



The Impact of Intellectual Property Protection in Importing Countries on the Export Quality of China's High-tech Products

Zhuiqiao Jin^{1, a, *}, Wenxia Lia^{2, b, *}, Kailin Lou³, Xinyu Zhang⁴

¹*School of Business, Sanda University, Shanghai, China;*

²*School of International Economics and Trade, Shanghai Lixin University of Accounting and Finance, Shanghai, China;*

³*School of Business, Sanda University, Shanghai, China;*

⁴*School of Business, Sanda University, Shanghai, China;*

^{a, *}*Corresponding author. E-mail: jzqjin@sandau.edu.cn*

^{b, *}*Corresponding author. E-mail: wxli@lixin.edu.cn*

ABSTRACT

Since China's joined WTO, the import and export trade of high-tech products has entered a stage of rapid development. As a basic system for protecting innovation, intellectual property protection plays a vital role in promoting the export and high-quality development of high-tech products. In this paper I made an empirical analysis of the impact of the level of intellectual property protection of export destination countries on the export quality of China's high-tech products by using the sample data of 30 core exporting countries of China's high-tech products from 2004 to 2019. The results show that there is a significant positive correlation between the level of intellectual property protection and the export quality of China's high-tech products, that is, the improvement of the level of intellectual property protection will drive the improvement of the export quality of high-tech products. On this basis, in this paper I made a heterogeneity test according to the economic development level of export destination countries, and found that the level of intellectual property protection in high-income countries improves the quality of high-tech products export more than in upper-middle-income and lower-middle-income countries. I hold that the state can support the innovation of high-tech industrial enterprises and promote the negotiation of free trade zone to improve the export quality of China's high-tech products.

Keywords-*Intellectual Property Protection, Quality of Export Products, Influence Factor, China's High-tech Products*

1. INTRODUCTION

In the context of globalization of knowledge economy, the relationship between the intellectualization of international trade and the globalization of intellectual property rights is becoming closer and closer. In 2020, the total import and export volume of China's goods trade was 32.16 trillion yuan. Among them, the export was 17.93 trillion yuan, an increase of 4%. The trade surplus was 3.7 trillion yuan, an increase of 27.4%, and the scale of import and export reached a record high. In 1990, the proportion of high-tech products in global trade was 23.3% in the United States, 17.5% in Japan and 10.8% in Germany. At that time, China's high-tech exports

accounted for only 0.6% of the world. By 2020, the share of Chinese Mainland is 25.8%, ranking first. However, in terms of profit proportion, China's profit proportion is not high. We look at the distribution of global industrial chains. Among most high-tech exports, China occupies mostly medium and low-end products. Intellectual property protection plays an irreplaceable role in promoting the technological progress in the production of high-tech products and promote the transformation of innovative achievements. Therefore, it is very necessary to explore the specific impact of the level of intellectual property protection of importing countries on the export quality of China's high-tech products.

Using the data of 30 core exporting countries of China's high-tech products from 2004 to 2019, in this

paper we try to study the impact of the level of intellectual property protection of importing countries on the export quality of China's high-tech products. On this basis, we empirically analyze the impact of intellectual property protection in countries with different economic development levels on the export quality of China's high-tech products.

2. LITERATURE REVIEW

Both of intellectual property protection and quality upgrading of export products are research hotspots in international economics and international trade in recent years. However, there are few literatures that combine these two directions.

Ndubuisi (2019) [1] found that countries with more effective intellectual property protection (IPP) have a comparative advantage in producing and exporting high-quality R & D intensive products. Taking the Property Law of the People's Republic of China promulgated in 2007 as an example, Li et al. (2020) [2] investigated the impact of the degree of intellectual property protection on export quality and found that the degree of intellectual property protection enhances a country's international competitiveness by improving its export quality. Song et al. (2021) [3] found that the degree of intellectual property protection affects the export quality of enterprises through two opposite ways: innovation effect and threshold effect, which promote and inhibit quality upgrading respectively. Dong et al. (2022) [4] empirically tested the impact of the degree of intellectual property protection on the quality of export products based on the panel data of Chinese enterprises from 2008 to 2013. The impact ways include the strengthening of R & D investment, the development of new products and the reduction of financial constraints. The empirical results show that the improvement of intellectual property protection is conducive to the improvement of export quality of enterprises with low capital intensity and innovation intensive enterprises.

