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Study on the Impact of Intellectual Property Protection on Digital Trade

Dian Wang

School of Statistics and Applied Mathematics, Anhui University of Finance and Economics, Bengbu, Anhui, China

Abstract

Using panel data of 250 Chinese municipalities from 2011 to 2022, we will employ threshold regression methods to examine the effect of intellectual property protection on digital trade via the progress of digital technology and changes in the commercial environment. Intellectual Property Protection Promotes the Development of the Digital Economy and Enhances Regional Power. Innovation and institutional environments have improved, and as educational attainment has increased, so too has this situation. The three results are the first three policy recommendations for economic development.

Keywords

Intellectual Property Protection; Electronic Commerce; Digital Technology Development; Business Environment; Tipping Point Effect.

1. Introduction

Digital economy has developed all over the world recently, and now online shopping has become a significant force in the growth of foreign trade. According to the World Trade Organisation's statistics, by 2024, the amount of cross-border electronic trade around the world will reach about 7.13 trillion US dollars, and it is expected to increase by about 8.8% each year going forward. In 2020, the "Implementation Opinions on Promoting the Innovative Development of Foreign Trade" issued by the General Office of the State Council called for China to "actively promote the growth of digital trade". A main direction of the strategy set out in the 20th National Congress of the Communist Party of China was to advance digital trade and build high-level free trade zones. At present, the main problems in China's Digital Trade are digital trade barriers and cybersecurity risks. Promoting the development of digital economy and improving the overall level of the Chinese economy can help to address problems caused by fluctuations in the international economy at present[1]. Digital trade refers to commerce conducted via electronic data; although the reproduction and distribution costs of such data are very low, there are still many problems, such as intellectual property infringement and the protection of source code. Therefore, the protection of intellectual property (IPR) has become a problem in the regulation of digital trade.

A good IPP framework will curb infringement, promote new technologies and ideas, boost the development of the domestic creative economy, and improve the competitiveness of local enterprises [2]. The Chinese government has been paying more attention to IPPs and released the "Outline for Building a Strong Country in Intellectual Property (2021-2035)" in September 2021. Based on the above data, we need to accelerate the restructuring of intellectual property and achieve the goal of building a first-class world IP system by 2035. A well-developed Internet infrastructure can promote technological innovation and the construction of new business models in all sectors, strengthen the entire digital trade service system, and provide new momentum for the high-end development of global digital economy. Improving the cooperation mechanism of cross-border Internet service providers will reduce the obstacles to digital trade,

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help protect the data of enterprises and individuals, and provide an institutional basis for building an open and fair digital economy. IPPs have used various ways to promote the high-end development of digital trade as one of the main drivers for expanding the digital economy; why is this the case? Given the problems above, this paper will use panel data from the 250 prefecture-level cities in China to study the effect of IPPs on the development of digital trade systematically. First, a solid legal basis should be laid for the development of digital economy and e-commerce.

2. Literature Review

After its first release in 2010, it has drawn the attention of scholars and enterprises to this day. At present, the research on digital trade is divided into three parts.

First, some research has been carried out on the attributes of digital commerce. R.H. Weber [3] first presented the idea of electronic trade in his work "Digital Commodities and Offerings". Trade has changed over time, and so has the definition of digital trade. Lu Jing and Fu Nuo [4] propose that digital trade is a new type of trade based on the Internet, and Ma Shu Zhong [5] thinks that digital commerce can promote the rapid circulation of tangible goods, electronic products and services, electronic wisdom and data through digital tools, thus expanding and deepening traditional trade in the era of the digital economy. Next, the indicators for measuring the progress of digital trade are divided into two main categories. The first is a single-factor method; although data on the development of digital commerce in BOP services trade [6] and the UN Comtrade services database [7] are available, this method cannot cover all aspects of digital trade. One can also construct a general index system. Zhang Diping [8] and Ding Ziqi et al. [9] have built a structural map for evaluating the level of digital trade based on the main ideas of digital commerce. Hong Junjie [10] and others have put forward an index system for the development of digital trade in four areas: Internet infrastructure, logistics system, policy environment and trade outlook, and the indicators in these parts include components such as manufacturing, transportation, coverage, local consumption capacity and the degree of government support. Feng Zongxian and Duan Dingyun [11] have carried out all-round assessments of digital trade at various stages of its development by integrating digital trade security, digital trade hurdles, digital creativity and expertise, the volume of digital commerce, and digital infrastructure. Finally, as shown by Ou Zhonghui and others [12], the level of IPP is a main reason for the development of digital trade. Zhou Nianli and others [13] have found that regional trade agreements (RTAs) with an IPP clause promote digital trade. Technological breakthroughs [14], foreign direct investment [15], technological proficiency [16] and human resources [17] are also reasons for the growth of digital trade.

