

# Analyses of Intellectual Property Rights Affecting Sino-America Foreign Direct Investment

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## Abstract

The country's intellectual property rights (IPR) protection policies have a direct effect on its foreign direct investment (FDI). This paper will synthetically evaluate the differences of IPR protection level between China and America and empirically analyze the effects on FDI caused by such a disparity based on Ginarte and Park's index. Results indicate that the protection degree of IPR is the most influential factor in China; however, it is not evident in America. America has a relatively mature IPR system, whereas China has gradually improved its IPR system. Other more important factors such as scientific technology, market openness, and market scale also affect FDI. Hence, China should increase the legal protection of IPR and improve the relevant system to promote the healthy development of FDI. Moreover, China should enhance the strength of independent innovation, expand the market space and scale, and strive to create a good environment for IPR protection.

## Keywords

*Sino-America, Intellectual Property Protection, FDI, Effect*

## Awareness of the Problem

Intellectual property refers to the ownership of ideas or intelligence, including literary and artistic works, inventions, signs for distinguishing goods of an enterprise, and other elements of industrial property. Material or communicable results are in forms of discoveries, inventions, designs, and literary and art works. Intellectual property is a kind of intangible property right and an object of intellectual property or intellectual products. Moreover, intellectual property is an intangible property, a form of spiritual wealth, or the creative intellectual labor to create work achievement. Intellectual property rights protect ownership of an artistic or commercial nature. The rights are granted to creators and inventors to control the use of their products. They are traditionally divided into two branches: "copyright and related rights" for literary and artistic works" and "industrial property rights," which encompasses trademarks, patents, industrial designs, geographical indications, layout-designs of integrated circuits, and plant breeders' rights. However, investment and technology flows are decreasing in the process of economic globalization owing to government obstacles to trade. National and regional market linkages are increasingly close. Hence, protections of intellectual property requirements are also increasing with the process of cross-border flows of capital and technology. China's recent direct investment in the United States has also achieved rapid growth. China's direct investment in the United States of USD 18.1142 billion in 2011 reached USD 5.2 billion in 2014. Chinese enterprises of various types of investment in the United States reached a total of more than USD 38.5 billion by the end of 2014. The United States has become China's third largest destination for foreign direct investment. Cross-border direct investment is more dependent on the local government to create a good environment compared with the simple combination of international trade and investment. Therefore, the study of intellectual property protection level Sino-US foreign direct investment (FDI) has an impact on others with far-reaching significance.

Seyoum <sup>[1]</sup> empirically analyzed related data collected in 27 countries and found that the intellectual property rights (IPR) protection level of the countries is a positive determinant of their FDI inflow. Moreover, Bosco <sup>[2]</sup>, Xu <sup>[3]</sup>, and Ma <sup>[4]</sup> verified the same question. Their research indicates a positive correlation between IPR protection and

FDI. However, certain scholars believe that the effect between them should be the opposite, and their relationship is also negative. Markusen<sup>[5]</sup> studied and found that IPR protection level is negatively related to FDI inflow when a country's initial IPR protection stays at a lower level. Ethier et al.<sup>[6]</sup>, Class and Saggi<sup>[7]</sup>, and Markus et al.<sup>[8]</sup> also verified the same view using the same data and emphasized that IPR protection level decreases the FDI inflow when initial IPR protection stays at a lower level. Other representative scholars, such as Ferrantino<sup>[9]</sup>, Maskus and Konan<sup>[10]</sup>, Braga and Fink<sup>[11]</sup>, and Yang and Maskus<sup>[12]</sup>, hold a totally different view from the former scholars that FDI has nothing to do with IPR protection. They found no obvious correlation between FDI inflows and IPR protection level in these countries. Chinese scholars Sun and Xiong<sup>[13]</sup> draw the same conclusion.

The supporters of the three different opinions focus on the quantitative relation between IPR protection level and FDI inflow. Hence, does FDI also follow industrial development?

Mansfield<sup>[14]</sup> and Sherwood<sup>[15]</sup> interviewed some executives of six different industries in large companies in the United States about IPR protection and found that none of them believe that IPR has a protective effect on sales channels. They are more concerned on IPR's protection on primary production and package, component parts manufacturing, final product manufacturing, and R&D department and believe that IPR should pay more attention to the protection of the local R&D along with the continuation of the production phase, especially the international co-production. Lee and Maimiled<sup>[16]</sup>, Tang<sup>[17]</sup>, and Yi<sup>[18]</sup>, who are from different industries, analyze that FDI is in the control of the trend of industrial development. They considered that FDI prefers the industry that has minimal technology spillover effect. The strength of IPR protection in backward countries just meets the level of FDI attraction when larger technology gap appears. However, the strength should be the most optimal for multinational companies to use FDI when the gap is small. Cui and Lin<sup>[19]</sup> found that strengthening intellectual property protection can inhibit backward spillover effect.