3. RESEARCH METHOD

3.1 Measurement of Export Product Quality

The data sources of this paper include the database of the National Bureau of statistics, the WDI database of the world bank, the human development report, Barro-Lee website, service network of China free trade area and annual report issued by the Wall Street Journal and the American Heritage Foundation from 2004 to 2019. Thirty countries are selected as the research objects of this paper, and they are divided into high-income countries, upper-middle-income and lower-middle-income countries according to their income level.

As for the measurement of product quality, in this paper I calculate the quality of Export products of China's

high-tech industry from 2004 to 2019 by referring to O. Awokuse and Hong (2010) and Shi et al. (2013), who deduce product quality from demand information. In this model, the demand function of product i can be deduced as:

$$q_{ikt} = P_{ikt}^{-\sigma_i} \lambda_{ikt}^{\sigma_i - 1} (E_{ikt} / P_{ikt}) \quad (1)$$

Wherein, q_{ikt} , P_{ikt} and λ_{ikt} represent the quantity, price and quality of product i exported to country k at time t , and $\sigma_i > 1$ represents the elasticity of substitution of product i . E_{ikt} represents the total expenditure of importer k on product i at time t , P_{ikt} is the price index, and E_{ikt} / P_{ikt} represents the market size.

Logarithms are taken from both sides of equation (1) to construct the econometric regression model (2):

$$\ln q_{ikt} = X_{ikt} - \sigma \ln P_{ikt} + \mu_{ikt} \quad (2)$$

Where, $X_{ikt} = \ln E_{ikt} - \ln P_{ikt}$, $\mu_{ikt} = (\sigma - 1) \ln \lambda_{ikt}$, μ_{ikt} is the residual term, Finally, product quality is defined as formula (3):

$$quality_{ikt} = \ln \hat{\lambda}_{ikt} = \frac{\hat{\mu}_{ikt}}{\sigma - 1} = \frac{\ln q_{ikt} - \ln \hat{q}_{ikt}}{\sigma - 1} \quad (3)$$

To compare product quality, formula (3) is further standardized:

$$r_quality_{ikt} = \frac{quality_{ikt} - \min(quantity_{ikt})}{\max(quantity_{ikt}) - \min(quantity_{ikt})} \quad (4)$$

$\min(quantity_{ikt})$ and $\max(quantity_{ikt})$ represent the minimum and maximum value of quality respectively. After standardization, $r_quality_{ikt}$ is [0,1].

Using customs micro-trade data, extract value and quantity indicators, calculate price indicators, and perform regression according to formula (4). In order to ensure the reliability of the regression results, the original data have been processed according to certain principles.

Based on the practice of Li et al. (2021), The corresponding HS92 codes for high-tech products are: 8415; 8423; 8450; 8469-8472; 8501-8548; 9001; 9002; 9005-9017; 9023-9033; 9101-9114; 9405.

In the screening of export destination countries, considering the availability and representativeness of sample data, in this paper I select 30 countries (Australia, Austria, Brazil, Canada, France, Germany, Indonesia, Iran, Italy, Japan, Rep. of Korea, Malaysia, Mexico, Netherlands, Norway, Pakistan, Philippines, Poland, Russian Federation, Saudi Arabia, India, Singapore, Spain, Sweden, Switzerland, Thailand, United Arab Emirates, Turkey, United Kingdom and USA) from 2004 to 2019 as samples based on the CEPII database. From 2004 to 2019, China's annual exports of high-tech products to these 30 countries accounted for about 80% of the total exports of high-tech products, which is highly representative.

