The Impact of the Depth of Technology Transfer Type Provisions in Regional Trade Agreements on International Science and Technology Cooperation - An Empirical Study Based on RCEP Member Countries

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Abstract. Based on the 84 agreements concluded by RCEP member countries from 2003 to 2022 and their international patent cooperation data, this paper explores the impact of technology transfer-related provisions in RTAs on international scientific and technological cooperation among member states. The results show that the related provisions significantly promote international scientific and technological cooperation, while there exists heterogeneity in the promotion of cooperation between economies with different. It is found that three types of provisions, namely absorptive capacity, international personnel mobility, and technical cooperation, has much stronger role in promoting international scientific and technological cooperation among developing economies. Therefore, in the process of building high-quality free trade agreements, China should not only focus on improving the scope and depth of technology transfer provisions, but also adhere to the principle of seeking common ground while reserving differences, and carrying out regional cooperation with countries at different levels of economic development.

Keywords: Regional trade agreements; Depth of technology transfer-type provision; International scientific and technological cooperation; RCEP.

1 Introduction

In recent years, the multilateralization of global economic and trade agreements has been hampered, with regional bilateral cooperation becoming a second-best option. Existing RTAs have expanded to deeper agreements where provisions related to technology transfer have moved from being an exception to the rule. Under the new situation of coexistence of division and cooperation, countries will continue to emphasize technology transfer-type provisions in RTAs to promote international science and technology (S&T) cooperation between the two parties.

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At present, there are few studies on the classification of international technology transfer policies in domestic academic circles, and only Martínez-Zarzoso[1] has analyzed the provisions related to technology transfer and innovation in RTA for the first time. He has compiled a database containing four types of provisions: general intention of technology transfer; technical cooperation; R&D and innovation; Patents and Intellectual Property. Long Minglian[2] concluded from her analysis that the policy environment, S&T talents, and the form of research funding affect international S&T cooperation. Ma Jianlong[3] believes that international S&T cooperation is conducive to autonomous innovation, and autonomous innovation supports international S&T cooperation. Gui [4] found that economic proximity, scientific ability proximity, social proximity, and international students had a positive impact on international cooperation, while geographical distance had a negative and insignificant effect. Although there are no studies on the impact of the depth and heterogeneity of technology transfer provisions in RTAs on international S&T cooperation, Jinji et al.[5] used patent citations as a measure of technology spillovers to explore the impact of the depth of legally enforceable WTO-X provisions covered by RTAs on technology spillovers. Jinji et al. [6] used the common patent data of inventors residing in different countries to study the impact of the depth of WTO+, WTO-X, and intellectual property provisions in RTAs on international R&D cooperation, and found that deeper integration was associated with more active international co-inventions.

Given this, this paper explores the impact of international technology transfer(ITT) provisions on international S&T cooperation in RTAs that concluded by RCEP member and the heterogeneity of their impact on S&T cooperation among parties with different levels of development. This will help China to grasp the types of provisions that should be prioritized when negotiating technology transfer provisions with partner countries at different levels of development, either bilaterally or regionally. This will not only help China use the RCEP agreement to better promote international S&T cooperation, but also provide a basis for China to upgrade the optimization of ITT in RTA negotiations with South Korea, Australia, Japan, and other countries.

2 Framework construction and theoretical explanation of the categorization of RTA technology transfer provisions.

As can be seen from the technology gap theory, the provisions of the RTA agreement aimed at increasing absorptive capacity can help to remove some of the key bottlenecks in technology transfer and improve the ability to absorb, internalize, and use new knowledge. The "knowledge transfer theory" (Meyers, 1988) suggests that technology transfer is essentially the transfer and flow of knowledge. The RTA promotes international S&T cooperation through the protection of S&T achievements and the transfer of knowledge. However, in multi-party joint R&D, too low and too high protection will hinder S&T cooperation between the two countries. According to the technology transfer choice theory, foreign direct investment is a key way of transferring technology globally. RTA's FDI-related provisions facilitate the introduction of capital and technology, impacting international S&T cooperation. The global flow of capital has led to