Hence, the types of factors that influenced the flow direction of FDI, industrial market scale, or location factors need to be determined. Nigh<sup>[20]</sup> and Hennart and Park<sup>[21]</sup> believed that the most obvious factor that determines FDI flow is the market scale of the 27 countries. However, Edwards<sup>[22]</sup>, Wang and Swain<sup>[23]</sup>, and Bevan and Estin<sup>[24]</sup> argued that location factors determine FDI investment options. Moreover, Coughlin<sup>[25]</sup> analyzed and proved such argument based on detailed research on the rate of invested capital return, the rate of unemployment, state acreage, per-capita income, the level of agglomeration, and labor market conditions. Coughlin believed that the factors determine the regional distribution of FDI. Moreover, GaoFen<sup>[26]</sup> analyzed the strength of intellectual property protection to the effect of FDI under TRIPS agreement. Xu Chunming<sup>[27]</sup> suggested that the influence of the intensity of intellectual property protection is relatively small compared with the market scale and wage level. Similarly, Loberman and Shapiro<sup>[28]</sup> analyzed the selection of FDI flows from the economic determinants, policy framework, and convenient conditions for multinational companies in host countries. However, the technical capacity of the host country also determines FDI flow and quality<sup>[29]</sup>. Parello<sup>[30]</sup> concluded that strengthening the protection of intellectual property rights to attract FDI is invalid when the host country technical level is very low, and the human capital is very expensive. ChuKaiPing<sup>[31]</sup> showed that the long-term protection of intellectual property rights has a significant effect on the quality of FDI. The improvement of the protection of intellectual property rights promotes the improvement of the quality of FDI.

Hence, does the level of IPR protection in host countries also affect the effective flow and quality of FDI? Can appropriate and accurate IPR protection provided by both trade sides contribute to the growth of the FDI flow? Han Yuxiong and Li Huaizu<sup>[32]</sup> used Ginarte and Park (GP) index and have interpreted and evaluated the IPR protection in the country. However, Yang Quanfa and Han Ying<sup>[33]</sup> believed that only an appropriate and effective intellectual property protection policy can increase the inflow of FDI. Rapp, Rozek, Ginarte, and Park<sup>[34]</sup> scored based on the national intellectual property legislation text, whose index system includes five indicators, and each indicator is 1 / n points. Thus, the total score ranges from 0 to 5 points, and most are not integers. Moreover, the higher the score is, the higher strength of patent protection the country has. Kondo<sup>[35]</sup> and Lesser<sup>[36]</sup> combined the methods mentioned above and formed a comprehensive evaluation method. Du, Lu, and Tao<sup>[37]</sup> found that a precondition of FDI into intellectual property is to protect the environment.

The above research achievements have provided a better theoretical and methodological foundation for the questions about the relationship between IPR protection and FDI. However, the researchers only considered

individual factors that are influential in FDI (i.e., market size or pay level). Some of the researchers have summarized five influential indicators; however, they limited their researches based on the legislation index. Based on this background<sup>①</sup>, this paper takes China and America as two examples to interpret and study the influence of IPR protection on FDI with an intention to offer an empirical interpretation basis for benign development of IPR protection in our country using certain indicators. These indicators include domestic market scale, per capita consumption level, market exposure, labor cost, and R&D investment.

## The Measurement and Measuring Strength of Sino-American IPR Protection

### *The Selection of IPR Protection Level Index*

The most commonly used measurement for IPR protection is GP index. However, the strength of intellectual property protection index should integrate the intellectual property legislation index with enforcement index. Therefore, GP index should be used.

Hence, the strength of a country's IPR protection should be the product of the national legislation strength of IPR protection and the intensity of law enforcement.

$$P(t)=L(t)\times E(t) \quad (1)$$

$P(t)$  is the intensity of the national IPR protection at time  $t$ ,  $L(t)$ , the country's intellectual property legislation strength<sup>②</sup> at  $t$  time, and  $E(t)$  for the intensity of law enforcement<sup>③</sup>. The value of  $E(t)$  is set between 0 and 1, where 0 means no execution for IPR protection laws, and 1 is the opposite. That is, the law of IPR protection clause has been carried out. Therefore,  $E(t)$  is the variable of the actual execution effect of the IPR protection and displays the actual execution proportion.

The paper calculates the index of IPR protection in both China and America from 1991 to 2013 based on the above documents.

<sup>①</sup>The measurement of legislation strength should consist of the following aspects: patent law, copyright law, trademark law, trade secret law, and other intellectual property laws in layout designs of integrated circuits and new plant varieties. Hence, the legislation strength of IPR protection in a country can be fully reflected. However, patent primarily influences the economic development, especially the fact that specific legislation of intellectual property and its revision are synchronous. The legislation strength of patent law changes following the same pace with that of other specific intellectual property laws and time. For example, the country joined the Berne Convention and the Universal Copyright Convention during the first revising of the Patent Law in 1992. The conventions also enacted the Anti-unfair Competition Law when revising Trademark Law in 1993. The country revised Copyright Law and Trademark Law in 2000, which is the second year after the revision of Patent Law. Hence, the legislation strength of patent law is for the whole IPR legislation strength. The series of IPR legislation strength in China (Figure 1) are measured by GP method to ease international comparison.

<sup>②</sup>Five determinant factors to the enforcement strength are described as follows: the judicial protection level, administrative protection level, economic protection level, the public consciousness, and the international supervision and balance.

Judicial protection is the main way to solve the dispute of the intellectual property. The judicial level directly affects the implementation of the legislation strength of IPR protection. The proportion of lawyers in a total population is an important indicator to measure the judicial level in the country. The proportions of lawyers are all over 1‰ in Western developed countries. Those in other industrial countries are all over 0.5‰. The judicial protection of a country is at a high level when the proportion reaches 0.5‰.

The level of government protection and management depends on a perfect national legal system. A more complete legal system corresponds to clearer duty of administrative protection and management and lesser corruption phenomena (i.e., weak enforcement). A longer legislation time corresponds to better practice of judicial and enforcement and a more complete legal system. Hence, legislation time can be used to measure the perfectness of a national legal system.

Moreover, the protection strength of IPR in a country should adapt to its economic development level. Thus, the enforcement strength is definitely weak when economic development stays at a low level.

