The influence of international technology trade on enterprises' technological innovation ability

--Quantile regression based on the Shanghai Municipality data

Yingxiao Liu

Beijing Jiaotong University, Beijing, China

21120732@bjtu.edu.cn

Abstract. With the rapid development of science and technology and the deepening of global economic integration, technology trade has gradually become an important factor affecting the ability of technological innovation. Therefore, this paper in Shanghai as an example, using the Shanghai -- 2019,2010 panel data, with technology introduction, technology development, technology transfer, technology consulting contract amount to express Shanghai technology trade, with research and experimental development internal spending (R & D) to express the technology innovation ability in research and development stage, with the new product sales revenue to express the performance of technology innovation ability in the commercial stage, using the quantile regression method to study the influence of technology trade for enterprise technology innovation ability. The results show that technology trade has an obvious positive effect on promoting the technological innovation ability of enterprises, among which technology development and technology transfer are the most obvious, but with the enhancement of enterprise independent innovation ability, this promoting effect will be reduced.

Keywords: echnology trade, technology innovation quantile return

1 Introduction

Technology trade is an important part of international trade and an important driving force for China's economic development, which has had an impact on China's national economy that cannot be ignored. Technology trade includes technology introduction and technology export, technology introduction can improve the technical level and independent innovation ability of Chinese enterprises, technology export can optimize China's export structure, promote the upgrading of China's industry. Technology import directly promotes the improvement of production technology of technology introduction enterprises, so that the technical capabilities of enterprises undergo step-by-step changes. However, technology import will lead to enterprises' dependence on foreign technology, insufficient independent innovation ability, and affect the long-term technical level of enterprises. Therefore, the interaction between the positive and negative

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effects of technology imports does not determine the definite impact of technology imports on the technological innovation ability of domestic enterprises, so the empirical studies of different types of countries also draw different conclusions.

2 Research background

Since China's accession to the WTO, China's international technology trade has developed rapidly. From 2005 to 2017, China's contract amount in technology introduction showed an overall growth trend, and the contract amount increased from 155.137 billion yuan in 2005 to 1342.422 billion yuan in 2017, an increase of about 9 times. By 2017, the country's export trade volume increased to 670.815 billion US dollars, and the import trade volume increased to 586.773 billion US dollars, and the total trade volume showed a spurt growth. In addition, the technological innovation ability of Chinese enterprises has also shown an improvement trend. The internal expenditure of R&D funds soared from 244.998 billion yuan in 2005 to 1.760613 billion yuan in 2017, an increase of 7.2 times, indicating that the investment in R&D of enterprises has been increasing and their innovation ability has been continuously improved. In summary, the common growth of international technology trade and enterprise technological innovation indicates that there may be a certain relationship between the two.

3 Literature review

Regarding the impact of technology trade on the technological innovation ability of enterprises, some scholars have conducted research. Li Jie introduced revenue data from TBP (technical balance of payments), Empirical analysis of the relationship between R & D investment and international technology trade income [1]; Xing Xiaobing starts from the current situation of insufficient investment in innovation in Chinese enterprises, Analyze the impact of foreign trade on independent innovation [2]; Chen Zhongchang constructed an index evaluation system to measure technological innovation ability and innovation potential, and found that technology trade has structural characteristics on the technological innovation ability of high-tech industries through empirical analysis [3]; Liu Zhongli studied the relationship between technology import and enterprise innovation ability, and the results show that China's technology import has a positive effect on enterprise innovation ability [4]. Xu Peiyuan analyzed the influencing factors of technology innovation ability of Fujian Province based on the Bayesian model average (BMA) method [5]; Hu Pei studied the influence of high-tech product trade, R & D expenditure and scientific research personnel on the technology innovation ability of Chinese high-tech enterprises [6]; Zhang Yongwang examined the impact of technology introduction and independent innovation on the export technology content of the industry. It is found that technology introduction and independent innovation have a positive impact on export technology content [7]; In order to study the impact of technology trade on enterprise technological innovation, Liu Zhenyun used China's provincial panel data from 2009 to 2017, used R&D input to measure the technological innovation ability of enterprises, used technology development, technology transfer,

technical consultation and technical service contracts to represent technology introduction, and used technology product export trade volume to express technology exports, the results show that technology trade has a significant positive impact on the technological innovation ability of Chinese enterprises. [8]; Taking China's ICT service trade as an example, Wang Xiaohong demonstrated the important role of technology introduction in enhancing the independent innovation capability and competitiveness of China's ICT industry from the two dimensions of invention patents and export competitiveness [9]. Xu Yuyun used panel data for empirical analysis. The empirical results show that the significant difference in the impact of technology purchase and technology introduction on the innovation performance of high-tech industries lies in the different impact delays, and there are obvious time lag differences in the impact of technology purchase and technology introduction on the innovation performance of high-tech industries [10].