According to the above research, most studies have covered the national and provincial levels, but fewer have focused on prefecture-level cities. Under the tripartite administrative structure in China of "province, city and county", prefecture-level cities are the main implementers of policies and link central government with local governments. Therefore, this paper will examine the transmission process, operating mode and non-linear features of IPR in digital trade at the prefecture-level city level, and its main contribution is to show that traditional trade indicators fail to reflect the essential characteristics of digital trade due to its complexity. To overcome the deficiencies of individual indicators, this paper reconstructs the system of digital trade indicators to cover all aspects of digital commerce and strengthens these indices. First, we have set up a five-dimensional assessment framework for digital trade: digital infrastructure, logistics conditions, current digital trade situation, digital trade potential and digital trade policies. Then, based on the above, the mediation effect model will be employed to study how IPP affects digital trade through the two paths of digital technology innovation and optimisation of the commercial environment. According to the threshold effect model, this

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paper will also determine whether the stimulative effect of IPP on digital trade in education is non-linear.

3. Theory and Hypotheses

3.1. Direct Impact

First,data is the foundation of digital trade[18]. Since the sector handles the trading of intangible assets, a good system for protecting intellectual property needs to be established to ensure the security and privacy of data in the digital economy and prevent data breaches. A good system of intellectual property protection will reduce the need for monitoring and handling cases of infringement, increase the revenue of digital content creators, motivate more investment in creative works by companies and individuals, and promote innovation and development in the commercial market. Finally, IPP will help to create a good environment for the development of digital trade. Dual and multilateral intellectual property treaties signed by many countries can standardise trade technology, set up transparent rules for digital commerce, build an orderly market environment, promote connectivity in the digital trade sector, and provide strong support for the international flow of digital commodities.

H1: IPP will promote the development of digital trade.

3.2. Indirect Effects

IPP Promotes the Development of Electronic Commerce with Digital Technology. With the growth of electronic commerce, cases of piracy in commercial operations have become more frequent, and due to insufficient patent defence, companies are less motivated to develop. Strengthening the protection of intellectual property rights can encourage more creative works from enterprises and individuals, provide judicial guarantees for inventors, increase the incentive for research and development investment, and thus promote technological progress. New areas for the development of digital economy will be created, and more types of goods and services for online retail will be added by various technological innovations. Simultaneously, modern digital innovations have likewise altered the mode of manufacturing and improved manufacturing productivity.

IPP can help promote the development of e-commerce by creating a good commercial environment. Virtual goods are easy to reproduce and have a low cost, so a strong system of intellectual property protection can delineate the boundaries of rights, prevent illegal duplication and appropriation, and create a stable environment for electronic commerce. IPP can help curb illicit competition and ensure fair competition in the market to build a healthy and transparent industrial environment. A good business environment will reduce the risk and uncertainty of trade for companies by providing some stability and rules; thus, more companies will be motivated to use electronic commerce, more such enterprises will be added, and the amount of money in digital trade will increase. At the same time, a transparent commercial ecosystem will motivate countries and regions to participate more actively in the global digital economy, attract local and foreign expertise and capital, promote the spread of knowledge and innovation, encourage creativity, and drive the development and global expansion of digital trade.

H2: IPP can promote the development of digital economy and create a good business environment by promoting technological innovation.