Public consciousness lays the foundation for the practice of intellectual property law. The public has a stronger IPR awareness if the public receive higher education. Therefore, the rate of adult literacy can be used to measure public IPR consciousness.

The protection of intellectual property is an internal and overseas problem. WTO placed intellectual property as one of its three pillars. Some specific regulations were established about the minimum standards and DSB of IPR protection in the WTO framework. Moreover, WTO members must perform relative duties (i.e., enjoying low tariffs in bilateral trade). DSB is a powerful weapon to supervise the enforcement strength of IPR protection in member countries. The deviation can be adjusted timely and effectively. The western developed countries urge China by the DSB of WTO to promote its enforcement strength. Hence, WTO members can be used as an indicator to measure international supervision and balance. If a country is a member of WTO, the "WTO member" value is 1; otherwise, the value is 0.

**Measurement of the Sino-American IPR Protection Intensity**

**1) Measurement of the IPR Protection Intensity**

(1) The index of legislation strength in China

The national IPR protection is assessed from 1991 to 2013 according to the method of GP. The detailed statistics and calculation results are presented in Table 1.

TABLE 1. TIME SERIES OF IPR PROTECTION INTENSITY IN CHINA (GP INDEX)

		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Protection Scope	Utility Models	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Medicines	×	×	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Chemicals	×	×	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Food	×	×	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Animal and Plant Species	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
	Micro-organism	×	×	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Medical equipment	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Scores		2 / 7	2 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7	6 / 7
The membership of international treaties	Paris Convention	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	PCT	×	×	×	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	UPOV	×	×	×	×	×	×	×	×	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
Scores		1 / 3	1 / 3	1 / 3	2 / 3	2 / 3	2 / 3	2 / 3	2 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	
Protection loss clause exclusion	No request for implementing	×	×	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
	No compulsory license	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	
	No announcement of invalidation	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√	√	√	
Scores		0 / 3	0 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	2 / 3	2 / 3	
Enforcement mechanism	Injunction	×	×	×	×	×	×	×	×	×	×	√	√	√	√	√	√	√	√	√	√	√	√	
	Contributory infringement	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√	√	√	
	liability of pat to the proof opposite place	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
Scores		1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	1 / 3	2 / 3	2 / 3	2 / 3	2 / 3	2 / 3	2 / 3	2 / 3	2 / 3	2 / 3	2 / 3	2 / 3	1 / 3	1 / 3	
Scores of protection duration		3 / 4	3 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	1 / 4	
Total		1.70	1.70	2.86	3.11	3.11	3.11	3.11	3.11	3.11	3.11	3.11	3.11	3.11	3.11	3.11	3.11	3.11	3.11	3.11	4.52	4.52		

Data source: State Intellectual Property Office

## (2) The index of enforcement strength in China

The five indicators based on the GP method are judicial protection level, administrative protection and management level and its measurement, economic development level and its measurement, the social public consciousness and its measurement, and international supervision and checks and balances and their measurements. All indicators have the same weight of the enforcement intensity. Thus,  $E(t)$  is equal to the average arithmetic score of the five indicators. China's calculation results of the enforcement strength are shown in Table 2. "Lawyer proportion," "per-capita GDP," and "adult literacy rate" index data are calculated according to the statistics published on the National Bureau of Statistics website and in the *China Statistical Yearbook*.

TABLE 2. ENFORCEMENT STRENGTH OF IPR PROTECTION IN CHINA FROM 1991 TO 2013

Year	The lawyer proportion (per ten thousand)	Scores of the lawyer proportion (1)	Legislation Time (2) (years)	Scores of legislation time	Per-Capital GDP (3) (USD)	Scores of Per-capital FDO	Adult literacy rate (4) (%)	Scores of adult literacy rate (5)	Scores of World Trade Organization (WTO) members	Enforcement intensity $E(t)$
1991	0.403	0.081	38	0.38	234.875	0.07	83.16%	0.832	0.23	0.319
1992	0.504	0.101	39	0.39	285.875	0.08	85.26%	0.853	0.27	0.339
1993	0.602	0.120	40	0.40	367.375	0.11	85.79%	0.858	0.30	0.358
1994	0.698	0.140	41	0.41	490.375	0.14	84.84%	0.848	0.33	0.374
1995	0.748	0.150	42	0.42	606.750	0.18	85.05%	0.851	0.37	0.394
1996	0.819	0.164	43	0.43	697.000	0.21	85.79%	0.858	0.40	0.412
1997	0.800	0.160	44	0.44	756.750	0.22	86.53%	0.865	0.43	0.423
1998	0.811	0.162	45	0.45	754.750	0.22	87.16%	0.872	0.47	0.435
1999	0.885	0.177	46	0.46	818.875	0.24	87.89%	0.879	0.50	0.451
2000	0.926	0.185	47	0.47	885.750	0.26	88.63%	0.886	0.53	0.466
2001	0.960	0.192	48	0.48	956.375	0.28	91.37%	0.914	0.57	0.487
2002	1.064	0.213	49	0.49	1026.750	0.30	93.02%	0.930	0.60	0.507
2003	1.103	0.221	50	0.50	1138.875	0.33	93.74%	0.937	0.63	0.524
2004	1.117	0.223	51	0.51	1320.125	0.39	94.40%	0.944	0.67	0.547
2005	1.177	0.235	52	0.52	1697.837	0.50	>95%	1	0.70	0.589
2006	1.252	0.250	53	0.53	2002.850	0.59	>95%	1	0.73	0.620
2007	1.234	0.247	54	0.54	2498.912	0.73	>95%	1	0.77	0.657
2008	1.258	0.252	55	0.55	3109.741	0.91	>95%	1	0.80	0.702
2009	1.296	0.259	56	0.56	3682.398	1.08	>95%	1	0.83	0.746
2010	1.456	0.291	57	0.57	4433.858	1.30	>95%	1	0.86	0.804
2011	1.595	0.319	58	0.58	5449.619	1.60	>95%	1	0.89	0.878
2012	1.716	0.343	59	0.59	6092.515	1.79	>95%	1	0.92	0.929
2013	1.827	0.365	60	0.60	6766.776	1.99	>95%	1	0.95	0.981

