Research on Interaction Mechanism Between China's Manufacture NVC and "Belt & Road Initiative " RVC -- Based on Simultaneous Equation Model

Nina Zhu[1*], Yingqiao Qin[2]

[1]*School of Economics and Management, Beijing University of Technology, Beijing, Beijing 100124, China*
[2]*School of Economics and Management, Beijing University of Technology, Beijing, Beijing 100124, China*
*Corresponding author. Email: zhunina1210@bjut.edu.cn

ABSTRACT

This paper aims to study interaction mechanism between China's manufacture national value chain (NVC) and "Belt & Road Initiative" regional value chain (RVC). It starts from calculation of interaction coefficient, which is described by value chain position index, and then uses simultaneous equation model and 2SLS & 3SLS methods to make an empirical analysis. The paper draws the conclusion that NVC of Chinese manufacture industry and RVC of "BRI" have mutual positive effects, the regression elastic coefficient of ln nvc to ln rvc is 1.078, and the elastic coefficient of ln rvc against ln nvc is 2.367.

Keywords: Manufacture national value chain (NVC), Belt & Road Initiative Regional value chain (BRI RVC),

Interactive mechanism, Simultaneous equation model

1. INTRODUCTION

From the very beginning on setting up the Global Value Chain (GVC), its process and development were dominated by some developed countries such as the United States and EU. Facing the challenge of new trade situation, China has gradually lost his traditional advantage on manufacturing industry, however, "Belt & Road Initiative" strategy was proposed in 2013, the regional value chain began to form and became more and more important for China. To some extent, it provides an opportunity to develop "B&R" RVC for China's manufacturing industry and meanwhile it provides a new path to climb up on GVC. Since the reform and opening up, China has gradually formed its domestic value chain based on its lower labour cost and regional comparative advantages, and now China has already built up his own NVC and also try to become the leader within "B&R" RVC. This paper tries to make a study on the interaction mechanism between NVC and RVC. Firstly, we used the data of domestic manufacturing industry and its sub-divided industries to measure the status with indicators and evaluate the present conditions. Then, we used industrial competitiveness indexes to analyse the "B&R" RVC of manufacturing industry, and also made a comparison between original condition of China's manufacturing industry in RVC and the current situation of RVC development. Finally, we took 2SLS & 3SLS empirical analysis and drew the conclusions.

2. LITERATURE REVIEW

Since Gereffi (2000) [1] firstly proposed the concept of global value chain, study on this topic of global value chain has attracted much more attention. Foreign researchers like Hummsels (2001) [2], Koopman (2014) [3]and some other scholars provided several effective methods to study this topic. While Chinese researcher Liu Zhibiao (2011) [4] firstly presented the concept of NVC and the differences between industrial upgrading on NVC and emerged into NVC, he put forward two paths on the regional economy coordinated development, one path is from domestic to international, the second is between different areas in China.

And lately, Zhang Shaojun & Liu Zhibiao (2013) [5] tried to make quantitative analysis between NVC and RVC based on the simultaneous equation model, then Chinese scholar Shan Ying (2018)[6] also studied the correlation between NVC and GVC, especially the detailed information analysis and measurement on the regional interior of a country's value chain and also used vertical specialization index to calculate the participation on a certain region and various industries in the value chain. The common point of these two studies is adoption of simultaneous equation model and conducting an empirical research by combining the input-output data in the region.

3. EMPIRICAL ANALYSIS AND DATA

In this section, we took empirical tests for these three following hypotheses:

Hypothesis 1: NVC and RVC are positively correlated and promote each other.

Hypothesis 2: Market size and technological gap have a positive effect on RVC.

Hypothesis 3: Industrial externalities have a positive effect on NVC.

Based on the model of Zhang Shaojun & Liu Zhibiao (2013), we made some new expansion (see Table 1). The data and variables were designed as follows: The calculation method of domestic value chain data selection from China Jiangsu province and Guangdong province as computing $\ln nvc_{i,p,t}$ of the original data source, respectively in combination with national statistical yearbook, Jiangsu statistical yearbook, Guangdong statistical yearbook and China industrial statistical yearbook of input and output data is calculated. Regional value chain $\ln rvc_{i,p,t}$ is based on the UIBE GVC database part of countries along the "B&R", the calculated value chain to participate in the index.

