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Patent examination at the State Intellectual Property Office in China

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ABSTRACT

This paper provides an overview of the institutional background of patent examination and its duration in China. The number of patent applications filed at the Chinese State Intellectual Property Office (SIPO) has grown tremendously in recent decades; by 2009, SIPO had become the world's third largest patent office. We find that the average grant lag in 1990–2002 was 4.71 years, with considerable variation across 30 different technology areas. We also empirically analyze the determinants of the grant lags at the SIPO. Using a multivariate duration analysis of the population of 443,533 SIPO patent applications from 1990 to 2002, we find that, even after controlling for other important determinants of grant lags, Chinese applicants achieved faster patent grants than their non-Chinese counterparts.

1. Introduction

Intellectual property rights (IPRs) play a crucial role in protecting ideas and inventions against unauthorized use by third parties. On the micro level, IPRs can create incentives for innovative activity by providing a mechanism for inventors to recoup the cost of developing innovative work (Scotchmer, 2004). On the aggregate level, transparent intellectual property laws promote international trade and foreign direct investments (FDI) (Branstetter et al., 2007; Maskus and Penubarti, 1995; Saggi, 2000; Smith, 1999). Against this backdrop, and as a consequence of the People's Republic of China's (PRC's) strong efforts to promote innovation and international trade after the proclamation of the Open Door Policy in the late 1970s (Maskus et al., 2005), China introduced a system of intellectual property (IP) laws that meets international requirements as specified in the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreement. The State Intellectual Property Office (SIPO), founded in 1985, plays a central role in China's IP system by assigning and enforcing patent rights in China.[1] It has since become the world's third largest patent office behind the United States Patent and Trademark Office (USPTO) and the Japanese Patent Office (JPO) (in terms of patent applications filed per year, see World Intellectual Property Organization, 2009). In 2009, the number of patents applications totaled nearly 250,000 filings (Huang, 2010; World Intellectual Property Organization, 2009).

Given the growing importance of the Chinese market – China was the world's second largest economy (measured in GDP) in 2010 – a profound understanding of the Chinese intellectual property system and its governing procedures at the SIPO are critical for many stakeholders. From a policy perspective, there are increasing concerns about the consequences of the tremendous growth in patent application filings at the SIPO on the office's grant lags (the duration between the filing of a patent application and the final grant decision). Extended backlogs in the examination of patent applications translate into suboptimal response times and thereby cause a serious drag on patent applicants (Harhoff and Wagner, 2009; Popp et al., 2003). From a managerial perspective, it is important for firms to possess detailed information on administrative procedures at patent offices in order to make informed decisions about their IP filing strategies. Existing studies have scrutinized patent examination procedures at major patent offices (Van Pottelsberghe de la Potterie, 2011) and their duration in Japan (Kotabe, 1992), the United States (Johnson and Popp, 2003) and Europe (Harhoff and Wagner, 2009). The latter two studies reported that large increases in the number of applications had significantly increased the duration of patent examination. Studies of the Chinese patent system, however, have yet to provide comprehensive

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[1] While China provides legal rights for the protection of various intellectual property, this article focuses its analysis on the Chinese patent system, established to protect patent holders against unauthorized use of their technological inventions.

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information about the consequences of rising applications on the SIPO's response time.[2]

This paper provides detailed information about SIPO patent examination procedures that will be important for policy makers and for managers responsible for corporate IP strategy. We will first present the institutional background and the legislation governing patent examination at the SIPO. Then we will provide empirical evidence of SIPO's application volumes and grant lags based on a comprehensive dataset on all patent applications filed with the office between 1990 and 2002. We show that SIPO's average grant lag in the period was 4.71 years, which is comparable to grant lags at the EPO but significantly longer than lags at the USPTO.[3] We also scrutinize the determinants of the duration of patent examination at the SIPO employing multivariate duration models. Our results suggest that, while the examination process at the SIPO follows a routine similar to those of other major patent offices, there are several major differences unique to the SIPO. As in other jurisdictions, we find significant variation in examination times across applicant characteristics, as well as across technology fields. More interestingly, we show that Chinese applicants achieved faster patent grants than their counterparts from other Asian and non-Asian countries. While this effect might be a consequence of language advantages, we also show that Chinese applicants achieved disproportionally faster patent grants in areas of high technological relevance for the PRC, raising the question of favorable treatment for domestic applicants.

The remainder of the paper is structured as follows: in Section 2, we provide an overview of the institutional background covering both the legislative regulations and the administrative procedures at the SIPO. Section 3 discusses why process durations, along with their potential determinants, are important for policy makers and patent applicants. Section 4 begins our empirical analysis with a short overview of our data sources and the definitions of our variables. In Section 5, we introduce the multivariate framework and provide results from our analysis. Section 6 concludes with a summary and potential avenues for further research.

2. Institutional background

The PRC joined the World Intellectual Property Organization (WIPO) in 1980, paving the way for an IPR system that complies with international standards (Bosworth and Yang, 2000). Five years later, in 1985, the PRC also signed the Paris Convention for the Protection of Industrial Property and, in 1993, the Patent Cooperation Treaty (PCT). China reached another important milestone by becoming a member of the World Trade Organization (WTO) in 2001 and agreeing to adhere to the TRIPS agreement. Today, the PRC has implemented laws for all relevant IPRs, such as patents, trademarks, and copyrights (Yang and Clarke, 2005). All IPRs are filed at branches such as the Patent Office of the SIPO. These offices are responsible for the acceptance, examination, and publication of all IPR related documents. To adjudicate IPR-related disputes, the PRC established a system of people's courts that enforce IPR laws. This tiered system is divided into the Supreme, Higher, Intermediate, and Basic People's Courts. At the Intermediate People's Court level and above, there are specialized divisions for IPR disputes (Wang, 2004).

Chinese patent law was enacted by the Standing Committee of the sixth National Congress in 1984 and is the governing legislation for the protection of technological inventions in China. It went into effect in 1985 and was amended three times, in 1992, 2000, and 2008. Article 2 of the Implementing Regulations of the Patent Law of the People's Republic of China defines an invention as "any new technical solution relating to a product, a process, or improvement thereof".[4] According to the patent law, patents can be granted to inventions that fulfill the basic requirements of Article 22: novelty, inventiveness, and practical applicability. With the exception of some minor differences, these standards are largely comparable to the regulations governing the USPTO and the EPO.

In order to meet the novelty criterion, no identical invention or utility model can have been publicly disclosed in the PRC or in any other country before the patent application was filed.[5] During the examination of the application's novelty, examiners have to follow the principle of individual comparison. This means each document of prior reference is compared with the technical solution of the invention under review. In the case of two or more applications on the same subject matter by different applicants, the patent should be granted to the first applicant (first-to-file principle). The requirement of inventiveness applies to an invention if it has prominent substantive features and represents a notable progress, compared with the technology existing before the date of filing (state of the art). In order to prove this criterion all relevant prior art is compared to the technical solution of the current application (Ganea and Pattloch, 2005). The third criterion is practical applicability, which requires that inventions can be made or used and can produce effective results. "Made or used" refers to the commercial production or utilization of an invention. An invention is not considered practically applicable if it is non-reproducible or if its reproduction requires unique natural conditions.