3.2 Setting of Measurement Model

I set an econometric model (5) to investigate the impact of intellectual property protection in importing countries on the export quality of China's high-tech products

The model is set as follows:

$$Quality_{ijt} = \beta_0 + \beta_1 \ln regp_{it} + \sum control_{ijt} + \mu_t + \mu_j + \varepsilon_{ijt} \quad (5)$$

Among them, i represents China, j represents the country of export destination, k represents the high-tech

product export, and t represents the year. The dependent variable $Quality_{ijt}$ represents the quality of high-tech products exported by China to 30 countries in t year. $regp_{it}$ is the core variable, that is, the strength of intellectual property protection in importing countries in period t . The data comes from the global competitiveness report. $control_{ijt}$ is other control variables. μ_j and μ_t are the country fixed effect and year fixed effect respectively. ε_{ijt} is the residual term.

3.3 Control Variables and Sources

Table 1 Variables information

Variables	Measure of variables	Data Sources
<i>quality</i>	China's export quality of high-tech products to 30 countries	Calculated based on the model
<i>regp</i>	Intellectual property protection of importing countries	The Global Competitiveness Report
<i>pgdp</i>	Per capita GDP of China and importing countries	World Bank Open Data
<i>ef</i>	Economic freedom of importing countries	The Wall Street Journal and annual report issued by Heritage Foundation
<i>tax</i>	The import tariff rate (weighted average) of high-tech products in importing countries	World Bank Open Data
<i>pan</i>	Patent applications (residents and nonresidents)	World Bank Open Data
<i>edu</i>	Imitation ability, the number of years of education over the age of 25	Barro Lee
<i>fdi</i>	China FDI from importing countries, net inflows (% of GDP)	World Bank Open Data
<i>fta</i>	If importing country signs a free trade agreement with China, take 1, otherwise take 0	China Free Trade Zone Service Network

4. EMPIRICAL RESULTS

The benchmark regression analysis is based on the overall perspective of all samples for regression analysis. Table 2 shows the benchmark regression results of this paper, in which (1) - (8) are listed as adding control variables successively on the basis of analyzing the level of intellectual property protection, so as to investigate whether the core variables have a significant impact on the export quality of Chinese high-tech products. Table 2 shows the estimated results of export product quality based on all samples. The estimated results show that the

impact of intellectual property protection on export quality is significantly positive at the level of 1%, indicating that the improvement of the intellectual property protection in importing countries has a significant role in promoting the export quality of high-tech products. The result is consistent with the expected sign.

From other control variables, the estimated coefficient of GDP per capita of 30 countries is significantly positive, indicating that the higher the GDP per capita, the higher the export quality. GDP per capita can measure a country's economic development level. The higher its value, the more capable of high-quality

high-tech products the country is to produce, resulting in the improvement of export quality, which is consistent with the previous expectations. The estimation coefficient of the number of patent applications (*pan*) in various countries is significantly negative, indicating that it has a negative correlation with the quality of export products.

The result of *edu* regression is negative, which means that although the number of years of education in China has increased, the export quality of China's high-tech products is declining. The reason may be that though China's independent R & D level has been improved, it still cannot meet the requirements of foreign markets for imported high-tech products to meet the intellectual property rights of export destination countries.

Considering from the perspective of profit, enterprises will choose products that meet the requirements of foreign intellectual property rights, and the export quality of these high-tech products may be low.

The variable *fta* reflects whether countries sign free trade agreements. In data processing, the value of signing free trade agreements is 1 and that of not signing free trade agreements is 0. The estimated coefficient of *fta* is significantly positive, indicating that signing a free trade agreement is helpful to improve the quality of export products. Free trade agreement helps countries eliminate trade barriers, allow products and services to flow freely among countries, open investment and promote exchanges among countries, so as to improve the quality of export products.

