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What determines the duration of patent examination in China? An outcome-specific duration analysis of invention patent applications at SIPO

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ABSTRACT

Although China is now the largest patent filing country in the world, research on the duration and outcomes of patent examination remains scarce. In this study, we conduct a replication and extension of Harhoff and Wagner's (2009) work on the determinants of patent examination duration at the European Patent Office (EPO), using a rich dataset covering the population of about 1.1 million invention patent applications to China's State Intellectual Property Office (SIPO) from 1993 to 2006. By considering all three competing examination outcomes (grant, withdrawal, and refusal) simultaneously, our competing risks analysis replicates many of the results in prior research and confirms that a number of the determinants have differential effects on pendencies for different outcomes. Our analysis also reveals several applicant and application characteristics whose effects on pendencies for specific outcomes differ from prior research. Finally, by incorporating a number of new determinants, we report a set of new findings about their effects on the examination duration for the three outcomes at SIPO.

1. Introduction

Establishing and maintaining a sound patent system is critical to today's economy that is increasingly driven by innovation and entrepreneurship. Inventors rely on patent protection from jurisdictions across the globe to recoup the cost of innovation and further profit from it (Teece, 1986; Scotchmer, 2004). Understanding the patent system and the examination process is also crucial to firms, as whether and when a patent will be granted or refused is extremely important for patent portfolio management and corporate investment decisions (Lemley and Shapiro, 2005; Gans et al., 2008; Hsu and Ziedonis, 2013). Scholars have long been interested in understanding the patent examination process at major patent offices, including the European Patent Office (EPO), United States Patent and Trademark Office (USPTO), Japanese Patent Office (JPO), and China's State Intellectual Property Office (SIPO) (Kotabe, 1992; Johnson and Popp, 2003; Popp et al., 2004; Goto and Motohashi, 2007; Yang, 2008; Harhoff and Wagner, 2009; Regibeau and Rockett, 2010; Liegsalz and Wagner, 2013). However, most of the extant research focuses on patent grant as if it is the only outcome of examination, and studies the determinants of grant lag as a result. In the literature, Harhoff and Wagner (2009) conduct the first study to analyze the determinants of patent examination durations at EPO by considering all three competing outcomes of examination (grant, withdrawal, and refusal) simultaneously.

While the growth of patent applications at established patent offices remains strong, a recent World Intellectual Property Report (WIPO, 2011) discusses the "Changing Face of Innovation", highlighting the surge of patent filings in younger patent offices such as SIPO. Notably, applications of invention patents to SIPO increased from 14,409 in 1992 to 526,412 in 2011, overtaking the U.S. to become the world's top patent filer (WIPO, 2012: 58), a position China has since maintained. Despite the increasing role China plays in the global patent system, research on patent examination at SIPO remains scarce; in addition, the existing research has only studied patent grant and related grant pendency questions.

In this study, we aim to replicate and extend Harhoff and Wagner's (2009) work by applying a competing risks approach to analyze the determinants of patent examination durations at SIPO, using a rich dataset that contains the population of about 1.1 million invention patent applications to SIPO from 1993 to 2006. We go beyond a direct replication by offering several extensions (Bettis et al., 2016). First, our study examines the generalizability of Harhoff and Wagner's (2009) findings on EPO patents by using new data from a different and increasingly important institutional context, SIPO. A comparison of

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determinants of examination durations between the two largest patent offices in the world is unique and provides a useful addition to the literature. Second, our research complements prior studies of patent grant rate and grant pendency at SIPO (Yang, 2008; Liegsalz and Wagner, 2013) by analyzing examination durations for all three competing outcomes simultaneously, thereby providing a more complete picture of patent examination at SIPO. Finally, our study incorporates a number of new variables, and we report a set of new findings about their effects on the examination duration for the three outcomes.

2. Related literature

Understanding whether or not a patent may be granted and what determines the timing of grant is critical to applicants. Before a patent is granted, only limited options for patent enforcement are available (Gans et al., 2008). After the grant, the scope of the patent right is delineated, and the patent holder has full access to legal recourse (Regibeau and Rockett, 2010). Even in cases where a patent is not granted, the applicant may still prefer to learn the decision of refusal early so they can prioritize other means of protection of the technology. Thus, patent applicants usually prefer shorter waiting periods to dispel the uncertainty regarding whether a patent will be granted, when it will be granted, and the scope of protection if it is granted (Lemley and Shapiro, 2005; Reitzig and Puranam, 2009; Hegde and Luo, 2017). Because of this, existing research has often focused on patent grant as the outcome of examination and analyzed the determinants of grant pendency. While this stream of research has historically focused on granted patents at USPTO, recent work begins to study patents at other patent offices in the world, including EPO, JPO, and SIPO (e.g., Kotabe, 1992; Van Zeebroeck, 2007; Yang, 2008; Harhoff and Wagner, 2009; Liegsalz and Wagner, 2013; Mitra-Kahn et al., 2013). In particular, Harhoff and Wagner (2009) extend prior research by conducting the first analysis of determinants of patent examination durations at EPO for all three competing outcomes—grant, withdrawal, and refusal—simultaneously. They show that many of the determinants have differential effects on pendencies for grants, withdrawals, and refusals, suggesting that a singular focus on granted patents only provides a partial picture of patent examination durations and likely suffers from sample selection bias.

