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Patent Application, Grant and Patent Law Amendment in China

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Abstract

This study employs 920,108 invention patents from the State Intellectual Property of China (SIPO) to examine the impact of two patent law amendments, which occurred in 1993 and 2001 respectively, on the patent grant. The first patent law amendment in 1993 led to less strict criteria for patent approval. And the second patent law amendment, which occurred in 2001, showed a similar positive impact on patenting as well. It is more likely that the first patent law amendment encouraged foreign applicants to make patent application, because their applications and grant share started to rise after 1993. By contrast, the second patent law amendment played an opposite role by motivating Chinese applicants to make patent application, which is reflected by a rise of application and grant share by Chinese applicants in post-2001 period. Patent grant is viewed as one of the key indicators for judging the patent value. We find that foreign applicants from the U.S., Japan and European Union have higher patent grant rate than that of Chinese applicants, suggesting that patents held by foreign applicants may have higher potential value than those held by Chinese applicants. Different types of applicants may differ from each other in terms of the patent grant rate, where research institutes have higher patent grant rate than that of corporations and individuals. Since the filed patents in China can enjoy a provisional protection for 3 years at most, some applicants do not request their examination. After an examination of the novelty, inventiveness and practicality of patent, the patent office determines whether to grant it. By using a bivariate probit model, we make an econometric analysis of this case. The result confirms the positive impact of both patent law amendments in 1993 and 2001 on the patent grant. We also find other determinants of the patent grant, for example, R&D human capital investment, applicant's competitive technology advantage in the patent's field, and applicant's research ability, play positive roles in driving applicant to ask for examination. Patent's complexity plays a positive role in driving the patent office to grant it. We discuss the significance of our study at the end of this paper.

Keywords

patent application; patent grant; patent law; examination request; bivariate probit model

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1. Introduction

In recent years patent grant has been receiving more focus because of its enriched contents. Many scholars take granted patent as object for calculating patent value (Schankerman and Pakes, 1986; Bessen, 2008; Maurseth, 2005; Svensson, 2007; Zhang and Chen, 2012; Zhang *et al*., 2014). However, Zeebroeck (2007) and Guellec and Pottelsberghe (2000) argued that all filed patents own the value, and granted patents are of higher value than patents refused or withdrawn. Therefore, Guellec and Pottelsberghe (2000) focused on the legal status of patent grant only.

Several literatures have considered the impact of patent policy on patenting. Roughly coincident in time with the significant patent policy change in the 1980s in the U.S., there has been a dramatic, historically unprecedented surge in patenting by U.S. inventors (Jaffe, 2000). Jaffe (2000) argued that the strengthening of the patent system presumably reinforced this incentive, and the R&D boom would not have been so large or lasted so long without this reinforcement. A quantitative analysis about the impact of patent system is made by Maskus and McDaniel (1999), who studied the impacts of the Japanese patent system on productivity growth, and the econometric result showed that the technology diffused through the Japanese patent system has a significant and positive impact on Japan's technical progress. Yueh (2009) argued that Chinese patent law system has produced a stock of patents which has grown rapidly alongside economic growth, and an econometric model aiming at the determinants of patent application is given. However, no works of literature focused on the impact of patent law amendment in China.

In the first amendment in 1993, patent grant field was enlarged, including removing the ban of patent grant on medicines, materials produced with chemical approach, and the ban on drinks and ingredients, removing the obligation of patent applicants intending to execute the patent in China, and modifying the mandatory permission clause (Tang, 2002). Plus, the patent protect length was extended to 20 years for invention patents. The second amendment in 2001 clarified the property right of patent and introduced differentiation between on-duty invention and off-duty invention (Tang, 2002). From the amendment clause we see that the patent system has changed dramatically, and this may have a significant impact on patent application and grant.

The main contribution of this paper is that an unmatched dataset on Chinese patent application from 1985 to 2009 is used. We obtained Chinese invention patents database that contains 1,610,798 observations from 1985 to 2009. Of all the data, about 0.7 million patents' current legal status is "Publication" or "Examination". Patents in these two legal statuses may be withdrawn by applicants, or refused or grant by patent office. What we concern here is whether patent is granted or not. Because of the uncertainty of these 0.7 million patents, we omitted them from our analysis. After the omission, 0.92 million patents left, with about 0.56 million grant and 0.36 million withdrawn or refused.