Data source: The China Statistical Yearbook from 1991 to 2013

## (3) The strength of IPR protection in China

According to Equation (1) and some related calculation of enforcement intensity, the results of national protection intensity from 1991 to 2013 can be seen in Table 3 as follows:

TABLE 3. IPR PROTECTION STRENGTH IN CHINA FROM 1991 TO 2013

Year (t)	Legislation intensity L(t)	Enforcement intensity E(t)	Protection intensity P(t)	Year (t)	Legislation intensity L(t)	Enforcement intensity E(t)	Protection intensity P(t)
1991	1.70	0.319	0.542	2003	3.86	0.524	2.023
1992	1.70	0.339	0.576	2004	3.86	0.547	2.111
1993	2.86	0.358	1.024	2005	3.86	0.589	2.274
1994	3.19	0.374	1.193	2006	3.86	0.620	2.393
1995	3.19	0.394	1.257	2007	3.86	0.657	2.536
1996	3.19	0.412	1.314	2008	3.86	0.702	2.710
1997	3.19	0.423	1.349	2009	3.86	0.746	2.880
1998	3.19	0.435	1.388	2010	4.52	0.804	3.634
1999	3.52	0.451	1.588	2011	4.52	0.878	3.969
2000	3.86	0.466	1.799	2012	4.52	0.929	4.199
2001	3.86	0.487	1.880	2013	4.52	0.981	4.434
2002	3.86	0.507	1.957				

2) The Measurement of the Protection Intensity in America

(1) The legislation strength of the IPR protection

The index of the IPR protection intensity was calculated according to the above analysis. The details are in shown in Table 4.

TABLE 4. TIME SERIES OF THE IPR PROTECTION INTENSITY IN AMERICA (GP INDEX)

		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Protection scope	Utility models	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Medicines	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Chemicals	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Food	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Animal and plant species	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Microorganism	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Medical equipment	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Scores		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
The membership of international treaties	Paris convention	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	PCT	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	UPOV	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Scores		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Protection loss clause exclusion	No request for implementing	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	No compulsory license	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
	No announcement of invalidation	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Scores		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Scores of protection duration		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Enforcement Mechanism	Injunction	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Contributory infringement	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Liability of part to the proof opposite place	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Scores		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Scores of protection duration		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
		7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7

Data sources: The relevant documentation of the U.S. Patent and Trademark Office and the World Intellectual Property Office

## (2) The enforcement strength of IPR protection in America

Based on the calculation of the intensity of law enforcement, the intensity in America is shown in Table 5.

TABLE 5. THE ENFORCEMENT STRENGTH OF THE IPR PROTECTION IN AMERICA FROM 1991 TO 2013

Year	The Lawyer Proportion		Legislation Time		Per-Capita GDP		Adult Literacy Rate		WTO Members	Enforcement Intensity
	Per ten thousand	Scores	Year	Scores	USD	Scores	(%)	Scores	Scores	E(t)
1991	31.00	620	205	205	19986	588	>95%	1	0.20	3.066
1992	31.35	627	206	206	21126	621	>95%	1	0.23	3.154
1993	31.65	633	207	207	22191	653	>95%	1	0.27	3.24
1994	32.31	646	208	208	23574	693	>95%	1	0.30	3.354
1995	33.00	660	209	209	24659	725	>95%	1	0.33	3.454
1996	33.27	665	210	211	26056	766	>95%	1	0.37	3.556
1997	33.69	674	211	211	27681	814	>95%	1	0.40	3.678
1998	34.15	683	212	212	29157	858	>95%	1	0.43	3.792
1999	34.46	689	213	213	30893	909	>95%	1	0.47	3.916
2000	34.77	695	214	214	32723	962	>95%	1	0.50	4.042
2001	35.12	702	215	215	33760	993	>95%	1	0.53	4.126
2002	35.77	715	216	216	34900	1026	>95%	1	0.57	4.228
2003	36.38	728	217	217	36537	1075	>95%	1	0.60	4.36
2004	36.69	734	218	218	38953	1146	>95%	1	0.63	4.522
2005	37.81	756	219	219	41407	1218	>95%	1	0.67	4.72
2006	38.46	769	220	220	43927	1292	>95%	1	0.70	4.902
2007	43.98	880	221	221	46023	1354	>95%	1	0.73	5.256
2008	46.15	923	222	222	47548	1398	>95%	1	0.77	5.44
2009	48.08	962	223	223	47527	1398	>95%	1	0.80	5.526
2010	50.12	1002	224	224	48358	1422	>95%	1	0.83	5.662
2011	52.04	1041	225	225	49855	1466	>95%	1	0.87	5.838
2012	55.21	1104	226	226	51755	1522	>95%	1	0.90	6.084
2013	59.17	1183	227	227	53152	1563	>95%	1	0.93	6.332

Data sources: The related documentation of the BLS, the United States Patent and Trademark Office, and the National Bureau of Statistics

## (3) The measurement of the IPR protection strength in America

According to Formula 1, the calculation results of the IPR protection intensity from 1991 to 2013 are illustrated in Table 6.

