R&D efficiency can upgrade the position in the value chain. This effect is also reinforced in China Market, which is being transformed from the centralized market to competitive market. Our study finds that the R&D efficiency in the highly competitive industry is more likely to upgrade its position in the value chain than the centralized industry that the Chinese government heavily invested and biased in regulation (Liu et al., 2016）. To take manufacturing industry as example, Chinese products generally are still mainly low technology and R&D efficiency that results in this industry still stays at the tail of the value chain. With increasing of Chinese labor cost, labor resource endowment is fading (Liu, W., 2015). Although China is one of the biggest manufacturing hubs in the world, the term “big” is focusing more on the scale than the R&D capacity. Under the pressure of the high technology shortage and growing labor cost, upgrading the industry in global value becomes more and more difficult.

Most studies in the global value chain believes China has already had capacity involved in the global market (Zhu et al., 2006; Cheng, D., 2015). However, the disagreement rises at the exact China position in the global value chain. On the one side, the value-added export is decreasing from 88% in 1995 and 67% in 2009. (Cheng, D., 2015). On the other hand, the productivity of exports in the industries, such as TV, broadcast, medical equipment and etc., was dramatically increasing. (Liu, W., 2015). But the certain industries, such as new energy, biology, material and etc., are still very weak. Many researchers believe that firm’s ownership structure and government bias have significant influence on the industry R&D efficiency. The firm’s R&D efficiency not only depends on firm itself, but also depends on the market environment. There are two different opinions in China about market environment. The centralized market usually consists of only several giant corporations accounting for major industrial income. These corporations mostly either are state own or have joint equity with government.

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2. Mechanism Analysis

The industry position rising in the global value chain depends on many factors.

2.1. Human Capital

It is well known that human capital is the key factor of high-tech firm gaining excess return. The human capital is the main body of digesting, absorbing, developing and adopting new technology. In terms of intermediate products' export in high-tech industries, they need continuous investment in manufacturing and R&D so that they can maintain irreplaceable role. This process requires the people who have good education background and adapts to fast-changing demands. Especially for the emerging economy, like China, the human capital plays the key role in learning from competitors and maintaining the added value. Qiu et al. (2012) have already give the empirical evidence that the human capital has positive impact on the position in global value chain.

2.2. R&D Efficiency

R&D efficiency is the indicator of several inputs and outputs. The R&D efficiency is expected to increase the product's added value and upgrades the position in the global value chain. In China, the productivity from the high-tech innovation is still low. The low value-added work, such as assembly, assorting and etc., constitutes main work in the high-tech industry and fully utilizes the endowment of low cost of human resource. The advantage of this role initially pinpointed in the global value is very obvious. On the one hand, the high-tech products themselves compel the Chinese high-tech industries to update their technology in order to keep with up their collaborator's requirements. With the deepening cooperation between upstream and downstream internationally, the high-tech industries in China gradually build up the ecologic system which is the foundation for exporting the high value-added products. On the other hand, the low value-added work in the global value chain can be regarded as the comprehensive learning opportunity. The learning contents include not only the technology itself, but also management method, business operation mode, suppliers and customers connections. The research finds that the technology spillover has positive correlation with the growing value-added export. This is the process of constantly breaking the technology barrier and building up the new technology (Levin and Tadelis, 2010).

3. Empirical Analysis

3.1. Baseline Model

The model uses vertical specialization and vertical trade to measure the industry position in the global value chain. The baseline model is:

$$GVC\_Position_{it} = \beta_0 + \beta_1 contribition_{it} + \beta_n Control_{it} + \varepsilon_{it}$$

In above equation, GVC_Position_{it} is denoted as the position of global value chain . $contribition_{it}$ is the proxy of the R&D efficiency. $Control_{it}$ represents the control variables, which include the gravity model variables, R&D cumulative capital, human capital and etc. ε_{it} is denoted as random error. In addition, the influence from the export target market is also considered.

The process of model construction also considers the following factors. First, R&D efficiency is measured based on the Stochastic Frontier Approach (SFA) covering 16 high-tech industries from 2000 to 2014. R&D efficiency illustrates different industry performance during the various time periods. Due to the time gap between input and output, we delay one period of

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output in order to let the input fully function in the value chain. Second, the input variables in SFA are measured as new products' value growth and new products' market value. These two variables represent not only products' commercial performance, but also R&D effects in the perspective of products' value and its manufacturing process improvement. Third, we consider the scale of fixed asset, which is calculated based on the perpetual inventory method, since the massive amount of old fixed assets may defer technology upgrading.