According to Article 3 of the Chinese patent law, the patent administration department under the State Council is responsible for patent examination throughout the country. It receives and examines patent applications and grants patent rights for inventions. There are three major routes to file a patent at the SIPO. The direct way is to file the patent as a Chinese priority filing. Note that a Chinese priority filing was mandatory until 2009 for inventions made in the PRC by Chinese individuals and entities.[6] Because China adheres to the Paris Convention for the Protection of Intellectual Property, a second filing option is to extend a foreign application by a subsequent SIPO application within the priority year. There also exists a third option, based on the PCT treaty. An applicant may file an international PCT application at any of the defined receiving offices. This allows an applicant to delay deciding in which jurisdiction he will seek patent protection for up to 30 months.

A patent application has to contain a description of the underlying invention, an abstract, and the claims, supplemented by technical drawings if necessary. The basic application fee of Renminbi Yuan (RMB) 950 is comparable to the online filing fee of EUR 105 at the EPO.[7] The examination of the application follows the

[2] One notable exception is Yang (2008), who examines the time between the filing of patent applications and the decision on the application at the SIPO. However, because Yang (2008) does not use patent-level data, she is unable to access the fine-grained results of the determinants of grant lags.

[3] Note that a significant fraction of all USPTO patent applications is based on a refiling of an original application as a continuation or a continuation-in-part. This claims the benefit of the filing date of a prior application and restarts the examination process (Quillen and Webster, 2001). Therefore, reported figures on the duration of patent examination at the USPTO, which focus on individual patents, might be only a lower bound of the actual durations.

[4] References to Chinese patent law were taken from the SIPO website (http://www.sipo.gov.cn/sipo_English/laws/lawsregulations/200804/t20080416_380327.html) on or before September 5, 2009.

[5] Note that the standards of novelty were part of the third revision of the patent law.

[6] 2009 this requirement has been replace by the requirement to file a confidential examination at the SIPO.

[7] See schedule of fees and expenses of the EPO (applicable as from 1 April 2010), p. 2, available at http://documents.epo.org/projects/babylon/eponet.nsf/0/E1E64D914A411ABEC12576DB004BA80A/$File/schedule_of_fees_04_10.pdf,

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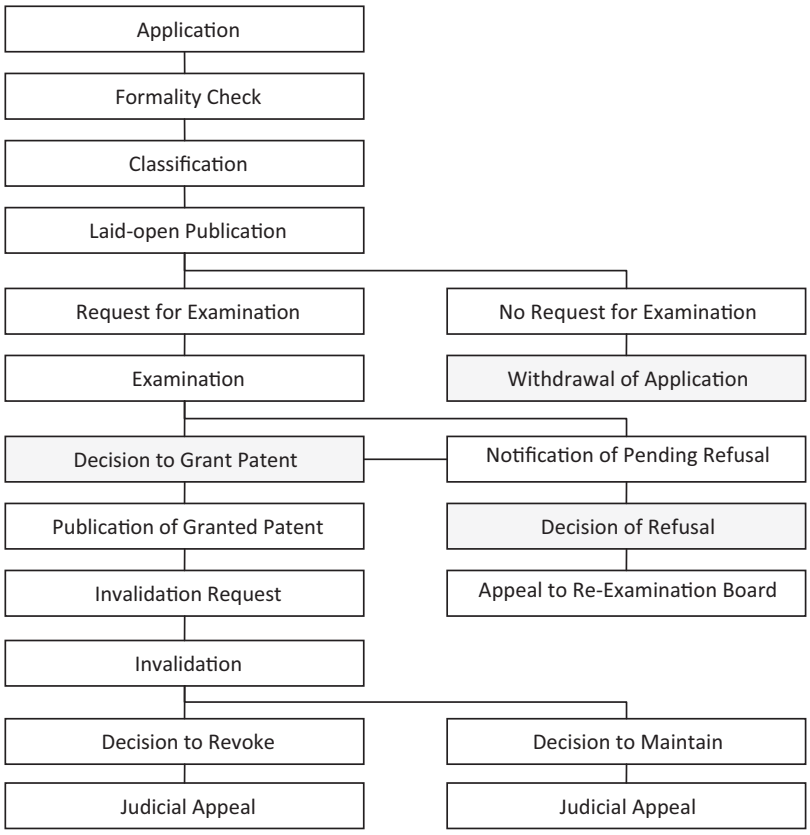

Fig. 1. Patent examination process at the SIPO from 2001.[8]

procedural steps depicted in Fig. 1. During examination, an applicant may amend an application as long as the amendments are within the scope of the documents submitted initially. The applicant may withdraw the application at any time during examination. If the invention fulfills the basic formality requirements, it will be classified according to the International Patent Classification (IPC) by the patent examiner. Eighteen months after its filing, the application will be published; publication may also take place earlier at the applicant's request.

Within 3 years after the filing, the applicant may request a substantive examination of the filed patent invention. The fee for requesting substantive examination is RMB 2500. If the applicant fails to make the request, the application is considered withdrawn by the applicant. If the examination proceeds and the examiner finds that the invention is not in line with Chinese patent law, the SIPO must notify the applicant. The applicant will then have an opportunity – within a certain time limit – to amend the application and to correct the defects that led to the preliminary decision. If the examiner judges the amended application is still non-conforming, it will be rejected. Any applications, original or amended, that meet the legal requirements of patentability will be granted. The SIPO issues these a patent certificate and registers and publishes the granted patent.

If the application is not rejected or invalidated, the patent right will be in effect for up to 20 years after the priority date, provided the applicant pays its renewal fees. Renewal fees and annual and increase over time, from RMB 900 in the first 3 years to RMB 8000 during the 16th year.[9] In the case of a refused application, the applicant may request a re-examination by the SIPO Patent Re-Examination Board or file a direct judicial appeal. The first administrative or judicial decision can be appealed up to two times, per Chinese law. Once a patent is granted, Chinese patent law allows any party to ask the SIPO Patent Re-Examination Board to invalidate the patent. The Re-Examination Board has the option to maintain the patent as granted, revoke the patent, or maintain the patent in an amended form. Another judicial proceeding can be initiated if either party is not satisfied with the Re-Examination Board's decision (Yasong and Connor, 2008).

3. The duration of patent examination

The duration of patent examination is of interest to patent applicants and third parties alike. The uncertainty regarding whether an application will lead to a patent grant is relieved only after a patent office reaches its final decision. In addition, the claims (and therefore the protective scope) of a patent are often altered during the examination process. Only after a grant does the final delineation of a patent become known. Patent applicants usually prefer examinations of a shorter duration because investment decisions that depend on patent protection usually proceed only after a patent is granted and delineated (Regibeau and Rockett, 2003). Rapid patent grants are also beneficial because patent grants make licensing deals more likely to occur (Gans et al., 2009). As a result, obtaining fast patent grants is treated as a valuable organizational capability

latest access on 18th October 2011. An overview on the fees at the SIPO can be found in Yu (2010).

[8] According to Yasong and Connor (2008) and the EPO website (http://www.epo.org/patents/patent-information/east-asian/helpdesk/china/grant.html), last visited December 19, 2008. Applicants may also withdraw their application any time before a patent is granted.

[9] The annuities at the SIPO are lower compared to the EPO. However, the SIPO fees are increasing more steeply up to the 16th year whereas at the EPO the fees only increase up to the 10th year.

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in the strategy literature (Reitzig and Puranam, 2009).[10] Shorter durations are preferable to third parties, as well, because a patent decision is necessary to determine if their own products are at risk of infringement and costly litigation.