Table 2 Estimation results of export product quality based on all samples

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Lnregp</i>	0.069***	0.045***	0.044***	0.033***	0.025***	0.026***	0.023***	0.024***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
<i>Lnpgdp</i>		0.095***	0.097***	0.112***	0.133***	0.136***	0.134***	0.129***
		(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)
<i>Lnep</i>			-0.016***	0.015**	0.002	-0.001	0.005	0.005
			(0.003)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)
<i>Lntax</i>				-0.003**	-0.003*	-0.002*	-0.002	-0.001
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
<i>Lnpan</i>					-0.004***	-0.003***	-0.002*	-0.002
					(0.001)	(0.001)	(0.001)	(0.001)
<i>Lnedu</i>						-0.023***	-0.030***	-0.027***
						(0.007)	(0.007)	(0.007)
<i>Lnfdi</i>							0.000	-0.000
							(0.000)	(0.000)
<i>fta</i>								0.004***
								(0.001)
<i>_cons</i>	0.489***	-0.395***	-0.344***	-0.596***	-0.697***	-0.669***	-0.678***	-0.641***
	(0.004)	(0.027)	(0.030)	(0.036)	(0.039)	(0.040)	(0.040)	(0.041)
<i>N</i>	197437	197437	185116	172859	166899	166899	164810	164810
<i>R2</i>	0.751	0.753	0.757	0.765	0.768	0.768	0.769	0.769
<i>t</i>	yes	yes	yes	yes	yes	yes	yes	yes
<i>k</i>	yes	yes	yes	yes	yes	yes	yes	yes
<i>i</i>	yes	yes	yes	yes	yes	yes	yes	yes

Standard errors in parentheses

* p<0.1, ** p<0.05, *** p<0.01

According to the analysis of the theoretical part, in this paper I believe that there are differences in the level of technological development and economic development in different countries. Therefore, the results may be different among different countries. In the heterogeneity test, the above 30 countries are divided into high-income countries, upper-middle-income and lower-middle-income countries according to their income level.

As shown in Table 3, after adding all control variables, the coefficient of intellectual property

protection(*repg*) is negative and fails the significance level test. This may be related to the low level of intellectual property protection in lower-middle-income countries, and will not have a "reversible effect" on the improvement of China's export quality of high-tech products. The estimated coefficient of GDP per capita (*pgdp*) in lower-middle-income countries is significantly positive, indicating that in lower-middle-income countries, the higher the GDP per capita, the higher the export quality. The estimation coefficient of economic

freedom (*ef*) is significantly positive, which reflects that the economic freedom accelerates technological progress and improves the ability to absorb technology, so as to improve the quality of export products. Secondly, the estimated coefficient of tariff rate (*tax*) of industrial products in various countries is significantly negative, indicating that the higher the tariff rate, the higher the cost of imported products, resulting in the decline of the quality of export products. The estimation coefficient of the number of patent applications in various countries is significantly negative, indicating that it has a negative

correlation with the quality of export products. The estimation coefficient of China's imitation ability (*edu*) is significantly negative, which indicates that the imitation ability of the national group poses a threat to the export countries and is not conducive to the improvement of the quality of China's export products. The estimated coefficient of signing free trade agreement (*fta*) is significantly negative, indicating that signing free trade agreement does not help to improve the quality of export products.

Table 3 Estimation results of export product quality of lower-middle-income sample countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln <i>regp</i>	0.032*** (0.007)	0.020*** (0.007)	-0.006 (0.008)	-0.018* (0.009)	-0.025*** (0.009)	-0.026*** (0.009)	-0.037*** (0.011)	-0.017 (0.013)
Ln <i>pgdp</i>		0.115*** (0.008)	0.073*** (0.009)	0.052*** (0.013)	0.127*** (0.020)	0.144*** (0.021)	0.200*** (0.025)	0.182*** (0.026)
Ln <i>ef</i>			-0.031*** (0.003)	0.053** (0.022)	0.126*** (0.026)	0.075** (0.033)	0.130*** (0.042)	0.141*** (0.042)
Ln <i>tax</i>				-0.007** (0.003)	-0.011*** (0.003)	-0.013*** (0.003)	-0.014*** (0.004)	-0.011*** (0.004)
Ln <i>pan</i>					-0.033*** (0.007)	-0.033*** (0.007)	-0.039*** (0.007)	-0.036*** (0.007)
Ln <i>edu</i>						-0.064** (0.026)	-0.071** (0.028)	-0.107*** (0.030)
Ln <i>fdi</i>							-0.000 (0.000)	0.000 (0.000)
<i>fta</i>								-0.014*** (0.004)
_cons	0.505*** (0.009)	-0.334*** (0.060)	0.121* (0.071)	-0.008 (0.112)	-0.555*** (0.160)	-0.359** (0.175)	-0.899*** (0.226)	-0.796*** (0.229)
N	31190	31190	29184	23895	23065	23065	20976	20976
R2	0.716	0.719	0.724	0.731	0.727	0.727	0.730	0.730
t	yes	yes	yes	yes	yes	yes	yes	yes
k	yes	yes	yes	yes	yes	yes	yes	yes
i	yes	yes	yes	yes	yes	yes	yes	yes