At first, we assumed that Chinese manufacture had almost close to dominate the RVC, then the interaction mechanism between NVC and "BRI" RVC were studied, and in this paper we also proposed the sub-regional value chain, so this paper set up simultaneous equation model as follows:

$$\ln rvc_{i,p,t} = \alpha_0 + \alpha_1 \ln nvc_{i,p,t} + \alpha_2 \ln ie_{i,p,t} + \alpha_3 \ln ms_{i,p,t} + \alpha_4 \ln tg_{i,p,t} + \varepsilon_{i,p,t} \quad (1)$$

$$\ln nvc_{i,p,t} = \beta_0 + \beta_1 \ln rvc_{i,p,t} + \beta_2 \ln ie_{i,p,t} + \beta_3 \ln ms_{ipt} + \beta_4 \ln lr_{i,p,t} + \mu_{i,p,t} \quad (2)$$

For a country and a region, ovc=rvc+nvc , so the following equation is derived:

$$\ln ovc_{i,p,t} = \gamma_0 + \gamma_1 \ln rvc_{i,p,t} + \gamma_2 \ln nvc_{i,p,t} + \delta_{i,p,t} \quad (3)$$

Among them, i, p, t indicated in t year province i industry. In this section, the participation index of NVC was defined by referring of Hu Hao et al. (2020) [7], and the following indexes were constructed. The position index of the domestic value chain of the manufacturing industry was measured by using the relevant data in China Industrial Statistical Yearbook and the statistical yearbook data of Guangdong province and Jiangsu Province.

$$NVC\_Position_{ij} = \ln\left(1 + \frac{IV_{ij}}{E_{ij}}\right) - \ln\left(1 + \frac{FV_{ij}}{E_{ij}}\right) \quad (4)$$

Formula (4) were used to measure the participation of China's manufacture industry and its segmented industries in NVC, the calculated results were shown in Table 2. Seen from the table, result of position index was within the range of 0.1-0.15, the overall trend was slowly rising up, which indicated that the deepening of China's manufacture's participation in NVC. It can be seen that China's manufacturing industry is also in a climbing up stage, and a complete NVC system needs to be built if China's manufacturing industry wants to achieve a higher value chain climb.

According to the KPWW method, the indexes of RVC participation rate index and status index were constructed, and the position index of RVC was calculated in combination with UIBE GVC database. In the UIBE GVC

database, select "B&R" countries. The position index of RVC is the regional value chain participation:

$$RVC\_Position_{is} = \ln\left(1 + \frac{IV_{is}}{E_{is}}\right) - \ln\left(1 + \frac{FV_{is}}{E_{is}}\right) \quad (5)$$

In Formula (5), the overall RVC participation rate is determined by the forward and backward participation rate. Combined with the analysis framework of added value of trade, it was measured based on the UIBE GVC database.

Table 3 shows the comparison of China's manufacturing position index in RVC in 2013 and 2017.

Table 1 Main Variable and explanation

Variable types	Variable	Variable definitions	Variable expression	Symbols expected
Endogenous variable	RVC	The degree to which p province i industry is integrated into the "The Belt and Road" regional value chain in t years	ln rvc	+
Endogenous variable	NVC	The degree to which p province i industry is integrated into the domestic value chain in t years	ln gvc	+
Endogenous variable	OVC	The degree to which p province i industry integrates into the external value chain in t years	ln ovc	+
Exogenous variable	Industrial externality	In t years, the number of i industry enterprises in p province/the number of national industry enterprises	ln ie	-
Exogenous variable	The size of the market	In year t, p provincial GDP/ national GDP	ln ms	+
Exogenous variable	Labor rate	In year t, the average balance of net fixed assets in the i industry in p province/the average annual number of all employees in the i industry in p province	ln lr	+
Exogenous variable	Technology gap	In year t, the labor productivity of all employees in the i industry in p province/the labor productivity of all employees in the i industry in China	ln tg	-

Table 2 Index of China manufacture's NVC position

Year	$NVC\_Position_{ij}$
2013	0.12537
2014	0.13258
2015	0.14341
2016	0.13634
2017	0.14369
2018	0.14597

Table 3 Comparison of the position index of Chinese manufacturing industry in the "B&R" regional value chain

Manufacturing classification	2013	2017
Low-end manufacturing	0.357	0.457
Mid-end manufacturing	0.210	0.231
High-end manufacturing	0.087	0.153

4. EMPIRICAL RESULTS

According to the above recognition test, the equation satisfies the recognition condition. Therefore, 2SLS and 3SLS methods are respectively used for regression to study the relationship between NVC and RVC.As shown in the above Table 4, from the analysis of regression results of 2SLS and 3SLS, the regression results of 3SLS are closer to the actual situation. **According to equation (1)**, the regression coefficient of ln nvc to ln rvc is 1.078. The regression coefficient of ln ie to ln rvc is obviously negative, and its coefficient is -0.247. The coefficient of ln ms to ln rvc is 12.642. The regression coefficient between ln tg and ln rvc is positive and its coefficient is 1.946. **According to equation (2)**, the coefficient of ln rvc against ln nvc is 2.367. The coefficient of ln ie to ln nvc is 0.255. The coefficient of ln ms to ln nvc is significantly negative, and its coefficient is -36.443. The coefficient of ln lr to ln nvc is -0.42. **Seen from equation (3)**, the coefficient of ln nvc against ln ovc is 0.636. The coefficient of ln rvc against ln ovc was significantly positive, and its coefficient was 0.427.