3.3. Nonlinear Impact of IP Protection on Digital Trade

The level of education affects both the spread of IPP adoption and the general effect of this safeguard. In areas with lower levels of education, people's knowledge of intellectual property is relatively weak, so piracy is widespread; therefore, it is difficult to build an effective system

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for protecting intellectual property and advance electronic commerce. On the other hand, in areas with higher educational achievements, the people are more legally literate and better informed about the laws. Respecting the creative ideas of others, people do not copy them and thus promote the development of IPP. Areas with good education are more attractive to skilled professionals and foster more innovation. Good IPP support will be provided in the above areas to achieve technological breakthroughs in commerce, help realise the goals of IPP, and use data as one of the necessary materials for digital transactions. In areas with a high proportion of literate people, too much IPP may lead to data monopolisation and prevent the spread of information, thus harming digital trade.

H3: The Effect of IPP on Digital Trade is Not a Simple Function of Educational Level.

4. Research Design

4.1. Variable Selection

4.1.1. Dependent Variable : Level of Digital Trade Development (DTL)

As a single indicator is unable to show all the characteristics of development accurately, based on the studies of researchers such as Zhang Weihua, Duan Dingyun and Feng Zongxian [19, 20], this paper reorganises the evaluation system. The five factors in the development of digital commerce at the municipal level are electronic infrastructure, transportation conditions, current digital trade status, latent digital trade prospects and policy environment. The five main indicators and 11 supporting factors have been combined to form 23 subcategories in total; that is, they cover all areas of digital trade and are not dominated by any one single index.

Table1. Digital Trade Indicator System

First-Level Indicators	Second-Level Indicators	Tertiary Indicators
Digital Infrastructure	Level of Network Sharing	Number of Mobile Phone Subscribers at Year-End (10,000)
		Number of International Internet Users (10,000)
		Mobile Phone Penetration Rate (units per 100 people)
	Level of Hardware Infrastructure	Number of Internet Broadband Access Ports per Capita (per 100 people)
		Long-distance optical cable density (10,000 km)
Logistics Environment	Level of Logistics Development	Express Delivery Volume (10,000 pieces)
	Level of logistics infrastructure	Logistics and Warehousing Land Area (square kilometers)
		Number of Employees in the Transportation, Warehousing, and Postal Sectors (10,000 people)
		Total Freight Volume (10,000 metric tons)
Current Status of Digital Trade	Employment in the Digital Sector	Number of R&D Personnel (10,000)
		Percentage of Employees in the Information Transmission, Computer Services, and Software Industries (%)
	Level of Digitalization in Trade	E-commerce Transaction Volume (10,000 yuan)
		Digital Inclusive Finance Index (%)
		Number of Foreign-Invested Enterprises (units)
	Level of Digital Industrialization and Trade	Total Postal Service Volume (10,000 yuan)
		Total Telecommunications Service Volume (10,000 yuan)
Digital Trade Potential	Level of Innovation	Number of Patent Applications and Grants (10,000)
		Internal R&D Expenditures (10,000 yuan)
		Regional Innovation Index (%)
	Trade Openness	Foreign Trade Dependency (%)
		Total Imports and Exports (10,000 yuan)
	Market Consumption Capacity	Total Retail Sales of Consumer Goods (10,000 yuan)
Digital Trade Policies	Digital Trade Policies	Local Government Focus on Digital Trade (%)

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4.1.2. Core Explanatory Variable: Level of Intellectual Property Protection (IPP)

The main purpose of this paper is to study the effect of IPP. Since judicial rulings are an important indicator of the intensity of IPP, this paper uses the number of IP litigation cases in local courts (IPPCourtjt) to reflect the IPP level of each urban area. Since neither the Supreme People's Court nor the municipal courts have released complete city-level intellectual property litigation data, this paper will use the analysis method of Wu Chaopeng and Tang Ke [21] and take the total number of finalised IP cases in the Peking University Law Database as a substitute index. According to the analysis by Shen Guobing [22], regional GDP is added to account for the scale factor and reduce the impact of different sizes of municipal economies on IPP. The particular calculation formula is as follows:

$$IPP1_{jt} = \frac{IPPCourt_{jt} / GDP_{jt}}{IPPCourt_{ct} / GDP_{ct}}$$

where $IPP1_j$trepresents the city-level IPP level of city j in year t, based on the number of concluded intellectual property cases; a higher value indicates a higher level of IPP in city j;IPPCourtjtand GDP_j trepresent,respectively, the number of concluded intellectual property cases and the GDP of city j in year t; IPP Courtctand GDP ctrepresent, respectively, the total number of concluded intellectual property cases and the GDP of China as a whole in year t.