Against this backdrop, firms need to have a profound understanding of the procedures and the determinants of pendency times to optimize their patent filing strategies. Empirical studies have identified determinants of grant lags at the most important international patent offices, including the EPO (Harhoff and Wagner, 2009; Van Zeebroeck, 2007), the USPTO (Popp et al., 2003; Regibeau and Rockett, 2003) and the JPO (Kotabe (1992) compares patent examination at the JPO with the USPTO). These studies demonstrate that the duration of patent examination is related to the complexity and the voluminosity of the examination task as well as to institutional characteristics (such as the application path chosen), patent office capacity, applicant behavior and characteristics, and nationality.

Despite the growing importance of the SIPO, there is little evidence about the determinants of the duration of patent examination in China. A notable exception is Yang (2008) who compares grant rates and the duration of patent examination at the USPTO and the SIPO. Employing a simple lagged-regression approach distinguishing Chinese and non-Chinese applicants, she finds evidence that domestic applicants achieved higher grant rates and less volatile durations than foreign applicants at the SIPO in 1985–2002.[11] Yang (2008, p. 1044) concludes that "domestic applicants are more favored than foreign applicants." Her findings add to previous literature scrutinizing the duration and outcomes of examination procedures at international patent offices. Favorable outcomes for domestic applicants have been reported by Kotabe (1992) who shows that domestic applicants achieved shorter pendency times at the JPO and higher grant rates at the USPTO. Additional evidence of preferential treatment for domestic applicants is mixed, however. Treating the country of origin as a control variable, Popp et al. (2003, p. 26) find that foreign applications take longer to be processed at the USPTO but also that among "patents that naturally take a long time, domestic patents take longer than foreign ones". Similarly, Harhoff and Wagner (2009) find that German and UK applicants achieved fastest grant decisions at the EPO but that German applicants needed to wait longer for negative decisions regarding their patent applications. While the time discrepancy between domestic and non-domestic patent application lags has been explained as a result of "discrimination" by the patent office (Kotabe, 1992; Yang, 2008) or "disharmony in international patent office decisions" (Jensen et al., 2006), patent offices and some scholars have rejected this assertion (Katznelson, 2007).

In this paper, we revisit the duration of patent examination at the SIPO using a wider set of explanatory variables than existing studies, and employ a micro-econometric approach that operates on the patent level. In addition to the question of whether domestic (Chinese) applicants achieve faster patent grants than foreign applicants, we are able to draw a more detailed picture of the SIPO's examination procedure. We include additional applicant characteristics, such as measures related to patent applicants' familiarity with the Chinese patent system and their focus on the Chinese market. This is important because applicants with a clear China focus can be expected to possess superior skills in managing the application process at the SIPO, thereby achieving faster patent grants. Moreover, we include a measure of the importance of a technology field for the PRC because, if there is discrimination of domestic applicants, one could expect its effect to be more pronounced in areas that China regards as important. We also control for characteristics of the patent application itself. This includes variables related to the voluminosity and the complexity of the examination task as well as the application path chosen by the applicant. Finally, we consider the impact of structural differences across technology fields on the duration of patent examination, which might emerge from differences in the workload situations of examiners. We account for this in the multivariate framework.

4. Data description

4.1. Data sources and variable definitions

Our empirical study is based on a worldwide patent database provided by the EPO (PATSTAT).[12] The dataset used for this study contains information based on the April 2008 version of PATSTAT and covers all 443,533 patent applications filed at the SIPO between 1990 and 2002.[13] For the population of 443,533 applications two subgroups of patents were identified: (i) SIPO patent applications with equivalent filings at the USPTO (190,429 applications) and (ii) SIPO patents with equivalent filings at the EPO (188,388 applications). Identifying USPTO and EPO equivalents allows us to augment the initial data on SIPO applications with patent indicators such as patent citations and references, which are not reported for SIPO applications within PATSTAT or other available databases. We include those measures derived from the USPTO/EPO equivalent filings in our analyses as proxies for the characteristics of the SIPO applications. Based on this data, we compute variables at the level of the individual patent, at the applicant level, and at the level of the technology area to which each patent application belongs.

4.1.1. Dependent variable

4.1.1.1. Grant lag. Grant lag is defined as the duration, in years, between the date of filing at the SIPO and the final decision to grant a patent on the respective application. PATSTAT allows us to identify the publication of the grant decision.[14] It should be noted that, for patents without a grant decision reported in PATSTAT April 2008, we cannot distinguish between applications that are still under examination and applications that have left the examination process (because of rejection by an examiner or because the applicant withdrew the application).

[10] Patent applicants sometimes try to drag out final decisions on patent applications in order to maintain uncertainty for their competitors. This strategy has been referred to as "submarine patents". Stevnsborg and van Pottelsberghe de la Potterie (2007) contains a comprehensive overview on different patent filing strategies at the EPO.

[11] While this finding is remarkable in itself it should be noted that Yang's (2008) data contain information on grant lags and the nationality of the applicants only and therefore does not allow controlling for alternative determinants that have been shown to influence examination times in previous literature. Moreover, the lagged regression approach chosen by Yang (2008) does not use grant lags of individual patent applications but only compares the number of applications relative to the number of grants in different cohorts.

[12] While there are a multitude of data sources for patent applications filed at the SIPO, we chose PATSTAT because it appears to be the most comprehensive database for Chinese patents. For more information about PATSTAT, see http://www.epo.org/patents/patent-information/raw-data/test/product-14-24.html. Our latest visit was September 3, 2010.

[13] As we include the number of citations a patent receives within 5 years of its initial application, we must limit our observation period to the years before 2003. This restriction also reduces the number of applications in our sample that are still awaiting a grant decision.

[14] The SIPO classifies patent documents as Unexamined Patent Publication (A – Gōngkāi), Examined Patent Publication before 1993 (B – Shěndìng Gōnggào), and Granted Patent Publication since 1993 (C – Shòuquán Gōnggào). Similar to the studies of the USPTO (Popp et al., 2003; Regibeau and Rockett, 2003), it is impossible to distinguish whether a patent application is still pending or whether it has already been withdrawn (by the applicant) or rejected (by the examiner). Reducing the observation period to the years before 2003 allows us to reduce the rate of pending cases in the sample.

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4.1.2. Independent variables

4.1.2.1. Applicant characteristics. Size (global annual patent applications per applicant). As a measure of size, the number of global patent applications per applicant is computed annually based on all patent families contained in PATSTAT for a given applicant. We include the number of global annual patent applications per applicant in log form.

Years of experience with the SIPO. We compute the years of experience an applicant has with the SIPO as the difference between the last year of our observational period (2002) and the year an applicant filed his first patent application at the SIPO.

China focus. We define the China focus of an applicant as the number of patent applications filed in China relative to all patent applications an applicant filed in the same year.

Country of origin. We control for the country of origin of patent applicants. In particular, we distinguish the largest five groups of applicants by including dummy variables for Chinese, German, Japanese, Korean, and US applicants in the regression analyses and treating the remaining applicants as the reference group.