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

As shown in Table 4, among the groups of upper-middle-income countries, the estimated coefficient of *regp* is significantly positive, indicating that intellectual property protection contributes to the improvement of the quality of China's export products. The estimation coefficient of GDP per capita (*pgdp*) is significantly positive, indicating that in upper-middle-income countries, the higher the GDP per capita, the higher the

export quality. The estimation coefficient of economic freedom (*ef*) is significantly negative, which reflects that in upper-middle-income countries, the improvement of economic freedom does not improve the export quality. Secondly, the estimated coefficients of industrial tariff rate (*tax*) and imitation ability (*edu*) are significantly negative, indicating that both are negatively related to China's export quality.

Table 4 Estimation results of export product quality of upper-middle-income sample countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Lnregp</i>	0.005 (0.006)	0.014** (0.006)	0.023*** (0.006)	0.014* (0.007)	0.018** (0.008)	0.030*** (0.008)	0.028*** (0.008)	0.025*** (0.009)
<i>Lnpgdp</i>		0.090*** (0.009)	0.145*** (0.010)	0.122*** (0.011)	0.134*** (0.012)	0.173*** (0.013)	0.170*** (0.013)	0.172*** (0.014)
<i>Lnef</i>			-0.098*** (0.012)	-0.069*** (0.013)	-0.064*** (0.013)	-0.070*** (0.013)	-0.072*** (0.013)	-0.071*** (0.013)
<i>Lntax</i>				-0.013*** (0.003)	-0.012*** (0.003)	-0.006** (0.003)	-0.005* (0.003)	-0.005* (0.003)
<i>Lnpan</i>					-0.004** (0.002)	-0.002 (0.002)	-0.001 (0.002)	-0.002 (0.002)
<i>Lnedu</i>						-0.137*** (0.017)	-0.144*** (0.017)	-0.141*** (0.017)
<i>Lnfdi</i>							-0.000*** (0.000)	-0.000*** (0.000)
<i>fta</i>								-0.002 (0.003)
<i>_cons</i>	0.577*** (0.008)	-0.232*** (0.078)	-0.330*** (0.086)	-0.206** (0.093)	-0.299*** (0.100)	-0.400*** (0.102)	-0.352*** (0.103)	-0.371*** (0.106)
<i>N</i>	40150	40150	37732	33132	33132	33132	33132	33132
<i>R2</i>	0.695	0.696	0.700	0.709	0.709	0.710	0.710	0.710
<i>t</i>	yes	yes	yes	yes	yes	yes	yes	yes
<i>k</i>	yes	yes	yes	yes	yes	yes	yes	yes
<i>i</i>	yes	yes	yes	yes	yes	yes	yes	yes

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

As shown in Table 5, among high-income groups, the *regp* is significantly positive, indicating that intellectual property protection helps improve the quality of China's export products. The estimation coefficient of GDP per capita (*pgdp*) is significantly positive, indicating that in upper-middle-income countries, the higher the GDP per capita, the higher the export quality, which are similar to the low, middle and high groups and the overall conclusion. The estimation coefficient of economic freedom (*ef*) is significantly positive, indicating that it is positively correlated with the quality of export products.

However, in this group, the estimated coefficient of tax rate (*tax*) is significantly positive, indicating that the increase of tax rate is conducive to the improvement of export quality. The estimated coefficients of *edu* are significantly negative, indicating that the enhancement of imitation ability of various countries is not conducive to the improvement of the quality of China's export products. The estimated coefficients of signing free trade agreement (*fta*) are significantly positive, indicating that signing free trade agreement will help the circulation of transactions and improve the quality of China's export products.