Our study is organized as follows: Section 2 describes the contents of two patent law amendments; Section 3 tells how the share of patent application and patent grant mobilized in the time in accordance with the occurrence of the two patent law amendments; Section 4 presents the variables and summary statistics, as well as the empirical results and Section 5 concludes.

2. Two Patent Law Amendments in 1993 and 2001

China's patent law was officially approved in 1984 and has been amended for 4 times. The first patent law amendment that occurred in 1993 expanded the scope of patent authorization, cancelled part

of the obligations of patentees to implement their patent rights in China, modified the conditions for the approval of compulsory license, and extended the protection period of invention patents from 10 years to 20 years. The restrictions on drugs, substances obtained by chemical methods, and no patent rights for foods, beverages and condiments were removed. The patentee has the right to stop others from using, selling and importing products directly obtained by the method without permission. The patentee's obligation accompanying his/her patent right in China has been revised. It also improved the patent application process and the approval procedures of the patent examination.

The second patent law amendment that occurred in 2001 abolished the stipulation that the patent right can be divided into "holding" and "owning". The patent right of service invention creation belongs to the affiliation, and the patent right of non-service invention creation belongs to the inventor or the designer. The second patent law amendment also strengthened the protection of patent right, increased the right of promise sale in the exclusive right of patentee, cancelled the final decision power of the Patent Reexamination Board, and amended some of the provisions, like the compulsory license, to make the patent law be in accordance with the international treaties.

3. Impact of Patent Law Amendment on Patent Grant

It is easy to conclude that the patent filed in a year may not be granted in the same year, but granted in the following years. What the yearbook records is the number of patent application and grant of a given year. The grant patents group may not be wholly included in the filed patents group in the same year. Therefore, the grant rate is incalculable only with patent data in the yearbook. This difficulty could be resolved by using micro patent data. And the value of the granted patent means the number of granted patents filed in the year, rather than number of patents granted in that year. This could ensure that the granted patents group is totally included in the applied patents group in the same year. In order to increase the accuracy of the grant rate, we remove the patents with the current legal status "publication" or "examination". That's because we are not sure whether these patents are granted or not. And the patent grant rate is calculated as follows

3.1. Patenting variation by applicants' nationality

With the intention of viewing patent grant variation in a more detailed way, we classify patents into different cohorts by the nationality of applicants. From Figure 1 we find that after the first amendment of patent law, the share of patent application by foreign applicants is increasing. While before 1993, this share fluctuated with a slightly decreasing trend. The share of patent application by Chinese applicants began to decrease in 1993 and reached the lowest point in 1997. Figure 1 shows that after the second amendment in 2001, the share of patent application by Chinese applicants began to rise. While between 1998 and 2001, this share tends to go up, but not very obvious.

Plus, Figure 1 shows that patent application share by U.S. applicants was the most stable between 1985 and 2001. After 2001, like their counterparts in other countries, its application share began to shrink, and to a minimum level of no more than 4 percent to the year 2009. Patent application share of Japan is shrinking before 1993 and began to increase after the first amendment. After 2005, it began to shrink again. The variation trend of patent application share of E.U. applicant is similar to that of Japan. And patent application share of other countries tended to increase till 2001, then kept stable between 2001 and 2006. In recent several years it began to decrease again. From Figure 1 we can see that currently Japanese

patent application share is the highest of all foreign countries. What deserves noticing is the rocketing up of Chinese patent application share since about 2005, which might imply Chinese improving ability of technology innovation. And the share of patent grant by country in Figure 2 shows the same trend as Figure 1.