Existing research has categorized determinants of the duration of patent examination into three groups. The first group is applicant characteristics, such as the applicant's patenting experience or capability, country of origin, and so forth. Regarding the role of patenting experience, Harhoff and Wagner (2009) find that at EPO, the annual applications of an applicant are related to shorter time-to-grant and time-to-refusal, but longer time-to-withdrawal. By contrast, Liegsalz and Wagner (2013) find that at SIPO, annual applications do not have a significant effect on grant pendency. Regarding the effect of the country of origin, three prior studies focusing on differences between domestic and foreign applicants are pertinent. In a first study, Yang (2008) uses a lagged-regression approach (Kotabe, 1992) to calculate grant lags for a sample of Chinese patents during 1985–2002 from WIPO. She finds that although there were similar grant pendencies for domestic and foreign applications at SIPO, domestic applicants experienced less volatile durations than foreign applicants. In a related study, Liegsalz and Wagner (2013) examine grant lags at SIPO using a sample of 443,533 granted Chinese patents during 1990–2002 from PATSTAT, and find that domestic applicants achieved faster grants than their foreign counterparts. Because PATSTAT does not report information regarding whether a non-granted patent application is ultimately withdrawn or refused at SIPO, it is not possible to analyze all three competing outcomes of patent examination simultaneously in their study. In a third study, using a random sample of EPO patents during 1982–1998, Harhoff and Wagner (2009) find that non-European applications experienced a longer grant pendency compared to European applications, though the results for pendencies for withdrawals and grants are somewhat mixed.

The second group focuses on application characteristics. The first characteristic is whether an application is a PCT filing. Harhoff and Wagner (2009) find that at EPO, patent examination for PCT filings is prolonged for the outcomes of grant and withdrawal, but not refusal. Relatedly, Liegsalz and Wagner (2013) report that at SIPO, PCT filings have longer grant lags. Second, several studies have examined how patent values proxied by forward citations affect examination duration. Using a sample of granted patents from USPTO, Johnson and Popp (2003) and Popp et al. (2004) find that more valuable patents take longer to be granted; however, with a small sample of granted patents in plant biotechnology from USPTO, Regibeau and Rockett (2010) report contradictory findings that more valuable patents are granted faster. Harhoff and Wagner's (2009) analysis of EPO patents also reveals that the number of forward citations has a positive effect on grant pendency, but comment that the result contradicts their expectation. Liegsalz and Wagner (2013) similarly find that forward citations have a positive effect on grant pendency at SIPO. Third, prior studies have also examined the role of backward citations. For instance, Harhoff and Wagner (2009) find that a larger number of patent references increases the duration of examination in EPO because of greater complexity of the examination task. Liegsalz and Wagner (2013) similarly find that the number of patent references is related to longer grant lag at SIPO. Fourth, prior research (Harhoff and Wagner, 2009; Liegsalz and Wagner, 2013) reports that the number of IPC classifications in a patent lengthens the examination duration for grants, in line with arguments that a larger number of classifications proxies for greater complexity of the examination task. Relatedly, Harhoff and Wagner (2009) analyze other proxies of complexity, including originality, number of claims, and number nonpatent references, which are found to increase examination durations for all three outcomes.

The third group relates to environmental characteristics. For instance, application volumes and examination capacities at the patent office may vary across years, affecting examination durations (Griliches, 1990). For example, Harhoff and Wagner (2009) show that the number of pending applications per examiner at EPO is associated with slower grants and refusals, but faster withdrawals. Relatedly, Liegsalz and Wagner (2013) find that the growth rate of patent filings at SIPO is associated with slower grants, though the variable does not control for the number of patent examiners. In addition, patent applications in different technology fields exhibit different technological characteristics, and researchers often include technology fixed effects to control for any technology heterogeneity that may affect the duration of examination.

3. Data and variables

3.1. Empirical context: patent examination at SIPO

The record number of patent filings to SIPO and the increasing role China plays in global innovation have attracted increasing research attention to the efficiency of China's patent system (He et al., 2017). China's first formal patent law was promulgated in 1985, and has since then undergone three amendments in 1992, 2000, and 2008, respectively (each went into force in the following year), which progressively aligned the Chinese patent system with international norms (Park, 2008; Huang, 2010; Li, 2012). SIPO grants three types of patents: invention, utility model, and design patents. While invention patent applications receive substantive examination by examiners for novelty, inventive steps, and practical applicability before grant, utility model and design patent applications are subject only to preliminary examination, which involves merely formality checks. Given our interest in patent examination durations, our study focuses on invention patent applications. Fig. 1 depicts several major steps in the patent examination process at SIPO: application; publication; request for substantive examination; and grant, or withdrawal, or refusal. As in most other