4.1.3. Variables characterizing technology areas

4.1.3.1. Revealed Technological Advantage (RTA). Technology areas are of varying importance for nations. Soete and Wyatt (1983) propose the Revealed Technological Advantage index (RTA) as a measure of a nation's advantage regarding its patenting activities relative to other nations.[15] Based on their work, we define China's Revealed Technological Advantage (*RTA_CN*) in technology area *i* and year *t* as

$$RTA\_CN_{it} = \frac{PAT\_CN_{it}/\sum_i PAT\_CN_{it}}{PAT_{it}/\sum_i PAT_{it}} \quad (1)$$

where PAT_CN_{it} is the number of patents grants to Chinese applicants in technology area i (we use an updated version of OECD's (1994) technology classification distinguishing 30 different technologies) in year t and PAT_{it} is the number of all patent grants at the SIPO. When *RTA_CN* is larger than one it indicates that China has a relative technological advantage over other nations in a given technology area i since a larger-than-average share of patents granted to Chinese applicants falls in that area.

4.1.3.2. Growth of applications in a technology area. Harhoff and Wagner (2009) demonstrate that the duration of patent examination is an increasing function of the workload (number of pending patent applications per patent examiner). Since there is no detailed information available about the number of patent examiners at the SIPO, we capture workload effects with the annual growth rate of patent applications filed in 30 technology areas. As the number of examiners should be inflexible in the short run, it is reasonable to expect an increase in the number of applications to be directly related to examiner workloads. We expect a higher application growth rate to be associated with patent examinations of longer duration.

4.1.4. Patent characteristics for all SIPO patent applications in our sample

4.1.4.1. Family size. According to the Paris Convention for the Protection of Industrial Property, applicants can use their priority patent applications to file further applications in other countries within the priority year. We compute the family size of a patent as the number of states in which an application was filed.

4.1.4.2. PCT application. A dummy variable indicates whether a patent family contains an international patent application.

4.1.4.3. Number of International Patent Classification (IPC) assignments. The SIPO uses the IPC classification scheme to classify each patent application into one or more technology areas. We use the number of different 4-digit IPC subclasses to which a patent has been assigned as a measure of patent scope and the complexity of patent examination.

4.1.5. Additional variables available only for SIPO patents with USPTO or EPO equivalents

4.1.5.1. Number of claims. Each patent contains a set of claims that marks the boundaries of the patent. The number of claims indicates the voluminosity of the examination task; it has been shown that a larger number of claims leads to an increase in the time needed for examination. Moreover, the number of claims significantly increased over the last years (Van Zeebroeck et al., 2009).

4.1.5.2. References to patent literature/non-patent literature. During the process of patent examination, the patent examiner includes references to older patents and to non-patent literature that contain the state of the art relevant to determine the novelty of an invention. For the subsamples of SIPO applications with USPTO or EPO equivalents, we proxy for the complexity of the examination task using the number of references to patents and non-patent literature contained in a SIPO application's USPTO/EPO equivalents. It can be expected that a larger number of backward references requires more time and effort from the examiner and should therefore be related to longer pendency (Popp et al., 2003; Harhoff and Wagner, 2009).

4.1.5.3. Forward citations. Along with information on patent and non-patent literature references, it is also important to know how frequently a patent is cited by other patents. Numerous studies have established a close link between the number of citations a patent receives and the commercial value of the underlying invention (Trajtenberg, 1990; Harhoff et al., 2003). Since early applications have the opportunity to be cited more often, we limit the number of EPO and USPTO forward citations to those made within 5 years of the application date.

4.2. Descriptive statistics

We present descriptive statistics for filing trends at the SIPO between 1990 and 2002. As shown in Fig. 2, the number of patent applications and grants increased steadily in recent years, with a particularly steep increase after China joined the WTO in 2001.

Between 1990 and 2002, the average grant rate for all SIPO patent applications was 52.7%. Table 1 shows considerable variation in the grant ratios among applicants from different nations, as also reported by Yang (2008). Comparing the countries with the most frequent foreign applications at the SIPO demonstrates that Japanese and South Korean applicants show considerably higher grant rates than applicants from the US, Germany, and other non-Chinese countries.[16] Interestingly, the grant rate for Chinese applicants increased from 23% in 1990 to more than 50% in 2002. The average SIPO patent had a grant lag of 4.71 years.[17] Note that

[15] The RTA index has been applied frequently in the management and economics literatures (see, e.g., Patel and Pavitt, 1987; Paci and Usai, 2000; Cantwell and Iammarino, 2000).

[16] More than 96.5% of the SIPO applications between 1990 and 2002 were filed by Chinese, Japanese, South Korean, U.S., German, and other European applicants.

[17] The U.S. and EP subgroups show only slightly longer examination periods of 5.08 and 5.20 years, respectively. Comprehensive descriptive statistics for the two subsets of SIPO applications with USPTO/EPO equivalents are not reported here but can be obtained from the authors upon request.

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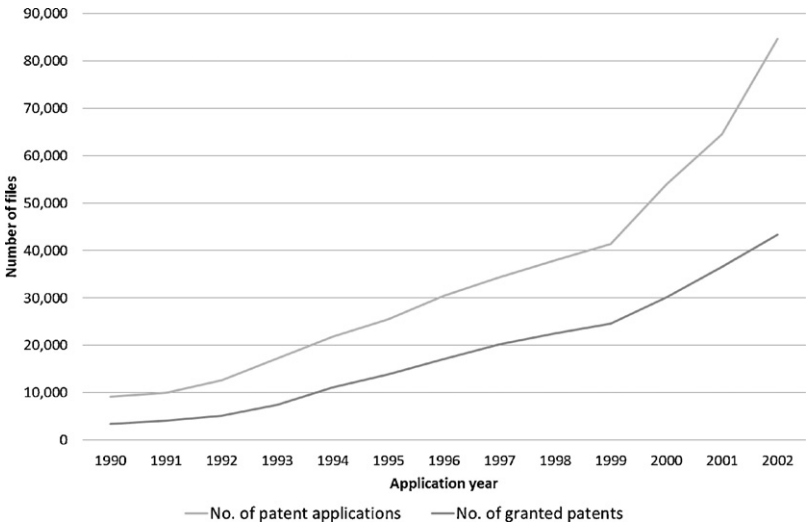

Fig. 2. SIPO patent applications and grants (1990–2002).

Table 1
Patent applications filed at the SIPO by applicants country.

Applicant country	No. of patent applications (1990–2002)	Average annual no. of patent applications	Average annual growth rate of applications	Granted patents (1990–2002)	Average annual no. of granted patents	Average annual grant ratio %	Average annual grant lag in years
China	177,911	13,685	19.48%	75,922	5840	38.48%	4.10
Germany	26,744	2057	24.12%	16,307	1254	59.50%	5.13
Japan	83,815	6447	33.08%	60,023	4617	72.93%	5.15
Korea	16,215	1247	38.32%	10,801	831	67.51%	5.07
US	70,191	5399	18.55%	35,808	2754	52.16%	5.28
Other	68,657	5281	21.69%	40,512	3116	59.38%	5.12
Total	443,533	34,118	23.21%	239,373	18,413	52.72%	4.71

Chinese applicants achieved the fastest grants when compared to non-Chinese applicants.