TABLE 6. STRENGTH OF INTELLECTUAL PROPERTY PROTECTION IN AMERICA FROM 1991 TO 2013.

Time (t)	Legislation intensity L(t)	Enforcement intensity E(t)	Protection intensity P(t)	Time (t)	Legislation intensity L(t)	Enforcement intensity E(t)	Protection intensity P(t)
1991	4.67	3.066	14.32	2003	4.67	4.36	20.36
1992	4.67	3.154	14.73	2004	4.67	4.522	21.12
1993	4.67	3.24	15.13	2005	4.67	4.72	22.04
1994	4.67	3.354	15.66	2006	4.67	4.902	22.89
1995	4.67	3.454	16.13	2007	4.67	5.256	24.55
1996	4.67	3.556	16.61	2008	4.67	5.44	25.40
1997	4.67	3.678	17.18	2009	4.67	5.526	25.81
1998	4.67	3.792	17.71	2010	4.67	5.662	26.44
1999	4.67	3.916	18.29	2011	4.67	5.838	27.26
2000	4.67	4.042	18.88	2012	4.67	6.084	28.41
2001	4.67	4.126	19.27	2013	4.67	6.332	29.57
2002	4.67	4.228	19.74				

### **3) Comparison between Sino–American Indices of IPR Protection**

The legislation strength of IPR protection in China has gradually increased since 1991 (see Tables 2 to 6). More specifically, the index has increased from 1.7 in 1991 to 4.52 in 2013, which is a 165.88% overall increase in 23 years, exhibiting constant improvement and great achievement. In contrast, the legislation strength in America is maintained at a high level of 4.67 from 1991 to 2013. Such a difference between the two countries is primarily induced by whether IPR protection or even a compulsory license has been provided to the fields of animal and plant species.

In addition, the execution strength in China has risen by 207.52% from 0.319 in 1991 to 0.981 in 2013. The execution strength has completed considerable achievements during these 23 years, but this strength remains at a low level when compared transversely. The execution strength in America has increased by 106.52% from 3.066 to 6.332 in 23 years. The difference mainly lies in the sizable gap between the number of lawyers and GDP.

According to Formula 1 ( $P = L(t) * E(t)$ ) and the statistics from Figures 3 and 6, great disparities exist between the two countries regardless of the legislation or enforcement strength of IPR protection. The disparity is even greater in terms of the degree of protection. The degree of IPR protection in China from 1991 to 2013 has increased by 718.08% from 0.542 to 4.434, whereas that in America has increased by 106.49% from 14.32 to 29.57. Nevertheless, the gap has declined from 25 times to 8 times during these 23 years.

However, how the intensity of IPR protection in these two countries affects FDI should be determined.

#### Mechanism of Benign Intellectual Property System for Enterprise Behavior of FDI

##### ***Good Intellectual Property Protection System Design Acts An Incentive For The Enterprise Behavior of FDI.***

The fundamental motivations of enterprise innovation behavior include feedback from the market on profit margins, and Knowledge and technological innovation serve as the core of knowledge economy. A benign intellectual property system is used to identify companies and individuals in the form of intellectual activity results through national law; this system enables companies and individuals to obtain legal rights. Anyone can freely use innovative products when the value of an intellectual property is protected through a weak intellectual property system (i.e., an intellectual property system with no spillover); thus, an innovation can lose momentum. Therefore, an intellectual property system promotes innovation and protects the knowledge crucial to the future of an enterprise. In addition, the intellectual property system continues to encourage enterprises to continuously innovate because such system protects the timeliness of innovative products, forming a sustainable market viability. Therefore, a benign intellectual property system is a form of knowledge capital to provide enterprises with a competitive advantage and the consequent institutional arrangements for effective corporate direct investment.

##### ***Benign Intellectual Property System Reduces Risks Of Uncertain Role Of Knowledge In Innovation.***

Nicholson <sup>[38]</sup> revealed that a strong intellectual property protection system can encourage enterprises to produce overseas because their ownership advantages can be adequately protected. Knowledge, including innovation externalities, can be easily spread and diffused; hence, the “free rider” effect is extremely easy to create. Without benign intellectual property systems, the risk of knowledge innovation leakage is entirely shouldered by the knowledge producers. In terms of the asymmetry of knowledge innovation and investment income, such burden can dampen the enthusiasm of innovators. Therefore, a benign intellectual property system should be used to reduce uncertainty and protect the rights of knowledge producers as well as the overseas production and R&D activities.

##### ***Benign Intellectual Property System Can Affect The Location Choice And Industry Distribution of FDI and FDI Reduce Transaction Costs.***

Markus <sup>[39]</sup> implied that the importance of the intellectual property system significantly varies in different industries; investors who encounter difficulties imitating product knowledge may not be overly concerned about the host country's intellectual property system. Kalande <sup>[40]</sup> also viewed that most multinational companies are more willing to invest in the non-manufacturing sector or mining industry rather than technology-intensive



industries in countries with weak intellectual property protection. When multinational corporations invest in the host country, the establishment and implementation of the country's intellectual property system eliminate the cost of protecting intellectual property rights and transnational corporations must negotiate with competitors. The multinational public choice results in the benefit of the intellectual property system, which is saving the multinational FDI transaction costs. Institutional alternative markets reduce the cost of entry of FDI.