Table 5 Estimation results of export product quality of high-income sample countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Lnregp</i>	0.048*** (0.005)	0.050*** (0.005)	0.039*** (0.005)	0.035*** (0.005)	0.023*** (0.005)	0.027*** (0.005)	0.029*** (0.005)	0.028*** (0.005)
<i>Lnpgdp</i>		0.037*** (0.004)	0.028*** (0.004)	0.056*** (0.005)	0.067*** (0.007)	0.064*** (0.007)	0.057*** (0.007)	0.049*** (0.007)
<i>Lnef</i>			0.096*** (0.009)	0.073*** (0.009)	0.071*** (0.010)	0.072*** (0.010)	0.076*** (0.010)	0.083*** (0.010)
<i>Lntax</i>				0.005** (0.002)	0.003 (0.002)	0.003 (0.002)	0.002 (0.002)	0.008*** (0.002)
<i>Lnpan</i>					-0.006*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)
<i>Lnedu</i>						-0.062*** (0.011)	-0.064*** (0.011)	-0.059*** (0.011)

Lnfdi							0.000***	0.000**
							(0.000)	(0.000)
fta								0.009***
								(0.001)
_cons	0.527***	0.140***	-0.160***	-0.352***	-0.372***	-0.222***	-0.173***	-0.135**
	(0.008)	(0.046)	(0.054)	(0.056)	(0.062)	(0.065)	(0.067)	(0.067)
N	126097	126097	118200	115832	110702	110702	110702	110702
R2	0.778	0.778	0.782	0.786	0.792	0.792	0.792	0.792
t	yes	yes	yes	yes	yes	yes	yes	yes
k	yes	yes	yes	yes	yes	yes	yes	yes
i	yes	yes	yes	yes	yes	yes	yes	yes

Standard errors in parentheses

* p<0.1, ** p<0.05, *** p<0.01

5. CONCLUSIONS AND IMPLICATIONS

The results show that there is a significant positive correlation between the intensity of intellectual property protection in exporting countries and the export quality of China's high-tech products, that is, the improvement of the degree of intellectual property protection will drive the improvement of the export quality of high-tech products. Secondly, in this study I found that the GDP per capita of exporting countries and whether to sign trade agreements have a positive impact on the improvement of the export quality of China's high-tech products. The higher GDP per capita, the more countries can produce high-quality high-tech products, so as to improve the export quality. Free trade helps countries eliminate trade barriers, allow products and services to flow freely among countries, open investment and promote exchanges among countries, so as to improve the quality of export products. In terms of education level, the number of education year in China has increased, but the export quality of China's high-tech products is declining. The reason may be that although China's independent R & D level has been improved, it still cannot meet the requirements of foreign markets for imported high-tech products to meet the intellectual property rights of export destination countries. Considering from the perspective of profit, enterprises may choose products that can meet the requirements of foreign intellectual property rights, and the export quality of these high-tech products may be low.

For China to improve the export quality of high-tech products, in this paper I put forward the following suggestions. Firstly, when enterprises choose the export target market, I suggest them to focus on the intensity of intellectual property protection in the importing country, so that their products can be effectively protected when export to the importing country, so as to form sustained and stable foreign market demand and ensure the sustained and stable growth and peaceful development of China's export trade.

Second, our government should try to promote trade liberalization and facilitation, attract foreign investment through the intellectual property protection system, and encourage cooperation projects among enterprises. Chinese government should continue to promote multilateral or bilateral free trade zone negotiations with willing countries, and it can create a superior environment for the export of China's high-tech products. Foreign direct investment is also conducive to the diffusion of advanced technology in China and accelerate the improvement of enterprises' R & D technology ability.

Thirdly, the state and enterprises should strengthen R & D investment, support innovation, formulate targeted industrial development strategies for key development industries and technology intensive industries, and improve the ability of independent innovation and the conversion rate of scientific and technological achievements. The state should encourage and attach importance to intellectual property protection systems such as patent application, patent protection, patent revocation and trademark right.

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