Table 2 lists differences across technology areas. The total number of patent applications between 1990 and 2002 varied from around 1000 applications in Nuclear Engineering or Space Technology and Weapons to more than 30,000 applications in areas such as Electrical Machinery or Pharmaceuticals and Cosmetics. Interestingly, the Revealed Technological Advantage (as defined above) based on the 30 OECD (1994) technology areas (and matched to the revised Catalogue of Industries for Guiding Foreign Investment 2004) broadly coincided with economic areas that the Chinese had designated highly important or had restricted using governmental guidelines (see Table 2). The areas Agriculture and Food Chemistry, as well as Agriculture and Food Processing, for instance, exhibited the highest RTA values of all industries. This is in line with findings by Maskus (2004) and suggests that the Chinese government tried to control agricultural industries in order to secure its food supply and to maintain a certain level of competition. Regarding grant lags, Table 2 shows considerable variation across technology fields. For instance, Materials and Metallurgy show the shortest grant lags, with an average of 4.25 years, while grants in Biotechnology took an average of 5.24 years. It is noteworthy that there is a significant negative correlation (−0.21) between the duration of patent examination and the Revealed Technological Advantage, indicating that patent examination takes less time in areas where Chinese applicants have a relative advantage. In the multivariate analysis of the subsequent section, we try to disentangle whether this is simply a consequence of a high share of Chinese applicants (who achieve faster patent grants) or whether, after controlling for applicants' origins, examination in those areas simply required less time.

Table 3 reports the most important trends for patenting activities at the SIPO on an annual basis. Strikingly, the grant ratio over time exhibits the shape of an inverted U-curve. Starting in 1990, grant ratios increased until the mid-1990s and then decreased slightly afterward. We observe a similar development for examination times. Beginning with an average grant lag of 5 years, the examination time for granted patents extended to 6 years in the mid-1990s and decreased to about 4 years in 2002.[18] A closer look at the patent characteristics at the SIPO reveals patterns similar to most international patent offices. In particular, the share of PCT applications rose continuously from 4.84% in 1990 to more than 30% in 2002. Harhoff and Wagner (2009) have reported a similar development at the EPO. Not surprisingly, there was a strong increase in applications after China signed the PCT treaty in 1993, making it easier for applicants to transfer PCT applications to the SIPO. In 2002, more than 30% of all SIPO patents and more than 60% of patents within the US and EP groups had a PCT filing within their patent family. The number of IPC assignments has been quite stable over time, with an average of 4.99 different IPC classes on patent applications. The average yearly number of global patent applications by an applicant increased steadily after 1993 and exhibited a steeper increase after 2001, reflecting a general surge in patenting activities after that year around the globe.

[18] One major argument for this trend can be found in the low workforce at the SIPO during the 1990s. The strong recruitment of examiners in the late 1990s and 2000s, as well as the implementation of supporting systems for examiners, certainly contributed to the shortening of grant lags. The decrease in grant lags for SIPO patents might also be caused by the censoring of data. However, shortening the observation period to 1990–2000 creates no considerable changes in our findings.

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Table 2
Grant ratios and lags across technological areas (all SIPO applications, 1990–2002).

Area name	No. of patent applications[a]	No. of granted patents[a]	Grant ratio %	Min. grant lag in years	Average grant lag in years	Max. grant lag in years	Chinese RTA index	FDI catalogue 2004[b]
Electr. Machinery, Electrical Energy	30,323	18,612	61.38	1.14	4.75	13.77	0.62	E
Audiovisual Technology	17,402	10,942	62.88	1.21	5.03	12.63	0.41	N/A
Telecommunications	37,354	21,368	57.20	1.09	4.93	12.72	0.49	E/R/P
Information Technology	23,929	12,383	51.75	1.09	4.95	15.19	0.73	(E)
Semiconductors	10,924	7315	66.96	1.34	4.70	11.72	0.55	(E)
Optics	12,985	7885	60.73	1.43	4.78	12.20	0.49	E
Analysis, Measurement, Control Tech.	19,385	10,297	53.12	1.05	4.83	12.67	0.80	(E)
Medical Technology	13,532	5993	44.29	1.33	5.22	15.33	0.97	E/R/P
Nuclear Engineering	1000	617	61.76	1.66	4.91	11.06	0.59	E
Organic Fine Chemistry	22,577	12,439	55.09	1.21	4.98	13.37	0.89	E
Macromolecular Chem., Polymers	17,568	10,365	59.00	1.11	4.82	12.40	0.78	N/A
Pharmaceuticals, Cosmetics	30,312	14,721	48.57	1.21	4.86	13.17	1.13	E/R/P
Biotechnology	9376	3584	38.23	1.21	5.24	13.37	1.21	N/A
Agriculture, Food Chem.	17,527	5984	34.14	1.22	4.30	11.18	1.86	E/R/P
Chem. & Petrol Ind., Basic Mat. Chem.	20,645	9989	48.38	1.16	4.75	13.02	1.02	E/R
Surface Technology, Coating	8066	4741	58.78	1.19	4.78	12.84	0.76	E
Materials, Metallurgy	17,666	10,196	57.72	1.05	4.25	11.33	1.21	N/A
Chemical Engineering	13,068	8261	63.21	1.17	4.63	12.36	0.87	E/R
Mat. Proc., Textiles, Paper	18,042	9991	55.38	1.05	4.73	16.47	0.78	E/R
Handling, Printing	14,021	8978	64.03	1.05	4.63	12.96	0.57	R
Agricultural & Food Proc.	4666	2044	43.80	1.41	4.49	12.98	1.41	E/R/P
Environmental Technology	4580	2284	49.86	1.22	4.52	11.23	1.20	E
Machine Tools	9161	5497	60.00	1.20	4.53	11.49	0.85	E
Engines, Pumps, Turbines	9451	5177	54.77	1.16	4.64	13.13	0.83	E
Thermal Proc. & Apparatus	8968	4656	51.92	1.22	4.87	13.67	1.00	E
Mechanical Elements	8810	5163	58.60	1.18	4.53	12.84	0.72	E
Transport	10,209	5118	50.13	1.03	4.60	12.82	0.83	E
Space Technology, Weapons	950	416	43.79	1.57	4.65	10.97	1.10	P
Consumer Goods & Equipment	19,463	8999	46.24	1.20	4.83	13.84	0.95	N/A
Civil Eng., Building, Mining	11,574	5359	46.30	1.07	4.58	12.23	1.23	R
All SIPO Patent Applications	443,533	239,373	54.97	1.03	4.71	16.47		

[a] The number of patent applications and grants are weighted by the number of technology areas (one patent can fall into several technological areas).
[b] Classification of industries according to the revised Catalogue of Industries for Guiding Foreign Investment 2004 – E: encouraged; R: restricted; P: prohibited; N/A: not applicable. One industry can fall into several areas. As indicated by classification in brackets (e.g., (E)), some industries could only be roughly matched with the investment catalogue.

Table 3
Yearly patent indicators of all SIPO patent applications (1990–2002).