For the low-end manufacture, see Table 5. The coefficient between ln nvc and ln rvc is 0.831. The coefficient of ln ie to ln rvc is -0.375 and coefficient of ln ms to ln rvc is significantly positive, it is 27.745, which indicats that the expansion of market scale promotes the development of RVC in the manufacturing industry. The coefficient of ln tg against ln rvc is -0.184.

Narrowing the technological gap between regions, achieving a reasonable division of labor in the industry, and transferring low-end manufacturing industry to less developed regions can improve the status of manufacturing industry in RVC.

For the mid-end manufacture sector(see Table 6). The regression coefficient between ln nvc and ln rvc is 1.396 and ln ie to ln rvc is -0.201. The regression coefficient of ln ms to ln rvc is -2.974. In "B&R" region, the market size of the middle-end manufacturing is negatively correlated, and the export of the middle-end manufacturing industry is restricted by the region and market. If it leads to accumulated exports, it will be detrimental to the development of China's manufacturing industry in the regional value chain. The regression coefficient between ln tg and ln rvc is significantly positive, and its regression coefficient is 3.905. The technical gap is the same as the analysis results of low-end manufacturing industry.

For the high-end manufacturing industry, as seen in Table 7, the regression coefficient between ln nvc and ln rvc is 1.298 and ln ie to ln rvc is -0.548. The coefficient of ln ms to ln rvc is significantly positive, and its coefficient is 31.841. The coefficient of ln tg to ln rvc is 1.753. The high-end manufacture industry cannot realize industrial division of labour transfer like the low-end manufacture industry, but needs to form unique competitiveness of this industry, concentrate technological resources and innovation ability, and realize the transition and upgrading of high-end manufacturing industry.

Table 4 Full sample analysis result

	Equation model（1）		Equation model（2）		Equation model（3）	
	ln rvc		ln nvc		ln ovc	
ln nvc	1.031***	1.078***			0.636***	0.636***
	（3.39）	（3.91）			（10.93）	（10.83）
ln rvc			2.318**	2.367**	0.427***	0.427***
			（2.07）	（2.48）	（5.97）	（5.91）
ln ie	-0.229**	-0.247***	0.230*	0.255**		
	（-2.57）	（-3.08）	（1.68）	（2.17）		
ln ms	13.503***	12.642***	-37.560*	-36.443**		
	（4.786）	（2.91）	（-1.83）	（-2.02）		
ln tg	1.787	1.946*				
	（1.50）	（1.87）				
ln lr			-0.369	-0.42		
			（-0.97）	（-1.42）		
cons	28.085**	25.975**	-77.427**	-77.427**	0.871***	0.871***
	（2.45）	（2.52）	（-2.03）	（-2.03）	（5.86）	（5.86）
Number of samples	155	155	155	155	155	155
R²	0.376	0.353	0.634	0.281	0.904	0.904
Estimation method	2SLS	3SLS	2SLS	3SLS	2SLS	3SLS

(Note: ***, ** and * respectively represent significant at the significance level of 1%, 5% and 10%, with T-value in brackets.)

Table 5 Sample regression result of low-end manufacture

	Equation model（1）		Equation model（2）		Equation model（3）	
	ln rvc		ln nvc		ln ovc	
ln nvc	0.683*	0.831***			0.625***	0.625***
	（1.72）	（2.27）			（10.98）	（10.65）
ln rvc			0.942	1.093*	0.288***	0.288***
			（1.48）	（1.90）	（3.75）	（3.64）
ln ie	-0.287***	-0.375*	0.447***	0.459***		
	（-1.35）	（-1.92）	（3.09）	（3.45）		
ln ms	28.918	27.745***	-28.154*	-30.151*		
	（3.12）	（3.17）	（-1.58）	（-1.89）		
ln tg	-0.619	-0.184				
	（-0.49）	（-0.16）				
ln lr			0.106	0.016		
			（0.57）	（0.10）		
cons	65.484***	62.379***	-64.002	-67.705*	0.513**	0.513**
	（3.04）	（3.06）	（-1.64）	（-1.93）	（2.46）	（2.39）
Number of samples	51	51	51	51	51	51
R²	0.363	0.318	0.282	0.131	0.935	0.935
Estimation method	2SLS	3SLS	2SLS	3SLS	2SLS	3SLS

