Can Developing Economies Move Up the Relative Value Chain Division of Labour through "North-South" R&D Cooperation?

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Abstract. R&D cooperation is the main way for humankind to address common challenges, grasp the direction of the technological revolution and absorb the dividends of change. However, can developing economies narrow the gap between their relative value chain position and that of developed economies through "North-South" international R&D cooperation? Using OECD international R&D cooperation patent data and the 2000-2018 world input-output table, this paper theoretically analyses and empirically tests the effects and mechanisms of "North-South" international R&D cooperation on the relative value chain division of labour position of developing economies. The study shows that "North-South" international R&D cooperation widens the gap in the relative value chain division of labour position between developing economies and developed economies, but significantly increases the gains from trade in intermediate products.

Keywords: International R&D cooperation; global value chains; gains from trade in intermediate goods.

1   Introduction

Driven by economic globalization and the rapid development of information technology, goods, services, capital, personnel, technology and knowledge are easily transferred across national boundaries. The global R&D networks of multinational corporations in developed economies gradually break through their own or local geographical boundaries, organizational boundaries and knowledge boundaries, and are constantly evolving in the direction of reallocating global innovation resources[1,2] in order to quickly acquire differentiated technologies and knowledge. So as to improve the innovation efficiency of enterprises. Emerging market countries regard international R&D cooperation as an important means for enterprises to catch up with their international leading competitors[3]. It is considered that R&D elements are important strategic resources for a country to gain technological advantages, achieve product upgrading and improve the division of labor status of the global value chain[4].

When the positive externalities of R&D are small, it is difficult for developing economies to reach the technological level of developed economies through independent R&D[5], but they can acquire knowledge, avoid risks and achieve mutual benefit through international R&D cooperation[6]. However, in the North-South R&D cooperation, the blockade of "technology exchange" and "technology transfer" by developed economies, and even stigmatize them with "technology theft", have added many obstacles to such international R&D cooperation[7]. Therefore, will developing economies narrow the gap of relative value chain division of labor between developing economies and developed economies through "north-south" international R&D cooperation?

To sum up, the possible marginal contribution of this paper is that most of the existing literature focuses on the change of the division of labor status of the value chain of a single country, and there is little literature to explore the gap of the division of labor status of the value chain between countries. From the perspective of developing economies, this paper can more comprehensively examine the impact of "north-south" international R&D cooperation on the relative division of labor in the value chain of developing economies.

2   Theoretical Analysis and Research Hypotheses

R&D cooperation provides opportunities for both sides to exchange and learn from each other, promotes the rapid dissemination of knowledge, and improves the innovation level of enterprises and countries participating in international cooperation[8]. However, developing economies mainly participate in the low value-added links of the value chain, export labor-intensive products with low-cost advantages, and have poor ability to absorb technology spillover. It is easy to be "captured" by developed economies and fall into the trap of "low-end lock-in"[9]. Based on this, this paper puts forward the following hypotheses:

H1: "North-South" international R&D cooperation expands the relative division of labor status gap between developing economies and developed economies.

Enterprises have developed new products through upstream international R&D cooperation, and the products have entered the production link of the whole industrial chain, and developing economies have participated in the upstream R&D and design link. more bear the mid-stream product manufacturing links and downstream processing and assembly, storage and transportation links. Through international R&D cooperation with developed economies, we can increase the knowledge reserves of developing economies, promote technological innovation, further improve the efficiency of the transformation of scientific and technological achievements and expand the scale of exports[10]. Based on this, this paper puts forward the following hypothesis:

H2: developing economies undertake the production process after product research and development through "north-south" R&D cooperation to increase the benefits of intermediate goods trade.

3   Indicator Measurement, Data Description, and Modeling

3.1   Estimated Model Setup

In order to examine the impact of "north-south" international R&D cooperation on the relative division of labor in the value chain of developing economies, this paper sets up the following benchmark regression models:

$$GVC\_BP_{ijt} = \alpha_0 + \alpha_1 \ln Patent_{ijt} + \theta_{ij} + \delta_t + \varepsilon_{ijt} \tag{1}$$

Among them, GVC_BP_{ijt} represents the relative value chain status gap between developed economies i and developing economies j during the t period. $\ln patent_{ijt}$ is the number of R&D cooperation between developed economies i and developing economies j in t years. According to the traditional trade gravity model, θ_{ij} are the joint fixed effects of economies, which control the natural variables and cultural differences between economies that do not change with time, such as common boundary, geographical distance and common language, δ_t represents time fixed effect, and ε_{ijt} are random disturbance items.