Application year	No. of patent applications	No. of granted patents	Grant ratio %	Average grant lag in years	Family size	Share of PCT applications %	No. of IPC classes	Average global patent applications per applicant	Average SIPO patent applications per applicant
1990	9227	3378	36.61	4.77	4.39	4.84	4.46	7.16	6.16
1991	9968	4079	40.92	4.64	3.99	7.35	4.19	6.69	5.73
1992	12,597	5148	40.87	4.89	3.49	8.18	3.96	6.60	5.85
1993	17,264	7447	43.14	5.47	3.78	12.40	4.33	11.78	9.79
1994	21,872	11,156	51.01	5.93	4.56	22.58	4.98	22.05	17.63
1995	25,477	13,846	54.35	6.05	4.74	27.02	5.17	39.06	32.45
1996	30,400	17,152	56.42	5.85	4.64	29.09	4.97	56.00	48.09
1997	34,381	20,178	58.69	5.47	4.68	30.85	4.94	81.52	69.69
1998	37,920	22,477	59.27	5.16	4.74	34.86	5.08	92.36	80.03
1999	41,400	24,561	59.33	4.76	4.75	37.82	5.34	83.53	70.59
2000	53,962	30,151	55.87	4.32	4.21	33.71	5.44	113.17	100.25
2001	64,477	36,498	56.61	4.00	3.86	33.34	5.18	122.98	98.90
2002	84,588	43,302	51.19	3.62	3.21	31.41	4.75	157.10	131.83
Total	443,533	239,373	54.97	4.71	4.14	29.48	4.99	91.71	77.36

5. Duration analysis

5.1. Model specification

Duration analysis has frequently been applied to study the duration of patent examination (Harhoff and Wagner, 2009; Van Zeebroeck, 2007). In duration models, the survival function can be written as

$$S(t) = Pr(T \geq t) \quad (2)$$

where T denotes a non-negative random variable representing the time until an event occurs. While the survival function describes how the risk for a certain event changes over time, the hazard function measures the instantaneous failure rate, also called the time-specific failure rate. This rate represents the probability of an event occurring at time t conditional on "survival", i.e., no occurrence of an event up to that time, and can be defined as

$$\lambda(t) = \lim_{\Delta t \to 0} \frac{1}{\Delta t} Pr(t \leq T < t + \Delta t | T \geq t) \quad (3)$$

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Since we are not interested in merely computing the survivor function, but in analyzing the relationship between survival times and a set of covariates, we introduce explanatory variables in a linear model where the hazard rate $\lambda_i(t)$ for observation i is given by

$$\lambda_i(t) = \exp(h(t) + \beta_1 z_{i1} + \cdots + \beta_p z_{ip}) \quad (4)$$

where the variables $z_1, \ldots, z_p$ are covariates. In this case, however, it is necessary to specify a baseline hazard rate $h(t)$ as the point of reference if all covariates equal zero. Cox (1972) introduced the proportional hazard model in which the hazard rate $\lambda_i(t, z)$ of observation i is given by

$$\lambda_i(t, z) = \lambda_0(t) \exp(\beta_1 z_{i1} + \cdots + \beta_p z_{ip}) \quad (5)$$

with $\lambda_0(t)$ being an unspecified function and the covariates $z_1, \ldots, z_p$ entering linearly. In cases where there is only one binary covariate vector z_1, the hazard rate is $\lambda_0(t)$ if $z_1 = 0$. When $z_1 = 1$ the hazard rate equals

$$\lambda(t, z_1) = \frac{\lambda_0(t) \exp(\beta_1)}{\lambda_0(t)} \quad (6)$$

Dividing the hazard rate by $\lambda_0(t)$ results in the exponentiated coefficient β_1. Accordingly, the hazard rate arises from the comparison of observations with $z_1 = 1$ to those with $z_1 = 0$. With continuous covariates, the hazard rate represents the change in the time-specific failure rate associated with a one-unit increase in this variable. When more than one covariate is incorporated into a model, the hazard rate β_i measures the risk of failure across time for observations that differ on z_i (Kalbfleisch and Prentice, 1980).

It should be noted that we only observe the duration of examination for applications that were ultimately granted. For patents with no grant decision prior to April 2008, we cannot distinguish whether examination was ongoing or whether examination had ended in a withdrawal or rejection. Because it is not possible to know whether and when non-granted applications left the risk pool, we must exclude from the survival analysis all observations without a grant decision.[19] Granted patents may be systematically different from patents that were not granted, introducing a bias to the estimates in the proportional hazards model. In order to validate the findings from our survival analysis, we also report findings from a Heckman selection model (Heckman, 1979) in which the first stage contains whether a patent grant is observed or not (0/1) and the second stage contains the duration of patent examination in years.[20]

5.2. Results and discussion

We present the results from Cox proportional hazard models and, to confirm robustness, from Heckman selection models. The estimations were carried out for all SIPO patent applications and the two subsets of SIPO patents with USPTO/EPO equivalents from 1991 to 2002. (We exclude patent applications from 1990 because we compute the growth rate of applications filed in a given technology area starting from this year.) In a first step, we report a simple specification containing only the main effects of the explanatory variables. In a second step, we scrutinize whether there are different effects depending on applicants' countries of origin in those areas that are of particular relevance to China. To do this, we interact the Revealed Technological Advantage with the country dummy variables. All regressions contain year and technology area fixed effects, which are not reported but can be obtained from the authors upon request.

Table 4 presents the coefficients from Cox proportional hazard regressions. Coefficients larger than zero increase the hazard rate and are therefore associated with shorter examination periods, and vice versa. Columns (1) and (2) contain results for the population of patent applications at the SIPO from 1991 to 2002. Most of the estimates are highly significant and carry the expected signs. In particular, we find that applicants characterized by a higher familiarity with the procedures at the SIPO (measured by their years of experience with the SIPO and a stronger China focus in their patenting activities) achieved faster patent grants. Column (1) of Table 4 reveals that Asian applicants achieved significantly faster patent grants at the SIPO than applicants from Germany, the US, and the rest of the world (reference group).

Turning to the characteristics of the technology areas, we find that higher growth in patent applications was associated with longer grant lags. Column (1) also shows that the duration of patent examination in areas with high RTA indices was shorter than in other areas. This effect is driven primarily by Asian applicants (see Column 2): once we interact the dummy variables for Asian applicants with the RTA index, we find that Asian applicants enjoyed faster procedures in areas characterized by high RTA indices. Again, Chinese applicants had the largest advantage. At the same time, the baseline effect of the RTA index vanishes once we control for interaction effects, indicating that the SIPO does not prioritize certain areas but that acceleration seems to be driven mainly by an applicant's nationality. Interestingly, once we interact the RTA and the country dummy variables, we find that Korean and Japanese applicants achieved faster grants (compared to applicants from Germany, the US, and the rest of the world) only in areas with high RTA indices. Only Chinese applications were systematically processed faster across all areas. These findings were obtained after we controlled for important patent characteristics that influence grant lags: PCT applications were characterized by significantly longer examination times, which can be explained by institutional characteristics of the PCT application path (Harhoff and Wagner, 2009). Moreover, the higher the number of IPC classes on an application, the longer the duration of its examination. We argue that these applications are more complex to examine because they require a broader search of prior art. The effect of family size reduced duration by only a small magnitude.

We present additional estimations for the two subsets of SIPO patents in which we include the number of claims, references, and forward citations from their EPO/USPTO equivalents as a proxy for the complexity of the examination task (see Columns 3–8). Adding further controls for the voluminosity and complexity of the examination task does not change most of the findings described above. With regard to country effects, we find some variation across the subsamples. For patents with EPO equivalents, we find no changes compared to the results from the overall sample (see Column 5): Chinese applicants enjoyed the fastest patent grants across all technologies, followed by Korean applicants. Regarding the subsample of SIPO patents with USPTO equivalents, we find minor differences for all SIPO patents with regard to the effect of applicants' nationalities: Chinese applicants enjoyed the fastest patents grants across all technology areas (see the base effect of Chinese applicant in Column 8); only in areas characterized by RTA indexes above 1.28 did Korean applicants achieve faster grants.

Table 5 contains results from the second stage of a Heckman selection model (Heckman, 1979), which we estimate as a

[19] If we observed withdrawals and rejections, we could treat those applications either as censored cases or use estimated competing risks models to determine the influence of the independent variables on the duration of examination leading to the different outcomes (grant, withdrawal, rejection).