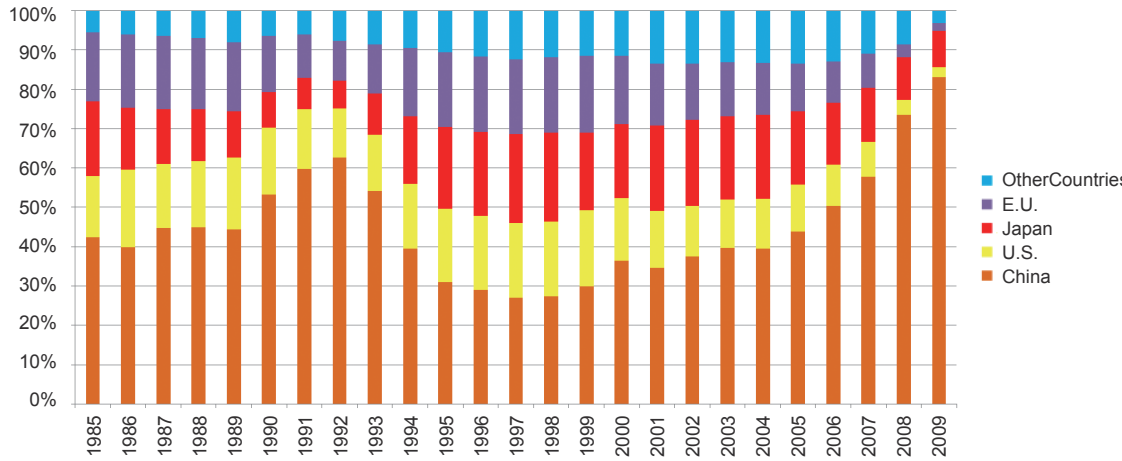

Fig. 1 Share of patent application by country

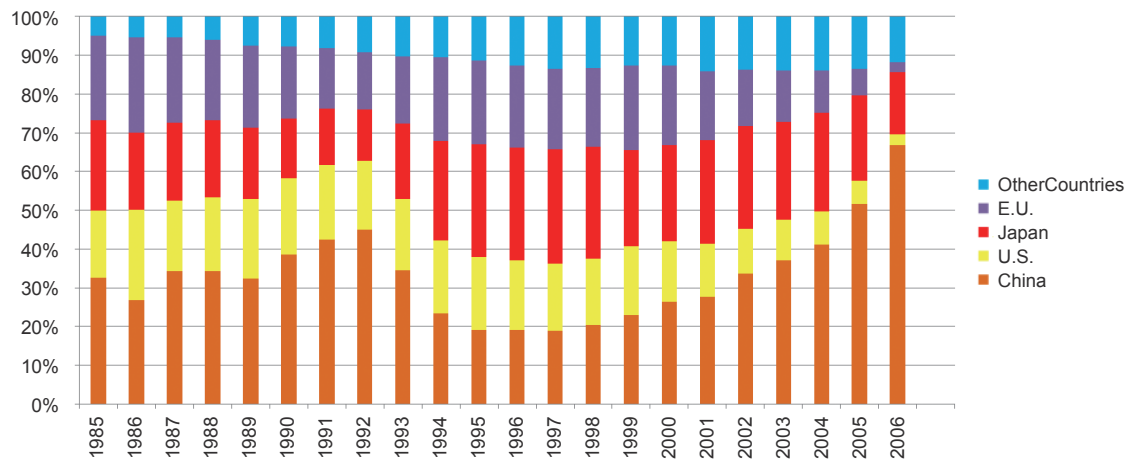

Fig. 2 Share of patent grant by nationality of applicants

3.2. Patenting variation by identity of Chinese applicants

In order to get some Chinese local patent application and grant information, we extract the invention patent data with Chinese applicants only. The number of invention patents by Chinese applicants is 759,845, accounting for 47.17% of the total invention patents.

From Figures 3 and 4 we can see that both patent applications and grant share by individuals rose during 1985-1995, and then went gradually down. Patent applications and grant share by corporations remained steady during 1985-1997, then went gradually up. And the patent application and grant share by research institutes showed totally inverse trends compared with that of individuals. So from Figures 3 and 4 we see that before 1997, individual applicants played a leading role in patent application, while this leading role was gradually taken by corporations after 1997.