In order to explore the real demand for international R&D cooperation in developing economies, this paper will further introduce relative value-added for empirical analysis. to explore whether developing economies can increase the benefits of intermediate goods trade through "north-south" R&D cooperation to undertake the production links after product research and development in the global value chain. The econometric model is set as follows:

$$VA\_B_{ijt} = \alpha_0 + \alpha_1 \ln Patent_{ijt} + \theta_{ij} + \delta_t + \varepsilon_{ijt} \tag{2}$$

Among them, VA_B_{ijt} represents the relative added value of the developing economy i in the t period compared with the developed economy j, first of all, the average value added of each industry in each economy is calculated by using the OECD input-output table, and VA_B_{ijt} is the ratio of the added value of the developing economy to the value added of the developed economy. The settings of the remaining variables are the same as those of formula (1).

3.2   Variable Setting, Indicator Construction and Description of Data Sources

(1) Relative value chain division status

This paper refers to the WWZ method of Wang et al. (2013)[11], decomposes a country's total export into 16 parts, and calculates the relative value chain division status gap index according to the decomposed results as follows:

$$GVC\_BP^{NS} = \ln\left(1 + \frac{IV_i^{NS}}{E_i^{NS}}\right) - \ln\left(1 + \frac{FV_i^{NS}}{E_i^{NS}}\right) = \ln\left(1 + \frac{DVA\_INTrex_i^{NS}}{E_i^{NS}}\right) - \ln\left(1 + \frac{MVA_i^{NS} + OVA_i^{NS}}{E_i^{NS}}\right) \tag{3}$$

Among them, DVA_INT_{rex} represents the domestic added value of indirect exports that a country's intermediate goods are produced by a direct importing country and exported to a third country, while MVA and OVA represent the added value of the importing country implied in its own exports and the third (other) country's added value implied in its own exports. the higher the GVC_BP^{NS} value, the higher the division of labor status of economy N relative to economy S in the global value chain.

(2) Intensity of international R&D cooperation

The relationship and degree of R&D cooperation among different economies in technological innovation activities. It is expressed by the number of joint patent applications developed jointly by economy i and economy j in the OECD database, and the variables are logarithmically processed.

4   Empirical Results and Analysis

4.1   Base Regression Estimate

This paper takes the division of labor status gap of the developing economies relative to the value chain as the explained variable, the intensity of international R&D cooperation as the explanatory variable, and uses the Stata software to use the fixed effect model for regression. As can be seen from column (1) of Table 1, "North-South" international R&D cooperation has significantly widened the gap in the relative division of labour in the value chain between developing and developed economies. As shown in column (2) of Table 1, "North-South" international R&D cooperation has significantly increased the relative added value of developing economies. "North-South" international R&D cooperation in developing economies increases the scale of value-added exports by undertaking more manufacturing links, which can increase the benefits of intermediate goods trade.

Table 1. Impact of International R&D Cooperation on the Relative Value Chain Position of Developing Economies.

	(1)	(2)
	GVC_BP^{NS}	VA_B^{SN}
ln $patent$	0.006***	0.055***
	(6.386)	(15.179)
national fixed effects	YES	YES
time fixed effects	YES	YES
observed value	15,960	15,960
R^2	0.870	0.984

note: p-values in parentheses. *, ** and *** indicate significance at the 1%, 5% and 10% levels.

4.2   Robustness Check

In order to test the reliability of the regression results and avoid the influence of the particularity of index selection and data acquisition on the stability of the regression results, this paper uses the methods of replacing the explained variables and lagging behind one period to carry out the robustness test. First, drawing lessons from the practice of Zhang Zhiming (2022)[12], the relative value chain status gap index between countries is calculated by using the following formula:

$$GVC\_BP^{NS} = |GVC\_P^N - GVC\_P^S| \tag{4}$$

The index is used as a dependent variable for robustness test, the specific results are shown in column (1) of Table 2, and the regression results remain unchanged. Secondly, because the influence of R&D cooperation lags behind, this paper uses the lag period of explanatory variables for regression, and the result is still robust.