## Model Analysis of Sino-American IPR Protection and FDI

### *Selection of Variables and Their Figures*

To estimate the degree of IPR protection influence, we first construct a model that can affect the FDI influx. Drawing on previous studies, the model supposes the level of IPR protection and obtains the domestic market size, average consumption, the degree of market openness, labor costs, and R&D investments in a country as independent variables. All of these variables affect the FDI influx.

Considering the availability of data, this paper intends to obtain the average GDP index to measure the market size, the import and export values for market openness, average wages of manufacturing jobs for labor costs, R&D funds for scientific and technological level, and the index of IPR protection for its protection degree. The selected sample includes specific time-series data in China and America from 1991 to 2013 (see Tables 7 and 8). According to the assumed aforementioned independent variables, we construct a model for regression analysis on the influential factors of FDI.

TABLE 7. FIGURES OF VARIABLES IN THE MODEL (CHINA).

year	FDI (billions of USD)	Total amount of import and export trade (billion)	Workers' average wage ( CNY/year)	Index of IPR protection	R&D funds (billion CNY)	GDP per capita (CNY)
1991	43.66	7225.8	2340	0.542	142.3	1879
1992	110.08	9119.6	2711	0.576	169	2287
1993	275.15	11271	3371	1.024	196	2939
1994	337.67	20381.9	4538	1.193	222	3923
1995	375.21	23499.9	5500	1.257	349	4854
1996	417.26	24133.8	6210	1.314	404.48	5576
1997	452.57	26967.2	6470	1.349	481.47	6054
1998	454.63	26849.7	7479	1.388	551.1	6038
1999	403.19	29896.2	8346	1.588	678.9	6551
2000	407.15	39273.2	9371	1.799	895.7	7086
2001	468.78	42183.6	10870	1.880	1042.5	7651
2002	527.43	51378.2	12422	1.957	1287.6	8214
2003	535.05	70483.5	14040	2.023	1539.6	9111
2004	606.3	95339.1	16024	2.111	1966.6	10561
2005	603.20	116921.8	18364	2.274	2367	14053
2006	630.21	140974.0	21001	2.393	3003.1	16165
2007	747.68	166863.7	24932	2.536	3710.240	19524
2008	923.95	179921.5	29229	2.710	4616	22698
2009	900.33	150648.1	32244	2.880	5802.1	25125
2010	1057.3	201722.1	36539	3.634	7062.58	30567
2011	1160.11	236402.0	41799	3.969	8687.00	36018
2012	1117.16	244160.2	46769	4.199	10298.41	39544
2013	1175.86	258168.9	51483	4.434	11847.10	43320

Data sources: National Bureau of Statistics (1991–2013)

TABLE 8. FIGURES OF VARIABLES IN THE MODEL (AMERICA).

Year	FDI (billion USD)	Total amount of import and export trade (billion USD)	Workers' average wage (USD/year)	IPR protection index	R&D funds (billion USD)	GDP per capita (USD)
1991	220.1	11878.23	103723	14.32	1630.88	19986
1992	175.8	12729.76	104668	14.73	1679.49	21126
1993	430.1	13560.37	106101	15.13	1677.66	22191
1994	450.05	15050.01	107989	15.66	1711.47	23574
1995	587.72	16851.58	110038	16.13	1856.82	24659
1996	844.55	18072.69	111960	16.61	1993.31	26056
1997	1033.98	19771.79	114533	17.18	2142.51	27681
1998	1743.34	20324.88	116730	17.71	2291.71	29157
1999	2833.76	21983.52	118963	18.29	2465.29	30893
2000	3140.1	25231.58	122089	18.88	2689.86	32723
2001	1594.61	23728.19	122229	19.27	2795.33	33760
2002	744.57	23763.66	121826	19.74	2785.02	34900
2003	531.46	25347.26	122358	20.36	2915.63	36537
2004	1358.26	29329.82	123554	21.12	3026.67	38953
2005	1047.73	32862.89	125889	22.04	3254.56	41407
2006	2371.36	36770	128237	22.89	3525.67	43927
2007	2659.57	40124.7	129767	24.55	3794.54	46023
2008	3245.60	43919.51	129377	25.40	4056.30	45420
2009	1298.83	35498.8	124490	25.81	4038.03	44861
2010	3288.21	42018.69	134780	26.44	4067.08	43236
2011	4000.24	48026.67	157847	27.26	4140.35	43961
2012	3864.69	49747.51	162415	28.41	4507.71	44325
2013	4103.37	50382.68	180314	29.57	4837.19	45009

Data Sources: several related documentations of China's National Bureau of Statistics, the State Intellectual Property Office of China, the Bureau of Labor Statistics, and American Bureau of Labor Statistics (1991–2013)

### Building and Analysis of the Model

Based on the aforementioned analysis, the linear measurement model is set up as follows:

$$\ln F = c_0 + c_1 \ln Y + c_2 \ln T + c_3 \ln W + c_4 \ln K + c_5 \ln I + \varepsilon \quad (2)$$

Among the variables,  $\ln F$  is the natural logarithm of the total amount of annual FDI. On behalf of the annual growth rate of FDI,  $\ln Y$  obtains the average GDP as a measurement of the market size, and it is the natural logarithm (base e) of the annual GDP per capita, representing the changing rate of market scale.  $\ln T$  is the natural logarithm of R&D funds, which signifies the annual growth rate of R&D funds.  $\ln W$ , the natural logarithm of the workers' average wage a year, indicates the increasing rate of wage level.  $\ln K$ , the natural logarithm of the total amount of import and export trade, means the market opening degree. Finally,  $\ln I$  is the natural logarithm of the annual IPR protection strength that demonstrates the annual increase rate of the IPR protection strength.