rapid growth in S&T collaboration. Some RTA investment incentives attract foreign investors to localize their technology R&D activities in the host country's economy, promoting potential spillovers to local firms. The design and implementation of these measures are complex, and if they are not well-tailored, they can become a financial burden for governments. The impact of Prohibition of Performance Requirements provisions on international technical cooperation is also complex. In the past, host countries implemented compulsory transfers through performance requirements, but prohibiting performance requirements may be detrimental to international technical cooperation by discouraging TNCs from transferring technology locally. On the contrary, the prohibitive performance requirement clause in the RTA provides a fair and friendly political environment for technology transfer between the contracting parties, which better stimulates the motivation of multinational companies to transfer technology spontaneously, thus promoting S&T cooperation between countries. Finally, according to the theory of brain mobility[7], international talent flow brings about the flow of technology. Whether or not a natural person can move freely between the two parties depends on the provisions regarding cross-border visas. Therefore, the personnel mobility clause in the RTA provides visa facilitation for the movement of technical personnel, experts, and elites between countries, and promotes S&T cooperation between countries. At the same time, Martínez-Zarzoso[1] pointed out that there are more and more agreements with technology-related cooperation form clauses, which will have a certain impact on the transfer of technology at the international level; the cooperation form provisions in RTAs are specifically designed to promote S&T cooperation between countries by establishing platforms for technicians to exchange technology and promoting their exchange and cooperation.

Given the above analysis, this paper argues that the absorptive capacity provisions, personnel mobility provisions, and specific forms of cooperation provisions in the technology transfer provisions of the RTA agreement are conducive to promoting international S&T cooperation, while theoretically the intellectual property provisions, FDI provisions, and Prohibition of Performance Requirements have a more complex impact on international S&T cooperation.

3 Empirical models, variable selection, and data sources

In this paper, 84 RTAs in force including 15 RCEP member countries as contracting parties from 2003 to 2022 are selected as research samples to construct the following empirical models:

$$\ln P_{ijt} = \beta_0 + \beta_1 \, ITT\_Prov\_index_{ij,t} + \gamma_1 \ln(C_{it}) + \gamma_2 \ln(C_{jt}) + ID_{ij} + \ln dist_{ij} + \psi_t + \eta_i + \lambda_j + \varepsilon_{ijt} \quad (1)$$

Pijt is the variable representing the number of patents jointly filed by inventors in countries i and j with the USPTO in year t. The data is taken from USPTO. ITT_Prov_indexij,t is the explanatory variable, which is the depth index of the technology transfer provisions in the RTA; according to the method of "Clause Counting Index" of Hofmann et al. [8], the depth composite index is constructed. According to the

above theoretical explanation in the previous section, the provisions in this paper are categorized into six indexes, namely, absorptive capacity policy provisions, intellectual property rights-related provisions, FDI-related provisions, performance requirements provisions, personnel mobility provisions, and technical cooperation provisions. ln(Cit), ln(Cjt), IDij, and lndistij are control variables. Where ln(Cit) and ln(Cjt) are the logarithms of country i and j 'patent stock in year t, respectively, which represent the research capacity of the countries. idij is the institutional distance between country i and j. This paper draws on Kaufmann et al.'s [9] study to measure institutional distance between state parties along six dimensions: expression and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law level, and corruption control. It is also measured by the KSI index method with reference to Xu Jiayun et al. The variable lndistij is the logarithmic value of the straight-line distance between the capitals of country i and j. ψt, ηi, λj are fixed effects, respectively; εijt is the randomized disturbance term.

4 Analysis of empirical results

4.1 Analysis of Baseline Estimation Results

We empirically test using Poisson Pseudo Maximum Likelihood estimation (PPML). As can be seen from the results of PPML in Table I, the regression result of $index_{ij}$ is significantly positive, which indicates that the ITT provisions in the RTA have a significant facilitating effect on international science and technology cooperation between countries. The possible reasons for this are: the deepening of the technology transfer provisions in RTA helps to improve the contracting parties' labor absorptive capacity, the ability to introduce technology and capital, provides a fairer policy environment for technology transfer, promotes intellectual exchanges and technological learning between countries, etc. These will facilitate deeper and closer cooperation in technology transfer or S&T research and development among States Parties.