4.1.3. Control Variables

The following control variables were selected to address estimation errors caused by omitted variables.Industrial structure (SPD), measured by the share of value added by the tertiary sector in GDP; regional economic development level (PGDP), measured by per capita GDP in each region; level of fiscal support (FSE), measured by the ratio of fiscal education expenditure to local general public budget expenditure in each region; and R&D investment (R&D), measured by R&D funding in each region.

4.1.4. Mediating Variables

This study uses digital technological innovation (INOV) and business environment (PBE) as mediating variables. Digital technological innovation is measured by the number of invention patent applications per 10,000 people in each city. The business environment is measured by foreign direct investment.

4.1.5. Threshold Variables

Regional educational levels may play a moderating role in the effect of IPP on digital trade,and in accordance with Hypothesis H3 proposed in this paper, educational level (EDU) is selected as a threshold variable, measured by the number of students enrolled in undergraduate and vocational programs.

4.2. Data Sources and Descriptive Statistics

Data Sources

The data in this paper are sourced from the *China Statistical Yearbook*, Beida Fa Bao, the Peking University Open Research Data Platform, the National Bureau of Statistics, statistical yearbooks of various provinces and municipalities, and databases such as Guotai An.Due to data availability issues, cities with missing data were excluded. Ultimately, panel data from 250 prefecture-level cities were used to examine the impact of IPP on the development of digital trade. The time span covered 2011–2022, comprising a total of 3,000 data samples. For missing data in certain years, linear interpolation was applied. The descriptive statistics for the main variables are presented in Table 2.

ISSN: 2692-7608 DOI: 10.6981/FEM.202608_7(8).0020

Table 2. Descriptive Statistics

Stats	DTL	IPP	SPD	PGDP	FSE	R&D	PBE	INOV	EDU
Max	0.599	3.298	4.429	13.06	16.28	15.53	1,664.32	12.70	0.144
Min	0.0035	0.00056	2.664	9.187	11.19	0	0.002	3.40	5.92e-05
Mean	0.0421	0.239	3.725	10.80	13.26	10.58	67.80	8.01	0.0199
p50	0.0281	0.112	3.748	10.77	13.23	10.43	18.05	7.88	0.0109
SD	0.0511	0.385	0.234	0.555	0.782	1.466	159.18	1.59	0.0246
N	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000

5. Empirical Analysis

5.1. Baseline Regression

As revealed by the Hausman test, this paper selected a fixed-effects model for estimation. Table 3 presents the results of the baseline regression on the impact of IPP on the level of digital trade development. The baseline specification in Column (1), which controls for no additional variables, indicates that IPP significantly boosts digital trade at the 5% level.Columns (2)–(5) present the results of regressions with control variables added stepwise; it can be seen that the research conclusions remain valid. When controlling for other factors, IPP is conducive to the growth of digital trade.

Table 3. Baseline Regression Results

VARIABLES	(1)	(2)	(3)	(4)	(5)
	DTL	DTL	DTL	DTL	DTL
IPP	0.232**	0.236***	0.240**	0.184**	0.182**
	(0.104)	(0.104)	(0.103)	(0.083)	(0.083)
SPD		0.367***	0.488***	0.587***	0.584***
		(0.055)	(0.054)	(0.056)	(0.056)
PGDP			0.590***	0.415***	0.385***
			(0.040)	(0.051)	(0.053)
FSE				0.663***	0.611***
				(0.164)	(0.161)
R&D					0.038***
					(0.013)
Time	Yes	Yes	Yes	Yes	Yes
Individual	Yes	Yes	Yes	Yes	Yes
N	3,000	3,000	3,000	3,000	3,000
r2	0.957	0.958	0.962	0.967	0.968

Standard errors in parentheses

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

5.2. Robustness Tests

5.2.1. Controlling for Combined Fixed Effects

Although the base regression model includes separate fixed effects for city and year, it may have omitted the interaction term of province and year. Therefore, we have added a combined "province-year" fixed effect to account for the impact of external factors in different provinces and at different times. As shown in Column (1) of Table 4, the coefficient for IPP is still positive and statistically significant at the 1% level; thus, the province-year interaction term does not affect the results of this study.