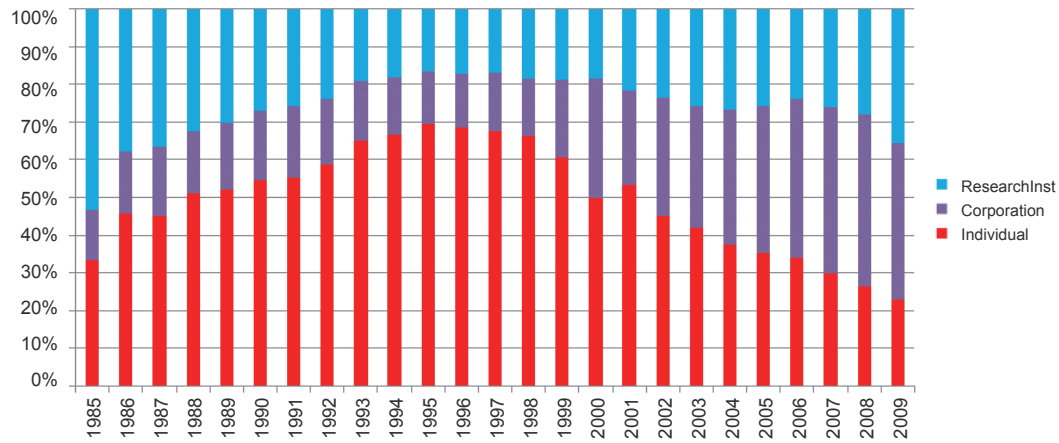

Fig. 3 Share of patent application by identity of Chinese applicants

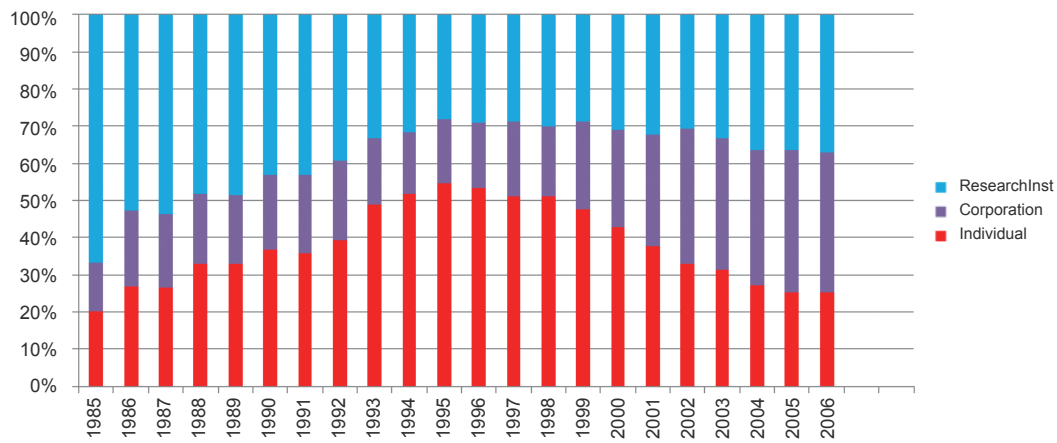

Fig. 4 Share of patent grant by identity of Chinese applicants

4. Determinants of Patent Grant: A Bivariate Probit Model

4.1. Bivariate probit model

Our analysis of patent grant is similar to Guellec and Pottelsberghe (2000) and Zeebroeck (2007). However, we consider the case of patent grant in a more detailed way. The above scholars didn't make a coalition between request for examination and patent grant. Exactly patent grant depends on two sides—applicants and the patent office—that is, as an applicant asks for examination, the patent office determines whether or not grant the patent after examination. So using a univariate probit model to study patent grant may not be quite proper. However, up to date no authors make such a clear division.

Since patent applicants need to pay examination fee, they will decide whether request for examination or not according to the cost and benefit. After applicant's request for examination is made, patent office will decide whether grant the patent or not according to the patent's novelty, inventiveness and practicality. We may use y_a^* as the implicit variable to denote applicant's willingness of request for examination, y_a as the decision variable to denote whether or not request for examination; We use y_g^* as the implicit variable to denote patent office's willingness of granting the patent, y_a as the decision variable to denote whether or not grant the patent; We use X_1 as the explanatory variable vector that affects applicant's willingness of request for examination; We use X_2 as the explanatory variable vector that affects patent office's willingness of granting the patent. And we assume ε_1 and ε_2 obey bivariate normal distribution, then the following model can be established:

$$y_a=\begin{cases}1 \text{ when } y_a^* >0\\ 0 \text{ when } y_a^* <0\end{cases} \qquad y_g=\begin{cases}1 \text{ when } y_g^* >0\\ 0 \text{ when } y_g^* <0\end{cases}$$

Where $y_a^*=X_1\beta_1+\varepsilon_1$, $y_g^*=X_2\beta_2+\varepsilon_2$, $E[\varepsilon_1]=E[\varepsilon_2]=0$, $Var[\varepsilon_1]=Var[\varepsilon_2]=1$, $Cov[\varepsilon_1,\varepsilon_2]=\rho$.