Table 6 Sample regression result of mid-end manufacture

	Equation model（1）		Equation model（2）		Equation model（3）	
	ln rvc		ln nvc		ln ovc	
ln nvc	1.404**	1.396**			0.755***	0.755***
	(2.42)	(2.51)			(5.25)	(5.38)
ln rvc			-1.367	-1.588	0.421***	0.421***
			(-0.76)	(-0.95)	(3.26)	(3.34)
ln ie	-0.201**	-0.201*	-0.222	-0.248		
	(-2.02)	(-2.10)	(-0.70)	(-1.04)		
ln ms	-3.249	-2.974	10.352	21.131*		
	(-0.44)	(-0.42)	(0.58)	(1.69)		
ln tg	3.926**	3.905**				
	(2.36)	(2.45)				
ln lr			0.669	0.667		
			(1.13)	(1.17)		
cons	-12.214	-11.572	14.159	38.265	1.124***	1.124***
	(-0.70)	(-0.69)	(0.38)	(1.59)	(3.05)	(3.13)
Number of samples	63	63	63	63	63	63
R²	0.245	0.252	0.370	0.739	0.842	0.842
Estimation method	2SLS	3SLS	2SLS	3SLS	2SLS	3SLS

Table 7 Sample regression result of high-end manufacture

	Equation model（1）		Equation model（2）		Equation model（3）	
	ln rvc		ln nvc		ln ovc	
ln nvc	1.258**	1.298**			0.721***	0.721***
	(2.260)	(2.500)			(9.71)	(10.09)
ln rvc			0.995***	0.955***	0.301***	0.301***
			(4.13)	(4.41)	(4.18)	(4.34)
ln ie	-0.532***	-0.548***	0.475***	0.475***		
	(-2.43)	(-2.68)	(3.45)	(3.68)		
ln ms	32.462***	31.841***	-33.667***	-33.688***		
	(3.12)	(3.21)	(-3.10)	(-3.31)		
ln tg	1.496	1.753				
	(0.38)	(0.48)				
ln lr			-0.109	-0.108		
			(-0.40)	(-0.42)		
cons	72.107***	70.41***	-75.823***	-75.879***	0.750***	0.75***
	(2.73)	(2.85)	(-24.005)	(-3.37)	(5.53)	(5.74)
Number of samples	41	41	41	41	41	41
R²	0.540	0.52	0.577	0.57	0.946	0.946
Estimation method	2SLS	3SLS	2SLS	3SLS	2SLS	3SLS

5. CONCLUSION

Take the summary of above analysis, this paper regards Chinese manufacture industry as a main study object, according to our calculation results, NVC of Chinese manufacture industry has upgraded itself in recent years, it can be seen from the index of China manufacture's NVC (Table 2), the value goes from 0.12 in 2013 to 0.14 in 2018. And at the same time, the status of Chinese manufacture industry convergent with B&RI Countries has also climbed up, it can be seen from the position index of Chinese manufacture industry, especially several mid-end industries which go up quickly in resent 5 years (Table 3), therefore, we make an assumption that NVC and RVC have already promoted for each other and then we make an empirical test to prove our viewpoint. Based on simultaneous equation model and 2SLS & 3SLS empirical tests, this paper mainly discusses the interactive mechanism between NVC and RVC, and combined with index analysis, it found that NVC and RVC were positively correlated and promoted for each other, the regression elastic coefficient of ln nvc to ln rvc is 1.078, and the elastic coefficient of ln rvc against ln nvc is 2.367. AS for the other variables, industrial externalities are negatively correlated to three types of manufacturing industry, which indicated that fierce competition among enterprises making effect on the development of value chain. In addition, as for the market size, low-end and high-end manufacturing industries are positively affected by it, and the market size also affects its development degree to a large extent. Finally, the technology gap mechanism makes it the "hard power" of China's manufacturing industry development.

REFERENCES

[1] Gereffi, Gary & Fernandez Stark, Karina. Global Value Chain Analysis: A Primer, 2nd Edition. Center on Globalization, Governance & Competitiveness, Duke, 2000(5) 22-35.

[2] Hummels D, Ishii J, Yi K M. The nature and growth of vertical specialization in world trade. Journal of International Economics, 54(1) (2001) 75－96.

[3] Koopman Ｒ, Wang Z, Wei S J. Tracing Value-Added and Double Counting in Gross Exports. American Economic Review, 104(2) (2014) 459－494.

[4] Liu Zhibiao. Restructuring the National Value Chain: Reflections on Transforming the Development Mode of China's Manufacturing Industry. World Economic and Political Forum,2011(4) 1-14.

[5] Zhang Shaojun, Liu Zhibiao. Whether Domestic value chains connect with global value Chains -- An

empirical Analysis based on simultaneous Equation Model [J]. International Trade Issues,2013(2) 14-27.

[6] Shan Ying. Research on the Correlation between Domestic Value Chain and Global value Chain [D]. Jilin: Dongbei University of Finance and Economics,2018 1-51.

[7] Hu hao, Xi xun, Zhang Yueyue. Does Chinese industry convergence make a promotion on the upgrading onto the Global value chain? [J], International Economics And Trade Research 36(4) (2020) 55-70