Table 1. PPML, OS, and heterogeneity regression results

	Bench-mark	robustness			Heterogeneity analysis		
	PPML	OLS			Developed - developed	Developing - developing	Developed - developing
	lnPIJ	lnPIJ			lnPIJ	lnPIJ	lnPIJ
indexij	0.326***	0.601***	indexij	/	0.272***	0.617***	1.910***
	(0.047)	(7.96)		/	(0.055)	(0.089)	(0.574)
lnPI	0.306***	0.003***	abij	0.186***	0.196***	2.350***	0.739***
	(0.026)	(0.13)		(0.048)	(0.055)	(0.647)	(0.160)
lnPJ	0.255***	0.022***	konwij	0.103***	0.059*	0.239	0.242***

	(0.025)	(0.94)		(0.027)	(0.034)	(0.213)	(0.047)
lnIDIJ	-0.024***	-0.099***	fdiij	0.795***	0.859***	-3.104***	1.133***
	(0.008)	(-11.39)		(0.089)	(0.111)	(0.870)	(0.183)
lndistIJT	-0.253***	-0.460***	techij	0.120**	0.204***	0.267	-0.001
	(0.014)	(-27.66)		(0.049)	(0.053)	(0.562)	(0.120)
Constant	-2.380***	4.651***	peoij	0.090***	0.092***	0.191**	0.125***
	(0.368)	(17.53)		(0.016)	(0.018)	(0.093)	(0.035)
YEAR FE/ R2	Yes	0.748	coij	0.254***	0.370***	0.506***	0.253***
				(0.038)	(0.043)	(0.186)	(0.054)
COUNTRYI FE/ adj_R2	Yes	0.744	control variable	Yes	Yes	Yes	Yes
COUNTRYJ FE/ F	Yes	210.5	fixed effect	Yes	Yes	Yes	Yes

Standard errors/t-statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01

4.2 Robustness Tests

We use OLS to conduct robustness tests, the second column of robustness in Table 1, the indexij coefficients and significance are similar to the PPML results, proving that the PPML regression is robust.

4.3 Heterogeneity of terms under homogeneous economic pairs

The first column of heterogeneity analysis in Table 1, it can be seen that the coefficients for all six types of provisions are significantly positive. We could see FDI-related provisions have the highest effect on the promotion of international technical cooperation. Conversely, the coefficient of the turnover clause is minimal. Within the country-specific heterogeneity, the promotion of international S&T cooperation between developed and developing economies is more pronounced in technology transfer-type provisions in RTAs. To explore the reasons for this, all Parties were grouped into three types of economy pairs. The results are shown in the last three columns of Table 1.

For developed economies, the provisions on FDI-related provisions have had the greatest catalytic effect on international S&T cooperation. For both developed and developing countries, it is the FDI-related provisions that are most catalytic, which may be due to the high depth of investment facilitation and investor protection in FDI-related

measures. Many developing countries provide more opportunities to improve their domestic technology and promote economic development through joint ventures with foreign countries or allowing wholly foreign-owned enterprises to set up enterprises in their countries, at the same time promote international S&T cooperation. For developing economies, the absorptive capacity clause has the greatest effect on promoting international S&T cooperation, it may be that developing economies lack of corresponding learning capacity and funds for improving educational institutions in their original workforce. Different from the full sample, the current FDI-related provisions significantly inhibit S&T cooperation between member countries, which may be because the FDI negotiation provisions in RTAs in developing countries are more inclined to attract high-tech FDIs through measures such as investment restrictions and screening. The IP-related provisions and the provisions prohibiting performance requirements have no impact on their international S&T cooperation, which may be because the current protection and enforcement of IP-related provisions among these countries is weak and favors performance requirements, such as local R&D, and has a limited impact on the promotion of S&T cooperation.

5 Conclusions

It is found that RTA technology transfer-type clauses can promote S&T cooperation between countries of the contracting parties, and there is heterogeneity in the impact of different types of technology transfer-type clauses on international S&T cooperation, in which the depth of FDI-related clauses is increased to promote S&T cooperation the most, followed by absorptive capacity clauses, technology-related cooperation clauses, as well as intellectual property rights-related clauses and clauses that prohibit performance requirements. Lastly, international mobility clauses. The results of the country heterogeneity subgroups show that the formulation and improvement of technology transfer clauses in RTA agreements bring more opportunities for international S&T cooperation between developed and developing economies than between developed and developing economies. In addition, the test results of subdividing the effects of the types of technology transfer clauses on the samples of RTA subgroups among countries with different levels of economic development show that the six types of technology transfer clauses have a facilitating effect on the international scientific and technological cooperation among developed economies, but the clause on FDI-related measures has the most obvious driving effect; the clause on absorptive capacity has the greatest facilitating effect on the scientific and technological cooperation among developing economies, while the clause on FDI-related measures plays an inhibiting role. For international S&T cooperation between developed and developing economies, except for the prohibition of performance requirements, the other five types of clauses have a facilitating effect, with the FDI-related measures clause having the greatest facilitating effect.

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