We usey to denote patent grant event. Only when applicant requests for examination ($y_a=1$), and patent office grants the patent after examination ($y_g=1$), the patent will be granted. Then:

$$y=\begin{cases}1 \text{ when } y_a=1 \text{ and } y_g=1\\ 0 \text{ otherwise}\end{cases}$$

This is a typical bivariate probit model. Under the assumption that ε_1 and ε_2 follow the bivariate normal distribution, then we can establish the following lognormal likelihood function originally proposed by Poirier (1980):

$$\ln L(\beta_1,\beta_2,\rho)=\sum_{i=1}^{N}\{y_i\ln\Pr(y_i=1)+(1-y_i)\ln[1-\Pr(y_i=1)]\}$$

$$=\sum_{i=1}^{N}\{y_i\ln\Phi(X_{1i}\beta_{1i}, X_2\beta_2;\rho)+(1-y_i)\ln[1-\Phi(X_{1i}\beta_1, X_{2i}\beta_2;\rho)]\}$$

By using the correlation between ε_1 and ε_2, we can get a more accurate estimator. However, since the dependent variables are partially observed, the effectiveness of the model will be influenced. This price has to be paid for limitedness of information (Meng and Schmidt, 1985).

4.2. Explanatory variables

The independent variables in this study are similar with Guellec and Pottelsberghe (2000) and Zeebroeck (2007). And we add other variables reflecting the characteristics of applicants, including the comparative advantage and absolute advantage of applicants in the patent's field. The explanatory variables in this regression are as follows:

(1) Filing Age

Chinese patent law experienced 4 amendments since 1993. The patent applicants' obligation is progressively relieved and patent protection is gradually intensified by these amendments. Although Chinese patent system is not perfect (see e.g., Hu and Jefferson, 2009), this imperfect IPR system is nevertheless generating innovation (Yueh, 2009). With the intention of studying the effect of these two amendments on patent grant, we introduce 2 dummy variables denoting the filing age of 1985-1993, 2001.7-2009 respectively, and take 1993-2001.6 as references.

(2) Nationality of Applicants

We classify the patent applicants into 5 categories according to their nationality: China, E.U. (European Union), Japan, U.S. (United States) and other countries. We take China as the reference. After an in-depth analysis of EPO data, Zeebroeck (2007) find Austrian applicant's patent grant rate tend to be the highest, while lowest is that of Australian applicants.

(3) Identity of First Applicant (FirstApplicant)

We extract patents by Chinese local applicants and make an independent analysis. We divide the identity of first applicant into 3 types: research institutes (ResearchInst), corporations and individuals, where the research institutes include universities, colleges, research institutes, hospitals, government departments and other public institutions; the corporations include national run corporations, private run corporations, military industrial enterprises and nongovernmental organizations; individual includes those file patents with the name of the natural person.

(4) R&D Human Capital Investment (HCInvestment)

We measure the R&D human capital investment of a patent by the number of inventors who contributed to the creation of invention. Zeebroeck (2007) finds the number of inventors contribute positively to patent grant. We will test this conclusion by Chinese patent data.

(5) Applicant's Relative Technical Advantage (RelTechAdv)

This indicator is used for measuring applicant's relative technical advantage in field of the patent. The field is divided according to 4-digit IPC. And we judge the patent's field by its main IPC. The indicator is calculated by the following formula:

$$\text{RelTechAdv}=\frac{\text{Number of patents by the applicant in the field}/\text{Number of patents in the field}}{\text{Number of patents by the applicant in all fields}/\text{Number of patents in all fields}}$$

For the Chinese patent data, since many applicants' name frequently vary by year, it's very difficult to sum up patents of several years by the same applicant to calculate RelTechAdv. So we calculate applicant's RelTechAdv of each year. If there are more than one applicant, this indicator is the mean of RelTechAdv of all applicants. To our knowledge, up to now no authors pay attention to the effect of this indicator on patent grant. The reason that we introduce this indicator is that applicant who owns a relative advantage in a certified field may pay more attention to it, and a relatively higher ratio of R&D investment of that applicant will be put into this field. This might positively impact patent grant.

(6) The Mega Technical Advantage of Patent's Field (MegaTechAdv)

This indicator is measured by the ratio of number of patents in the field to number of patents in all fields. This indicator is also calculated annually. A field containing more patents usually tends to be a technically mature field that have more researchers. When the technical field of applicant is mature, it's easier to predict income from the patent. So applicant might be more willing to request for examination and a grant decision will more likely to be made. This is the second indicator that scholars haven't discussed.