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5.2.2. Eliminating the Influence of Outliers

To avoid the influence of very large or very small values in the estimation results caused by outliers, this paper trimmed the top and bottom 1% of the data for all variables before regression analysis. As shown in Column (2) of Table 4, the coefficient for IPP is still at the 10% significance level. Therefore, the conclusions of this study are very reliable and not due to any single extreme case.

5.2.3. Excluding Directly Administered Municipalities and Sub-provincial Cities

Both centrally administered municipalities and sub-provincial cities hold superior positions in the administrative hierarchy and enjoy a greater concentration of resources compared to ordinary cities. To eliminate the influence of administrative privileges, this study excluded the four municipalities directly under the central government and the fifteen sub-provincial cities from the sample and reran the regression analysis. The results are shown in Column (3) of Table 4. It is worth noting that the findings remain valid even after excluding these cities.

5.2.4. Adjusting the Sample Range

To eliminate the interference of outliers during exceptional periods, this study re-ran the regression using data from years prior to 2020 to verify the robustness of the baseline regression. The results show that in Column (4) of Table 4. It can be observed that, after adjusting the sample period, the impact of IPP on digital trade remains positively significant at the 1% level, indicating that the conclusions are robust.

5.2.5. Bootstrap Method

The Bootstrap method was used to generate multiple sample datasets through repeated sampling of the original sample, and the model was estimated for each dataset to test the robustness of the results. The results are shown in Column (5) of Table 4. They indicate that IPP has a positive impact on digital trade at the 5% significance level, suggesting that the conclusions of the baseline regression are robust and reliable.

Table 4. Robustness Tests

VARIABLES	(1) Control Combination Fixed Effects	(2) Removing the influence of outliers	(3) Excluding municipalities directly under the central government and sub-provincial cities	(4) Adjusted sample range	(5) Bootstrap method
IPP	0.252*** (0.088)	0.107* (0.025)	0.221* (0.126)	0.257*** (0.021)	0.182** (0.084)
Control variables	Yes	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes	Yes
Individual	Yes	Yes	Yes	Yes	Yes
Province-Time Effect	Yes	No	No	No	No
N	3,000	3,000	2,784	2,250	3,000
r2	0.888	0.848	0.954	0.970	0.968

Standard errors in parentheses

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

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5.3. Heterogeneity Test

(1) Geographically, the study divided the sample into four subsamples-the Central, Eastern, Western, and Northeastern regions-to conduct a regional heterogeneity test. The results in Table 5 show that the digital trade coefficients for the Central and Western regions are statistically significant. Possible reasons include: digital trade occurring in central and western China is still in its growth phase; market mechanisms and the institutional environment are not yet fully developed; and the marginal effects of IPP are more pronounced.Strengthening IPP can effectively curb imitation, incentivize corporate innovation, and provide more stable institutional safeguards for digital trade, thereby yielding significant policy effects.In contrast, the Eastern region has a high degree of marketization, a mature digital trade industrial chain, and a relatively well-developed IPP system; its level of protection may be close to the optimal threshold, resulting in diminishing marginal returns from further strengthening. Meanwhile, the Northeastern region is constrained by factors such as the slow transformation of traditional industries and insufficient innovation vitality, which has prevented the promotional role of IPP in digital trade from becoming prominent.