#### 1) Trend Analysis on the Influence of China's IPR Protection toward its FDI

The number of absorbing FDI in China is continually growing and improving since the introduction of foreign direct investment in 1979. The change trend is illustrated in Figure 1.

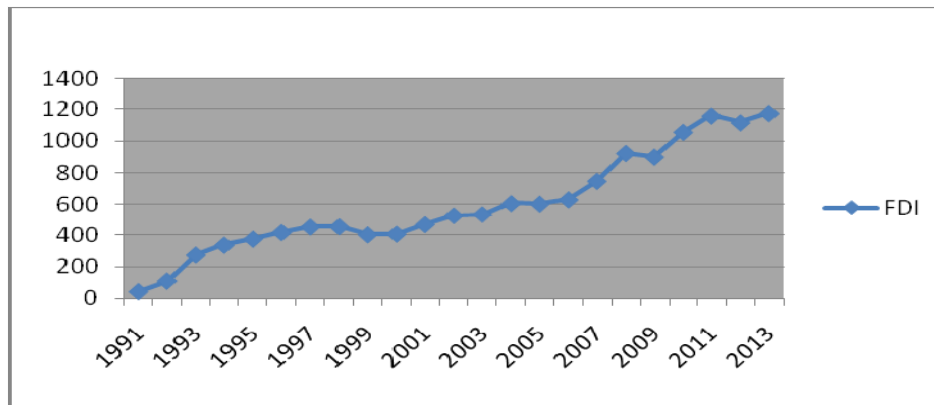


FIGURE 1. CHANGE TREND OF FDI IN CHINA.

To test the influence of IPR protection intensity on FDI, we interpreted the correlation between the intensity of IPR protection and FDI, and used  $LnI$  for regression analysis. The results are listed in group I (see Table 9). Consequently, we introduce all the five explanatory variables in the econometric model for regression analysis to measure the coefficient of each variable in details. The results are indicated in group II. Finally, we conducted another quantitative inspection after excluding the variables that failed the significance test in group II, and the results are presented in group III.

TABLE 9. REGRESSION ANALYSIS RESULTS OF TIME-SERIES OF IPR PROTECTION IN CHINA AND FDI.

	I	II	III
Constant term	5.364 (66.498)	-1.070 (-0.217)	1.111 (0.492)
$LnI$	1.436 (11.485)	1.502 (3.109)	1.717 (5.502)
$LnY$		1.283 (2.495)	1.091 (2.834)
$LnW$		-0.034 (-0.045)	
$LnT$		-0.868 (-2.417)	-0.828 (-4.082)
$LnK$		0.075 (0.723)	
R2	0.886	0.951	0.949
Adjusted R2	0.879	0.932	0.938
F value	131.915	50.249	92.292
Number of samples	19	19	19

These results indicate that:

- (1) When we only select one explanatory variable of IPR protection intensity in group I,  $LnI$  clearly has a positive correlation with  $LnF$ . The regression coefficient is 1.436 and the t value is 11.485, with a significance test of over 1% and the fit of the model and the adjusted being 0.886 and 0.879, respectively. Thus, IPR protection strength in China has a significant influence on FDI from 1991 to 2013 if other factors are not considered. The influence coefficient is 1.436.
- (2) The intensity coefficient of IPR protection has increased at 1.502 when all the five explanatory variables in the measurement model are introduced into group II. The t value is 3.109, which also passed the 1% level of significance test. Hence, that the intensity of IPR protection continues to have a significant positive correlation with FDI with a comprehensive consideration to the different influence factors of FDI.
- (3) In group II,  $LnW$  and  $LnK$  failed to pass the level significance test over 10%. Therefore, the total import and export trade and workers' average wage have no significant effect on the FDI growth.
- (4) In group III, two explanatory variables (i.e.,  $LnW$  and  $LnK$ ) and the constant term are removed because they have failed the significance test. We used  $LnI$ ,  $LnY$ , and  $LnT$  as explanatory variables in the retest. The regression

coefficients of  $LnI$ ,  $LnY$ , and  $LnT$  are significant at the 1% level (t statistic are 5.502, 2.834, and 4.082, respectively), and the regression coefficients are 1.717, 1.031, and 0.828 respectively. Moreover, the fit of the adjusted is 0.938. The regression equation is:

$$LnF = 1.717LnI + 1.031LnY - 0.828LnT \tag{3}$$

These results demonstrate that the intensity of IPR protection, R&D funds, and GDP per capita has a significant influence on FDI. The intensity of IPR protection and GDP per capita has a significant positive correlation with FDI, whereas R&D funds have a negative one with FDI.

**2) Trend Analysis on the Influence of American IPR Protection toward its FDI**

The FDI in America exhibits an overall increasing tendency from 1991 to 2009; this investment has a small peak in 2000 and 2008. It began to decline after the rising trend from 1991 to 2000 but increased again around 2004. The specific results are illustrated in Figure 2.