(7) Patent's Technical Complexity (Complexity)

We measure the technical complexity by number of specification pages in application. Zeebroeck (2007) takes this indicator as one of the variables describing drafting styles of filing strategy and it shows a negative impact on patent grant. It's natural to conclude that a more complex technique needs more words and figures to explain, so measuring patent's technical complexity by number of specification pages is proper.

(8) Size of Applicant's Portfolio (APPPortfolio)

This indicator is measured by the number of patents the applicant filed to SIPO in application year. If there are more than one applicant, this indicator is the sum number of patents of all applicants. Zeebroeck (2007) measures it with the cumulated number of applications filed to the EPO by the same applicant over the past 5 years and the current year. He found this indicator has a negative impact on patent grant. Compared with our measurement, there is no doubt that Zeebroeck's is more scientific. However, it is almost impossible to achieve that measurement for Chinese patent data, because many applicants have modified or totally changed their name in several years of patent application. If we want to know the applicants' number of filing within several years, we have to consider they may have changed their name once or even twice during certified years. So we have to track each applicant's name modification in the total time interval. We don't know if Zeebroeck (2007) has done it in this way, but in our database there are so many applicants that it's impossible to track them in such a way. To make things easier, we calculate the size of applicant's portfolio.

(9) Patent Width (PatentWidth)

This variable is calculated by counting the number of distinct IPC at four digits. This variable can be

used to represent the technical fields that a patent covers. Originally, patent width is filled by applicants. Therefore, this indicator can be viewed as a patent protection width that is applied. Guellec and Pottelsberghe (2000) and Zeebroeck (2007) find this indicator has a negative impact on patent grant.

(10) Scale Advantage of Applicant in Patent's Field (ScaleAdv)

This is the numerator of RelTechAdv. This indicator can be used for measuring applicant's scale advantage in patent's technology field, because a relatively large amount of filing in the patent's field may affect applicant's patenting behavior.

(11) Joint-Application (JointAppl)

We introduce a dummy variable that takes the value 1 when there are two or more applicants, and 0 otherwise. Nakata and Zhang (2012) show that joint-application show somewhat mixed effects on the length between filing date and examination date. Compared with this settings, Guellec and Pottelsberghe (2000) take a more detailed study. Zeebroeck (2007) finds joint application tends to prevent patent grant.

(12) The Classification of Patent

We introduce these dummy variables to exclude patents' heterogeneity among different classifications. We classify the patent data into 8 groups that are denoted by A-H according to the 1st digit IPC.

The summary statistics of the above variables are presented in Table 1.

4.3. Econometric results

Explanatory vector X_1 in applicant's decision function mainly contains variables of applicant's and inventor's characteristics, such as R&D human capital investment (HCInvestment), Size of Applicant's Portfolio (APPPortfolio), Joint-Application (JointAppl), and so on. Since the grant decision is made after patent office examines materials submitted by applicant, explanatory vector X_2 in patent office's decision function mainly contains variables of material characteristics, such as number of specification pages, patent's technical protection width (PatentWidth) requested by applicant. Plus, we add filing age and classification of patent.

Table 2 shows the estimated result from bivariate regression with about 420 thousand patents by Chinese local applicants and 920 thousand patents by all applicants respectively. As is shown in Table 2, the estimated parameters of dummy variable 1985-1992 is negative, and 2001.7-2009 is positive. This implies both the two patent law amendments in 1993 and 2001 play positive roles in applicant's willingness of examination and patent office's willingness of granting the patent.

The estimation result from applicant's decision function shows that non-Chinese applicants are more likely to request for examination. And Japanese applicant's willingness of requesting for examination is the highest, applicants from E.U., other countries and U.S. follow. Chinese applicants' examination request is the lowest. Of all 3 types of Chinese local applicants, the examination willingness of corporations and research institutes is higher than that of individuals, and the research institutes willingness is the highest.

An applicant is more likely to request examination with more human capital investment. When using all the data for regression, we find applicants who own a relative technical advantage (RelTechAdv) in the filed patent's field, or a larger size of portfolio (APPPortfolio), are more likely to request for examination. However, the positive impact of relative technical advantage on examination is not significant when using Chinese filed patent data only. It seems the mega technical advantage (MegaTechAdv) of the patent's field relative to other field may prevent applicants from requesting for examination. When using Chinese filed patent data only, we find the impact of patent's scale advantage in the patent's field (ScaleAdv) on this patent's grant tends to be negative. However, this impact becomes insignificant when using all the patent data.