(2) Regarding the institutional environment, based on the six batches of cities designated as National IPP Demonstration Zones-announced by the China National IPP Administration since 2012-this paper categorizes cities into two groups: IPP demonstration cities and non-demonstration cities, and conducts estimates for both subsamples. Columns (1) and (2) of Table 6 show that IPP significantly promotes the development of digital trade, with this effect being more pronounced in IPP demonstration cities.Possible reasons include the fact that cities designated as IP protection demonstration cities typically possess more comprehensive legal enforcement systems, higher public awareness of intellectual property rights, and stricter market regulatory mechanisms. Therefore, strengthening IP protection can significantly promote the development of digital trade. In contrast, cities not designated as demonstration cities have relatively lower enforcement efficiency and levels of judicial protection, which weakens the promotional effect of IP protection on digital trade.

(3) Based on the median IP protection value, the whole dataset was divided into two groups according to whether the IP protection was strong or weak. As shown in Columns (3) and (4) of Table 6, high IP protection is favourable for the development of the digital economy and thus harms its progress. One is that when the intensity of IPP is low, local enforcement efficiency is relatively weak; thus, firms are more likely to engage in technological imitation rather than digital innovation, and the rights of digital inventions and patent holders are not well protected. Although strengthening the power of IPPs will increase the cost of regulation, it will not effectively curb piracy and will harm digital trade.

Table 5. Heterogeneity Analysis 1

VARIABLES	(1)	(2)	(3)	(4)
	Chinese	East	West	Northeast
IPP	0.593*** (0.280)	0.006 (0.036)	0.261* (0.146)	-0.075 (0.123)
Control variables	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes
N	912	1104	756	228
r2	0.923	0.981	0.975	0.968

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Table 6. Heterogeneity Analysis 2

VARIABLES	(1)	(2)	(3)	(4)
	IPP Model City for IPP	Non-IPP Demonstration Cities	Cities with Strong IPP	Weak Intellectual Protection
IPP	0.052*** (0.017)	0.229* (0.135)	0.194** (0.083)	-0.428* (0.239)
Control variables	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes
Individual	Yes	Yes	Yes	Yes
N	720	2,280	1,500	1500
r2	0.978	0.948	0.970	0.966

Standard errors in parentheses

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

6. Further Research

6.1. Testing for Mediating Effects

Based on the above theoretical analysis, IPP promotes the development of digital economy through the two channels of digital technology and the commercial environment. To verify Hypothesis 2, this paper uses a mediation model, and it has been determined that IPP promotes technological innovation. Column (2) is the mediating variable "technological innovation", and at present, both the coefficient for innovation and the IPP coefficient are positive and statistically significant at the 5% level. Therefore, it has been shown that the function of IPP in promoting digital trade acts as an important intermediary at 35.64%. As shown in Column (3) of Table 7, IPP helps to create a good business environment, and when this factor is added to the model in Column (4), it can be seen that the effect of the business environment on digital trade is positive and statistically significant at the 1% level; at the same time, the IPP coefficient remains significantly positive. It can be seen that IPPs promote the development of digital economy through their own strengths and have an indirect positive effect of approximately 31.28%. Therefore, Hypothesis 2 of this study is supported.

Table 7. Results of the Mediation Test

VARIABLES	(1)	(2)	(3)	(4)
	INOV	DTL	PBE	DTL
IPP	0.202*** (0.077)	0.122** (0.048)	81.664*** (25.274)	0.091*** (0.035)
INOV		0.295*** (0.076)		
PBE				0.001*** (0.000)
Control variables	Yes	Yes	Yes	Yes
Individual	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes
N	3,000	3,000	3,000	3,000
r2	0.963	0.972	0.802	0.974
Sobel test	8.108***		8.932***	
Proportion of Mediated Effect	35.64%		31.82%	

Standard Errors in Parentheses.

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

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6.2. Analysis of Threshold Effects

Based on the previous research, educational attainment has been taken as the dividing point, and Hansen's method will be used to examine the non-linear effect of IPP on digital trade. To determine whether there is a threshold effect, this paper has carried out threshold significance tests for both single and double thresholds, and Table 8 shows the F-statistics of these threshold effects, as well as the threshold levels and critical thresholds obtained by bootstrap resampling. Based on the above results, the education-level breakpoint variable meets the dual threshold condition at the 1% significance level, and its first threshold point is 0.0023 and the second is 0.0053.

