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Patent statistics: A good indicator for innovation in China? Patent subsidy program impacts on patent quality

Jianwei DANG *, Kazuyuki MOTOHASHI

Department of Technology Management for Innovation, School of Engineering, the University of Tokyo, Hongo 7-3-1, Bunkyo-ku, Tokyo 113-8656, Japan

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ABSTRACT

Using a merged dataset of Chinese patent data and industrial survey data, we make a bibliometric analysis of patenting activities of Chinese large and medium-sized enterprises under local patent subsidy programs and test whether patent statistics are a good indicator of innovation in China. Our empirical results show that patent count is correlated with R&D input and financial output, which suggests that patent statistics are meaningful indicators. However, patent subsidy programs increase patent counts more than 30%. We emphasize the necessity of adjustments and provide a novel method of using the number of nouns in claims to quantify the claim scope, thereby overcoming the shortcomings of Chinese patent data that have no citations or lack well-documented patent claim information. We extend prior studies on patent subsidy programs by providing a detailed clarification of policy designs and their impacts and by evaluating policy impacts on both the quantity and quality of patent applications.

1. Introduction

A recent surge of patent applications in China has aroused significant research interest in investigating whether the surge is an indicator of the growth of innovative capabilities in Chinese industries and a change from “imitation” to “innovation.” Although the rapid increase of Chinese patent applications can be explained by the nation's technology catching up with international players in developed economies, patent quality concerns arise as studies have suggested that such applications are largely supported by local government patent subsidy programs (Li, 2012). Thus, can we rely on patent statistics as an indicator of innovation in China? Several studies have analyzed the determinants of patent application growth, but few have provided empirical evidence on the quality of these patents. It particularly remains unclear whether patent subsidy programs have resulted in the deterioration of the quality of Chinese patent applications.

As patents contain rich and timely information on inventive activities, patent statistics are increasingly used to analyze and measure innovations. While R&D expenditures are widely used as a proxy for innovation input, patent statistics can measure the output. This measure is also more easily obtainable than other proxies for outputs, such as total factor productivity (TFP) (Nagaoka, Motohashi, & Goto, 2010). However, patent statistics are not perfect as innovations are not necessarily patentable or patented, and patent quality varies (Griliches, 1998). The former is generally treated by controlling for industry differences, which largely explains

* Corresponding author. Tel.: +81 3 5841 8855; fax: +81 3 5841 1829.
E-mail addresses: dangjw@gmail.com (J. Dang), motohashi@tmi.t.u-tokyo.ac.jp (K. Motohashi).

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variations in patenting propensity. For instance, patents are more effective in protecting pharmaceutical, chemical, and electronics technology. The latter problem is treated by weighting patents by citations, as frequently cited patents have been proven to have higher technological and economic value (Arora, Fosfuri, & Gambardella, 2001; Harhoff, Scherer, & Vopel, 2003; Trajtenberg, 1990). However, special care is needed when using patent statistics in China as institutional factors could have distorted patenting behaviors and ultimately patent statistics. One needs to evaluate to what extent Chinese patent statistics have drifted away from the "real" output, which should be highly correlated with R&D expenditures as has been observed in other countries (Hall, Griliches, & Hausman, 1986; Pakes & Griliches, 1984).

Using survey data from the National Bureau of Statistics (NBS) of China, Hu and Jefferson (2009) estimate a patent production function for Chinese enterprises, finding significantly low patent-R&D elasticity and claim that foreign direct investment, institution change, and other factors are behind the patent surge. A recent study shows that patenting propensity has been boosted as much as 160% by patent promotion policies (Li, 2012). These two studies underscore the need to adjust quantitative statistics for patent applications in China. However, it is unclear whether granted patents have also been boosted significantly, which prevents granted patents from being a valid indicator of innovations. Unfortunately, pioneer studies (Hu & Jefferson, 2009; Li, 2012) that use industrial survey data cannot answer this question because firms can only provide the number of their applications in the year a survey is conducted; they cannot provide the number of granted patents as that figure can only be known several years later when examination decisions are issued. A more difficult aspect lies in assessing the different qualities of patents. Patent quality is generally assessed using detailed patent information, including citation, renewal information, and patent claims. Several studies that use renewal information demonstrate that Chinese-granted patents have lower value than patents by foreign players (Thoma, 2013; Zhang & Chen, 2012). However, using renewal information has its disadvantages in terms of timeliness and thus cannot reflect recent changes in patent quality. Moreover, the two lines of research seem to be parallel when dealing with patent quality. Studies based on survey data have illustrated exaggerated growth of patent applications compared to growth of R&D but cannot answer whether the quality of granted patents has been affected. On the contrary, studies using patent information can make horizontal comparisons of patent quality but cannot determine whether this is a new phenomenon that resulted from patent subsidies. The solution should be found in exploiting both data sources. By matching industrial survey data with patent data, a bibliometric analysis of patent statistics can be performed to evaluate the policy impacts on applications, grants, and quality of granted patents. To the best of our knowledge, no such analysis has been performed previously.

Therefore, this study makes the first attempt to match China's patent data with widely used industrial survey data, and then uses this dataset to obtain a clear view on how patent statistics serve as an indicator of output of R&D investment and answers to what extent the statistics are biased by policy incentives. The matched dataset enables us to extend current research in several directions: first, to test whether granted patents, rather than applications, are valid indicators of innovations, second, to analyze patent quality using patent claim information, and third, to investigate whether the policies affect state-owned enterprises (SOEs), privately owned enterprises (POEs), and foreign funded enterprises (FFEs) differently.

We also extend Li's pioneering study of patent subsidy programs by classifying patent subsidies into three categories that reflect their timing and conditions: filing fee subsidies, examination fee subsidies, and rewards contingent on patent grants (hereinafter "grant-contingent rewards"), and empirically investigate their effects in the patenting process. The detailed examination can provide insights on effective policy designs.

Our empirical results show that subsidies increased patent-R&D elasticity. For a "typical" firm, the average number of patent applications may have been increased by 32% and granted patents by 36%. Thus, quantitative statistics of both patent applications and granted patents need downward adjustments. The result is contrary to general intuition as one would expect a large number of

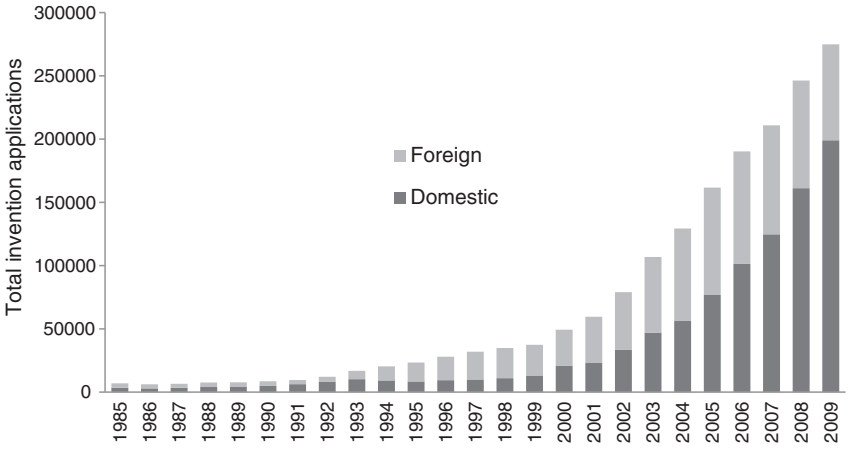

Fig. 1. Growth of invention patent applications in SIPO (1985–2009).
Data source: Chinese patent data from SIPO.