4 Model design; pattern desing; pattern plan

In order to investigate the influence of technology trade of Shanghai enterprises on technology innovation ability, the following measurement model is established:$Ln\ innovation = \alpha_0 + \beta_1 Lnx_1 + \beta_2 Lnx_2 + \beta_3 Lnx_3 + \beta_4 Lnx_4$， The medium variable $Ln\ innovation$ indicates the technological innovation ability of Shanghai enterprises，In this paper, the number of patent applications and the sales revenue of new products represent the embodiment of technological innovation ability in the research and development stage and the commercialization stage respectively. In the model, the number of patent applications is expressed by $Ln\ PT$， and the sales revenue of new products is expressed by $Ln\ NS$. The Lnx_1、Lnx_2、Lnx_3 and $\beta_4 Lnx_4$in the model represent technology development, technology transfer, technical consultation, and technical services, respectively.

Since the impact of technology import on the innovation ability of enterprises is also limited by the company's own technical level, the relationship between the two may not be linear, and the impact of technology trade on the innovation ability of enterprises can be better judged by using the method of quantile regression, so this paper adopts the method of quantile regression.

5 Measurement results

The quantile regression method is able to estimate the overall conditional distribution of y under the given x, giving more information to judge the relationship between x and y. Representative sites 0.1,0.25,0.5 and 0.75 points were selected and the results of the specific quantile regression models are shown in Tables 1 and 2.

Table 1. Quantile regression of enterprise patent application in Shanghai Municipality

Shanghai municipal enterprise patent application				
Ln PT	fractile quantile			
	0.1	0.25	0.5	0.75
Lnx_1	0.31	0.31	0.44	0.48
Lnx_2	0.30	0.30	0.55	0.77
Lnx_3	0.18	0.18	0.12	0.14
Lnx_4	0.35	0.35	0.11	0.02
constant term	1.26	1.26	0.39	-0.63

From Table 1, it can be found that under each quantile, the elastic coefficient of the four types of technology trade is positive, indicating that these four items have a positive effect on the number of patent applications. Among them, the elasticity coefficient of technology development and technology transfer at 0.5 and 0.75 quantile is significantly higher than the elasticity coefficient at 0.1 and 0.25 quantile, which indicates that the stronger the technological innovation ability of Shanghai enterprises, the more obvious the role of technology development and technology transfer in promoting the technological innovation ability. On the contrary, the elasticity coefficient of technical consulting and technical service at 0.1 and 0.25 quantiles is greater than its elasticity coefficient at 0.5 and 0.75 quantiles, which indicates that the stronger the technological innovation ability, the weaker the impetus effect of technical consulting and technical service on the technological innovation ability.

Table 2. Ple regression of new product sales revenue of enterprises in Shanghai

Shanghai city enterprise new product sales revenue				
Ln NS	fractile quantile			
	0.1	0.25	0.5	0.75
Lnx_1	0.32	0.32	0.34	0.26
Lnx_2	0.28	0.28	0.30	0.06
Lnx_3	0.14	0.14	0.11	0.10
Lnx_4	0.01	0.01	-0.05	0.00
constant term	5.13	5.13	5.27	6.87

Table 2 shows that the elastic coefficient of technology development and technology transfer is relatively large, indicating that from the perspective of commercialization, technology development and technology transfer have an obvious positive effect on technological innovation capabilities. Among them, the technology development in 0.1,0.25,0.5 quartile of elastic coefficient is larger, and the change is not big, and under the 0.75 quartile of elasticity coefficient has certain reduction, it shows that technology development for technology innovation ability has obvious effect, and as the technology innovation ability to reach a higher degree, its role will be slightly reduced. Technology transfer in 0.1,0.25,0.5 quantile under the elastic coefficient is larger, and relatively stable, and in 0.75 quantile, its elasticity coefficient significantly reduced, which

shows that technology transfer for technology innovation ability, but when the enterprise innovation ability reached a higher level, the impetus significantly smaller. The elastic coefficient of technical consulting in the four quartiles is relatively small, and with the increase of the quantile, the elastic coefficient is decreasing, which indicates that technical consulting has a driving effect on the technological innovation ability, but it is not obvious, and with the improvement of the technological innovation ability of enterprises, this promoting effect will be less and less. The elastic coefficient of technical service in each quartile is close to 0, sometimes even negative value, which shows that technical service has no obvious driving or hindering effect on the technological innovation ability of enterprises.

6 Conclusions

From the perspective of technology trade and technology ability difference, the paper analyzes the influence of technology import on the technology innovation ability of Shanghai enterprises by using the quantile regression model, showing the following points.

(1) Technology trade has a positive role in promoting the technological innovation ability of enterprises in Shanghai, and has different promoting effects under different technical levels. When the technology level is low, the promoting effect of technology trade is relatively high, and when the technology level is high, the promotion effect of technology trade is relatively low.

(2) In the research and development stage, technology trade plays a positive role in promoting technological innovation ability, among which technology development and technology transfer play the most obvious role.

(3) In the commercialization stage, technology development, technology transfer and technology consultation in technology trade have a positive role in promoting, while technology service has no obvious effect on technology innovation ability, and the promotion role of technology development and technology transfer is relatively obvious.

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