3.2. R&D Efficiency

Due to the data consistency, this paper select 16 high-tech industries from China Statistics Yearbook on High Technology Industry (CSYHTI), which are Manufacture of Chemical Medicine, Production of Finished Traditional, Manufacture of Biological Medicine, Manufacture of Airplanes, Manufacture of Communication Equipment, Manufacture of Broadcasting and TV Equipment, Manufacture of Radar and Its Fittings, Manufacture of TV Set and Radio Receiver, Manufacture of Electronic Appliances, Manufacture of Electronic Components, Manufacture of Other Electronic Equipment, Manufacture of Entired Computer, Manufacture of Computer Component and Peripheral Equipment, Manufacture of Office Equipment, Manufacture of Medical Equipment and Appliance, Manufacture of Measuring Instrument and etc. We treat each industry as the Decision Making Unit (DMU), indicated as DMUi (i=1,2…n). There are m outpEuts and s inputs for each DMU. The Data Envelopment Analysis (DEA) model is illustrated as following:

$$\min[\theta\text{-}\varepsilon(\textstyle\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^r)]$$

$$\text{s.t.} \sum_{j=1,j\neq j_0}^{n} \lambda_j x_{ij} + s_i^- = \theta x_{ijo} \qquad i = 1,2,\dots,m$$

$$\sum_{j=1,j\neq j_0}^{n} \lambda_j y_{rj} - s_r^+ = y_{ijo} \qquad r = 1,2,\dots,s$$

$$\lambda_j \geq 0, \qquad j = 1,2,\dots,n; \quad s_i^- \geq 0, \qquad s_r^+ \geq 0$$

Where, xij is the j input for i DMU, and yrj is the j output for r DMU.

The R&D expenditure with perpetual inventory method is expressed as:

$$RD_{CapitalStock} = RD_{it} + \sum_{1}^{n}(1+r)^{n} RD_{i(t-n)} \qquad (n=1...4)$$

Where, RDit is the R&D expenditure in i industry in year t, and r is the depreciation rate.

The data is selected from China Statistical Yearbook (CSY), China Statistics Yearbook on High Technology Industry (CSYHTI) and China Statistical Yearbook on Science and Technology (CSYST) and China's Industrial Enterprise Database from 2000 to 2014. We delay one period of time because of the R&D transforming from input and output.

3.3. Control Variable

Following (Liu et al., 2016), The main control variables are GDP, trade distance, whether inland or not, trading risk, industry capital intensity, industry scale and etc.

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3.4. R&D Efficiency and Value Chain

The column (1), (2), (3) and (4) in Table 1 report the effect of R&D efficiency on the position in value chain. The results show that R&D efficiency has significantly positive effect on the position and specialization in value chain.

Table 1. The effect of R&D efficiency on the GVC

	Position in GVC			
Variables	(1)	(2)	(3)	(4)
Contribution	0.001**	0.003***	0.002**	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
Ln(CHN_GDP)		-0.00001*	-0.00003*	-0.00001*
		(0.0001)	(0.0001)	(0.0001)
Ln(42_GDP)		0.001***	0.001***	0.001***
		(0.00003)	(0.00003)	(0.00003)
Export risk		-0.0002***	-0.0002***	-0.0002***
		(0.00003)	(0.00003)	(0.00003)
Ln(distance)		-0.001***	-0.001***	-0.001***
		(0.0001)	(0.0001)	(0.0001)
Density	0.0004*		0.002**	0.002*
	(0.001)		(0.001)	(0.002)
Size	0.0003***			-0.00003*
	(0.00002)			(0.0001)
Observations	2,520	2,520	2,520	2,520
Adjusted R2	0.332	0.608	0.611	0.615
Residual	0.003	0.003	0.003	0.003
	(df= 2517)	(df= 2515)	(df= 2514)	(df= 2513)
F test	418.26***	781.73***	653.26***	559.76***
	(df=3;2517)	(df=5;2515)	(df=6;2514)	(df=7;2513)

Consistent with the expectation, the results show that R&D efficiency has positive effect on the position in value chain.

4. Conclusion

The paper builds up the theoretical model and prove that R&D efficiency in the high-tech industries significantly raise the position in the value chain. Although China has developed so fast, yet there is still a long trip to go. Many exporting goods in high-tech industry is still low. Improving R&D efficiency can raise the position in the value chain.

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