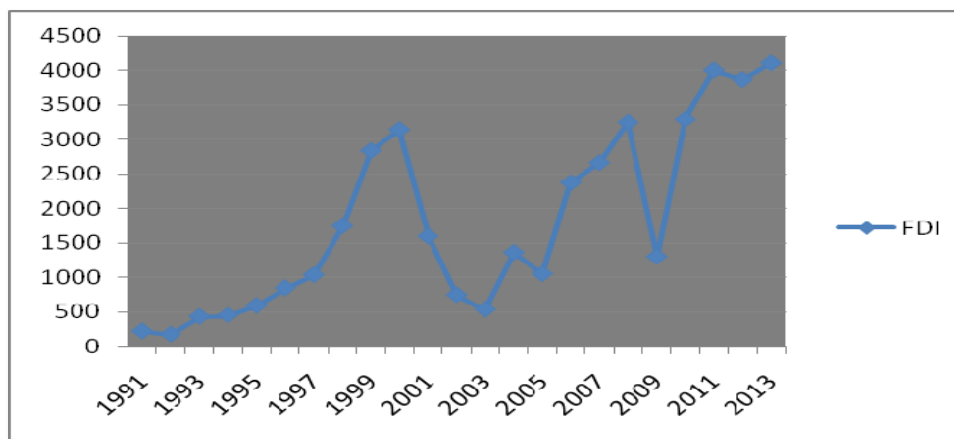


FIGURE 2. CHANGE TREND OF FDI IN AMERICA.

Subsequently, we conduct a similar regression analysis of certain data in America. The Specific results are presented in Table 10.

TABLE 10. REGRESSION ANALYSIS RESULTS OF TIME-SERIES OF IPR PROTECTION IN AMERICA AND FDI.

	I	II	III
Constant term	-2.965 (-1.256)	-473.709 (-5.572)	-457.2704 (-6.057)
$LnI$	3.363 (4.198)	3.150 (0.476)	
$LnY$		-8.798 (-1.611)	-6.313 (-4.108)
$LnW$		51.305 (4.975)	48.291 (6.107)
$LnT$		-8.419 (-4.001)	-8.547 (-4.214)
$LnK$		2.748 (2.490)	3.053 (3.499)
R2	0.509	0.917	0.916
Adjusted R2	0.480	0.885	0.892
F value	17.623	28.781	38.021
Number of samples	19	19	19

These results indicate that:

(1) In group I, we only selected one explanatory variable of the IPR protection intensity.  $LnI$  has a significant positive correlation with  $LnF$ . The regression coefficient is 3.363 and the t value is 4.198, which is over 1% level of significance test. The fits of the model and the adjusted are 0.509 and 0.480, respectively, which are rather low.

Therefore, the IPR protection strength in America has a significant influence on FDI from 1991 to 2009 if other factors are not considered. The coefficient is 3.363.

(2) The coefficient of IPR protection intensity declined to 3.150 when all of the five explanatory variables in the measurement model are introduced into group II, and the coefficient is under the 10% level of significance test. The *t* value is 0.476, indicating that the intensity of IPR protection has no significant positive correlation with FDI if the different influential factors of FDI are considered comprehensively.

(3) In group III, the explanatory variable (i.e., *LnI*) and the constant term are removed because both failed the significance test. The other explanatory variables are used in the retest. The *LnW*, *LnY*, *LnT*, and *LnK* regression coefficients are significant at the 1% level (*t* statistic are 6.107, 4.108, 4.214, and 3.499, respectively), and the regression coefficients are 48.291, 6.313, 8.547, and 3.053, respectively. Moreover, the fit of the adjusted is 0.892. The regression equation is:

$$LnF = 48.291LnW - 6.313LnY + 8.547LnT + 3.053LnK \quad (4)$$

The test results demonstrate that R&D funds, GDP per capita, workers' average wage, and the total value of import and export trade have a significant influence on FDI. Among the explanatory variables, the intensity of IPR protection has no significant positive correlation with FDI; it failed to pass the significance test.

### ***Analysis and Comparison between the Two Countries***

From the aforementioned analysis, the level of IPR protection in China and America has different effects on their FDI. After comparing the influential factors (e.g., the degree of IPR protection, domestic market scale, market openness, labor costs and R&D investment), the degree of IPR protection has a significant positive correlation with FDI in both countries if other factors are not considered. Under this circumstance, China's and America's IPR protection degree coefficient are 1.436 and 3.363, respectively, indicating that as the degrees of IPR protection increases by 1% in China and America, their FDI increases by 3.363% accordingly. The American elasticity coefficient of IPR protection degree is 2.34 times of that in China.

At the same time, the influence of scientific research level and market size toward FDI is relatively obvious by comparing the influential factors (e.g., degree of IPR protection, domestic market scale, market openness, labor costs and R&D investment) on FDI coefficient. Among these variables, the degree of IPR protection in China is the most influential factor of direct investment in the country and abroad. When the level of IPR protection in China increases by 1%, the FDI increases by 1.5%, which is higher than the increase in the other factors. However, the degree of IPR protection in America does not obviously affect FDI. This factor also failed to pass the significance test. Among all the factors that affect American FDI, the workers' average wage and scientific research level play a larger role.

### **Conclusion**

Through a quantitative inspection of the related time-series data in China and America from 1991 to 2009, this paper examined the IPR protection legislation and enforcement strengths in these 19 years and ultimately obtained the actual strength of IPR protection in both countries. Although the two strengths in China started from a relatively low base, they have advanced rapidly and completed great achievements during these 19 years. However, the further promotion of IPR protection may take long because of the late foundation of IPR legislation system and weak legal consciousness of citizens. The results of the measurement test indicate that the degree of IPR protection has a significant positive correlation with the direct investment in the country and abroad, which is consistent with the research conclusions reached by numerous native and foreign scholars.

In contrast, owing to the early legislation, strong legal consciousness of citizens, and a correspondingly sound legislation and enforcement system, the degree of legislation in America from 1991 to 2009 is stable, and the level of law enforcement is also significantly enhanced. At the same time, its higher research level, larger domestic market, and more open market play a significant role in the FDI. The results of the measurement test demonstrate that the level of IPR protection in America faintly affects its FDI when compared with the size of the market, the level of scientific research, and the degree of market openness.

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