Table 2. Robustness check.

	(1)	(2)
	GVC_BP^{NS}	GVC_BP^{NS}
$\ln patent$	0.005***	
	(8.705)	
$L.\ln patent$		0.005***
		(5.258)
national fixed effects	YES	YES
time fixed effects	YES	YES
observed value	15,960	15,120
R^2	0.949	0.875

5   Conclusions

The main conclusions of this paper are as follows: in the initial stage of "north-south" international R&D cooperation, developing economies mainly reap the benefits of intermediate goods trade by undertaking downstream production links, rather than the promotion of the status of division of labor in the global value chain. This is a necessary stage for developing economies to participate in "north-south" international R&D cooperation. Accordingly, this paper puts forward the following policy recommendations:

Firstly, increase investment in independent research and development. The fact that developing economies gain trade value added gains through "north-south" international R&D cooperation is a characteristic fact that they participate in the division of labor in the global value chain. However, in order to avoid falling into the trap of comparative advantage or being "locked in at the low end", developing economies need to climb to both ends of the value chain through late-developing independent innovation.

Secondly, deepen international cooperation in scientific and technological innovation with the concept of a community with a shared future for mankind. The R&D cooperation of certain antagonism between developed and developing economies is not

the long-term trend of international scientific and technological cooperation. International R&D cooperation requires countries to overcome differences, forge consensus on development, and use the concept of "win-win cooperation" to strengthen the consultation, co-governance and sharing of "north-south" scientific and technological R&D activities.

References

1. OECD. The links between global value chains and global innovation networks: an exploration[Z]. OECD Science, Technology and Innovation Policy Papers No.37, 2017.
2. Xiuying Chen, Sheng Liu. The impact of international R&D cooperation on the division of labor status of global value chains-threshold effect based on absorptive capacity [J]. Journal of capital university of economics and business, 2020,22(04):25-35.
3. Mathews J A. Competitive advantages of the latecomer firm: A resource-Based account of industrial catch-up strategies[J]. Asia Pacific Journal of Management, 2002,19(4):467-488.
4. Wang Yuanbin, Lin Wang. Domestic R&D and spillover, R&D spillover of imported intermediate products and the position of global value chain division of manufacturing industry [J]. International Trade Issues, 2022(08):53-68.
5. Jinping Xi. Holding high the great banner of socialism with Chinese characteristics and unitedly striving for the comprehensive construction of a modern socialist country [M]. Beijing: People's Publishing House, 2022.
6. Xingtang Wang, Jie Li. Research on International R&D Cooperation from the Perspective of Intermediate Trade [J]. journal of management sciences in china, 2020,23(09):61-75.
7. Neng Shen, Jingjing Zhou. Can participating in the global production network improve the value chain position of China enterprises: "network pie" or "network trap" [J]. journal of industrial engineering and engineering management, 2016,30(04):11-17.
8. Jianfeng Wu, Zhenning Yang, Qiu Yonghui. Study on the relationship between regional breadth, resource endowment and technological innovation performance of international R&D cooperation [J]. Journal of Management, 2015,12(10):1487-1495.
9. Yue Lu, Shuai Chen, Bin Sheng. Will embedding into global value chains lead to "low-end lock-in" made in China? [J]. Managing the World, 2018,34(08):11-29.
10. jianghuai Zheng, Wei Dai. the influence of transnational flow of invention talents on the status of global value chain-industry heterogeneity effect and its strategic significance [J]. economic management, 2023,45(03):5-27.
11. Zhi W, Wei S J, Zhu K. Quantifying International Production Sharing at the Bilateral and Sector Levels[J]. NBER Working Papers, 2013(September).
12. Zhiming Zhang. Deepening of Regional Trade Agreements and Reconstruction of Asia-Pacific Value Chain Cooperation Mode [J]. International Trade Issues, 2022(05):85-102.