Table 1 Summary statistics of dependent variables and independent variables

	Patents Filed by Chinese Applicants					All the Patents				
Dependent Variables	No. of Obs.	Mean	Std. Dev.	Min	Max	No. of Obs.	Mean	Std. Dev.	Min	Max
Patent Grant	420,364	0.5276	0.5001	0	1	920,108	0.6180	0.3714	0	1
Independent Variables										
Filing Age										
1985-1992	420,364	0.0810	0.2729	0	1	920,108	0.0876	0.2827	0	1
1993-2001.6	420,364	0.3279	0.4694	0	1	920,108	0.2397	0.4269	0	1
2001.7-2009	420,364	0.5911	0.4916	0	1	920,108	0.6727	0.4692	0	1
First Applicant										
Corporation	420,364	0.2966	0.4568	0	1					
ResearchInst	420,364	0.2653	0.4415	0	1					
Individual	420,364	0.4381	0.4962	0	1					
Nationality										
China						920,108	0.4568	0.4981	0	1
E.U.						920,108	0.1254	0.3312	0	1
U.S.						920,108	0.1160	0.3203	0	1
Japan						920,108	0.1839	0.3874	0	1
HCInvestment	420,364	2.5359	2.0538	1	30	920,108	2.5283	1.9190	1	30
RelTechAdv	420,364	2.7515	8.7781	0.0018	1276.50	920,108	3.0242	8.4356	0.0018	1538.33
MegaTechAdv	420,364	0.0157	0.0225	5.01E-06	0.1187	920,108	0.0144	0.0196	5.01E-06	0.1187
JointAppl	420,364	0.1056	0.3073	0	1	920,108	0.0755	0.2642	0	1
Complexity	420,364	9.6799	6.7716	1	609	920,108	18.9672	24.3205	1	3,100
APPPortfolio	420,364	189.91	635.21	0.9999	6801.33	920,108	218.18	584.76	0.9999	7,802.85
ScaleAdv	420,364	0.0369	0.1024	4.14E-05	1	920,108	0.0410	0.0925	4.14E-05	1
PatentWidth	420,364	1.5393	0.0015	1	10	920,108	1.5228	0.0009	1	20
Other Countries						920,108	0.1178	0.3224	0	1
Classification										
A	420,364	0.2412	0.4278	0	1	920,108	0.1653	0.3714	0	1
B	420,364	0.1231	0.3285	0	1	920,108	0.1343	0.3409	0	1
C	420,364	0.2412	0.4278	0	1	920,108	0.1981	0.3986	0	1
D	420,364	0.0204	0.1414	0	1	920,108	0.0203	0.1410	0	1
E	420,364	0.0374	0.1898	0	1	920,108	0.0262	0.1597	0	1
F	420,364	0.0766	0.2659	0	1	920,108	0.0757	0.2644	0	1
G	420,364	0.1266	0.3325	0	1	920,108	0.1785	0.3830	0	1
H	420,364	0.1335	0.3401	0	1	920,108	0.2017	0.4013	0	1

The estimated result of patent office's decision function shows that the length of specification tends to play a positive role in patent office's willingness in granting the patent. Therefore, the more complex the patent technology is, the more likely the patent office will grant the patent. However, if the patent technology protection requested by applicant is so wide, patent office tends to refuse to grant the patent. And this result corresponds to the findings by Guellec and Pottelsberghe (2000) and Zeebroeck (2007).