[20] Note that the second stage of the selection model is an OLS-type regression that assumes a normally distributed dependent variable. Strictly speaking, the duration of patent examination is not normally distributed, as it is non-negative by definition. However, the normal distribution is a good first approximation for the observed duration data.

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Table 4
Estimation results of a Cox proportional hazards model for SIPO patent applications from 1991 to 2002.

Duration until patent grant	SIPO patents		SIPO patents with EP equivalents			SIPO patents with US equivalents		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Applicant characteristics								
US applicant (0/1)	−0.127**	−0.087**	−0.160**	−0.136**	−0.089**	−0.125**	−0.091**	−0.024
	[0.007]	[0.018]	[0.008]	[0.023]	[0.023]	[0.009]	[0.024]	[0.026]
German applicant (0/1)	0.022*	0.052*	0.018+	0.037	0.001	0.016	0.04	0.027
	[0.009]	[0.026]	[0.011]	[0.032]	[0.032]	[0.011]	[0.034]	[0.036]
Korean applicant (0/1)	0.228**	0.034	0.221**	−0.081	−0.008	0.184**	−0.046	0.000
	[0.012]	[0.028]	[0.022]	[0.056]	[0.056]	[0.015]	[0.039]	[0.062]
Japanese applicant (0/1)	0.024**	−0.075**	−0.017+	−0.162**	−0.077**	0.017+	−0.117**	−0.120**
	[0.007]	[0.017]	[0.010]	[0.024]	[0.024]	[0.009]	[0.022]	[0.026]
Chinese applicant (0/1)	0.875**	0.588**	0.527**	0.334*	0.293*	0.664**	0.681**	0.431**
	[0.009]	[0.020]	[0.048]	[0.133]	[0.133]	[0.037]	[0.103]	[0.165]
Yearly applications (log)	0.002	0.002	0.014**	0.016**	0.011**	0.012**	0.013**	0.012**
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Years of experience with SIPO	0.012**	0.012**	0.002*	0.002*	0.002+	0.002**	0.002**	0.001
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
China focus	0.065**	0.071**	0.043**	0.053**	0.058**	0.055**	0.063**	0.059**
	[0.012]	[0.012]	[0.016]	[0.016]	[0.016]	[0.015]	[0.015]	[0.018]
Technology area characteristics								
Revealed Technological Advantage (RTA)	0.171**	0.007	0.071**	0.02	0.035	0.073**	0.011	0.041
	[0.012]	[0.017]	[0.018]	[0.023]	[0.023]	[0.018]	[0.024]	[0.026]
Growth rate of application filings	−0.226**	−0.221**	−0.164**	−0.162**	−0.155**	−0.134**	−0.132**	−0.148**
	[0.012]	[0.013]	[0.022]	[0.022]	[0.021]	[0.019]	[0.019]	[0.022]
US applicant × RTA		−0.060**		−0.033	−0.034		−0.048+	−0.059+
		[0.022]		[0.028]	[0.028]		[0.029]	[0.032]
German applicant × RTA		−0.042		−0.025	−0.019		−0.03	−0.033
		[0.031]		[0.038]	[0.038]		[0.040]	[0.044]
Chinese applicant × RTA		0.335**		0.239	0.313*		−0.016	0.094
		[0.021]		[0.152]	[0.148]		[0.123]	[0.198]
Korean applicant × RTA		0.279**		0.433**	0.349**		0.347**	0.308**
		[0.040]		[0.077]	[0.078]		[0.058]	[0.089]
Japanese applicant × RTA		0.130**		0.196**	0.128**		0.185**	0.139**
		[0.021]		[0.030]	[0.030]		[0.028]	[0.033]
Patent characteristics								
Family size	0.003**	0.005**	−0.003**	−0.002**	−0.001	−0.001	0.000	0.000
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
PCT application (0/1)	−0.256**	−0.256**	−0.252**	−0.302**	−0.297**	−0.324**	−0.329**	−0.282**
	[0.006]	[0.006]	[0.008]	[0.008]	[0.008]	[0.007]	[0.007]	[0.008]
No. of IPC classes	−0.008**	−0.007**	−0.005**	−0.010**	−0.010**	−0.009**	−0.009**	−0.006**
	[0.000]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
References to patent literature					−0.014**			−0.003**
					[0.001]			[0.000]
References to non-patent literature					−0.050**			−0.008**
					[0.002]			[0.001]
Forward citations within 5 years					−0.016**			−0.004**
					[0.001]			[0.000]
Number of claims					−0.009**			−0.006**
					[0.000]			[0.000]
Pseudo Log-Likelihood	−2,614,598.3	−2,614,318.8	−1,208,942.7	−1,208,884.7	−1,207,316	−1,337,702.1	−1,337,635.6	−937,793.93
Chi-squared	92,104.94	91,573.17	55,107.37	55,042.16	55,403.04	60,139.87	60,156.14	41,901.79
Observations	235,995	235,995	116,021	116,021	116,021	127,372	127,372	92,006

Note: The number of claims has been available only for a subset of USPTO equivalents to SIPO applications. Standard errors of coefficient estimates are reported in brackets.
** Significant at 1% level.
* Significant at 5% level.
+ Significant at 10% level.

robustness test to control for the different quality of patent applications. The first stage of this model is a probit regression identifying those applications for which a grant decision was observed. In the second stage, the duration of patent examination was regressed on our explanatory variables.[21] Since this regression is a standard linear regression, estimated coefficients larger than zero indicate longer grant lags, and vice versa. The results presented in Table 5 largely confirm our findings from the Cox proportional hazards model. Most importantly, the pattern of examination times for different nationalities is comparable: Chinese applicants achieved fastest patent grants overall and, in fields of high RTA indexes, Korean applicants managed to shorten the duration of patent examination more than applicants from other nations.

Taken together, we obtain a very robust finding that domestic applications are characterized by faster grant decisions than non-domestic applications. Moreover, the effect is more pronounced in areas that are of importance to China and Chinese firms, as indicated by high RTA indexes. The advantage of Chinese applicants could be explained by different (and not mutually exclusive) mechanisms. First, the SIPO might discriminate between Chinese and non-domestic applicants. Second, Chinese applicants might

[21] Identification in the first stage is based on family size. Note that the effect of family size on the duration of patent examination is limited. However, as the results from the selection models show, it is a significant determinant of the selection. Results from the first stage of the Heckman models are not reported but will be provided upon request.

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Table 5
Estimation results from the second stage of a Heckman selection model (duration of patent examination) for SIPO patent applications, 1991–2002, conditional on a patent grant taking place (first stage).