Table 8. Test for Threshold Effects

Model	Threshold Values	F-value	P-value	Critical Value		
				10%	5%	1%
Single Threshold	0.0023	275.80***	0.0000***	12.2419	16.0091	25.9898
Dual Threshold	0.0053	77.58***	0.0067***	15.3376	21.3032	62.8414

Table 9 shows the regression results of the panel threshold model. Therefore, it was concluded from the above analysis that, in the lower tier (below the first threshold of 0.0023), the coefficient for IPP did not show a statistical difference in promoting the development of digital trade. Therefore, it can be concluded that IPP does not promote digital trade among people with low levels of education. When the education level reaches the first step of 0.0023 but does not exceed the second step of 0.0053, the impact coefficient of IPP will rise sharply from 0.122 to 0.91 and turn positive; therefore, a qualitative shift will occur in the promotion of digital trade by IPP. However, when education exceeds the secondary level of 0.0053, the coefficient falls to 0.157 and is no longer high. It is possible that areas with high educational attainment have too many IPPs; thus, the spread of knowledge and corporate creativity will be hindered, affecting the development of digital trade. In areas with higher education, there is a higher probability of the formation of corporate monopolies; such monopolies will establish intellectual property barriers that restrict small and medium-sized enterprises and thus reduce the promotion effect of IPP in digital trade. In short, the effect of IPP on the scale of digital trade is not constant with education and changes sign from positive to negative. Therefore, Hypothesis 3 of this paper is confirmed.

Table 9. Panel Threshold Regression Model

VARIABLES	Panel Threshold Regression Model	
IPP	EDUC<0.0023	0.122
		(0.117)
	0.0023 < EDUC < 0.0053	0.910***
		(0.250)
	EDUC > 0.0053	0.157**
		(0.076)
Control Variables	Yes	
Time	Yes	
Individual	Yes	
N	3,000	
r^2	0.727	

Standard Errors in Parentheses.

* p<0.10, ** p<0.05, *** p<0.01

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7. Conclusion

The first aim of this paper is to explore how IPP drives the development of the digital economy and to quantify the reasons for this impact. The results are as follows: Initially, IPP promoted the development of digital trade, and this result was in line with all the model variations. Subsequently, through the examination of heterogeneity, it has been found that IPP has promoted the development of digital trade in central and western municipalities, IPP model regions and prefecture-level cities with strong IPP. Based on the results of the mechanism test, IPPs promote the development of digital trade by fostering innovation in digital technology and improving the business environment; among the supporting factors, the progress of digital technology is particularly important. Finally, based on the assessment of threshold effects, the influence of IPP on the development of digital trade by education level is not monotonic.

Based on the theoretical and practical studies by experts on the development of digital trade through Internet platforms (IPPs), the following three recommendations are put forward to strengthen the IP framework and create a good operating environment for electronic trade. Regional governments need to fully utilize the trend of digitalisation to introduce specific regulations on copyright for digital works and data rights, clarify the path for IPPs in digital economy and digital trade, strengthen institutional support for digitalisation, promote the construction of intellectual property pilot and demonstration bases, etc. Second, support the leadership and momentum of IPPs in the development of digital technology, improve the business environment, and promote independent innovation and optimise the operating conditions. Promote the combination of Big Data and IPPs to build intelligent IP systems based on digital technology and inspire the creativity of market participants. First, improve the structure of property rights and other institutions for the commercialisation of scientific achievements to help enterprises realize the benefits of their research results and build an institutional basis for digital commerce. Strengthen the supervision of the system for the Internet economy to curb illegal activities in the digital economy, improve the conflict-resolution mechanism, and use big data and blockchain technology to monitor transactions on the platform in real time. It will promote the development of digital commerce and ensure the safe and stable operation of electronic trade. Increase funds for education in all regions to improve the general level of academic conditions. Higher education will improve the quality of talent; as a result, the public's awareness of intellectual property rights will grow, and a community focused on innovation and defence of IP will be built to support the development of digital economy through the role of IPPs.

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