Table 2 Econometric results by bivariate probit model

Data	Chinese Filed Patents				All the Patents			
	Decision Function of Applicant		Decision Function of Patent Office		Decision Function of Applicant		Decision Function of Patent Office	
Independent Variables	Coef.	Z	Coef.	Z	Coef.	Z	Coef.	Z
Filing Age (Reference: 1993-2001.6)								
1985-1992*	-0.2861	-36.69	-0.0892	-11.92	-0.1441	-27.71	-0.0674	-34.35
2001.7-2009*	0.2185	49.44	0.5008	124.15	0.1997	71.50	0.0745	68.12
First Applicant (Reference: Individual)								
Corporation*	0.2672	50.62						
ResearchInst*	0.6400	107.44						
Nationality (Reference: China)								
U.S. *					0.1914	44.47		
Japan*					0.6452	165.00		
E.U. *					0.3594	85.54		
Other Countries*					0.2723	63.10		
HCInvestment	0.0461	40.00			0.0714	99.33		
RelTechAdv	-0.0001	-0.60			0.0019	10.37		
MegaTechAdv	-0.1484	-1.40			-1.1876	-15.42		
JointAppl*	0.1087	16.08			-0.0458	-8.83		
Complexity			0.0096	80.90			0.0016	76.19
APPPortfolio	7.62E-5	17.92			2.09E-5	7.68		
ScaleAdv	-0.6349	-25.79			0.0010	0.06		
PatentWidth			-0.0523	-26.35			-0.0204	-34.47
Classification (Reference: H*)								
A*	-0.5298	-86.59	-0.3841	-72.74	-0.3727	-86.23	-0.1829	-109.66
B*	-0.3765	-55.85	-0.1709	-26.04	-0.1114	-25.18	-0.0284	-16.10
C*	-0.3697	-65.53	0.0076	1.38	-0.1619	-41.39	-0.0522	-32.46
D*	-0.4472	-30.92	-0.2641	-18.74	-0.2224	-22.69	-0.0692	-18.84
E*	-0.2748	-25.05	-0.2267	-21.29	-0.2151	-25.11	-0.1142	-34.86
F*	-0.5261	-65.11	-0.4258	-54.09	-0.2301	-42.09	-0.0798	-37.49
G*	-0.4566	-66.46	-0.1841	-28.20	-0.1610	-39.27	-0.0447	-27.59
ρ	0.3330	6.74			0.8813	15.31		
Number of Obs.	420,153				919,656			
Wald chi2	35,680.64				87,422.41			
Log likelihood	-278,874.01				-599,222.37			
Prob>chi2	0.0000				0.0000			

(*) dummy variable

5. Conclusion

Patent grant is viewed as one of the key indicators for judging patent value. Accordingly, to investigate the effect of the two patent law amendments of China that occurred in 1993 and 2001 respectively, we carry out a detailed study of the patent grant. The two patent law amendments in China changed its patent system and hence influenced patent application and grant. Both patent application and grant have risen sharply since the first patent law amendment. The first patent law amendment is more likely to motivate foreign applicant to make a patent application, because of the rise of its applications and grant share after 1993. And the second patent law amendment is more likely to motivate Chinese applicants to make patent applications, because their applications and grant share began to rise after 2001. Chinese applicants patent grant rate began to rise since the first patent law amendment. However, it lied in the lowest position in the whole-time interval and Japanese applicants patent grant rate lied in the highest position.

The share of patent application and grant by Chinese corporations have been increasing compared with Chinese research institutes and individuals. Of all three types of Chinese applicants, research institutes patent grant rate is the highest, corporations and individuals follow.

The event of patent grant is a co-work of applicant and patent office. Therefore, we establish a bivariate probit model considering the behavior of both sides when analyzing the case of patent grant.

The econometric result proves the positive impact of two patent law amendments on patent grant. And it shows that non-Chinese applicants are more likely to request for examination compared with Chinese applicants. This might reflect a R&D quality gap between China and foreign countries. And compared with Chinese corporations and individuals, research institutes willingness of requesting for examination is the highest.

R&D human capital investment, applicant's relative technical advantage in the patent's field and size of portfolio tend to play a positive role in urging applicant to request for examination. Chinese research institutes willingness of requesting for examination is the highest, which is followed by corporations and individuals. Of all the applicants with different nationality, the examination willingness of Japanese applicants is the highest, while the examination willingness of Chinese applicants is the lowest.

Patent's technical complexity plays a positive role in patent office's willingness of granting the patent. And the width of patent protection field tends to play a negative role in patent office's willingness of granting the patent.

Our study has important managerial and policy implications. Since China provides insufficient protection for the patent right, it is thus necessary to amend the patent law to intensify the patent protection. The patent law amendment generates different impact on different types of patent applicants. Thus, the patent office should comprehensively assess the effect of the patent law amendment, and balance the possible effect among different types of patent applicants. The patent law should neither be biased towards foreign nor domestic patent applicants. Otherwise, the patent protection environment would lead to negative effects that may prevent the innovators from acquiring the proper protection.

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