Duration until patent grant	SIPO patents		SIPO patents with EP equivalents			SIPO patents with US equivalents		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Applicant characteristics								
US applicant (0/1)	0.043**	0.046+	0.227**	0.167**	0.113**	0.188**	0.135**	0.065*
	[0.010]	[0.026]	[0.010]	[0.026]	[0.026]	[0.010]	[0.027]	[0.030]
German applicant (0/1)	−0.028*	0.027	−0.015	−0.126**	−0.089*	−0.022+	−0.131**	−0.099*
	[0.013]	[0.037]	[0.011]	[0.035]	[0.035]	[0.012]	[0.036]	[0.039]
Korean applicant (0/1)	−0.031+	0.137**	−0.309**	−0.04	−0.125*	−0.282**	−0.110**	−0.085
	[0.016]	[0.038]	[0.023]	[0.057]	[0.057]	[0.016]	[0.037]	[0.062]
Japanese applicant (0/1)	0.261**	0.294**	−0.068**	0.077**	−0.015	−0.095**	0.022	0.073*
	[0.010]	[0.024]	[0.012]	[0.026]	[0.026]	[0.011]	[0.025]	[0.028]
Chinese applicant (0/1)	−0.979**	−0.831**	−0.805**	−0.579**	−0.571**	−0.881**	−0.763**	−0.532**
	[0.011]	[0.024]	[0.038]	[0.115]	[0.114]	[0.028]	[0.080]	[0.145]
Yearly applications (log)	0.009**	0.009**	−0.008**	−0.010**	−0.006**	−0.005*	−0.007**	−0.008**
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]
Years of experience with SIPO	−0.005**	−0.005**	−0.005**	−0.005**	−0.005**	−0.006**	−0.006**	−0.003**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
China focus	0.097**	0.094**	−0.039*	−0.048**	−0.056**	−0.046**	−0.052**	−0.041*
	[0.018]	[0.018]	[0.017]	[0.017]	[0.017]	[0.017]	[0.017]	[0.019]
Technology area characteristics								
Revealed Technological Advantage (RTA)	−0.398**	−0.304**	−0.068**	−0.046+	−0.058*	−0.094**	−0.062*	−0.079**
	[0.013]	[0.023]	[0.019]	[0.025]	[0.024]	[0.018]	[0.025]	[0.028]
Growth rate of application filings	0.306**	0.304**	0.213**	0.211**	0.205**	0.202**	0.199**	0.231**
	[0.015]	[0.015]	[0.021]	[0.021]	[0.021]	[0.019]	[0.019]	[0.022]
US applicant × RTA		0.002		0.080*	0.080*		−0.153	−0.254
		[0.031]		[0.031]	[0.031]		[0.093]	[0.170]
German applicant × RTA		−0.067		0.142**	0.133**		0.075*	0.067+
		[0.044]		[0.042]	[0.042]		[0.033]	[0.036]
Chinese applicant × RTA		−0.175**		−0.279*	−0.303*		0.138**	0.131**
		[0.025]		[0.131]	[0.130]		[0.044]	[0.048]
Korean applicant × RTA		−0.246**		−0.383**	−0.291**		−0.261**	−0.283**
		[0.050]		[0.075]	[0.074]		[0.051]	[0.084]
Japanese applicant × RTA		−0.042		−0.202**	−0.128**		−0.166**	−0.142**
		[0.030]		[0.031]	[0.031]		[0.030]	[0.035]
Patent characteristics								
Family size	0.051**	0.050**	−0.007**	−0.008**	−0.009**	−0.007**	−0.009**	−0.004**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
PCT application (0/1)	0.261**	0.261**	0.374**	0.380**	0.326**	0.399**	0.404**	0.347**
	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]	[0.007]	[0.007]	[0.009]
No. of IPC classes	0.009**	0.009**	0.011**	0.011**	0.006**	0.010**	0.010**	0.007**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
References to patent literature					0.013**			0.002**
					[0.001]			[0.000]
References to non-patent literature					0.062**			0.010**
					[0.003]			[0.001]
Forward citations within 5 years					0.016**			0.006**
					[0.001]			[0.001]
Number of claims					0.010**			0.006**
					[0.000]			[0.000]
Constant	3.193**	3.131**	4.331**	4.337**	4.181**	4.333**	4.330**	4.330**
	[0.025]	[0.029]	[0.036]	[0.038]	[0.037]	[0.032]	[0.035]	[0.032]
Pseudo Log-Likelihood	−635,167	−634,956	−288,910	−288,840	−287,297	−299,184	−299,125	−214,010
Chi-squared	166,185	166,792	67,247.9	67,363.5	71,131.7	77,106.3	77,163.7	53,689.5
Observations	434,306	434,306	185,327	185,327	185,327	187,816	187,816	131,205

Note: The number of claims has been available only for a subset of USPTO equivalents to SIPO applications. Standard errors of coefficient estimates are reported in brackets.
** Significant at 1% level.
* Significant at 5% level.
+ Significant at 10% level.

achieve faster patent grants due to greater familiarity with the examination procedures at the SIPO or due to greater familiarity with the Chinese language.[22] Given the data at hand, we cannot subject these explanations to a clean statistical test. While our regressions include measures of applicants' familiarity with the patent system, we cannot rule out the possibility that faster patent grants by domestic applicants are a result of higher familiarity with the system rather than discrimination by the SIPO. This limitation needs to be taken into account when interpreting our results. To unambiguously identify the effect of the two different explanations might require a more complex research design that exploits variation across the various patent offices. For instance, Kortum and Lerner (1999) exploit variation across patent offices to analyze the effect of changes in US patent law on the propensity to file for patent protection. Despite harmonization efforts, the differences in examination procedures across international patent offices

[22] In principle, one could easily test the language effect by comparing domestic applications with applications filed by non-domestic applicants listing at least one Chinese inventor. Our entire sample of 443,533 patent applications contains only 510 such applications (compared to 178,144 applications with Chinese inventors filed by Chinese applicants). Therefore, we refrain from an econometric test. Furthermore, Chinese patent law limits the effect language might have on grant lags because all applications at the SIPO finally have to be submitted in Mandarin Chinese. PCT applications can also be filed in English, but a translation of the application has to be submitted within 30 months of the priority date.

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might make it difficult to implement a similar approach in our context.

6. Conclusion

The People's Republic of China has experienced rapid economic development in recent decades. Along with its fast economic growth, China established a transparent system of IP laws and joined related international treaties such as TRIPS and PCT. Patent applicants from around the world seek patent protection in China and, as a consequence, the number of patent applications at the SIPO has risen tremendously. This article presented a short overview of the most important features of the regulations governing the process of patent filing and examination in China. We have shown that those procedures largely resemble international standards and do not create structural barriers for international applicants.

Our analysis of the population of SIPO patent applications filed from 1990 to 2002 revealed interesting insights about factors that affected the duration of patent examination for applications that were ultimately granted. Most interestingly, we show that Chinese applicants achieved faster patent grants when compared to applicants from other countries and to non-Asian applicants in particular. While this effect might be due to a greater familiarity of domestic applicants with the Chinese patent system, it might also be a sign of discrimination in favor of Chinese applicants. Since we are unable to ultimately determine if discrimination took place (and might be continuing), further research is warranted. This is particularly important because, according to TRIPS' Article 3 (National Treatment) and Article 4 (Most-Favored-Nation Treatment), as well as to Article 18 of China's own patent law, applications from foreign and domestic applicants receive equal treatment.

Our findings are also relevant for practitioners and managers responsible for IP filing strategies. We have provided the first comprehensive descriptive statistics for patent grant delays in China, based on the population of all patent filings from more than a decade of SIPO's operation. IP managers can use these details to plan their filing strategies, taking into account average pendency rates. We have also presented more fine-grained information about the determinants of the grant delays. For instance, we quantify the time advantage enjoyed by applicants who are more experienced in dealing with the SIPO. Also, applicants with a clear focus on the Chinese market, as well as by applicants filing a high number of SIPO applications, had their patents examined and granted in less time. Taken together, these findings imply that having experience in dealing with the SIPO can significantly reduce grant lags. Those firms with little or no experience dealing with Chinese patent authorities might find it advantageous to contract with a law firm experienced in dealing with the SIPO.

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